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characteristics" (see RCRA section 3001(a)). These criteria are different from those used under the CWA.

Accordingly, the two statutory programs have different goals. EPA believes that the TC regulatory levels represent concentrations above which a wastewater poses a potential hazard to human health and the environment, if mismanaged, even if it has been treated to some degree. Therefore, owners and operators of wastewater treatment facilities that treat wastewaters exhibiting the TC will be required to comply with all applicable regulations under RCRA and the CWA.

b. Permit Requirements for Wastewater Treatment Facilities. Many commenters stated that under the proposed TC, many wastewater treatment facilities will become hazardous waste treatment facilities subject to full RCRA permitting requirements. These commenters were concerned that the costs to industry of preparing permit applications and complying with RCRA regulations for hazardous waste treatment facilities will be prohibitive. Some commenters argued that EPA has insufficient resources to process permit applications from all of the wastewater treatment facilities that will require permits.

Although owners and operators of some wastewater treatment facilities that use newly-regulated surface impoundments could be subject to RCRA permitting requirements, EPA believes that the actual number of facilities requiring permits will not be large. The Regulatory Impact Analysis for this rule indicates that other options available to wastewater treatment facilities treating wastewaters exhibiting the TC are likely to be more cost-effective than obtaining an RCRA permit (see section VI. B for a more detailed discussion). In particular, an alternative that the Agency expects may be attractive to many owners and operators is the replacement of surface impoundments with tanks. Retrofitting existing surface impoundments to meet RCRA requirements for hazardous waste management facilities will often be more expensive than building tanks that are subject to CWA requirements in lieu of RCRA permitting requirements. ("Wastewater treatment units" are exempt from the hazardous waste management standards under 40 CFR 264.1(g)(6) and 265.1(c)(10). Similarly, "totally enclosed treatment facilities" are exempt under 40 CFR 264.1(g)(5) and 265.1(c)(9).) Thus, there are options available to owners/operators for whom RCRA standards may be too costly.

There may be some wastewater treatment facilities that opt to continue using surface impoundments to manage wastewaters exhibiting the TC, and these facilities will enter the RCRA permitting system. However, the Agency does not believe that there will be such a large number of facilities that it will overwhelm the Agency's permitting capabilities.

c. Sludges from Publicly Owned Treatment Works (POTW). The preamble to the June 13, 1986 proposed rule requested comments on the regulation of sewage sludge under RCRA and under the CWA. The preamble stated that EPA was considering an exemption from RCRA regulation for sludges from publicly owned treatment works (POTW sludges) upon the promulgation of sewage sludge management standards pursuant to section 405(d) of the CWA.

A number of commenters, including many municipalities, responded to this request for comments. Although a few commenters opposed an exemption from RCRA for POTW sludges, the commenting municipalities supported an exemption from RCRA. These municipalities stated that sewage sludge management regulations, in addition to pretreatment standards, are sufficient to protect human health and the environment without additional regulation under RCRA. Commenters stated that regulating POTW sludge under RCRA will place a significant economic burden on municipalities and will cause municipalities and EPA to face duplicative administrative costs and regulatory confusion.

EPA does not agree with commenters that regulation of POTW sludge under RCRA will place a significant economic burden on municipalities or increase the burden of implementation. EPA's office of Water tested 18 POTW sludge samples using the TCLP. None of the samples tested exhibited the TC at the proposed regulatory levels (Ref. 18). Because the final TC regulatory levels are higher than the proposed regulatory levels, the Agency believes that few, if any, POTW sludges will exhibit the TC. Thus, most POTW sludges will not be classified as hazardous waste under RCRA.

Although EPA does not believe it is necessary to exempt POTW sludges from RCRA at this time, the Agency may reconsider this decision after the sewage sludge management regulations are promulgated. In the unlikely event that a particular POTW sludge does exhibit the TC, the municipality may use the pretreatment program under the CWA to eliminate the indirect discharges of the pollutants that are causing the sludge to exhibit the TC.

3. Safe Drinking Water Act

Several commenters noted that the proposed regulatory level for chloroform is lower than the primary drinking water standard for trihalomethanes (a class of organic chemicals that includes chloroform) established under the Safe Drinking Water Act (SDWA). Most of these commenters consequently declared that the regulatory level had been set too low, and they argued that it would be unreasonable to regulate ordinary drinking water as a hazardous waste. Some commenters asserted that an industrial facility taking water from public water supplies (a facility supplying drinking water in compliance with the SDWA rules) could find that its noncontact cooling water becomes a hazardous waste after it is passed through the plant and is disposed.

In today's final rule, the regulatory level for chloroform has been raised from that proposed in the June 13, 1986, notice of proposed rulemaking. The change is because of two modifications to the data originally used to set the regulatory level: first, the chronic toxicity reference level for chloroform is roughly 12 times higher than when originally proposed (see 53 FR 18024) and, second, due to the changes in the model, the DAF is about 7 times higher than the one originally proposed. Together, these two changes result in a regulatory level that is higher than both the original regulatory level and the SDWA standard for trihalomethanes. Non-contact cooling water or other wastewaters derived from public water supplies complying with the SDWA thus should not exhibit the TC for chloroform unless these wastewaters are contaminated by other sources.

4. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

a. Pesticide Wastes. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) authorizes EPA regulation of pesticide sale, distribution, use, and disposal. Since RCRA regulations cover solid wastes which include pesticide product wastes, these wastes may be regulated under both FIFRA and RCRA.

Until recently, pesticide disposal under FIFRA was primarily controlled by mandating that product labeling include instructions for the proper disposal of the pesticide and its container. Recent amendments to FIFRA, effective October 25, 1988, authorize the Administrator to impose additional requirements relating to storage, transportation, and disposal of certain pesticides. For example, EPA under FIFRA may issue requirements

and procedures for the storage, transportation, and disposal of suspended or cancelled pesticides and of rinsates or containers associated with the pesticides. Also, EPA may require that applicants for registration of a pesticide submit information regarding methods for safe storage and disposal of the pesticide, and that applicants for registration provide evidence of sufficient financial resources to provide for disposal in the event of suspension or cancellation.

A number of pesticide-related wastes are listed as hazardous under 40 CFR part 261. The listings include four groups: The first, at § 261.31, includes certain discarded unused pesticide formulations containing tri-, tetra-, and pentachlorophenols (F027) or certain compounds derived from the chlorophenols; these are listed as acute hazardous waste. This listing includes approximately 20 phenoxy pesticides and their salts and esters. Today's rule will add the constituent 2,4,5-trichlorophenol, which is used as an active ingredient in pesticide products, to the TC list. Because products containing this constituent are separately listed under F027, the promulgation of specific toxicity limits will not affect their regulation under RCRA (i.e., they will continue to be regulated as acute hazardous wastes at all concentrations, both above and below the TC level).

The second group, at § 262.32, consists of "K" wastes from the production of specific pesticides, such as wastewater treatment sludges from the production of the pesticide chlordane (K032); these are listed as toxic wastes. Again, however, because these wastes are listed, they will not be affected by the regulatory levels of the TC, but will continue to be subject to regulation regardless of concentration levels.

The third grouping, at § 261.33 (e) and (f), consists of "P" and "U" wastes. Section 261.33 lists certain commercial chemical products as hazardous when discarded or intended for discard. Approximately [illegible] pesticide active ingredients are listed as acute hazardous wastes under § 261.33(e), while 63 pesticide active ingredients are listed under § 261.33(f) as toxic hazardous wastes. Pesticide products containing these chemicals as sole active ingredients or the pure or technical grade of these chemicals are regulated under both RCRA and FIFRA when they become wastes. Generally, products containing these ingredients as one of multiple active ingredients are not regulated (at this time) as hazardous wastes under subtitle C of RCRA unless they meet one of the characteristics; their disposal is still subject to any applicable FIFRA and RCRA subtitle D requirements. For the majority of the 133 listed pesticides, today's rule will not change their status under RCRA: waste pesticides that are either pure, technical grade, or sole active ingredient products will continue to be subject to regulation as hazardous at all concentrations under RCRA subtitle C. Wastes from multiple active ingredient products that do not exhibit a characteristic will still be regulated under any applicable FIFRA and RCRA subtitle D requirements.

Six pesticide wastes that are currently regulated on a concentration basis under the existing EPTC at § 261.24, form the fourth group. These six pesticides (endrin, lindane, methoxychlor, toxaphene, 2,4-D, and silvex) will be retained in the new rule with their current concentration limits, which are based on a DAF of 100. The significant difference between the listings and the TC is that, while multiple active ingredient products are not covered by the listings, they are covered under the characteristic. Thus, increasing the number of pesticidal constituents encompassed by the TC (whether or not they are also listed), brings more multiple active ingredient formulations into the subtitle C system. Consequently, today's rule is expanding regulation of pesticide wastes under RCRA.

Although EPA is adding pesticides to the TC list of constituents, today's rule will not have a significant effect on many pesticide users who generate wastes. RCRA regulations contain special requirements that affect the extent to which pesticide users will become subject to additional RCRA regulation:

- Household pesticide wastes are, like other household wastes, exempt from RCRA.
- Farmers who triple rinse their containers and dispose of the rinsate on their own farm in a manner consistent with 40 CFR 262.51 and label instructions are exempt from RCRA requirements.
- Other small quantity generators under § 261.5 need comply only with reduced requirements. Many pesticide users are small quantity generators.
- Under § 261.7, properly emptied containers may be exempted from further RCRA requirements. Thus, many pesticide containers may not be subject to regulation as hazardous wastes.

As a result, the principal effects of today's final rule will be felt by commercial applicators, such as aerial applicators and pest control operators, who are not eligible for the special requirements applicable to farmers and who may use sufficiently large volumes of pesticides that they exceed the small quantity generator limitations. If they use large quantities of multiple active ingredient pesticide products that have not previously been regulated, such commercial applicators may be newly subject to the RCRA hazardous waste management requirements.

b. Treated Wood Wastes. The Agency is promulgating TC regulatory levels for certain chemicals—for example, cresols and pentachlorophenol—that are commonly used as wood preservatives. In its review of wood preservative chemicals under FIFRA, EPA concluded that these wood preservatives may continue to be used under certain circumstances, and the Agency decided to allow disposal of treated wood by means of ordinary trash collection, burial, or incineration (49 FR 28666, July 13, 1984, and 51 FR 1234, January 10, 1986). However, the mandates of FIFRA and RCRA are different. EPA has previously stated that even if it were determined that certain ground uses of treated wood did not pose unreasonable risks, wood wastes might still be regulated under RCRA subtitle C (45 FR 78651, November 25, 1980). Under FIFRA, the Agency may determine that the economic benefits of continued use of a pesticide outweigh any potential risks posed by the pesticide. This does not mean, however, that materials treated with pesticides should not be managed in a controlled manner under RCRA at the end of their useful lives, to ensure that long-term risks are minimized.

Some treated wood that is hazardous solely because it fails the EP toxicity test for arsenic which is not a hazardous waste for any other reason or reasons is exempt from regulation as hazardous (40 CFR 261.4(b)(9)). The exemption is limited to wood wastes generated by persons who use wood products for their intended end use. Several commenters claimed that large quantities of treated wood wastes will be newly regulated as hazardous under the TC, and they argued that this result is inconsistent with other EPA policies and regulations. Most of these commenters recommended that EPA expand the existing exemption for arsenic-treated wood waste to encompass all treated wood that exhibits the TC.

EPA has decided not to expand the existing exemption for arsenic-treated wood. If a wood waste does exhibit the TC for a constituent other than arsenic, or if the waste is hazardous waste for any other reasons or reasons, the

Agency believes that the waste should be regulated as hazardous, in order to protect human health and the environment. The arsenic-treated wood exemption is not being revoked at this time, but it may be reevaluated in the future.

5. Food, Drug, and Cosmetic Act (FDCA)

a. Food Wastes. Several commenters noted that allowable levels set by the Food and Drug Administration (FDA) under the Food, Drug, and Cosmetics Act (FDCA) are, in some cases, higher than the proposed TC regulatory levels for the same chemicals. Most of these commenters then asserted that if it is safe to consume substances containing pesticides or additives it must also be safe to place such substances in municipal landfills. Some commenters expressed concern that food wastes that comply with FDCA pesticide tolerance or action levels may nevertheless have to be handled as hazardous wastes as a result of the TC. One food processing industry trade association requested that the final TC rule state that any waste from food already in compliance with a tolerance or action level set by EPA or FDA is nonhazardous.

The Agency acknowledges that for certain chemicals in waste, it proposed TC regulatory levels lower than FDCA tolerances or action levels in food. However, it is inappropriate to make a direct comparison of these two sets of levels. FDCA levels are set for concentrations in food products, while TC levels apply to concentrations in the *leachate from* waste materials. Because not all toxic constituents leach from the waste, levels in the leachate are lower than in the waste material itself. Accordingly, for a food waste to be hazardous, the waste would have to have constituent concentrations higher than the TC levels. The Agency is unaware of any food-related wastes that will be regulated as hazardous under the TC rule. (In addition, unlike the FDCA, RCRA does not allow consideration of economic factors in establishing regulatory levels of concern.)

If any food waste does exhibit the TC, it may be subject to lesser requirements as household waste (40 CFR 261.4(b)(1)) or under the small quantity generator provisions (40 CFR 261.5). For non-household food wastes that fail the TC (i.e., leachate from the waste contains contaminants in levels equal to or above the regulatory levels promulgated in today's rule) and that are generated in large quantities, it is appropriate that they be managed in a controlled manner to protect human health and the environment. Because EPA sees no conflict between the TC rule and tolerance or action levels under FDCA, this rule contains no exemption for wastes that meet the FDCA standards.

b. Pharmaceutical and Cosmetic Wastes. Several commenters arguing that the proposed TC levels were too low, pointed out that the proposed regulatory levels are lower than FDCA-allowed levels for the same chemicals in drugs or cosmetics.

Although the proposed TC regulatory levels for certain chemicals were lower than the FDCA levels for the same chemicals in drug and cosmetic products, the levels are higher in the final rule. Moreover, it is clear that different factors must be taken into account when regulating these constituents in drugs and cosmetics rather than in solid wastes, as confirmed by different statutory mandates. The constituents in drugs and cosmetics products, often used in very small quantities, serve a useful function and may be therapeutic in certain quantities and under proper circumstances. However, this does not mean that these same constituents should not be controlled where found at TC levels in waste materials.

Of course, drug and cosmetic wastes generated in households are not subject to subtitle C regulation (40 CFR 261.4(b)(1)) nor are wastes generated by small quantity generators (less than 100 kg/mo of non-acute hazardous waste—see 40 CFR 261.5). However, drug and cosmetic products when discarded may present risks to human health and the environment if disposed in large volumes. Thus, EPA maintains that regulation of large quantities of drug or cosmetic wastes exhibiting the TC is appropriate and not in conflict with the existing FDCA program.

6. Used Oil Recycling Act

The Used Oil Recycling Act of 1980 (UORA), which amended RCRA, was intended to increase safe recycling and reuse of used oil. It established that it is in the national interest to recycle used oil in a manner that both protects public health and the environment and conserves energy and materials. The UORA has been incorporated in section 3014 of RCRA.

Section 3014 of RCRA, as amended by HSWA, requires EPA to make a determination of whether to list or identify used oil as a hazardous waste (see RCRA section 3014(b)). In response to this statutory directive, EPA proposed to list most types of used oil, including recycled used oil, as a hazardous waste on November 29, 1985 (see 50 FR 48258). EPA subsequently decided in November 1986 not to list used oil because the Agency believed that the listing would discourage recycling of used oil and could result in an increase in the amount of used oil that is disposed of or illegally dumped. The Agency decided to continue to study whether used oil that is disposed should be listed as a hazardous waste under RCRA or regulated under different statutes (see 51 FR 41900 (November 18, 1986)). EPA's decision to withdraw the proposed listing of used oil was invalidated by the D.C. Circuit Court of Appeals in 1988. The Agency was directed by the Court to reconsider the listing of used oil as a hazardous waste based on the technical criteria contained in RCRA section 3001.

Some commenters claimed that used oil would be brought into the subtitle C system under the TC proposal. They stated that used oil is likely to fail the TC test for both aromatic hydrocarbons (e.g., benzene) and chlorinated solvents (e.g., trichloroethylene and tetrachloroethylene). The commenters argued that regulating used oil as a hazardous waste would be inconsistent with the intent of the UORA, as well as with current Agency policies regarding used oil.

Under today's rule, used oil will be regulated as a hazardous waste only: (1) If it exhibits one or more of the hazardous waste characteristics defined in subpart C of 40 CFR part 261 (including the TC as finalized today) and (2) if it is disposed of (rather that recycled). On the other hand, used oil that exhibits one or more of the hazardous waste characteristics and is recycled is exempt from regulation (see 40 CFR 261.6(a)(3)(iii)) except as provided in subpart E of 40 CFR part 266. In addition, RCRA prohibits the use of used oil as a dust suppressant or for road treatment if it is contaminated with dioxin or mixed with a hazardous waste. Thus, used oil that exhibits one or more of the characteristics (except for ignitability) cannot be used as a dust suppressant. In particular, the regulations have the following effect:

- Solid waste that is hazardous waste because it fails a characteristic and that is recycled (except by burning or use as a dust suppressant) is exempt from regulation.
- Characteristically hazardous used oil that is disposed of (or incinerated without recovery of energy value) is subject to full RCRA subtitle C regulation.
- Characteristically hazardous used oil that is being burned for energy recovery is subject to subpart E of part 266—i.e., off-specification used oil is subject to certain administrative requirements, while specification used

oil is subject only to the analysis and recordkeeping requirements of 40 CFR 266.43(b) (1) and (8).

• Characteristically hazardous used oil is prohibited from being used as a dust suppressant, unless it is hazardous solely for exhibiting the ignitability characteristic (see 40 CFR 266.23(b)).

• Characteristically hazardous used oil that is recycled in any manner other than being burned for energy recovery (e.g., by being rerefined) is exempt from subtitle C regulation.

Therefore, today's rule will not affect the regulatory status of most recycled used oil. In fact, today's rule should encourage the recycling of used oil, and not discourage its recycling as suggested by some commenters. It should also be noted that some percentage of used oil already is defined as hazardous (i.e., exhibits one or more of the hazardous waste characteristics and is disposed). Consequently, the amount of used oil that is affected by this rule and is either disposed of or recycled by being burned for energy recovery or used as a dust suppressant will be even less.

The Agency is currently determining how best to deal with used oil listing and management issues. Section 3014 of RCRA also requires EPA to promulgate management standards for used oil that is recycled. Standards for controlling used oil which is recycled were proposed on November 29, 1985 (50 FR 49212), but have not been finalized. The Agency will be addressing these issues as well as addressing the listing determination in the near future.

7. Toxic Substances Control Act (TSCA)

EPA has decided to exempt from the application of this rule certain polychlorinated biphenyl (PCB) wastes that are regulated under the Toxic Substances Control Act (TSCA) and would be identified as hazardous because of today's rule. Specifically, PCB-containing dielectric fluids removed from electrical transformers, capacitors, and associated PCB-contaminated electrical equipment may exhibit the TC, and thus become hazardous wastes when disposed, not because they contain PCBs (which are not among the constituents regulated under the TC) but because they may contain other TC constituents, such as chlorinated benzenes. The Agency has decided to exempt such wastes from the subtitle C management standards because new regulation of these wastes under RCRA may be disruptive to the mandatory phaseout of PCBs in certain electrical transformers and capacitors. In addition, the Agency believes that the regulation of these wastes under TSCA is adequate to protect human health and the environment. However, the exemption applies only to those dielectric fluids (as described above) that are fully regulated under TSCA. Other PCB-containing wastes that are hazardous (i.e., listed or exhibit a hazardous waste characteristic including the existing EPTC wastes—waste codes D004 through D017) are subject to all applicable subtitle C standards. Furthermore, these non-TC hazardous wastes that are (1) liquids containing PCBs at concentration greater than 50 ppm, or (2) solids containing PCBs listed in Appendix III of part 268 at concentrations greater than 1000 mg/Kg, are prohibited from land disposal under 40 CFR part 268.

The disposal and storage of PCB wastes is regulated under TSCA section 6(e)(1) authority rather than under subtitle C of RCRA. Since the enactment of TSCA, the manufacture, processing, and distribution in commerce of PCBs (without an exemption) has been banned and the use of PCBs without authorization has been banned. In addition, EPA has developed comprehensive PCB disposal regulations under TSCA. This regulatory framework includes specific disposal requirements for defined classes of PCB wastes, specific marking requirements for PCB items, facility recordkeeping requirements, approval requirements for disposers, and a proposed notification and manifesting system modeled on the subtitle C "cradle to grave" tracking system.

One commenter stated that utility transformer dielectric fluids are likely to exhibit the revised TC and urged the Agency to exempt PCB-containing utility transformer dielectric fluids from the rule. The commenter noted that the regulation of PCBs is unique because the manufacture of PCBs (without an exemption) has been banned. Thus, the critical regulatory concern with respect to these PCB wastes is the need to expedite safe disposal of the chemical. The commenter stressed that if PCB wastes were to be regulated now under RCRA as well as under TSCA, serious legal, practical and administrative complications could result.

The Agency agrees with the commenter. The most significant potential negative impact of dual regulation of these wastes under both RCRA subtitle C and TSCA [illegible] the unique scope and timing of PCB disposal. The Agency estimates that approximately 312 million pounds of PCBs are dispersed among nearly 30 million discrete units of electrical equipment. The TSCA regulations require the phaseout of certain PCB-containing electrical transformers, and EPA expects that the TSCA mandatory phaseout requirements and restrictions will render the next three years a peak period for PCB disposal. Under the authority of the TSCA mandatory phaseout, by October 1, 1990, owners of secondary network higher voltage transformers located in or near commercial buildings are required to either remove or reclassify these transformers. (Reclassification necessitates draining of all PCB fluids from the unit, and replacing them with non-PCB fluids or low concentration PCB fluids, and keeping the transformer in [illegible] service, under loaded conditions, for a minimum of three months.) In addition, the phaseout restrictions affect lower secondary voltage network units of PCB-containing electrical transformers located in or near commercial buildings; by October 1, 1993, such transformers must either be removed or be reclassified, or an alternative option for lower voltage units allows for providing enhanced electrical protection on such units by October 1, 1990. Radial PCB-containing electrical transformers must either have enhanced electrical protection or be removed.

The TSCA program, with which the regulated community is familiar, is specifically tailored to deal with the problem of widely dispersed waste generation and the timely disposal of a chemical that is no longer commercially produced. The confusion that could result from the addition of requirements under a separate regulatory disposal system, and the RCRA disincentives to waste production, would cause significant disruption to the expeditious disposal of large quantities of these PCB wastes if these wastes were to become subject to the RCRA hazardous waste regulations.

In addition, the Agency believes that the existing system for PCB disposal, including the existing TSCA disposal regulations and recent additions to the program (e.g., the proposed notification and manifesting rule, published at 53 FR 37426), are adequate to protect human health and the environment with respect to the disposal of these wastes. Thus, further regulation under RCRA for PCB-containing dielectric fluids and associated PCB-contaminated electrical equipment does not appear to be necessary at this time. The Agency will also evaluate the integration of the TSCA PCB regulations with the RCRA hazardous waste regulations for other PCB-containing wastes which are identified or listed as hazardous.

K. Implementation Issues

EPA received many comments concerning implementation of the TC rule. The comments addressed issues including the schedule for companies and municipalities to come into compliance with subtitle C requirements, exemptions and applicability, implications for permit modifications, and administrative requirements. Major comments on implemeatation are summarized and addressed below. Section V of this preamble further discusses how the Agency will implement today's rule.

1. Notification

In the June 13, 1986 Federal Register notice, EPA proposed to waive the RCRA section 3010 notification requirement for persons who manage TC wastes and have already: (1) Notified the Agency that they manage other hazardous wastes and (2) received an EPA identification number. Virtually all commenters who addressed the notification requirement supported EPA's proposal. However, one state agency opposed the proposal, on the grounds that a waiver would hinder efforts to develop a more accurate and complete understanding of hazardous waste management practices within the United States.

EPA has decided, as proposed, to waive the notification requirement for TC waste handlers that have already notified the Agency that they manage hazardous wastes and have received an EPA identification number. The Agency believes that, given the vast scope of the TC rule, a notification requirement for persons already identified within the hazardous waste management universe would present an administrative burden without providing any significant benefits to human health and the environment.

2. Effective Date

Several commenters claimed that the 6-month effective date of the TC rule would not provide them with sufficient time to come into compliance with the full array of hazardous waste regulations. Some commenters argued that it would be impossible for generators of TC wastes to test their wastes, obtain EPA identification numbers, arrange for transport and off-site management of their wastes, modify their short-term storage (i.e., accumulation) practices, and institute the necessary recordkeeping and reporting procedures within a 6-month time frame. The commenters stated that the time constraints are especially unreasonable in light of the shortages of laboratory and TSDF capacity that can be expected to result from the TC revisions. Other commenters claimed that TSDFs will require more than 6 months to come into compliance with the interim status standards of 40 CFR part 265 (e.g., personnel training, contingency planning, and financial responsibility).

EPA appreciates the concerns of the commenters, and the Agency is aware that all of the commenters addressing the effective date for the TC rule encouraged EPA to adopt a delayed effective date for most, if not all, requirements. However, RCRA section 3010(b) requires that hazardous waste regulations become effective 6 months after the date of promulgation unless EPA has good cause to establish an earlier effective date. Thus, the effective date for the final TC rule will be 6 months from the date of promulgation.

However, EPA is promulgating different compliance dates for two different categories of waste generators: (1) All generators of more than 100 and less than 1,000 kg/month of hazardous waste (small-quantity generators) must come into compliance with subtitle C requirements for management of their TC waste within one year of today; and (2) all generators of 1,000 kg/month or more of hazardous waste are required to comply with all subtitle C requirements for TC wastes within six months of today, on the effective date of the rule.

All generators of over 1,000 kg/month of hazardous waste are required to comply with all applicable RCRA regulations for their TC wastes on the effective date of this rule. (The generator quantity refers to all of a generator's hazardous waste, not just newly hazardous TC waste.) The Agency recognizes that this compliance category will include two groups of generators: current hazardous waste generators, including small quantity hazardous waste generators who will be generating additional hazardous wastes and generators of large quantities of solid wastes who will be regulated as hazardous waste generators for the first time. EPA believes that both of these groups of generators should predominantly be large businesses and either be familiar with the waste management regulations or be in a position to come into compliance with the requirements within the six month period. These persons should have been aware of the Agency's statutory commitment and have had ample notice of the impending TC rule through the proposed rule and supplemental notices.

On the other hand, the Agency is allowing an additional six months from the effective date (i.e., one year from today) for generators of greater than 100 but less than 1,000 kg/month of hazardous waste (small quantity generators) to comply with all applicable subtitle C regulations. (As with the over 1,000 kg/month category, this quantity refers to the total quantity of a generator's hazardous waste, not just newly hazardous TC waste.) The TC has the potential to affect an extremely large number of handlers that never before have been subject to the hazardous waste regulations; many of these firms are small businesses. Handlers that will assume small quantity generator status as a result of the TC rule are most likely not regulated under subtitle C at the present time. Thus, these handlers are less likely to be familiar with the waste management regulations, or because of their small business status, will need more than six months to come into compliance with the regulations.

As already indicated, these handlers are likely to be small entities and may be unaware that their practices, which were not regulated in the past, will now be regulated as a result of today's rule. The Agency recognizes that these new handlers of small quantities of TC wastes (over 100 but less than 1,000 kg/month) may have to test their wastes, obtain EPA identification numbers, arrange for transport and off-site management of their wastes, modify their short-term storage (i.e., accumulation) practices, and institute the necessary recordkeeping and reporting procedures. As recognized by the Agency in establishing special requirements for small quantity generators, the burden of initial compliance may fall relatively harder on these generators (see 51 FR 10146, March 24, 1986). Thus, to lessen the burden on the handlers of small quantities of TC wastes, the Agency has developed an outreach program targeted for the small quantity generators which will inform new generators of the required steps necessary to enter the hazardous waste management system. Effective program outreach, however, will take more than 6 months.

In amending RCRA in 1984, Congress, in requiring EPA to promulgate regulations for small quantity generators, indicated that the Agency should consider the impacts on small businesses, while still providing protection to human health and the environment. While this rule is not promulgated pursuant to this provision, we believe the intent of Congress is for the Agency (in promulgating any rule substantially affecting small quantity

addition, it described the Toxicity Characteristic Leaching Procedure (TCLP), a new version of the EP. The TCLP is designed to more accurately address the leaching of organic compounds and to improve upon technical aspects of the testing protocol.

The June 13 proposal used a subsurface fate and transport model to determine compound-specific dilution and attenuation factors (DAFs) as a basis for establishing the regulatory levels. (As mentioned above, the existing TC used a generic DAF of 100 which was not derived from modeling, but rather was an estimated factor indicating the potential for substantial hazard.) The extract from the second-generation extraction procedure, the TCLP, was analyzed for the presence of the 32 constituents at the proposed regulatory levels. In choosing the 36 new toxicants, the Agency identified those Appendix VIII constituents for which appropriate chronic toxicity reference levels were available and for which there existed adequate fate and transport data to establish a compound-specific DAF. (Appendix VIII of 40 CFR part 261 is the list of hazardous constituents that the Agency considers in evaluating the potential hazard posed by wastes; these constituents have been shown to have toxic, carcinogenic, mutagenic, or teratogenic effects.)

Chronic toxicity reference levels are those levels below which chronic exposure for individual toxicants in drinking water is considered safe or considered to pose minimal risk (in the case of carcinogens). The Agency decided to use, when possible, human health criteria and standards that have been proposed or promulgated for substances in particular media, because these have already received Agency and public review and evaluation. EPA proposed the continued use of the Drinking Water Standards (DWS) for the 14 existing EP toxicants and use of Recommended Maximum Contaminant Levels (RMCLs) for eight of the constituents being added to the TC list. For the remaining newly added constituents, EPA proposed to establish chronic toxicity reference levels using Reference Doses (RfDs) for non-carcinogens and Risk-Specific Doses (RSDs) for carcinogens.

The RfD is an estimate of the daily dose of a substance that will result in no adverse effect even after a lifetime of exposure to the substance at that dose. In order to account for toxicant exposure from sources other than water (i.e., air and food), the Agency proposed to apportion the RfD based on proportionate compound-specific exposure routes, as is done in developing drinking water standards.

The RSD is the daily dose of a carcinogen over a lifetime that will result in an incidence of cancer equal to a specific risk level. EPA proposed a weight-of-evidence approach, which involves categorizing carcinogens according to the quality and adequacy of the supporting toxicological studies, to establish the risk levels most appropriate for setting chronic toxicity reference levels for carcinogens.

The Agency proposed using a subsurface fate and transport model to calculate constituent-specific DAFs. This model incorporated compound-specific hydrolysis and soil adsorption data, coupled with parameters describing an underground environment (e.g., ground water flow rate, soil porosity, ground water pH). Values for parameters were selected based on review of geological conditions at existing landfills. Since the model was specifically developed to simulate transport of organics and a model for inorganics could not be completed in time for the June 13 proposal, EPA proposed to retain the existing EP for the eight inorganic toxicants.

The proposed rule introduced the TCLP as a second-generation leachin procedure to replace the existing EP. The main impetus behind the development of the TCLP was the ne to address the leaching of organic compounds. However, the Agency al recognized that the EP protocol could improved in certain ways. The TCLP was described in detail as a proposed revision to Appendix II of part 261. Further supporting information on the TCLP was provided through notices o availability of reports on July 9, 1988 (53 [illegible]) and September 19, 1988 (53 [illegible]). After the TC proposal, the Lan Disposal Restrictions final rule (53 FR 48972, November 7, 1988) promulgated the TCLP for monitoring compliance with treatment standards for certain spent solvent wastes and dioxin-contaminated wastes. See Section II.I below for further discussion of these notices.

E. Other Notices Relating to the Proposal

Today's rule is based on three fundamental analytic components th were set forth in the original June 13 proposal: a set of chronic toxicity reference levels, a subsurface fate transport model, and the TCLP. In addition to the June 13, 1988 proposed rule described in the preceding sectio of this preamble, EPA has published several other notices in the Federal Register dealing with these three components. These notices are listed Table II.1 and are summarized in this section. A more detailed discussion is presented on several of these notices other sections of this preamble, as identified in Table II.1.

TABLE II.1—RELATED FEDERAL REGISTER NOTICES DISCUSSING ONE OR MORE OF THE ANALYTICAL COMPONENTS OF THE REVISE TC

Federal Register Notice	Analytic Component			Relevant preamble section of today's r
	CTRLs [1]	Model [2]	TCLP [3]	
Jan. 14, 1988, 53 FR 1[illegible] (Proposed LDR framework)		X	X	II.E, II.J
Nov. 7, 1988, 53 FR 48[illegible] (Final LDR approach)			X	II.F
May 16, 1987, 52 FR 18[illegible] (Consideration of separate wastewater TC)		X	X	II.A, II.H
May 16, 1988, 53 FR 18[illegible] (CTRLs updated, two-tiered DAF alternative proposed)	X	X		II.C, II.D
May 24, 1988, 53 FR 18[illegible] (Proposal to replace particle reduction)			X	II.F
Aug. 1, 1988, 53 FR 28[illegible] (Proposed modifications to ground water model)		X		II.E

[1] Chronic Toxicity Reference Levels.
[2] Ground water fate and transport model.
[3] Toxicity Characteristic Leaching Procedure.

generators) to consider such impacts and to provide procedural adjustments where appropriate. EPA believes that extending the compliance date for this group of generators will allow the Agency time to provide necessary assistance and outreach to these generators and will allow sufficient time for small quantity generators to comply with the full range of applicable subtitle C requirements. Finally, by delaying the effective date of the TC for small quantity generators, the Agency will be able to concentrate its initial implementation efforts on large quantity generators, who will generate the vast majority of waste brought into the RCRA subtitle C system under this rule. Thus, because the delayed compliance date for small quantity generators enables the Agency to focus its attention on the waste generators expected to produce the largest volumes of waste, it maximizes protection of human health and the environment.

In summary, the Agency believes that allowing an additional six months for small quantity generators to come into full compliance with the TC will serve two purposes. First, it will allow the Agency time to educate small quantity generators on the RCRA rules, while at the same time, allowing the Agency to focus immediate implementation efforts on large generators of hazardous waste. Second, it will provide the necessary time for small quantity generators to comply with subtitle C requirements as a result of the TC.

3. Permitting

Several commenters expressed concern that they would not be able to submit required permit modifications before the effective date of the rule. Some commenters also expressed concern that the TC revisions could place a significant burden on the system for permitting hazardous waste treatment, storage, and disposal facilities.

The commenters recommended a number of different mechanisms for reducing the prospective burdens on the permitting system, such as (1) Allowing permitted facilities to operate under interim status with respect to newly regulated wastes; (2) handling requests from permitted facilities to manage TC wastes as minor permit modifications, rather than as major permit modifications (especially in the case of facilities that are already permitted to manage listed wastes containing TC constituents); (3) requiring permitted facilities to apply for major permit modifications by the effective date of the TC rule, but not requiring them to actually obtain the modification until a later date; or (4) delaying the effective date of the final rule.

EPA has promulgated amendments to the procedures for permit modifications for treatment, storage, and disposal facilities on September 28, 1988 (53 FR 37934). These changes to the regulations should generally allay the concerns expressed by the commenters. Although the new permit modifications rule will not automatically be effective in authorized states, EPA expects that many authorized states will adopt the provisions and EPA plans to use the new permit modification procedures to implement the TC. The new permit modification procedures are further explained in section V.

IV. Regulatory Levels

The regulatory levels established in today's rule are based on two elements—the toxicity of each constituent and the expected fate of the constituent when released into the environment. The latter element is expressed as a dilution/attenuation factor (DAF), which, when multiplied by the toxicity value, results in the regulatory level. It is this level that, when compared to the results of the TCLP, defines a waste as hazardous. If the waste leachate generated through the TCLP contains constituents equal to or above the regulatory levels in today's rule, the waste is a hazardous waste.

This section summarizes the Agency's basis for selecting the final list of constituents and the regulatory levels that are being promulgated in today's rule.

A. List of Constituents

1. Proposed List

The Agency initially proposed regulatory levels for 38 new organic constituents, proposed to modify the regulatory levels for the six organic constituents that are regulated under the existing EPTC, and proposed to retain the existing levels for the eight inorganic constituents regulated in the existing EPTC (see Table IV-1).

2. Constituents for Which Final Regulatory Levels Are Not Now Being Promulgated

The model used to predict DAFs for today's rule accounts for hydrolysis, which may occur during the transport of a constituent through the environment. If a constituent hydrolyzes during transport, its concentration will decrease more rapidly than it would if it were influenced by dispersion alone. Therefore, the DAF for a constituent that hydrolyzes during transport will be higher than that for a constituent that does not hydrolyze. However, the products that are formed because of hydrolysis of the constituent also may be toxic.

TABLE IV-1.—TC CONSTITUENTS AND REGULATORY LEVELS PROPOSED JUNE 13, 1986

HWNO [1]	Constituents	CASNO [2]	Regulatory level (mg/L)
D016	Acrylonitrile	107-13-1	5.0
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D019	Benzene	71-43-2	0.07
D020	Bis(2-chloroethyl) ether	111-44-4	0.05
D008	Cadmium	[illegible]	1.0
D021	Carbon disulfide	75-15-0	14.4
D022	Carbon tetrachloride	56-23-5	0.07
D023	Chlordane	57-74-9	0.03
D024	Chlorobenzene	108-90-7	1.4
D025	Chloroform	67-66-3	0.07
D007	Chromium	1333-82-0	5.0
D026	o-Cresol	95-48-7	10.0
D027	m-Cresol	108-39-4	10.0
D028	p-Cresol	106-44-5	10.0
D016	2,4-D	94-75-7	1.4
D029	1,2-Dichlorobenzene	95-50-1	4.3
D030	1,4-Dichlorobenzene	106-46-7	10.8
D031	1,2-Dichloroethane	107-06-2	0.40

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TABLE IV-1.—TC CONSTITUENTS AND REGULATORY LEVELS PROPOSED JUNE 13, 1988—Continued

HWNO [1]	Constituents	CASNO [2]	Regulatory level (mg/L)
D002	1,1-Dichloroethylene	75-35-4	0.1
D003	2,4-Dinitrotoluene	121-14-2	0.13
D012	Endrin	72-20-8	0.003
D034	Heptachlor (and its hydroxide)	76-44-2	0.001
D035	Hexachlorobenzene	118-74-1	0.13
D036	Hexachlorobutadiene	87-68-3	0.72
D037	Hexachloroethane	67-72-1	4.3
D038	Isosafrol	78-59-1	38.0
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.06
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	1.4
D039	Methylene chloride	75-09-2	8.6
D040	Methyl ethyl ketone	78-93-3	7.2
D041	Nitrobenzene	98-95-3	0.13
D042	Pentachlorophenol	87-86-5	2.6
D043	Phenol	108-95-2	14.4
D044	Pyridine	110-86-1	5.0
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D045	1,1,2,3-Tetrachloroethane	630-20-6	10.0
D046	1,1,2,2-Tetrachloroethane	79-34-5	1.3
D047	Tetrachloroethylene	127-18-4	0.1
D048	2,3,4,6-Tetrachlorophenol	58-90-2	1.5
D049	Toluene	108-88-3	14.4
D016	Toxaphene	8001-35-2	0.07
D050	1,1,1-Trichloroethane	71-55-6	30.0
D051	1,1,2-Trichloroethane	79-00-5	1.2
D052	Trichloroethylene	79-01-6	0.07
D053	2,4,5-Trichlorophenol	95-95-4	5.6
D054	2,4,6-Trichlorophenol	88-06-2	0.30
D017	2,4,5-TP (Silvex)	93-72-1	0.14
D055	Vinyl chloride	75-01-4	0.05

[1] EPA Hazardous Waste Code Number.
[2] Chemical Abstracts Service number.

As explained in section III.E.2.a.vii, the Agency does not have sufficient data to address the formation and toxicity of hydrolysis products. Therefore, in today's rule, the Agency is not establishing regulatory levels for those new organic constituents that are expected to appreciably hydrolyze and thereby form potentially toxic by-products. Rather, the Agency expects to address these constituents in a future Federal Register notice.

Three of the organic constituents currently regulated by the EPTC may hydrolyze to a significant extent. However, due to uncertainties associated with this mechanism, the Agency believes that it would not be prudent to remove these constituents from regulation on a temporary basis (i.e., until their hydrolysis products can be assessed). Therefore, these constituents (endrin, methoxychlor, and toxaphene) will continue to be regulated at the existing EPTC levels in the interim.

Also, as explained in section III.E.2.a, the Agency has concluded that the steady-state assumption used in the ground water transport model may not be appropriate for all constituents. The constituents for which a steady-state solution may not be appropriate are being deferred from the list of proposed constituents. EPA will promulgate or repropose (as warranted) regulatory levels for these constituents in a future Federal Register notice.

3. Final List of Constituents

a. *Organic Constituents.* The organic constituents for which the Agency is today establishing regulatory levels (i.e., those that are on the current ZP list, and those that do not appreciably hydrolyze and for which a steady-state assumption is appropriate) are presented in Table IV-2.

TABLE IV-2.—ORGANIC CONSTITUENTS

EPA HW number [1]	Constituent	CAS number [2]
D018	Benzene	71-43-2
D019	Carbon tetrachloride	56-23-5
D020	Chlordane	57-74-9
D021	Chlorobenzene	108-90-7
D022	Chloroform	67-66-3
D023	o-Cresol	95-48-7
D024	m-Cresol	108-39-4
D025	p-Cresol	106-44-5
D026	2,4-D	94-75-7
D027	1,4-Dichlorobenzene	106-46-7
D028	1,2-Dichloroethane	107-06-2
D029	1,1-Dichloroethylene	75-35-4
D030	2,4-Dinitrotoluene	121-14-2
D012	Endrin	72-20-8
D031	Heptachlor (and its hydroxide)	76-44-2
D032	Hexachlorobenzene	118-74-1
D033	Hexachloro-1,3-butadiene	87-68-3
D034	Hexachloroethane	67-72-1
D013	Lindane	58-89-9
D014	Methoxychlor	72-43-5
D035	Methyl ethyl ketone	78-93-3
D036	Nitrobenzene	98-95-3
D037	Pentachlorophenol	87-86-5
D038	Pyridine	110-86-1
D039	Tetrachloroethylene	127-18-4
D016	Toxaphene	8001-35-2
D040	Trichloroethylene	79-01-6
D041	2,4,5-Trichlorophenol	95-95-4
D042	2,4,6-Trichlorophenol	88-06-2
D017	2,4,5-TP (Silvex)	93-72-1
D043	Vinyl chloride	75-01-4

[1] Hazardous waste number.
[2] Chemical abstracts service number.

b. *Inorganic Constituents.* Among the constituents that were proposed for inclusion in the TC were eight inorganic constituents that are currently regulated in the EPTC. Because EPACML does not currently accommodate metallic species, it cannot be used to predict DAFs for these constituents. Therefore, the Agency is today retaining the regulatory

levels for these constituents at their current levels. When the MINTEQ model (see III.B.5.c) is available to accommodate these constituents, the Agency will reconsider their regulatory levels and propose new ones, if so warranted.

B. Selection of DAFs

The selection of the appropriate DAF for the constituents addressed in today's rule is based on the municipal landfill scenario, as proposed. However, based on comments on fate processes that were not appropriately considered in the model, several constituents have been omitted from the proposed list of constituents—specifically, those that may hydrolyze to more than a negligible extent and those for which the steady-state assumption may not be appropriate.

For the remaining constituents, the Agency believes that a DAF of 100 is appropriate for establishing regulatory levels in today's rule. The basis for this conclusion is explained in Section III.E.4.d.

C. Analytical Constraints

The regulatory levels for the compounds proposed for inclusion in the TC span approximately five orders of magnitude (i.e., from the low parts per billion to 100 parts per million). The calculated regulatory levels for three of these compounds (2,4-dinitrotoluene, hexachlorobenzene, and pyridine) are below the concentrations measurable using currently available methods.

EPA believes that the appropriate way to deal with a calculated regulatory level that is below the analytical detection limit is to use (for the regulatory level) the lowest level of detection that can be attained. The lowest level of a particular chemical that can be reliably measured within acceptable limits of precision and accuracy under routine laboratory operating conditions is that chemical's "quantitation limit." A quantitation limit is determined through such studies as method performance evaluations.

If data from interlaboratory studies are unavailable, quantitation limits are estimated based on the detection limits and an estimated multiplier that represents a practical and routinely achievable level with relatively high certainty that the reported value is reliable. EPA proposed to use a value of five times the analytical detection limit as the quantitation limit and to set the regulatory level at the quantitation limit for those compounds for which the calculated regulatory level is below the quantitation limit, and interlaboratory studies were not available.

Because TCLP extracts are aqueous in nature, the quantitation limits used in this rule are based on the presence of these compounds in a water matrix. The Agency received many comments on the use of the quantitation limit as the regulatory level for the three compounds with health-based thresholds below that level. Most commenters expressed concern that quantitation limits based on analysis of the constituent in a water matrix may not be achievable in more complex samples. The comments discussed potential complications that could hamper analysis of various kinds of wastes and recommended that EPA work toward determining actual quantitation limits on real wastes.

The Agency agrees that the ability to achieve the quantitation levels listed in the proposed rule is strongly influenced by the type of waste that is being analyzed. However, determination of a matrix-dependent quantitation limit would require analysis of a wide variety of wastes. EPA believes that it would be impractical to perform such waste-specific analyses at this time. Therefore, EPA has chosen to use the proposed definition (i.e., five times the method detection limit) for the quantitation limit.

A number of commenters addressed the issue of the generic multiplier used to derive the quantitation limit. Several commenters recommended using 10 to 25 times the detection limit as the regulatory level, while a few commenters supported setting the regulatory level at the detection limit itself, to provide what they believe would be greater environmental protection.

The Agency is working to improve the sensitivity of analytical methods to provide increased protection of human health and the environment. Analytical detection limits are, by definition, not routinely achievable under average laboratory conditions. Thus, a regulatory level set at the detection limit would be difficult for the Agency to enforce and would make it difficult for the regulated community to demonstrate compliance. To provide a consistently enforceable regulatory limit while providing assurance that those wastes that clearly pose hazards are subject to subtitle C requirements, the Agency will set the regulatory level at five times the detection limit. The Agency has a high degree of confidence in setting the regulatory level at the quantitation limit (i.e., five times the detection limit) because other programs within the Agency have successfully used this method in the past to set regulatory levels (e.g., the Contract Laboratory Program under the Superfund Program).

Comments on the use of the quantitation limit are addressed more extensively in the testing methods background document.

D. Final Regulatory Levels

The regulatory levels being promulgated today are equal to the product of each constituent's toxicity threshold and the DAF or the quantitation limit. These regulatory levels are presented in Table IV-3. These levels are designed to identify wastes that clearly pose a hazard and define those wastes as hazardous. However, it should be noted that wastes that do not exhibit this characteristic (e.g., result in TCLP levels that are less than the regulatory levels) are not necessarily nonhazardous and may be listed as a hazardous waste or become hazardous under other hazardous waste characteristics.

TABLE IV-3.—TOXICITY CHARACTERISTIC CONSTITUENTS AND REGULATORY LEVELS

EPA HW number[1]	Constituent	CAS Number[2]	Regulatory level (mg/l)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1.0
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	o-Cresol	95-48-7	[3] 200.0

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TABLE IV-3.—TOXICITY CHARACTERISTIC CONSTITUENTS AND REGULATORY LEVELS—Continued

EPA HW number [1]	Constituent	CAS number [2]	Regulatory level (mg/L)
D024	m-Cresol	108-39-4	[4] 200
D025	p-Cresol	106-44-5	[4] 200
D026	Cresol		[4] 200
D016	2,4-D	94-75-7	10
D027	1,4-Dichlorobenzene	106-46-7	7
D028	1,2-Dichloroethane	107-06-2	0
D029	1,1-Dichloroethylene	75-35-4	0
D030	2,4-Dinitrotoluene	121-14-2	[4] 0
D012	Endrin	72-20-8	0.
D031	Heptachlor (and its hydroxide)	76-44-8	0.
D032	Hexachlorobenzene	118-74-1	[4] 0.
D033	Hexachloro-1,3-butadiene	87-68-3	0.
D034	Hexachloroethane	67-72-1	3.
D008	Lead	7439-92-1	5.
D013	Lindane	58-89-9	0.
D009	Mercury	7439-97-6	0.
D014	Methoxychlor	72-43-5	10.
D035	Methyl ethyl ketone	78-93-3	200.
D036	Nitrobenzene	98-95-3	2.
D037	Pentachlorophenol	87-86-5	100.
D038	Pyridine	110-86-1	[4] 5.
D010	Selenium	7782-49-2	1.
D011	Silver	7440-22-4	5.
D039	Tetrachloroethylene	127-18-4	0.
D015	Toxaphene	8001-35-2	0.
D040	Trichloroethylene	79-01-6	0.
D041	2,4,5-Trichlorophenol	95-95-4	400.
D042	2,4,6-Trichlorophenol	88-06-2	2.
D017	2,4,5-TP (Silvex)	93-72-1	1.
D043	Vinyl chloride	75-01-4	0.

[1] Hazardous waste number.
[2] Chemical abstracts service number.
[3] Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.
[4] If o-m-, and p-cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level for total cresol is 200 mg

V. Implementation

This section is intended to assist the regulated community in understanding their regulatory obligations for managing TC wastes. Responses to comments and an analysis of issues related to implementation were presented in section III.K.

The first step in a solid waste generator's decision making process must be to determine whether or not particular wastes are hazardous (40 CFR 262.11). If a waste is excluded from regulation under 40 CFR 261.4, or if it is a listed hazardous waste under subpart D of 40 CFR part 261, then no further determination is necessary. If a waste is neither excluded nor listed, a generator must determine whether the waste exhibits any of the characteristics of hazardous waste; the Toxicity Characteristic is one such characteristic of hazardous waste. A generator may determine if a waste exhibits a characteristic either by testing the waste or applying knowledge of the waste, the raw materials, and the processes used in its generation.

When a waste is determined to be hazardous, handlers of that waste must comply with any applicable standards in parts 262, 263, 264, 265, 266, 267, 268 and 270 of chapter 40. Table V-1 presents an implementation timeline for the TC. The remainder of this section illuminates five implementation concerns: state authority, integration of today's TC with the existing EPTC, notification, permitting, and compliance date.

TABLE V-1.—IMPLEMENTATION TIMELINE FOR THE TOXICITY CHARACTERISTIC

0 Months: Publication in the Federal Register.

3 Months:
- Generators of 1000 kg/mo or more and TSDFs who have not previously notified submit 3010 Notification to EPA.

6 Months:
- Facilities wishing to avoid entering the RCRA program cease managing newly regulated TC hazardous wastes. Units that were receiving TC hazardous wastes must cease further receipt in order to avoid regulation under Subtitle C.
- Large quantity generators begin to comply with all applicable Subtitle C regulations for newly regulated TC wastes.
- Newly regulated facilities.
  —Submit Part A permit application.
- Already regulated facilities.
  —Interim Status Facilities: subm amended Part A permit applicatio
  —Permitted TSDFs: submit Class permit modification.

12 Months:
- Small quantity generators begin comply with all applicable Subtitle regulations for newly regulated T wastes.
- Already regulated facilities.
  —Permitted TSDFs: submit Class 2 c Class 3 permit modifications.

18 Months:
- Newly regulated land disposal units submit Part B permit application an certifications to EPA—Interim Status te minates for these land disposal unit that did not submit their Part B perm application and certifications by th date.

A. State Authority

1. Applicability of Final Rule in Authorized States

Under section 3006 of RCRA, EPA may authorize qualified states to

administer and enforce the RCRA program within the state (see 40 CFR part 271 for the standards and requirements for authorization). Following authorization, EPA retains enforcement authority under sections 3008, 7003 and 3013 of RCRA, although authorized states have primary enforcement responsibility. Prior to HSWA, a state with final authorization administered its hazardous waste program entirely in lieu of the federal program. The federal requirements no longer applied in the authorized state, and EPA could not issue permits for any facilities in a state that was authorized to issue permits. When new, more stringent federal requirements were promulgated or enacted, the state was obligated to enact equivalent authority within specified time frames. New federal requirements did not take effect in an authorized state until the state adopted the requirements as state law.

In contrast, under section 3006(g) of RCRA, 42 U.S.C. 6926(g), new requirements and prohibitions imposed by HSWA take effect in authorized states at the same time that they take effect in nonauthorized states. EPA is directed to carry out those requirements and prohibitions in authorized states, including the issuance of permits, until the state is granted authorization to do so. While states must still adopt HSWA-related provisions as state law to retain final authorization, the HSWA requirements are implemented by EPA in authorized states in the interim.

Today's rule is promulgated pursuant to RCRA section 3001(g) and (h). These provisions were added by HSWA. Therefore, the Agency is adding the requirement to Table 1 in § 271.1(j), which identifies the federal program requirements that are promulgated pursuant to HSWA and that take effect in all states, regardless of their authorization status. States may apply for either interim of final authorization for the HSWA provisions identified in Table 1, as discussed in the following section of this preamble.

2. Effect on State Authorization

As noted above, EPA will implement today's rule in authorized states until they modify their programs to adopt these rules and the modifications are approved by EPA. Because the rule is promulgated pursuant to HSWA, a state submitting a program modification may apply to receive either interim or final authorization under section 3006(g)(2) or 3006(b), respectively, on the basis of requirements that are substantially equivalent or equivalent to EPA's. The procedures and schedule for state program modifications for either interim or final authorization are described in 40 CFR 271.21. It should be noted that all HSWA interim authorizations will expire January 1, 1993 (see 40 CFR 271.24(c)).

40 CFR 271.21(e)(2) requires that states with final authorization must modify their programs to reflect federal program changes, and they must subsequently submit the modifications to EPA for approval. The deadline for state program modifications for this rule is July 1, 1991 (or July 1, 1992, if a state statutory change is needed). These deadlines can be extended in certain cases (40 CFR 271.21(e)(3)). Once EPA approves the modification, the state requirements become subtitle C RCRA requirements. States with authorized RCRA programs may already have requirements similar to those in today's rule. These state regulations have not been assessed against the federal regulations being promulgated today to determine whether they meet the tests for authorization. Thus, a state is not authorized to implement these requirements in lieu of EPA until the state program modification is approved. Of course, states with existing standards may continue to administer and enforce their standards as a matter of state law. In implementing the federal program, EPA will work with states under cooperative agreements to minimize duplication of efforts. In many cases, EPA will be able to defer to the states in their program implementation efforts, rather than take separate actions under federal authority.

States that submit their official applications for final authorization less than 12 months after the effective date of these standards are not required to include standards equivalent to these standards in their application. However, the state must modify its program by the deadline set forth in § 271.21(e). States that submit official applications for final authorization 12 months after the effective date of these standards must include standards equivalent to these standards in their application. The process and schedule for final state authorization applications is described in 40 CFR 271.3.

B. Integration of Today's Final Rule with Existing EPTC

As explained above, because this rule is promulgated pursuant to HSWA, it will be effective six months from today in both authorized and unauthorized states and will be implemented by EPA until states receive authorization for this rule. Thus, beginning on the effective date, large quantity generators that generate TC waste in all states are responsible for complying with the appropriate requirements. However, the rule promulgated today also revises the existing RCRA rule defining hazardous wastes that authorized states have been implementing for some time. The two principal changes in the rule are the revision to the leaching procedure, by replacing the EP with the TCLP, and the addition of constituents for which the leachate will be analyzed. The discussion below and Table V-2 describe how state implementation of the existing EPTC will be integrated with EPA implementation of the TC as promulgated today.

1. Facilities Located in Authorized States

There are three types of facilities located in authorized states which are affected by today's rule: facilities which are already operating under a RCRA permit, facilities which are already operating under interim status, and facilities which are subject to RCRA permit requirements for the first time as a result of today's rule. Permitted and interim status facilities can also be affected by today's rule in three distinct ways: (1) The facility may already be managing wastes that are hazardous under the existing EPTC, (2) the facility may already be managing wastes that are hazardous under the existing EPTC but which also exhibit the toxicity characteristic for a new constituent(s) under today's rule (and thus the waste would have a new waste code), or (3) the facility may be managing a solid waste which is newly subject to regulation as a result of today's revision of the TC. Table V-2 summarizes the initial filing requirements and applicable standards for each category of facility.

TABLE V-2.—INTEGRATION OF TC WITH EXISTING EPTC

Status of State authorization	Facility status	Type of waste	What to file	Where to file	Applicable permitting standards
I. Authorized State	A. Permitted	1. Regulated EPA waste w/no new constituents under revised TC.	NA	NA	State permit standards.
		2. Regulated EP waste w/new constituents.	Class 1 permit modification under 40 CFR 270.42.	EPA Regional Office and State.	State permit standards.
		3. Previously unregulated waste in:	Class 1 permit modification under 40 CFR 270.42.[1]	EPA Regional Office and State.	
		-Already regulated unit.			State permit standards.
		-Previously unregulated unit.			40 CFR Part 264.
	B. Interim Status	1. Regulated EP waste w/no new constituents under revised TC.	NA	NA	State interim status standards.
		2. Regulated EP waste w/new constituents under revised TC.	Revised Part A under 40 CFR 270.72.	EPA Regional Office and State.	State interim status standards.
		3. Previously unregulated waste.	Revised Part A under 40 CFR 270.72.[2]	EPA Regional Office and State.	40 CFR Part 264.
	C. Newly-regulated		Part A and 3010 under 40 CFR 270.70.[3]	EPA Regional Office	40 CFR Part 265.
II. Non-authorized State	A. Permitted	1. Regulated EP waste w/no new constituents under revised TC.	NA	NA	40 CFR Part 264.
		2. Regulated EP waste w/new constituents under revised TC.	Class 1 permit modification under 40 CFR 270.42.	EPA Regional Office	40 CFR Part 264.
		3. Previously unregulated waste in:	Class 1 permit modification under 40 CFR 270.42.[1]	EPA Regional Office	
		-Already regulated unit.			40 CFR Part 264.
		-Previously unregulated unit.			40 CFR Part 265.
	B. Interim Status	1. Regulated EP waste w/no new constituents under revised TC.	NA	NA	40 CFR Part 265.
		2. Regulated EP waste w/new constituents under revised TC.	Revised Part A under 40 CFR 270.72.	EPA Regional Office	40 CFR Part 264.
		3. Previously unregulated waste.	Revised Part A under 40 CFR 270.72.[2]	EPA Regional Office	40 CFR Part 265.
	C. Newly-regulated		Part A and 3010 under 40 CFR 270.70.[3]	EPA Regional Office	40 CFR Part 265.

[1] Facility may also need to receive a Class 2 or Class 3 modification under CFR 270.42.
[2] If newly regulated waste is being managed in a land disposal unit, facility may need to submit certification of compliance within one year under 40 CFR 270.73.
[3] If facility is a land disposal facility, Part B permit application and certification of compliance must be submitted within one year under RCRA Section 3005(e)(3) and 40 CFR 270.73.

For facilities which have been managing EPTC wastes under an authorized state program and the constituents exhibited by the wastes are unchanged under today's rule, (i.e., no waste code change is necessary), such interim status and permitted facilities have no changes to file with permitting authorities. Similarly, since the regulatory status of the waste is unchanged, management of that waste will continue to be regulated under the authorized state standards. The only effect of today's rule on such facilities is that the facility must use the TCLP when testing for toxic constituents. However, use of the EP in addition to the TCLP may continue to be required as a matter of state law.

For facilities which have been managing EPTC wastes under an authorized state program and the constituents exhibited by the wastes have changed as a result of today's rule, the facility will need to change the waste code assigned to its TC wastes. Permitted facilities must submit permit modifications to EPA reflecting the new wastes codes. Because EPA must implement this rule until the state is authorized to do so, the permittee must comply with federal permit modification procedures under 40 CFR 270.42 rather than state permit modification procedures. However, because the permit undergoing modification is most likely a joint EPA-state RCRA permit, a copy of the modification request should also be submitted to the authorized state. Similarly, interim status facilities must submit a revised part A permit application to EPA pursuant to 40 CFR 270.72, with a copy to state permitting authorities. Although these facilities must make appropriate waste code modifications to reflect the new TC constituents, the wastes are already regulated as EP wastes under the authorized state program. Accordingly, such wastes are not subject to any new management requirements as a result of this rule and must continue to comply with appropriate authorized state

requirements for management of these wastes.

Some permitted and interim status facilities in authorized states will be managing wastes which will become hazardous as a result of today's rule. These facilities must also submit permit modifications or part A permit application revisions to EPA. However, because these wastes were previously unregulated under RCRA, they also were not regulated under the authorized state program. As a result, if these wastes are in a previously unregulated unit, they will be subject to the self-implementing Federal standards for hazardous wastes management at 40 CFR part 265 until permit issuance (for interim status facilities) or modification (for permitted facilities). After permit issuance or modification, the Federal permitting standards at 40 CFR part 264 will apply to these wastes (or the state permitting standards if the permit is ultimately issued or modified by a state authorized for the TC). However, if the wastes are at a permitted facility in a unit that is already regulated, that unit will continue to comply with the applicable 40 CFR part 264 (or state equivalent) standards.

Facilities in authorized states which are newly subject to RCRA permit requirements as a result of today's rule must obtain an EPA identification number and submit their part A permit application and section 3010 notification to EPA in order to obtain interim status (see 40 CFR 270.70). Such facilities are subject to regulation under 40 CFR part 265 until a permit is issued by EPA or a state authorized for the TC.

2. Facilities Located in Unauthorized States

There are also three types of facilities located in unauthorized states which are affected by today's rule: already permitted facilities, facilities operating under interim status, and facilities newly subject to RCRA permit requirements under today's rule. As in authorized states, some of the permitted and interim status facilities have been managing EPTC wastes.

For interim status and permitted facilities which have been managing EPTC wastes that will exhibit no new constituents as a result of the replacement of the EP with the TCLP and the addition of constituents to the TC, there will be no waste code changes. Accordingly, such facilities do not need to submit permit modifications or revised permit applications to EPA and will continue to be subject to the applicable federal standards for hazardous waste management.

Facilities which have been managing EPTC wastes which exhibit the toxicity characteristic for new constituents as a result of today's changes to the TC must notify EPA of the waste code changes for its TC wastes. Permitted facilities must submit permit modifications to EPA as required under 40 CFR 270.42 that reflect the new wastes codes. Interim status facilities must submit revised part A permit applications in accordance with 40 CFR 270.72. These facilities must continue to comply with the applicable federal standards for hazardous waste management.

Permitted and interim status facilities which manage waste that is newly defined as hazardous waste as a result of today's rule must also submit permit modification requests or part A permit application revisions to EPA. Facilities must manage these wastes in accordance with 40 CFR part 265 or 40 CFR part 264 until permit modification or issuance, depending on whether the waste is managed in a newly regulated or previously regulated unit.

Facilities which are newly subject to RCRA permit requirements as a result of today's rule must get an EPA identification number and a part A permit application to EPA in order to obtain interim status. Such facilities are subject to regulat[illegible] under 40 CFR part 265 until a permit [illegible]ssued.

C. Notification

Pursuant to RCRA section 3010, the Administrator may require all persons who handle hazardous wastes to notify EPA of their hazardous waste management activities within 90 days after the wastes are identified or listed as hazardous. This requirement may be applied even to those generators, transporters, and TSDFs who have previously notified EPA with respect to the management of other hazardous wastes.

In the June 13, 1986, Federal Register notice, EPA proposed to waive the notification requirement for persons who manage TC wastes and have already (1) notified the Agency that they manage other hazardous wastes and (2) received an EPA identification number. EPA has decided to waive the notification requirement as proposed. The Agency believes that, given the vast scope of the TC rule, a notification requirement for persons already identified within the hazardous waste management universe is unnecessary.

EPA is not waiving the notification requirement for TC waste handlers that have neither notified the Agency that they manage hazardous wastes nor received an EPA identification number. Those persons must notify EPA no later than June 27, 1990 of these activities pursuant to section 3010 of RCRA. Notification instructions are set forth i[illegible] 45 FR 12746, February 26, 1980.

D. Permitting

Currently permitted facilities that manage TC wastes must submit Class [illegible] permit modifications if they are to continue managing the newly regulate[illegible] wastes in units that require a permit. The facilities must obtain the necessar[illegible] modification by the effective date of th[illegible] rule, or they will be prohibited from accepting additional TC wastes.

Interim status facilities that manage TC wastes in units that require a perm[illegible] must file an amended part A permit application under 40 CFR 270.10(g) if they are to continue managing newly regulated wastes. The facilities must fi[illegible] the necessary amendments by the effective date of the rule, or they will n[illegible] receive interim status with respect to t[illegible] TC wastes (i.e., they will be prohibited from accepting additional TC wastes until permitted).

Newly regulated facilities (i.e., facilities at which the only hazardous wastes that are managed are newly regulated TC wastes) must qualify for interim status by the compliance date [illegible] the rule in order to continue managing TC wastes prior to receiving a permit. Under 40 CFR 270.70, an existing facili[illegible] may obtain interim status by getting a[illegible] EPA identification number and submitting a part A permit application. To retain interim status, a newly-regulated land disposal facility must submit a part B permit application within one year after the effective date of the rule and certify that the facility i[illegible] in compliance with all applicable grou[illegible] water monitoring and financial responsibility requirements (see RCRA section 3005(e)(3)).

EPA recently promulgated amendments to the procedures for permit modifications for treatment, storage, and disposal facilities (see 53 FR 37934, September 28, 1988). The following discussion assumes implementation in accordance with the new rule. EPA will implement the TC b[illegible] using the new permit modification procedures, consistent with EPA policy (see 53 FR 37933, September 28, 1988).

Under the new regulation in § 270.42 there are now three classes of permit modifications with different submittal and public participation requirements for each class. In § 270.42(g), which concerns newly listed or identified wastes, a permitted facility that is "in existence" as a hazardous waste facili[illegible] for the newly listed or identified waste on the effective date of the notice must

submit a Class 1 modification by that date. Essentially, this modification is a notification to the Agency that the facility is handling the waste. As part of the procedure, the permittee must also notify the public within 90 days of submittal to the Agency.

Next, within 180 days of the effective date, the permittee must submit a Class 2 or 3 modification to the Agency. A permittee may submit a Class 2 modification if the newly regulated waste will be disposed in existing TSD units and will not require additional or different management practices from those authorized in the permit. A Class 2 modification requires public notice by the facility owner of the modification request, a 60 day public comment period, and an informal meeting between the owner and the public within the 60 day period. The rule includes a "default provision," so that for Class 2 modifications, if the Agency does not make a decision within 120 days, the modification is automatically authorized for 180 days. If the Agency does not reach a decision by the end of that period, the modification is permanently authorized. If the newly regulated waste requires additional or different management practices, a Class 3 modification is required. The initial public notification and public meeting requirements are the same as for Class 2. However, after the end of the public comment period, the Agency will develop a draft permit modification, open a public comment period of 45 days and hold a public hearing.

E. Compliance Date

The Agency is promulgating two different compliance dates for two different categories of TC waste generators: (1) All generators of greater than 100 and less than 1,000 kg/month of hazardous waste (small-quantity generators) must come into compliance with subtitle C requirements for management of their TC waste within one year from today; and (2) all generators of 1,000 kg/month or more of hazardous waste and TSDFs are required to comply with all subtitle C requirements for TC wastes within six months from today, on the effective date of the rule. Thus the EPTC remains in effect until six months after today's date for large quantity generators and TSDFs, and remains in effect for 12 months after today's date for small quantity generators. The generator quantity refers to all of a generator's hazardous waste, not just newly hazardous TC waste.

Further discussion of the Agency's reasons for promulgating an extended compliance date for small-quantity generators is provided in section III K of this preamble. In summary, the Agency believes that allowing an additional six months for small quantity generators to come into full compliance with the TC will serve two purposes. First, it will allow the Agency time to educate small quantity generators on the RCRA rules while, at the same time, allowing the Agency to focus immediate implementation efforts on large volumes of hazardous waste. Second, it will provide the necessary time for small quantity generators to comply with subtitle C requirements as a result of the TC.

VI. Regulatory Requirements

A. Introduction

This portion of the preamble discusses the analyses required by Executive Order No. 12291 and the Regulatory Flexibility Act. The Agency is required under the Executive Order to estimate the costs, economic impacts, and benefits of "major" rules by conducting a regulatory impact analysis (RIA). Recognizing the potential of the Toxicity Characteristic (TC) rule to affect a broad spectrum of American industry, EPA prepared an RIA comparing several regulatory alternatives. Based on the results of this analysis, the Agency concluded that this final regulation is a major rule. Section VI.B presents the methodology and results of the RIA.

The Regulatory Flexibility Act requires the Agency to assess small business impacts resulting from regulations. The analysis of small business impacts indicated that the TC rule would not have a significant impact on small businesses, and therefore a formal regulatory flexibility analysis was not prepared. Section VI.C addresses potential effects on small businesses.

The Agency received many comments on the RIA for the June 13, 1986 proposal. A summary of comments, along with Agency responses, is included as section VI.D. Section VI.E discusses requirements under the Paperwork Reduction Act.

Details of the regulatory impact analysis and small business analysis are available in the RIA document for the final rule (Ref. 8). This final rule was submitted to the Office of Management and Budget for review as required by E.O. No. 12291.

B. Regulatory Impact Analysis

1. Executive Order No. 12291

Executive Order No. 12291 requires EPA to assess the effect of Agency actions during the development of regulations. Such an assessment consists of a quantification of the potential costs, economic impacts, and benefits of a rule, as well as a description of any beneficial or adverse effects that cannot be quantified in monetary terms. In addition, Executive Order No. 12291 requires that regulatory agencies prepare a regulatory impact analysis (RIA) for major rules. Major rules are defined as those likely to result in (1) an annual cost to the economy of $100 million or more; (2) a major increase in costs or prices for consumers or individual industries; or (3) significant adverse effects on competition, employment, investment, innovation, or international trade.

EPA prepared an RIA comparing the final TC rule with several regulatory alternatives. Based on the RIA, EPA estimates that the final TC rule is a major rule with annual compliance costs of between $130 million and $400 million. The analysis was conducted based on the Office of Management and Budget's "Interim Regulatory Impact Analysis Guidance" and EPA's "Guidelines for Performing Regulatory Impact Analyses."

2. Basic Approach

In the final rule, EPA is amending its hazardous waste identification regulations under Subtitle C of the Resource Conservation and Recovery Act (RCRA) by refining and expanding the existing Extraction Procedure Toxicity Characteristic (EPTC). The resulting TC includes a new extraction procedure (the Toxicity Characteristic Leaching Procedure or TCLP) and 25 new organic constituents in addition to the 14 existing EPTC constituents. Wastes exhibiting the TC, based on concentrations of constituents in the TCLP extract, are designated as hazardous wastes and are brought under subtitle C regulation.

EPA estimated the costs, economic impacts, and benefits of the final rule and of a number of major regulatory alternatives to the rule. Only the anticipated effects of the final rule are presented in this preamble; results for the regulatory alternatives are discussed in the RIA. In presenting the results of the analysis, the Agency has presented range estimates for costs, economic impacts, and benefits to express the uncertainty associated with certain analytical assumptions.

In order to gauge the effects of the final rule, EPA first identified wastes and industries which would be affected by the rule. Incremental costs for affected facilities were estimated based on the change in waste management practices which would be required once

the wastes became hazardous. These incremental costs were aggregated to estimate national costs of the rule.

Economic impacts on facilities were based on a comparison of facility compliance costs with costs of production and cash from operations. The potential for facility closures was also examined.

Benefits, like costs, were based on required changes in waste management practices. Benefit measures included human health risk reduction, resource damage reduction, and cleanup costs avoided. Facility-level benefit estimates were aggregated to obtain national benefits.

Section VI.B.3, below, presents the methodology used to estimate costs, economic impacts, and benefits. It also briefly describes the sensitivity analyses that were conducted to determine the significance of key analytical assumptions; these sensitivity analyses are discussed in more detail in the RIA. Limitations of the analytical approach (e.g., assumptions which are likely to overstate, understate, or create uncertainty in results) are discussed in the RIA. Results of the analysis of costs, economic impacts, and benefits are provided in section VI.B.4.

3. Methodology

The methodology for the RIA is presented in several parts. First, the procedure for identifying wastes and facilities affected by the TC is discussed. Next, the development of national cost estimates is presented. The section on economic impact methodology describes the criteria used in gauging impacts on the regulated community. Following that is a section that presents several alternative measures of benefits of the rule. The last section describes the methodology for analysis of used oil.

a. *Determination of Affected Wastes and Facilities.* The first step in estimating the impacts of the rule was to determine which wastes and facilities would be affected by the rule, based on waste characteristics, quantities, and management practices. No single data source contained all of this information, and none of the data were facility-specific. Therefore, the Agency assembled aggregated data (e.g., by industrial sector) from separate sources and used it to draw inferences on facility-level impacts.

Data on waste characterization and volume came primarily from a series of TC industry studies. (Ref. 18 through 29) These studies were conducted for major industrial categories identified as likely to generate significant quantities of TC wastes; other sectors, generating smaller quantities of potentially affected waste, were not addressed. Standard Industrial Classifications (SICs) for the industrial sectors studied range between the two-digit and four-digit levels. The industries profiled are shown in Table VI-1.

TABLE VI-1.—POTENTIALLY AFFECTED INDUSTRIES CONSIDERED IN RIAS FOR THE PROPOSED AND FINAL TC RULES

Industry	SIC [1]	Proposed	Final
Textile Mills [2]	22		X
Lumber and Wood Products [2]	242* 2499		X
Pulp and Paper [2]	261, 262, 263, 265		X
Printing and Publishing	27		X
Plastics Materials and Resins [2]	2821	X	X
Synthetic Rubber [2]	2822	X	X
Synthetic Fibers [2]	2823, 2824		X
Pharmaceuticals [2]	283	X	X
Soaps and Other Detergents	2841	X	
Surface Active Agents	2843	X	
Paints and Allied Products	2851	X	
Organic Chemicals [2]	2865, 2869	X	X
Agricultural Chemicals	2879	X	
Petroleum Refining [2]	2911	X	X
Miscellaneous Petroleum and Coal Products [2]	2992		X
Rubber and Miscellaneous Plastics Products [2]	30		X
Non-Ferrous Wire Drawing and Insulation	3357	X	
Machinery and Mechanical Products	34 through 39		X
Pipelines, except Natural Gas [2]	461		X
Electrical Services	4911		X
Wholesale Petroleum Marketing [2]	517		X

[1] SICs listed are those defining the group considered in the analysis. SICs given at the two-digit or three-digit SIC level indicate that the analysis applies to all four-digit SICs contained within the broader category.

[2] Included in detailed quantitative analysis for the final RIA.

The industry studies provided data including waste type (wastewater, sludge, solid process residual, or organic liquid), waste quantity, constituent concentration ranges and distributions, and number of generating facilities. The data in the studies were based primarily on EPA's effluent guidelines reports, supplemented by best engineering judgement and data received in comments on the proposed rule or in follow-up correspondence (Refs. 30 and 31). Most of the wastes which were included were related to wastewater treatment; there was relatively little data on process residuals. Wastes which were already hazardous by virtue of a listing or characteristic (e.g., the EPTC) were not included. Due to lack of data, certain types of wastes were not included in the analysis (e.g., contaminated soil, off-spec products, contaminated debris).

It is particularly difficult to predict the behavior of oily wastes in the TCLP test. For the purpose of deriving upper bound estimates of costs, economic impacts, and benefits, one assumption that EPA adopted was that oily non-liquid wastes would not present filtration problems in the TCLP (i.e., that the oily phase passes through the filter and hazardous constituents in the oil phase leach to the test extract) and that if extract concentrations exceeded regulatory levels, these wastes would fail the TC. As a basis for lower bound estimates for costs, economic impacts and benefits, the Agency assumed that no oily wastes will be caught by TC regulation because the oily phase (and corresponding high levels of toxic constituents) would not filter through to the extract in the TCLP.

Due to the lack of facility-specific waste generation data, certain assumptions had to be made to derive the quantity of each wastestream per facility. First, potentially affected facilities within each industrial sector were split between small (with less than 50 employees) and large (with 50 employees or more) facility size categories based on 1982 Census of Manufacturers data on the number of facilities by size category. (The 1982 Census data were the most recent available.) Second, the total quantity of potentially affected waste was distributed between small and large facilities based on Census of Manufacturers data on the value of shipments for the small and large size categories. Using the distribution of facilities and of total waste quantity between small and large size categories, EPA estimated wastestream quantity per facility for small and large facilities.

EPA conducted a sensitivity analysis in order to test the sensitivity of results to the assumed distribution of wastes based on value of shipments. Since the division of waste quantities based on value of shipments resulted in most waste being generated by large facilities, EPA tested the alternative assumption that waste quantities were split evenly between the large and small facility size categories in each industry. (Results of sensitivity analyses are presented in section VI.B.4.)

Baseline management practices (i.e., management practices in the absence of the regulation) were derived primarily from the Screening Survey of Industrial subtitle D Establishments. (Ref. 16.) This survey provided information on the percent of facilities, by industrial sector, which manage non-hazardous wastes on-site in landfills, surface impoundments, waste piles, and land application units. Other baseline management practices were not specifically identified in the survey; therefore, EPA had to use knowledge of potentially affected TC wastes to identify these other practices and estimate the percentage of facilities using them.

In the case of non-wastewaters, the other practices considered included management in off-site landfills and land application units. For wastewaters, the other baseline practices included management in tanks as part of a wastewater treatment system, direct discharge under a NPDES permit, or indirect discharge to a Publicly Owned Treatment Works. These other wastewater management practices were assumed to be permissible under subtitle C; therefore it was assumed that facilities using these practices for wastes which were identified as hazardous by the TC would not be affected by the TC rule. EPA examined the sensitivity of results to this assumption by assuming, alternatively, that all wastewaters were managed on site in subtitle D surface impoundments.

For organic liquids, EPA determined, based on the Office of Solid Waste's Industry Studies Database, that the most likely baseline management practices were recycling and burning. EPA assumed that incremental management costs for these wastes would not be significant and therefore did not include the wastes in the analysis.

By combining the waste characterization and volume data with the management practice data, it was possible to estimate, by industrial sector, the amount of waste and the number of facilities potentially affected by the TC.

In order to determine the quantity of each wastestream which would be affected by the TC, the regulatory levels for constituents in the waste were compared with the estimated concentration distributions, derived from the TC industry studies, for constituents in the waste leachate. The constituent which caused the largest percentage of the wastestream to fail the TC was designated as the "cost-driving" constituent, and the quantity exhibiting the TC due to the presence of that constituent was used as the affected quantity. EPA tested the sensitivity of results to the assumption that waste would fail for a single driving constituent by adding the percentages failing for all constituents (up to 100 percent).

Due to the lack of facility-specific data, it was assumed that the percentage of facilities affected by the TC for a particular wastestream would equal the percentage of the total waste failing the TC. (For example, if 25 percent of a wastestream failed, it was assumed that 25 percent of the facilities generating the waste would be affected and that all of the wastestream at each affected facility would fail.) In order to test the importance of this assumption, EPA adopted two alternative assumptions as sensitivity analyses: for any percentage of waste failing (except for 0 and 100 percent, where clearly no facilities or all facilities would be affected), the percentage of facilities affected would be 10 percent or, alternatively, 80 percent.

The effects of potential production process changes in response to the rule were not addressed.

b. Cost Methodology. EPA estimated both the social costs and the compliance costs of the final rule. Social costs do not include transfer payments between different parties within society (i.e., they do not include tax payments or above-average profits); the social costs therefore represent the real resource costs imposed by the rule on society as a whole. Compliance costs, which include the effects of taxes and above-average profits, more accurately reflect the effect of the rule on particular entities within society.

1. Social Costs

EPA estimated the national social costs of the final rule by calculating before-tax incremental management costs for affected wastes at model facilities and then summing the facility costs across industrial sectors.

Before-tax incremental costs were calculated by subtracting baseline management costs from post-regulatory costs. Baseline management practices were determined as discussed previously. Post-regulatory management practices were developed based on waste types and quantities; the least-cost practice among those feasible for a waste was chosen as discussed below. The post-regulatory practices did not include potential waste treatment practices under the land disposal restrictions program since land disposal restrictions requirements for TC wastes will not come into effect until after the TC rule is promulgated. Possible post-regulatory management practices, as well as baseline practices, for TC wastes are shown in Table VI-2.

TABLE VI-2.—BASELINE AND POST-REGULATORY MANAGEMENT PRACTICES

Waste type	Baseline practice	Post-regulatory practice
Wastewater	On-site Subtitle D surface impoundment.	On-site tank equipped from Subtitle C. Subtitle C surface impoundment. [1]
	or	
	Practices permissible under Subtitle. [2]	Same as baseline. [3]
Non-wastewater	On-site Subtitle D landfill or land application unit or off-site Subtitle D landfill.	On-site or off-site Subtitle C landfill or land application unit.
Organic liquid	Burning, recycling.	Same as baseline. [3]

[1] Dikes and deep-well injection were also considered as post-regulatory practices but were found to be more expensive than tank management.

[2] Includes management in Subtitle C-exempt tanks, direct discharge under a NPDES permit, or indirect discharge to a Publicly Owned Treatment Works.

[3] Since the post-regulatory practice was the same as the baseline practice, the rule would not affect management of these wastes.

To estimate before-tax baseline and post-regulatory costs for wastes, EPA first estimated the cost per metric ton for the different on-site and off-site waste management practices. Before-tax costs for on-site management units include operation and maintenance (O&M) and capital costs. O&M costs are incurred annually for operation and maintenance of waste treatment or disposal units. Capital costs include costs for construction of the unit and for depreciable assets; these costs, which assumed an average operating life of 20 years, were restated as annual values by using a capital recovery factor based on a discount rate of three percent. RCRA-related costs such as personnel training, financial assurance, and liability insurance were included as indirect capital costs.

For the subset of subtitle D facilities which could potentially become subtitle C TSDFs in order to manage TC wastes on-site, post-regulatory costs for on-site management also included corrective action costs. Corrective action costs for units were based on data from the to-be-proposed corrective action subpart S rule RIA, which indicated the probability of a unit requiring a RCRA facility assessment, RCRA facility investigation, and corrective action cleanup. Corrective action costs were

not assigned to facilities which were determined to already be subtitle C treatment, storage, and disposal facilities, since units at these facilities would already be subject to corrective action requirements under subparts S and F. Like capital costs, corrective action costs were converted to annual values.

The annualized capital and (as appropriate) corrective action costs were added to yearly O&M costs to derive overall annualized costs for on-site units of various sizes. These annualized costs were then divided by the waste management capacities of the units to obtain the costs per metric ton for on-site management in different units.

Off-site management costs were based on commercial hazardous waste management prices, adjusted for the effects of above-average profits. Shipping costs were included for wastes sent off-site. Neither the on-site nor off-site costs included the cost of waste testing.

Since no data were available on the combinations of wastestreams generated at particular facilities, EPA used an algorithm to create model facilities. In estimating costs for the model facilities, wastes that were amenable to co-management were grouped to identify economies of scale.

Once the costs per metric ton for different types of on-site and off-site management had been developed and waste quantities for the model facilities had been determined, EPA estimated each facility's baseline cost based on the quantities of waste and the cost per metric ton for the baseline management practices identified for the wastes. The post-regulatory cost for each facility was estimated in a similar way. The post-regulatory management practices for facilities were selected by comparing the cost per metric ton for different feasible post-regulatory practices for wastes and selecting the least expensive alternative. (This comparison was made based on compliance costs, rather than social costs, as discussed below). EPA then subtracted baseline costs from post-regulatory costs to obtain the before-tax incremental cost for each facility. These before-tax incremental costs were then added across industrial sectors to obtain the total (national) social costs of the rule.

EPA examined the possibility that some facilities managing wastewaters would incur costs over and above the cost of switching from management in unlined surface impoundments to management in wastewater treatment tanks that are exempt from subtitle C. To calculate upper bound costs, the Agency assumed that facilities generating large quantities of TC wastewater (over 400,000 metric tons per year) would not be able to convert existing non-hazardous surface impoundments to tanks by the effective date of the rule (i.e., October 1, 1990) and therefore would become interim status facilities under RCRA and subject to subtitle C closure of any impoundments. The upper bound cost estimates included costs for subtitle C "landfill closure" of the surface impoundments currently used to manage TC waste. Costs for surface impoundment subtitle C closure included pumping of free liquid, solidification of sludges, construction of a cover system, installation of upgradient and downgradient ground water monitoring wells, closure certification, and potential corrective action costs triggered by bringing facilities with TC surface impoundments into the subtitle C system.

2. Compliance Costs

EPA used the same basic approach to estimate compliance costs that was used to estimate social costs except that the after-tax costs (or revenue requirements) of management practices were used rather than the before-tax costs, and the price of off-site management was used rather than the cost of off-site management (to address above-average profits). Since the compliance costs reflect the cost of the rule for particular entities within society more accurately than the social costs do, compliance costs were used in determining whether it would be less expensive for facilities to use on-site or off-site post-regulatory management practices.

Based on the cost analysis discussed above, EPA estimated the number of existing subtitle C treatment, storage, and disposal facilities (TSDFs) electing to manage TC non-wastewaters on site and the number of subtitle D facilities which would be likely to become subtitle C TSDFs in order to manage their non-wastewaters on-site. (The focus was on on-site management of non-wastewaters, since it was assumed that most facilities would be able to manage wastewaters on site without becoming subtitle C TSDFs.) This was done by first determining the number of facilities that would be likely to choose on-site management as the least-cost management practice for non-wastewaters and then estimating how many of these would be likely to already be subtitle C TSDFs. EPA also estimated the number of new subtitle C generators, by determining how many facilities would generate in excess of 100 kilograms per month of TC waste and then calculating how many of these facilities would be likely to already be subtitle C generators.

c. *Economic Impact Methodology.* To gauge impacts, EPA compared compliance costs (discussed previously) with average facility costs of production and with cash from operations. Financial data were obtained primarily from the Census and Annual Survey of Manufacturers (U.S. Department of Commerce, Bureau of Census) and were organized by Standard Industrial Classification (SIC) code and facility size. Impacts were estimated at the facility level rather than the firm level, due to lack of data on specific facilities and the firms owning them.

Two ratios were used to identify facilities likely to experience adverse economic effects: compliance cost divided by cost of production (the COP ratio) and cash from operations divided by compliance cost (the CFO ratio). These ratios bound possible effects on individual facilities by examining impacts assuming complete pass-through of compliance costs to customers, on the one hand, and assuming no pass-through of costs, on the other. The COP ratio represents the percentage product price increase for facility output that would be necessary if the entire compliance cost, accompanied by facility profit, were to be passed through to customers in the form of higher prices. A change exceeding five percent is considered an indication of a significant adverse economic impact on a facility. The CFO ratio represents the number of times that a facility's gross margin (profit) would cover the compliance cost if the facility were to fully absorb the cost. For this ratio, a value of less than 20 is considered to represent a significant adverse impact.

EPA then performed an analysis on the facilities experiencing significant economic impacts to identify the potential for facility closures. Those facilities for which the CFO ratio was less than two were considered likely to close.

Impacts on significantly affected product markets were addressed qualitatively by examining market structure and the ability of facilities to pass compliance costs on to customers.

d. *Benefits Methodology.* The benefits of the final rule were evaluated by considering the reduction in human health risk, the reduction in resource damage, and future cleanup costs avoided that would result from required changes in management practices for affected wastes. These benefits

measures centered primarily on the exposure to contaminants via the ground water medium, since this was the route of exposure addressed by the TC rule; however, a screening analysis of risks via air, due to emissions from surface impoundments, was also conducted to gauge the significance of these risks.

It is important to point out that the benefits measures should not be added. The measures provide alternative ways of evaluating benefits of the rule, and significant overlap between measures does occur.

EPA estimated benefits on a wastestream-by-wastestream basis. To simplify the analysis of benefits, EPA employed a screening analysis to identify two "risk-driving" constituents in each wastestream, one a carcinogen and one a non-carcinogen. These constituents were then used in developing benefit estimates.

A Monte Carlo modeling approach was used to simulate fate and transport of the constituents and subsequent exposure to them under a variety of waste characterizations, hydrogeologic settings, and exposure scenarios. Based on data from EPA's National Survey of Solid Waste Municipal Landfill Facilities (the "Municipal Landfill Survey"), it was assumed that only 48 percent of facilities had down-gradient wells. EPA examined the sensitivity of results to this assumption by assuming, alternatively, that all facilities had down-gradient wells.

Due to the way in which fate and transport of constituents was modeled (using an infinite source, steady-state model), benefits estimates were primarily a function of the number of facilities estimated to manage each wastestream and constituent concentrations in the waste; wastestream volumes did not affect benefits estimates. In contrast, cost analysis results were a function of the number of facilities, waste constituent concentrations, and wastestream volumes.

Worst-case estimates of baseline risk, resource damage, and cleanup costs were developed by assuming that the baseline management practice for both wastewaters and non-wastewaters was an unlined, non-hazardous waste landfill. This is the same assumption that was employed by the Agency in determining regulatory levels for TC constituents. Post-regulatory risk, resource damage, and cleanup costs were estimated by assuming that the wastes managed as hazardous under the TC would be effectively prevented from contaminating ground water and would therefore result in no risk, resource damage, or cleanup costs; only those wastes continuing to be managed as non-hazardous would pose a threat to human health or the environment.

For wastewaters, the baseline risk, resource damage, and cleanup cost due to ground water contamination were based on concentrations of constituents in the influents to waste management units. Consequently, since volatilization of constituents from waste management units was not accounted for, benefits due to reduction in ground water contamination may be overstated.

The three benefits measures used in this analysis are discussed separately below.

1. Human Health Risk Reduction

EPA estimated two types of human health risk: risk to the most exposed individual (MEI) and population risk. Human health risk is defined herein as the probability of injury, disease, or death over a given time (70 years) due to responses to doses of disease-causing agents. The human health risk posed by a waste management practice is a function of the toxicity of the chemical constituents in the wastestream and the extent of human exposure to the constituents. The likelihood of exposure is dictated by hydrogeologic and climatic settings at land disposal units and by the fate and transport of chemical constituents in environmental media.

a. MEI Risk Reduction. MEI risk was based on exposure to the risk-driving constituents. Concentrations of the risk-driving constituents in the waste leachate were selected randomly from the constituents' concentration distributions. A dilution-attenuation factor (DAF), derived from EPA's subsurface fate and transport model (EPACML), was then randomly selected and used to model the fate and transport of the constituents in ground water. (The DAFs were developed using data from the Municipal Landfill Survey on landfill size, hydrogeology, and distance from the unit to the closest drinking water well; see section III.E for further discussion of the model.) By dividing the initial leachate concentrations of the risk-driving constituents by the DAF, exposure concentrations at a down-gradient well were estimated. Risks from ingestion of contaminated ground water were then calculated. The carcinogenic MEI risk was expressed as the probability of the MEI contracting cancer over a 70-year lifetime, and the non-carcinogenic MEI risk was expressed as an exceedance of the health-effects threshold.

Risk estimates were developed in this way for baseline conditions and for the final rule. The difference between the final rule and baseline risk estimates yielded the MEI risk reduction (or benefit).

EPA conducted a separate screening analysis of baseline MEI risks due to air emissions from surface impoundments in order to assess whether potential air risks were significant. This was done by assuming that constituents in wastewaters would potentially volatilize to the air rather than leach to ground water. EPA's Liner Location Model (Ref. 32) was used to estimate concentrations of constituents at an exposure point 200 meters from the edge of the surface impoundment. Both carcinogenic and non-carcinogenic risks were estimated.

b. Population Risk Reduction. Population risk was estimated in much the same way as MEI risk, with the exception that ground water plume areas for risk-driving constituents were used to model the exposure of populations located downgradient from units. The plume areas were developed for a representative hydrogeologic environment, based on data from the Municipal Landfill Survey.

Each plume area contained a gradient of exposure concentrations, with the highest concentration near the unit boundary and the lowest concentration near the outside edge of the plume. By assuming a uniform population density of 1.8 persons per acre, based on the Municipal Landfill Survey, it was possible to estimate the number of persons exposed to each of the concentration levels within each plume.

The population risk for the carcinogenic constituent, based on the constituent's risk-specific dose (RSD), was expressed as the number of cancer cases over a 70-year lifetime. The population risk for the non-carcinogenic constituent, based on the constituent's reference dose (RfD), was expressed as the number of persons exposed to average daily concentrations exceeding the RfD over a 70-year period.

2. Resource Damage Avoided

Resource damage measures the cost associated with replacing contaminated ground water that had been used as a source of drinking water. Resource damage was assumed to result from any contamination of ground water which would render it unsuitable for human consumption; other potential foregone uses, such as industrial or agricultural uses, were not addressed.

If the concentration of a constituent in ground water exceeded a maximum contaminant level (MCL), the ground water was assumed to be damaged. If

the contaminant did not have an MCL but the concentration exceeded a taste and odor threshold or a health effects threshold, the ground water was also assumed to be damaged. Areas of damaged ground water were derived based on a comparison of the constituent's concentration within the plume with the constituent's MCL, taste and odor threshold, or health-based number, in an approach similar to that used to estimate plume areas for population risk.

To place a value on the damaged resource, EPA assumed that an alternative water supply system would have to be built to provide water to persons living above the area of the damaged ground water. The costs of constructing the water supply system included capital and O&M costs; these costs were discounted to the present at a rate of three percent to obtain the resource damage per facility. Addition of resource damage across facilities provided a national estimate.

3. Cleanup Costs Avoided

As an alternative measure of benefits, EPA estimated the cleanup costs avoided as a result of the TC rule. Costs of cleanup of contaminated ground water were estimated by assuming that sites with resource damage in the baseline would eventually require cleanups. To develop an upper bound estimate, it was assumed that sites with resource damage greater than $1,000,000 (present value) would require cleanup.

Cleanup costs were based on an average cost of $15 million per site, with cleanups beginning in 15 years. EPA estimated the average cost of cleanup by examining recent Superfund records of decision (RODs) for sites contaminated with TC constituents that required substantial ground water cleanup efforts. Costs were discounted to present values using a discount rate of three percent.

e. Used Oil Methodology. EPA addressed the impacts of the TC on used oil separately from other wastes for several reasons. First, used oil is generated across a wide variety of industrial sectors. Second, unlike other wastes, it has economic value and can be sold in intermediate or end-use markets; this complicates any analysis of the costs of regulating it as a hazardous waste. Also, data on used oil are quite limited. Finally, it is difficult to accurately estimate quantities of used oil that may exhibit the TC because in practice TCLP filtration is sample-specific and difficult to predict.

The analysis of costs, economic impacts, and benefits associated with used oil was qualitative in nature; no attempt was made to develop national estimates. In determining the quantity of used oil potentially affected, EPA excluded used oil that was: (1) Already hazardous because it exhibits a hazardous waste characteristic (e.g., ignitability); (2) recycled; or (3) generated by "do-it-yourselfers" (i.e., auto owners disposing of crankcase oil). In order to develop worst-case estimates of impacts on used oil, it was assumed that used oil would filter in the TCLP. It was also assumed that the facilities managing used oil were subtitle D facilities. Finally, estimated impacts on used oil did not account for the possible stigma associated with management of used oil as a hazardous waste.

4. Results

Results of the RIA are presented below. These results are approximations that are intended to identify the most significant impacts of the TC rule. As discussed previously, there were no data on the waste types and quantities generated by specific facilities in the different industrial sectors. Therefore, EPA used more aggregated data and focused on those industrial sectors which were most likely to generate significant quantities of TC wastes.

a. Affected Wastes and Facilities. EPA estimated the amount of waste and the number of facilities that would be "affected" by the rule, i.e., that would incur any incremental costs due to required changes in management practices for newly hazardous wastes.

1. Affected Wastes

The overall quantity of waste affected by the TC was driven by wastewaters. EPA estimated the quantity of affected wastewaters to be approximately 730 million metric tons (MMT) per year and the quantity of affected non-wastewaters (sludges and solids) would range from approximately 0.85 MMT/year to 1.8 MMT/year. It should be noted that the affected wastewaters, which would be hazardous wastes, are assumed to be exempt from subtitle C regulation in the post-regulatory scenario due to their management in exempt tanks. However, they would be affected wastes because a change in management practice (from surface impoundments to tanks) would be required.

The industrial sectors with the largest quantities of affected wastewaters were Petroleum Refining (SIC 2911), Organic Chemicals (SIC 286), Synthetic Rubber (SIC 2822), and Cellulosic and Non-Cellulosic Synthetic Fibers (SICs 2823 and 2824). For the lower bound estimate of 0.85 MMT/year of non-wastewaters affected, the sectors with the largest quantities of affected non-wastewaters were Pulp and Paper (SIC 26), Synthetic Fibers, Organic Chemicals, and Pharmaceuticals (SIC 283). For the upper bound estimate of 1.8 MMT/year, industry sectors generating the largest quantities of affected non-wastewaters were Petroleum Refining, Pulp and Paper, Synthetic Fibers, Organic Chemicals, and Wholesale Petroleum Marketing (SIC 517). Certain sectors generate significant quantities of both wastewaters and non-wastewaters due to the wastewater treatment sludges associated with wastewater streams. Most of the affected wastewaters and non-wastewaters are believed to be generated by large facilities.

A total of twelve constituents appeared as "cost-driving" constituents in the analysis. However, benzene was the driving constituent for over 80 percent of the affected waste quantity. Other volume-driving constituents include chloroform (25%), vinyl chloride (17%), and trichloroethylene (15%).

2. Affected Facilities

EPA estimated that between 15,000 and 17,000 generators would be affected by the rule. Costs and additional requirements among these affected facilities will vary (e.g., some may already be RCRA generators or TSDFs, others may need to apply for RCRA permits or send wastes off-site). Over 90 percent of these were small facilities (with fewer than 50 employees). The industries with the most affected large facilities were Hosiery and Knit Fabric Finishing (SIC 225), Wholesale Petroleum Marketing, Organic Chemicals, Petroleum Refining, and Plastics Materials and Resins (SIC 2821). The industries with the most affected small facilities were Wholesale Petroleum Marketing, Hosiery and Knit Fabric Finishing, Miscellaneous Petroleum and Coal Products (SIC 2992), Organic Chemicals, and Plastics Materials and Resins.

3. Sensitivity Analysis of Affected Wastes and Facilities

Changes in certain analytical assumptions had significant effects on the quantity of waste and number of facilities affected by the TC final rule. (Refer to section VI.B.3.e for discussion of the sensitivity analyses which were conducted.) Some of the changes also affected cost and benefit results, as discussed below under cost results and benefit results.

Assuming that oily wastes would not filter in the TCLP, rather than assuming that they would, would have a very significant effect on the quantity of non-

wastewaters affected by the TC. This effect can be seen in the difference between lower bound (assuming oily wastes do not filter) and upper bound (assuming oily wastes filter without complications) estimates of affected quantities of non-wastewaters. Nearly all of the non-wastewaters from Petroleum Refining (including a very large-volume primary treatment sludge), Wholesale Petroleum Marketing, and Petroleum Pipelines are oily wastes.

Assuming that all wastewaters were managed in surface impoundments, rather than some portion being managed by practices exempt under subtitle C, increased affected wastewater quantity significantly to approximately 1,900 MMT/year. It also increased the number of facilities affected in certain sectors.

Finally, assuming that only 10 percent of the facilities would be affected for a waste failing the TC, rather than using the percent of the waste failing, significantly reduced the number of facilities affected by the TC in most industrial sectors.

b. Cost Results—1. *Social Costs and Compliance Costs.* EPA estimated the total social costs of the TC rule (excluding taxes and above-average profits) to be approximately $90 million to $310 million per year (present value $1.3 billion to $3.7 billion); this does not include costs associated with used oil. Compliance costs (which include taxes and above-average profits) ranged from $130 million to $400 million per year (present value $1.9 billion to $6.0 billion). While affected waste quantities were driven by wastewaters, compliance costs (for the scenario where oily wastes fail the TC and no surface impoundment closure costs are incurred) were driven by non-wastewaters due to the significantly higher incremental costs of managing non-wastewaters. Non-wastewaters accounted for over 95 percent of compliance costs.

For the lower bound cost estimate, the industrial sectors with the largest compliance costs were Pulp and Paper, Synthetic Fibers, Organic Chemicals, and Synthetic Rubber. For the upper bound cost estimate, the industrial sectors with the largest compliance costs were Petroleum Refining, Pulp and Paper, Synthetic Fibers, Wholesale Petroleum Marketing, and Organic Chemicals. Constituents driving the cost results were: benzene, chloroform, trichloroethylene, vinyl chloride, and carbon tetrachloride.

Approximately 90 percent of the compliance costs (for the scenario where oily wastes fail the TC and no surface impoundment closure costs are incurred) were incurred by large facilities and 10 percent by small facilities across industrial sectors. A relatively small number of large facilities incurs the majority of compliance costs because large facilities are believed to have much greater waste generation rates than small facilities.

The estimated number of subtitle D facilities seeking permits to become non-commercial subtitle C TSDFs was 40 to 250; this does not include facilities seeking permits for storage or treatment only. Most of the expected permit applicants were in the Pulp and Paper Industry in the lower bound estimate. Most of these new TSDFs in the upper bound estimate were in Petroleum Refining.

The number of existing subtitle C non-commercial TSDFs expected to seek permit modifications to handle TC wastes was between 45 and 220, depending on whether permits are considered for only disposal or for treatment, storage, and disposal. Most of these facilities in the upper bound estimate were in the Wholesale Petroleum Marketing and Petroleum Refining industries.

The number of subtitle C commercial TSDFs (SIC 4953) seeking permit modifications or changes to interim status could be as high as 360, the estimated number of existing commercial TSDFs. Many of these commercial TSDFs are primarily storage facilities.

In addition, the TC rule would result in as many as 15,000 new subtitle C generators. Most of the new generators would be in Wholesale Petroleum Marketing and Hosiery and Knit Fabric Finishing.

2. *Sensitivity Analysis of Costs.* Changes in certain analytical assumptions had significant effects on the social costs and compliance costs of the TC final rule. (Refer to section VI.B.3.a for discussion of the sensitivity analyses which were conducted.) Some of the changes also affected benefit results, as discussed below under benefits results.

Assuming that oily wastes would not filter in the TCLP, rather than assuming that they would, would have a significant effect on both social costs and compliance costs. The Agency estimated, as a lower bound assuming that no oily wastes will fail the TC test, social costs of about $80 million per year and compliance costs of about $130 million per year. By comparison, if it were assumed for the purpose of predicting TCLP results that oily wastes behave like other non-liquid wastes, social costs would be $190 million per year and compliance costs would be $250 million per year.

Assuming that not all facilities would be able to convert within six months from surface impoundments to tanks for management of their TC wastewaters, rather than assuming that all facilities would be able to convert, significantly increased the cost of the rule. Based on landfill closure of impoundments, this assumption added approximately $120 million to annual social costs and $140 million to annual compliance costs.

Splitting wastestream quantity evenly between small and large facility size categories, rather than based on value of shipments, shifted wastes from large to small facilities. While this [illegible] the overall costs greatly, it significantly decreased compliance costs for large facilities and increased them for small facilities.

Finally, assuming that only 10 percent of the facilities would be affected for a waste failing the TC, rather than using the percent of the waste failing, significantly reduced social costs and compliance costs due to the larger quantities of waste being managed at a smaller number of facilities and the resultant economies of scale. The estimated number of new subtitle C TSDFs, existing TSDFs seeking permit modifications, and new subtitle C generators also decreased significantly.

c. Economic Impact Results—1. *Significantly Affected Facilities.* Based on the economic impact criteria discussed previously the estimated total number of significantly affected facilities was 65 to 81, of which most (51 to 68) are large. The fact that most of the significantly affected facilities are large can be partially explained by the fact that data indicate there are no small facilities in certain sectors (e.g., Cellulosic Synthetic Fibers). Another reason for the preponderance of significantly affected large facilities is that for some wastes, total compliance costs are less for small facilities than for large facilities because large facilities are believed to generate significantly more waste.

In the lower bound estimates, significantly affected facilities were expected in four industrial sectors: Pulp and Paper, Synthetic Rubber, Synthetic Fibers, and Organic Chemicals. In the lower bound estimates the Pulp and Paper industry was predicted to have the greatest number of significantly affected facilities (35), of which 30 are large facilities. The synthetic rubber industry had the highest number of significantly affected small facilities (8), out of a total of 14 significantly affected small facilities. None of the industries examined were expected to suffer facility closures as a result of the TC.

In the upper bound estimates, significantly affected facilities were expected in seven industries: Pulp and Paper, Synthetic Rubber, Synthetic Fibers, Organic Chemicals, Textiles, Pharmaceuticals, and Plastics and Resins. Pulp and paper had the largest number of significantly affected facilities—36 out of 80 for all facilities.

2. Effects on Product and Capital Markets

The industries with significantly affected facilities have very little potential to pass compliance costs on to consumers in the form of higher prices. These industries produce primarily intermediate goods (e.g., rubber, paper, fibers, and chemicals) which are used in a number of subsequent processes (e.g., manufacturing and fabrication) before they reach consumer markets. The users of these intermediate products have access to similar or identical products from U.S. suppliers that are not significantly affected by the TC and from foreign suppliers; because substitutes are available, these users would not be forced to pay higher prices for the intermediate products.

While results suggest that prices in product markets will not be affected, at least some impact is likely on capital markets. Because affected facilities will not be able to pass compliance costs through to buyers in the form of higher prices, they will experience lower profits. Lower profits will reduce the value of capital tied up in these facilities. However, as most of the affected facilities are part of integrated production systems and are owned by large firms with significant asset holdings, the effect on capital markets (i.e., stock prices and bond ratings) should be relatively small.

3. Sensitivity Analysis of Economic Impacts.

A change in one of the analytical assumptions had significant effects on economic impacts due to the TC final rule. Refer to section VI.B.3.a for discussion of the sensitivity analyses which were conducted.

Splitting wastestream quantity evenly between small and large facility size categories, rather than based on value of shipments, shifted wastes from large to small facilities. Under the scenario where oily wastes fail the TC and no surface impoundment closure costs are incurred, this resulted in nearly 40 additional small facilities with significant economic impacts and 10 small facility closures.

d. Benefits Results. EPA estimated the benefits of regulating TC wastes on a wastestream by wastestream basis; results of this analysis are presented in Table VI-3. As discussed in the benefits methodology section, results for different benefit measures (human health risk, resource damage, and cleanup costs avoided) are likely to overlap and should not be added.

TABLE VI-3.—BENEFITS OF THE TC RULE

Reduction in MEI Risk:	
• Reduction in Carcinogenic Risk (number of facilities with risk greater than 1 x 10E-6 at downgradient well).	370 to 780.
• Reduction in Non-Carcinogenic Risk (number of facilities with exposure above a health-based threshold at downgradient well).	8.
Reduction in Population Risk:	
• Reduction in Carcinogenic Risk (number of cancer cases over 70 years).	6.
• Reduction in Non-Carcinogenic Risk (number of persons with exposure above a health-based threshold at downgradient wells).	320.
Reduction in Resource Damage (present value, millions of 1988 dollars).	3,500.
Cleanup Costs Avoided (present value, millions of 1988 dollars).	Up to 15,000.

1. MEI Risk

As can be seen from the table, there is a potentially significant reduction under the final rule in the carcinogenic risk to the most exposed individual (MEI). There are from 370–780 fewer facilities managing wastes that present risks to the most exposed individual (MEI) greater than $1 \times 10E^{-6}$ under the final rule than there were under baseline conditions. The industrial sectors driving these benefits include Wholesale Petroleum Marketing (SIC 517) and Miscellaneous Plastics Products (SIC 3079). The constituent driving most of these benefits is benzene. The difference between the lower and upper bounds results from certain oily wastes that are unregulated in the lower bound.

For non-carcinogenic MEI risk, there are 8 fewer facilities managing wastewaters where the exposure to a non-carcinogenic constituent exceeds the reference dose (RfD) under the final rule than under baseline conditions. Wastes from Wholesale Petroleum Marketing drive these benefit results. Cresols are the risk-driving constituents.

The Wholesale Petroleum Marketing sector presents significant risks due to the large number of facilities managing wastewaters and non-wastewaters. The number of facilities in this sector estimated to manage wastewaters and non-wastewaters are 1,280 and 1,080 facilities, respectively; this compares with 1,900 and 8,600 facilities, respectively, managing affected wastewaters and non-wastewaters across all industrial sectors.

A screening analysis of MEI risks due to air emissions from surface impoundments was conducted to gauge the potential risk via the air medium. This analysis indicated that in sectors other than Wholesale Petroleum Marketing approximately 20 percent of modeled facilities had carcinogenic risks greater than $1 \times 10E^{-6}$ and 5 percent had non-carcinogenic doses greater than the RfD; MEI air risks from Wholesale Petroleum Marketing were less than $1 \times 10E^{-6}$. Benzene contributed most of the carcinogenic risks while phenol was responsible for most of the non-carcinogenic risks.

The industries generating wastes with high MEI air risks differ to some extent from those generating wastes with high MEI ground water risks. The industries generating wastes with high MEI air risks include Pulp and Paper, Plastics Materials and Resins, Synthetic Rubber, Cellulosic and Non-Cellulosic Synthetic Fibers (SICs 2823 and 2824), and Organic Chemicals.

There is some potential overlap in estimates of air and ground water risk. The wastewater MEI risks via ground water were based on the assumption that all the constituent mass was available for leaching to ground water; in contrast, the air risks assumed some percentage of constituent mass would volatilize from impoundments. As a result, the wastewater MEI risks via ground water are likely to be overstated.

2. Population Risk

Based on a very limited analysis of population risk, EPA estimates that there would be six fewer cancer cases over the 70-year modeling period due to the final rule. Wholesale Petroleum Marketing (constituent: benzene) and Plastics and Resins (SIC 2821) (constituent: vinyl chloride) drive these benefits. The reduction in number of persons exposed to non-carcinogens at concentrations greater than the RfDs was estimated to be 320 over a 70-year period. Sawmills and Planing Mills (SIC 2421) and Organic Chemicals (pentachlorophenol and methyl ethyl keytone) drive these results.

3. Resource Damage

The total reduction in resource damage would be approximately $3.5 billion (present value). Wholesale Petroleum Marketing and Miscellaneous Plastics Products are the industrial sectors driving resource damage benefits. Benzene is the driving constituent.

4. Cleanup Costs Avoided

Estimated cleanup costs avoided due to the final rule ranged up to $15 billion (present value). Under the assumption that all sites with significant resource damage (i.e., resource damage greater than $1,000,000 (present value)) would require cleanup, approximately 1,800 facilities would require cleanup.

5. Sensitivity Analysis of Benefits

Changes in certain analytical assumptions had significant effects on the benefits of the TC final rule. (Refer to sections VI.B.3. a and d for discussion of the sensitivity analyses which were conducted.) Some of the changes also affected cost results, as discussed under cost results.

Assuming that oily wastes would not filter in the TCLP, rather than assuming that they would, would reduce the benefits associated with non-wastewaters, as can be seen in the lower bound estimates indicated in the results above. This would result primarily from the significant reduction in the number of facilities managing non-wastewaters in Wholesale Petroleum Marketing.

Assuming that all wastewaters were managed in surface impoundments, rather than some portion being managed by practices exempt under subtitle C, would increase the number of facilities affected in many sectors and increase benefits significantly. Benefits for wastewaters could increase by approximately 10 times since there would be 10 times as many facilities with surface impoundments.

Assuming that only 10 percent of the facilities would be affected for a waste failing the TC, rather than using the percent of the waste failing, significantly reduced the number of facilities affected by the TC in all industrial sectors. This would significantly reduce benefits as a result, since fewer facilities would be managing wastes.

Assuming that all facilities have down-gradient wells, rather than assuming only 46% have down-gradient wells, would increase benefit results by a factor of approximately two.

e. Cost-Effectiveness. The Agency estimated the cost-effectiveness of the final rule and of several regulatory alternatives. This discussion is presented in the regulatory impact analysis document, which is part of the public docket for the rule.

f. Used Oil Results. Used oil is generated across a wide variety of industrial sectors. Some generators manage or dispose of their used oil directly while others provide their used oil to the used oil management system (UOMS), a system of intermediate collectors and processors (Ref. 33). Firms in the UOMS then re-refine or process the used oil and/or sell it for various end uses.

Under the worst-case assumption that used oil would not create TCLP filtration problems, EPA found based on constituent concentration data (see Ref. 8), that virtually all used oil would fail the TC. EPA determined that three end-use management practices for used oil would be affected: landfilling/incineration, dumping, and road oiling.

Once used oil became TC hazardous, it would have to be shifted to other end-use management practices. Much of the used oil that is currently dumped or applied directly to roads by generators would probably be collected and sold to the UOMS. Firms in the UOMS that currently sell used oil for road oiling would generally shift this oil to other management practices, such as re-refining or burning as a fuel. Used oil that is managed by landfilling or incineration in subtitle D units would likely be shifted to management in subtitle C units.

The shift in management practices would impose costs on used oil generators, the UOMS, and end-users of used oil. Used oil generators currently providing used oil to the UOMS would be likely to pay somewhat higher collection costs due to pass-through of compliance costs by firms in the UOMS. Generators that currently manage their wastes by road oiling would incur storage and collection costs for their used oil as well as costs for a road-oiling substitute. Generators directly managing their wastes by dumping would incur costs for storage and collection. Firms in the UOMS that sell used oil for road oiling would be forced to sell the oil in less profitable markets, and some firms could close if unable to enter another market. Firms in the UOMS could also incur costs for disposal of low quality used oil and related wastes in subtitle C (rather than subtitle D) units if these wastes were TC hazardous; as discussed above, some of these costs could be passed on to used oil generators. Firms that re-refine used oil could benefit from the TC rule, since a greater volume of used oil would potentially be available at a lower price. Finally, end-users that purchase used oil for road oiling would incur costs for an alternative dust suppressant.

The shift in management practices could also result in certain benefits. A previous study of carcinogenic risks from used oil management practices (Ref. 34) indicates that dumping of used oil may present significant risks relative to other management practices (with the possible exception of burning in boilers, where risks are more comparable). Road oiling appears to present more significant risks than recycling and comparable or fewer risks relative to burning in boilers or landfill disposal. It is difficult to draw definitive conclusions concerning benefits due to the different constituent profiles and population densities associated with each of the management practices in the risk analysis.

C. Regulatory Flexibility Analysis

1. Approach

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) requires that whenever an agency publishes a notice of rulemaking, it must prepare a Regulatory Flexibility Analysis (RFA) that describes the effect of the rule on small entities (i.e., small businesses, small organizations, and small governmental jurisdictions). An RFA is unnecessary, however, if the Agency's administrator certifies that the rule will not have a significant economic effect on a substantial number of small entities.

EPA examined the final rule's potential effects on small entities as required by the Regulatory Flexibility Act. Three measures, based on EPA guidelines for conducting an RFA, were used to determine whether the rule would have a "significant economic effect" on small entities: the ratio of compliance cost to cost of production, the ratio of compliance cost to value of sales, and the ratio of cash from operations to compliance cost (the last ratio being used to assess potential closures). Two of the three criteria, the ratio of compliance cost to cost of production and the ratio of cash from operations to compliance cost, are discussed in section VI.B.3.c. The third, the ratio of compliance cost to value of sales, was estimated for small and large facilities; if the difference between these ratios was greater than ten percent, this indicated a significant impact.

The guidelines for conducting RFAs are somewhat ambiguous with respect to evaluating impacts based on the third criterion. Determining whether the difference between ratios exceeds ten percent can be done by subtracting the large facility ratio from the small facility ratio or by dividing the small facility ratio by the large facility ratio. Dividing the small facility ratio by the large facility ratio may incorrectly indicate significant impacts on small facilities when both ratios are very small but the small facility ratio is larger than the large facility ratio. (For example, a small

facility ratio of 0.00002 divided by a large facility ratio of 0.00001 would indicate a significant impact on small businesses based on the division approach, despite the fact that the very low ratio of compliance cost to value of sales for small facilities indicates little impact on small facilities.) Therefore, the division approach must be interpreted with caution.

A "substantial number" of small entities was assumed to be 20 percent or more of the population of small businesses, small organizations, or small government jurisdictions within the universe of facilities affected by the rule.

The Agency defined a small business as a business employing 50 employees or less. (Standard Small Business Administration criterion is 500 employees.) EPA decided to use the 50 employee definition of a small business because the RIA estimates facility-level impacts, and the SBA definition applies to entire firms. The SBA definition would designate most of the facilities in the examined industries as small businesses, which would obscure differential impacts on smaller facilities.

Impacts on small businesses related to costs of compliance for used oil and contaminated soils were not examined due to lack of data on the facilities experiencing those costs.

2. Results

The only entities found to be affected by the final rule were small businesses, defined here as businesses employing fewer than 50 persons. No small organizations or small government jurisdictions were identified as potential TC waste generators in the TC industry studies which form the foundation for this analysis.

The Agency did not identify any industries in which 20 percent or more of the small businesses were significantly affected based on the ratio of compliance cost to cost of production, the ratio of cash from operations to compliance cost, or the ratio of compliance cost to value of sales (using the subtraction approach). Using the division approach for the ratio of compliance cost to value of sales indicated that small businesses in four sectors (including Pulp and Paper, Synthetic Rubber, Organic Chemicals, and Wholesale Petroleum Marketing) would be significantly affected. However, since the small facility and large facility ratios were both quite small (small facility ratios were less than 0.03), the Agency does not expect significant small business impacts in these sectors. Based on these results, EPA has concluded that today's final rule will not have a significant effect on a substantial number of small entities. As a result of this finding, EPA has not prepared a formal RFA in support of the rule. More detailed information on small business impacts is available in the RIA for this rule.

D. Response to Comments on RIA for June 13, 1989 Proposal

EPA received many comments on the RIA for the proposed TC rule. This section presents a general summary and analysis of the public comments concerning the original RIA; all of the comments are addressed in the background document for this final rule. Major issues addressed by commenters included consideration of particular industries, specific aspects of cost and benefit methodologies, cost and benefit estimates, and the assessment of small business impacts.

1. Industries Included in the Analysis

The majority of comments on the RIA for the proposed rule concerned the absence of specific industrial sectors from the group examined for potential impacts. Other commenters criticized the RIA for not considering the effects of the TC on end users of products and on facilities such as Publicly Owned Treatment Works and Municipal Landfills.

Industries that commenters suggested should have been evaluated included natural gas production, manufacturing of a variety of products, including forest products, pharmaceuticals, automobiles, plastics, metals, polyvinyl chloride, semi-conductors, wire and cables, and waste management. The Agency agrees with commenters that a number of industrial sectors were not addressed in the RIA for the proposed rule. The Agency notes, however, that several of the wastestreams that commenters believed should have been included in the RIA (based upon the proposed regulatory levels) are not expected to be defined as hazardous based upon the final regulatory levels being promulgated today. One of the fundamental problems with determining which industries would potentially be affected by the TC is lack of data on currently non-hazardous wastes. Since these wastes are currently outside the subtitle C system, requirements for information gathering related to them are minimal.

The Agency made extensive efforts, in preparing the RIA for the TC final rule, to obtain data on the industrial sectors potentially affected by the TC. These data were derived from a variety of sources. The Agency contacted numerous trade associations and individual facilities and collected pertinent EPA and other government publications. In addition, EPA prepared a series of TC industry study reports on those sectors most likely to generate significant quantities of TC wastes.

In preparing its TC industry studies, EPA first conducted preliminary studies which examined a large number of industries, with emphasis on identifying whether or not TC constituents would be likely to be present in industry wastes. Based on the preliminary studies, EPA completed detailed profiles of potentially affected industries for use in the final RIA. The Agency examined the potential for impacts on a number of industries that were not considered in the RIA for the proposed rule, as well as reconsidering some that were addressed in that RIA. Table VI-1 in section VI.B compares the coverage of industries for both the proposed rule RIA and the final rule RIA and indicates the industries for which detailed quantitative analysis was conducted.

Commenters also criticized the proposed rule RIA for not considering effects on end-users of products containing TC constituents. Examples of such end-user industries include agricultural chemical users, transporters, automotive maintenance facilities, petroleum retailers, medical facilities, and research laboratories. The Agency recognizes that TC toxicants exist in a variety of substances, and that end-users as well as producers of products containing TC constituents could be affected by the rule. Some end-users not identified in the RIA may be affected, but there is no information to quantify these potential impacts. The Agency believes that some of the impacts on affected end users may be mitigated by small quantity generator regulations under 40 CFR 261.5.

Finally, several commenters questioned EPA's assessment of impacts on Publicly Owned Treatment Works (POTWs), resource recovery facilities, public water suppliers, municipal landfills, the electrical services industry, and currently regulated RCRA facilities. As discussed previously in section III.K.2, the Agency has tested a number of POTW sludges to determine whether or not these sludges would be considered hazardous under the TC; the data generally indicate that these wastes would not be affected by the TC (Ref. 8). Because the final regulatory level for chloroform is significantly higher than originally proposed, EPA believes that public water suppliers also are unlikely to generate TC wastes. The Agency analyzed wastestreams generated by the Electrical Services

industry. These wastes were excluded from the RIA because they are fossil fuel combustion wastes, which are exempt from subtitle C regulation until a determination is made as to whether they should be regulated as hazardous. The Agency acknowledges that some waste generated by waste management facilities may exhibit the TC; however, most of these wastestreams that commenters believed should be included are not expected to exhibit the TC under the final regulatory levels. Finally, impacts on currently regulated RCRA facilities (in the industries included in the RIA) were addressed in the RIA.

2. Estimation of Costs and Economic Impacts

Many commenters expressed concern that the compliance cost estimates for facilities included in the economic impact analysis did not capture many of the expenditures faced by handlers of hazardous waste. The most common criticism was directed at the omission of the cost for actually performing the TCLP. Other commenters mentioned insurance costs and costs associated with RCRA permit applications. Another large group of comments concerned the costs for permitting and retrofitting the large universe of surface impoundments containing wastewaters which would exhibit the TC. In addition, a number of commenters contended that the RIA significantly underestimated potential economic impacts of the TC.

Other commenters claimed that the expense of the highly sophisticated equipment and specially trained personnel necessary for the testing of wastes would pose a significant burden on many firms, especially those without on-site laboratory facilities. The Agency recognizes that testing of wastes could pose a significant expense for firms that choose to test their wastes. On the other hand, there is currently no RCRA requirement for generators to test their wastes; the determination of hazardousness may be made based on either laboratory analysis of the waste or on knowledge of the waste, raw materials, and production processes. The Agency expects that many generators will rely on the latter method, and elect not to perform the TCLP. The Agency is still considering promulgating a testing requirement at a future date. If a testing requirement is proposed, potential costs of testing will be analyzed in detail.

Recognizing that administrative and insurance costs can constitute a significant portion of waste management costs, the Agency considered these in cost estimates in the final RIA. In addition, the cost of preparing RCRA permit applications is considered in the cost of subtitle C waste management, as are items such as liability insurance, personnel training, and contingency planning.

In response to comments that surface impoundment impacts were understated, the Agency examined the effect of the TC rule on wastewaters and estimated the costs of compliance with subtitle C requirements. The Agency assumed in the final RIA that, based on least-cost management practices, surface impoundments would not have to be retrofitted. Instead, it was assumed that affected wastewaters would be segregated and treated in a separate tank system, while remaining non-hazardous wastewaters could continue to be managed in the impoundments. In deriving an upper bound estimate of costs, it was assumed that some impoundments would have to undergo subtitle C clean closure.

Given the broad scope of the TC rule and the general lack of data on industries and facilities managing currently non-hazardous wastes, the Agency agrees that economic impacts on certain sectors may have been underestimated in the RIA for the proposed rule. As discussed above, the Agency has made significant efforts in the final RIA to more accurately characterize the sectors potentially affected by the TC and to estimate the actual impacts on affected facilities.

3. Estimation of Benefits

Several commenters remarked on the original methodology used for the estimation of benefits. The most frequent target of criticism was the assumption that all contaminated aquifers would be cleaned up as a result of the TC. Commenters also questioned the validity of assuming that ground water resource conditions in North Carolina were representative of conditions across the entire United States.

Commenters on the use of aquifer cleanup as the basis for estimating benefits of the proposed rule asked for justification of the assumption that all aquifers would be cleaned up and an explanation of the benefits to human health and the environment which would result from the cleanup. The Agency used a different methodology to estimate benefits for the final RIA than was used for the original RIA. For the final RIA, EPA examined three potential types of benefits: human health risk reduction, resource damage avoided, and cleanup costs avoided. The assumption that all aquifers would be cleaned up was not used in the final RIA. In estimating benefits based on cleanup costs avoided through controlled subtitle C management wastes, EPA assumed in the RIA final rule that, for the near term, subtitle D facilities with down-gradient wells and with at least some resource damage (as predicted by the resource damage analysis) would be the most likely candidates for cleanup.

The Agency agrees with the comment that ground water resource conditions North Carolina may not be representative of conditions across the entire United States. As a result, in the final RIA EPA used distributions of hydrogeologic parameters which were representative of nationwide conditions rather than relying on hydrogeologic information from one state.

4. Cost-Benefit Comparisons

In general, commenters argued that the RIA overestimated likely benefits of the proposed rule while underestimated the potential impacts. Commenters believed that the TC would bring large quantities of waste into the subtitle C system with little or no attendant environmental or health benefit. One commenter claimed that, after all indirect impacts are considered, the net benefits of the rule could be negative. Another commenter, however, stated that benefits were actually underestimated because of assumptions in the baseline scenario.

The Agency has used an improved methodology and additional data in the final RIA. EPA believes that the final RIA provides reasonable estimates of the potential costs and benefits of the rule. As presented in this section, the final RIA does indicate that the TC will bring relatively large quantities of waste into the subtitle C system, and also indicates that there will be attendant benefits. The Agency used cost and benefit estimates to compare relative costs and benefits of the various regulatory options. The analyses were conducted separately using approaches constructed to make the best possible use of available data. The separate analyses were not meant to be used to produce absolute measures of cost effectiveness. The RIA contains discussion of the Agency's evaluation and comparison of cost and benefit results.

5. Small Business Analysis

The Agency received many comments on its assessment of the effects of the proposed TC on small businesses. One group of comments focused on the definition chosen by EPA for small businesses. The Agency was also criticized for its threshold for

determining if a "substantial number" of small businesses would suffer significant economic impacts, and therefore necessitate the preparation of a full Regulatory Flexibility Analysis. Finally, many commenters felt that the analysis severely underestimated the impact of the rule on small businesses.

Commenters asked why the Agency did not use the standard Small Business Administration (SBA) criterion of 500 employees to define a small business. The Agency decided to use the 50 employee definition of a small business because the RIA estimates facility-level impacts, and the SBA definition applies to entire firms. In the absence of data to estimate firm-level impacts, the Agency chose the 50 employee cutoff as an appropriate small facility definition for the RIA. The SBA definition would designate most of the establishments in most of the examined industries as small facilities, which would obscure differential impacts on smaller facilities.

The Agency was criticized for using a 20 percent threshold for determining if a "substantial number" of small businesses would be significantly affected. Commenters claimed that it was arbitrary to consider the small business impact negligible if "only 19.9 percent" of small business were significantly affected. The Agency recognizes that, for an individual facility, the magnitude of impacts is not altered by the number of other facilities which are significantly affected. Nevertheless, the Agency believes that 20 percent is a reasonable benchmark for defining a "substantial number" of small businesses. The 20 percent threshold is commonly applied in RIAs conducted by EPA.

A large number of commenters criticized the overall conclusions of the small business analysis, declaring that the analysis severely underestimated the economic effects of the TC on small businesses. Commenters maintained that the universe of small businesses was inadequately addressed. Examples of small businesses not included in the analysis which commenters felt should have been considered included service stations and vehicle maintenance facilities. Commenters also mentioned the expense of performing the TCLP, claiming that it was an especially significant hardship for small businesses.

As explained in the general discussion of the industrial sectors included in the RIA, the Agency made extensive efforts to identify and include sectors potentially affected by the TC rule, including end users of products. And, as discussed under the comments on incorporating testing costs, these costs were not included since generators are not currently required to test their wastes. Although EPA maintains that a full RFA is not necessary for the TC rule, it realizes that the impact of the rule could be significant for individual small enterprises.

E. Paperwork Reduction Act

The information collection requirements in this rule have been approved by the Office of Management and Budget (OMB) under the Paper Reduction Act, 44 U.S.C. 3501 et seq., and have been assigned the following OMB control numbers: 2050-0007, Land Disposal Permitting Standards; 2050-0008, RCRA Closure/Post-Closure; 2050-0009, Hazardous Waste Storage and Treatment Facilities; 2050-0011, Contingency Plans for Hazardous Waste Facilities; 2050-0012, General Facility Operating Requirements; 2050-0013, Operating Record for Hazardous Waste Facilities; 2050-0028, Notification of a Hazardous Waste Activity; 2050-0033, Reporting, Recordkeeping, and Planning for Ground-Water Monitoring; 2050-0034, RCRA Hazardous Waste Permit Application Part A; 2050-0036, RCRA Financial Assurance Requirements; 2050-0037, Recordkeeping and Reporting for RCRA Permitees; and 2050-0039, Uniform Hazardous Waste Manifest for Generators and Transporters.

VII. References

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List of Subjects in 40 CFR Parts 261, 264, 265, 268, 271, and 302

Administrative practice and procedure, Air pollution control, Chemicals, Confidential business information, Hazardous materials transportation, Hazardous substances, Hazardous waste, Indian lands, Intergovernmental relations, Natural resources, Nuclear materials, Penalties, Pesticides and pests, Radioactive materials, Recycling, Reporting and recordkeeping requirements, Superfund, Water pollution control, Water supply, Waste treatment and disposal.

Dated: March 5, 1990.

William K. Reilly,

Administrator.

For the reasons set out in the preamble, Chapter I of Title 40 of the Code of Federal Regulations is amended as follows:

PART 261—IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

1. The authority citation for part 261 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6921, and 6922.

2. Section 261.4 is amended by revising paragraphs (b)(6)(i) introductory text, and (b)(9) and by adding paragraph (b)(10) to read as follows:

§ 261.4 Exclusions.

* * * * *

(b) * * *

(6)(i) Wastes which fail the test for the Toxicity Characteristic because chromium is present or are listed in subpart D due to the presence of chromium, which do not fail the test for the Toxicity Characteristic for any other constituent or are not listed due to the presence of any other constituent, and which do not fail the test for any other characteristic, if it is shown by a waste generator or by waste generators that:

* * * * *

(9) Solid waste which consists of discarded wood or wood products which fails the test for the Toxicity Characteristic solely for arsenic and which is not a hazardous waste for any other reason or reasons, if the waste is generated by persons who utilize the arsenical-treated wood and wood products for these materials' intended end use.

(10) Petroleum-contaminated media and debris that fail the test for the Toxicity Characteristic of § 261.24 and are subject to the corrective action regulations under part 280 of this chapter.

3. Section 261.8 is added to subpart A to read as follows:

§ 261.8 PCB Wastes Regulated Under Toxic Substances Control Act

The disposal of PCB-containing dielectric fluid and electric equipment containing such fluid authorized for use and regulated under part 761 of this chapter and that are hazardous only because they fail the test for the Toxicity Characteristic (Hazardous Waste Codes D018 through D043 only) are exempt from regulation under parts 261 through 265, and parts 268, 270, and 124 of this chapter, and the notification requirements of section 3010 of RCRA.

4. Section 261.24 is revised to read as follows:

§ 261.24 Toxicity characteristic.

(a) A solid waste exhibits the characteristic of toxicity if, using the test methods described in Appendix II or equivalent methods approved by the Administrator under the procedures set forth in §§ 260.20 and 260.21, the extract from a representative sample of the waste contains any of the contaminants listed in Table 1 at the concentration equal to or greater than the respective value given in that Table. Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering using the methodology outlined in Appendix II, is considered to be the extract for the purpose of this section.

(b) A solid waste that exhibits the characteristic of toxicity, but is not listed as a hazardous waste in subpart D, has the EPA Hazardous Waste Number specified in Table 1 which corresponds to the toxic contaminant causing it to be hazardous.

TABLE 1.—MAXIMUM CONCENTRATION OF CONTAMINANTS FOR THE TOXICITY CHARACTERISTIC

EPA HW No.[1]	Contaminant	CAS No.[2]	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1.0
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	o-Cresol	95-48-7	[4] 200.0
D024	m-Cresol	108-39-4	[4] 200.0
D025	p-Cresol	106-44-5	[4] 200.0
D026	Cresol		[4] 200.0
D016	2,4-D	94-75-7	10.0
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	[5] 0.13
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its hydroxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	[5] 0.13
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D035	Methyl ethyl ketone	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	[5] 5.0
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
[illegible]	2,4,6-Trichlorophenol	88-06-2	2.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D043	Vinyl chloride	75-01-4	0.2

[1] Hazardous waste number.
[2] Chemical abstracts service number.
[3] Quantification limit is greater than the calculated regulatory level. The quantification limit therefore becomes the regulatory level.
[4] If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/L.

5. Section 261.30 is amended by revising paragraph (b) to read as follows:

261.30 General.

* * * *

(b) The Administrator will indicate his basis for listing the classes or types of wastes listed in this subpart by employing one or more of the following Hazard Codes:

Ignitable Waste	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Toxicity Characteristic Waste	(E)
Acute Hazardous Waste	(H)
Toxic Waste	(T)

Appendix VII identifies the constituent which caused the Administrator to list the waste as a Toxicity Characteristic Waste (E) or Toxic Waste (T) in § 261.31 and 261.32.

* * * *

6. Appendix II of part 261 is revised to read as follows:

Appendix II—Method 1311 Toxicity Characteristic Leaching Procedure (TCLP)

1.0 Scope and Application

1.1 The TCLP is designed to determine the mobility of both organic and inorganic contaminants present in liquid, solid, and multiphasic wastes.

1.2 If a total analysis of the waste demonstrates that individual contaminants are not present in the waste, or that they are present but at such low concentrations that the appropriate regulatory thresholds could not possibly be exceeded, the TCLP need not be run.

1.3 If an analysis of any one of the liquid fractions of the TCLP extract indicates that a regulated compound is present at such high levels that even after accounting for dilution from the other fractions of the extract the concentration would be above the regulatory threshold for that compound, then the waste is hazardous and it is not necessary to analyze the remaining fractions of the extract.

1.4 If an analysis of extract obtained using a bottle extractor shows that the concentration of any regulated volatile contaminant exceeds the regulatory threshold for that compound, then the waste is [illegible] and extraction using the ZHE is not necessary. However, extract from a bottle extractor cannot be used to demonstrate that the concentration of volatile compounds is below the regulatory threshold.

2.0 Summary of Method (see Figure 1)

2.1 For liquid wastes (i.e., those containing less than 0.5 percent dry solid material), the waste, after filtration through a 0.6 to 0.8-um glass fiber filter, is defined as the TCLP extract.

2.2 For wastes containing greater than or equal to 0.5 percent solids, the liquid, if any, is separated from the solid phase and stored for later analysis; the solid phase, if necessary, is reduced in particle size. The solid phase is extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase. The extraction fluid employed is a function of the alkalinity of the solid phase of the waste. A special extractor vessel is used when testing for volatile contaminants (see Table 1 for a list of volatile compounds). Following extraction, the liquid extract is separated from the solid phase by filtration through a 0.6 to 0.8-um glass fiber filter.

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Figure 1 Method 1311 Flowchart

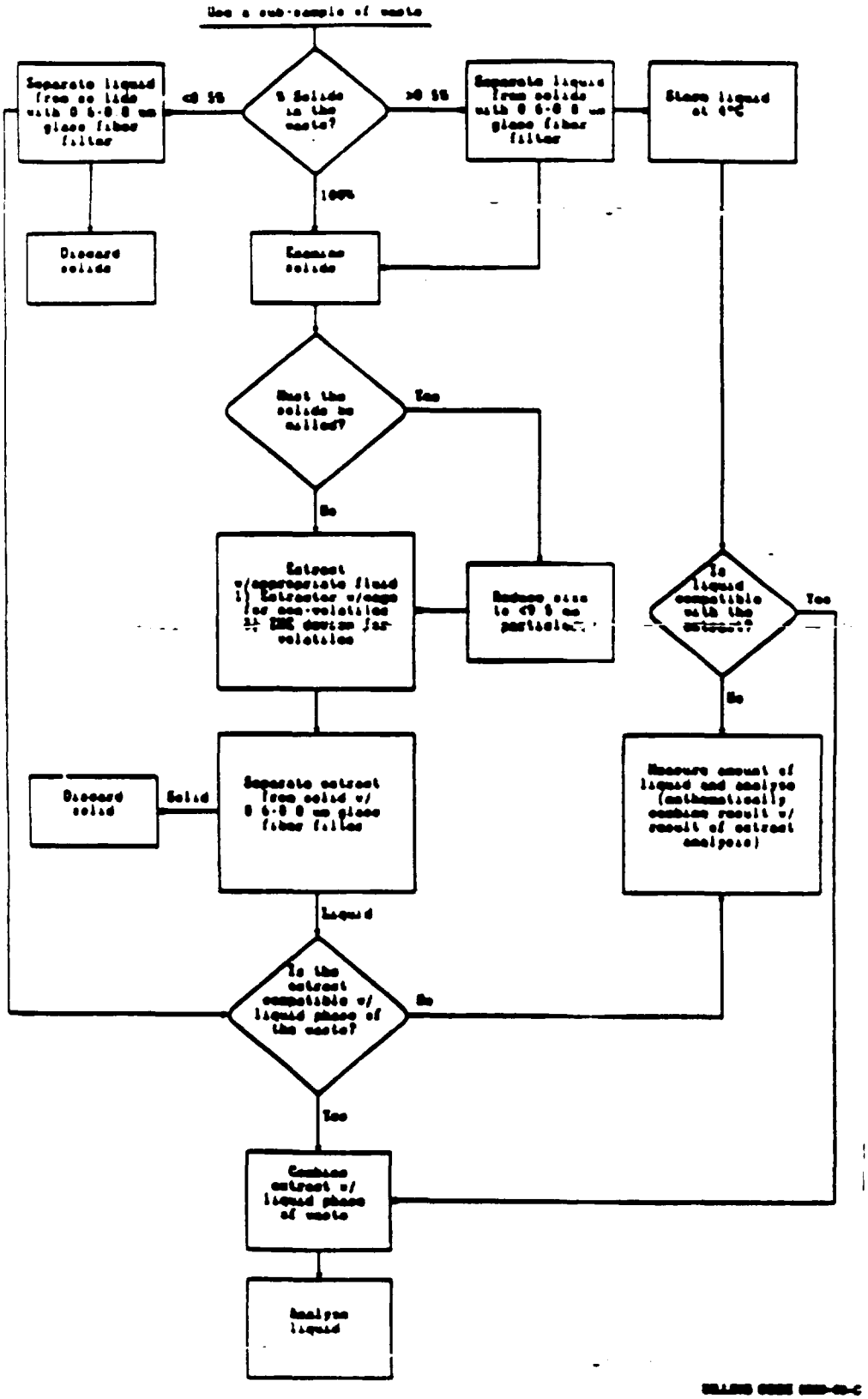

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TABLE 1.—VOLATILE CONTAMINANTS [1]

Compound	CAS no.
Acetone	67-64-1
Benzene	71-43-2
n-Butyl alcohol	71-36-3
Carbon disulfide	75-15-0
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroform	67-66-3
1,2-Dichloroethane	107-06-2
1,1-Dichloroethylene	75-35-4
Ethyl acetate	141-78-6
Ethyl benzene	100-41-4
Ethyl ether	60-29-7
Isobutanol	78-83-1
Methanol	67-56-1
Methylene chloride	75-09-2
Methyl ethyl ketone	78-93-3
Methyl isobutyl ketone	108-10-1
Tetrachloroethylene	127-18-4
Toluene	108-88-3
1,1,1-Trichloroethane	71-55-6
Trichloroethylene	79-01-6
Trichlorofluoromethane	75-69-4
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1
Vinyl chloride	75-01-4

TABLE 1.—VOLATILE CONTAMINANTS [1]—Continued

Compound	CAS no.
Xylene	1330-20-7

[1] When testing for any or all of these contaminants, the zero-headspace extractor vessel shall be used instead of the bottle extractor.

2.2 If compatible (i.e., multiple phases will not form on combination), the initial liquid phase of the waste is added to the liquid extract, and these are analyzed together. If incompatible, the liquids are analyzed separately and the results are mathematically combined to yield a volume-weighted average concentration.

3.0 Interferences

3.1 Potential interferences that may be encountered during analysis are discussed in the individual analytical methods.

4.0 Apparatus and Materials

4.1 Agitation apparatus: The agitation apparatus must be capable of rotating the extraction vessel in an end-over-end fashion (see Figure 2) at 30 ± 2 rpm. Suitable devices known to EPA are identified in Table 2.

4.2 Extraction Vessel:

4.2.1 Zero-Headspace Extraction Vessel (ZHE). This device is for use only when the waste is being tested for the mobility of volatile constituents (i.e., those listed in Table 1). The ZHE (depicted in Figure 3) allows for liquid/solid separation within the device, and effectively precludes headspace. This type of vessel allows for initial liquid/solid separation, extraction, and final extract filtration without opening the vessel (see sec. 4.2.1). The vessels shall have an internal volume of 200-600 mL and be equipped to accommodate a 90-110 mm filter. The device contains VITON [2] O-rings which should be replaced frequently. Suitable ZHE devices known to EPA are identified in Table 3.

[illegible]

[1] VITON [2] is a trademark of Du Pont.

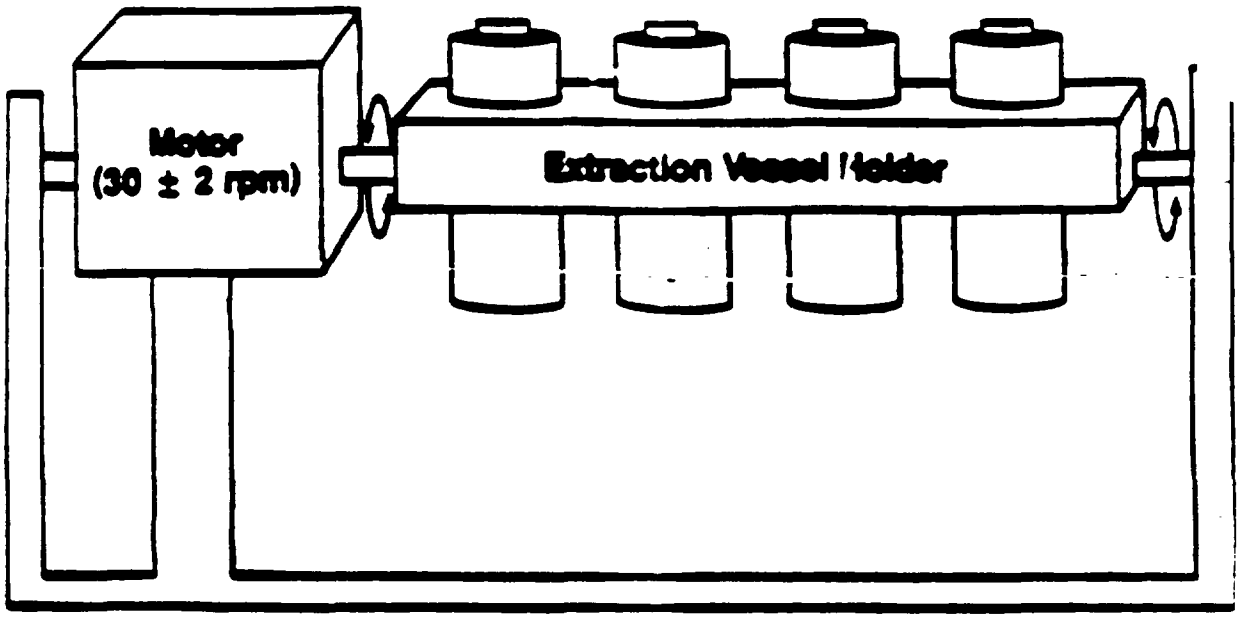

Figure 2. Rotary Agitation Apparatus

BILLING CODE 6560-50-M

TABLE 2.—SUITABLE ROTARY AGITATION APPARATUS [1]

Company	Location	Model no.
Analytical Testing and Consulting Services, Inc.	Warrington, PA (215) 343-4480	2-ZHE or 4-bottle extractor (DC20S); 4-ZHE or 8-bottle extractor (DC20); 8-ZHE or 12-bottle extractor (DC20S).
Associated Design and Manufacturing Company	Alexandria, VA (703) 549-5999	2-vessel (3740-2), 4-vessel (3740-4), 8-vessel (3740-6), 8-vessel (3740-8), 12-vessel (3740-12), 24-vessel (3740-24).
Environmental Machine and Design, Inc.	Lynchburg, VA (804) 846-8424	8-vessel (08-00-00), 4-vessel (04-00-00).
IRA Machine Shop and Laboratory	Sanford, FR (800) 752-4004	8-vessel (011001).
Lars Lande Manufacturing	Whitmore Lake, MI (313) 449-4116.	10-vessel (10VRE), 5-vessel (5 VRE).
Millipore Corp.	Bedford, MA (800) 225-3384	4-ZHE or 4 1-liter bottle extractor (YT3SORAHW).

[1] Any device that rotates the extraction vessel in an end-over-end fashion at 30 ±2 rpm is acceptable.

BILLING CODE 6560-50-M

S-041999 0071(03)(27-MAR-90-15:30:13)

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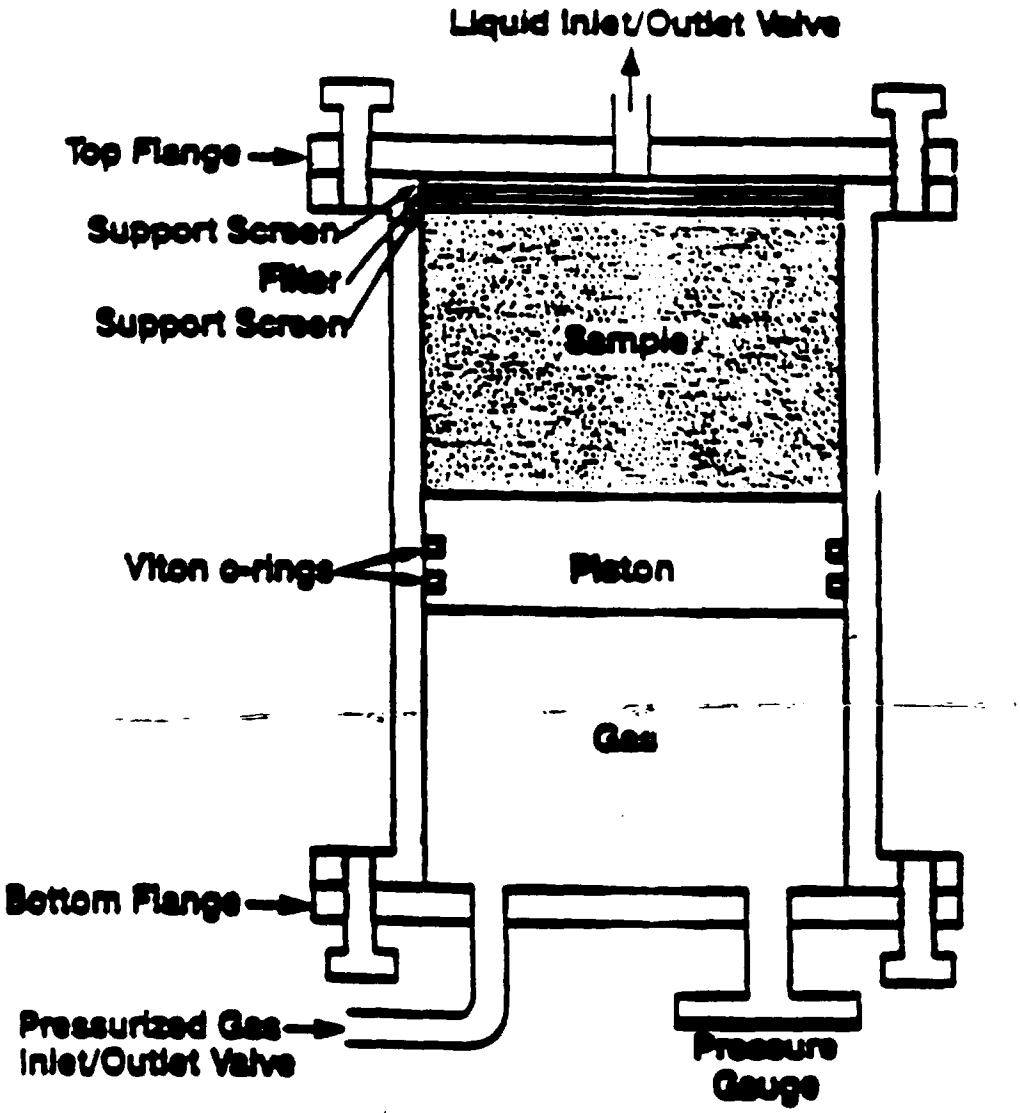

Figure 3. Zero-Headspace Extractor (ZHE)

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TABLE 3.—SUITABLE ZERO-HEADSPACE EXTRACTOR VESSELS [1]

Company	Location	Model no.
Analytical Testing & Consulting Services, Inc	Warrington, PA (215) 343-4480	C102, Mechanical Pressure Device.
Associated Design and Manufacturing Company	Alexandria, VA (703) 549-[illegible]	3740-ZHE, Gas Pressure Device.
Lars Lande Manufacturing [2]	Whitmore Lake, MI (313) 449-4116	ZHE-11, Gas Pressure Device.
Millipore Corporation	Bedford, MA (800) 225-3384	YT3000ZHW, Gas Pressure Device.
Environmental Machine and Design, Inc	Lynchburg, VA (804) 846-6434	VOLA-TCK1, Gas Gas Pressure Device.

[1] Any device that meets the specifications listed in Section 4.2.1 of the method is suitable.
[2] This device uses a 110 mm filter.

For the ZHE to be acceptable for use, the piston within the ZHE should be able to be moved with approximately 15 psi or less. If it takes more pressure to move the piston, the O-rings in the device should be replaced. If this does not solve the problem, the ZHE is unacceptable for TCLP analyses and the manufacturer should be contacted.

The ZHE should be checked for leaks after every extraction. If the device contains a built-in pressure gauge, pressurize the device to 50 psi, allow it to stand unattended for 1 hour, and recheck the pressure. If the device does not have a built-in pressure gauge, pressurize the device to 50 psi, submerge it in water, and check for the presence of air bubbles escaping from any of the fittings. If pressure is lost, check all fittings and inspect and replace O-rings, if necessary. Retest the device. If leakage problems cannot be solved, the manufacturer should be contacted.

Some ZHEs use gas pressure to actuate the ZHE piston, while others use mechanical pressure (see Table 3). Whereas the volatiles procedure (see section 9.0) refers to pounds-per-square-inch (psi), for the mechanically actuated piston, the pressure applied is measured in torque-inch-pounds. Refer to the manufacturer's instructions as to the proper conversion.

4.2.2 Bottle Extraction Vessel. When the waste is being evaluated using the nonvolatile extraction, a jar with sufficient capacity to hold the sample and the extraction fluid is needed. Headspace is allowed in this vessel.

The extraction bottles may be constructed from various materials, depending on the contaminants to be analyzed and the nature of the waste (see Step 4.3.3). It is recommended that borosilicate glass bottles be used instead of other types of glass, especially when inorganics are of concern. Plastic bottles, other than polytetrafluoroethylene, shall not be used if organics are to be investigated. Bottles are available from a number of laboratory suppliers. When this type of extraction vessel is used, the filtration device discussed in Step 4.3.2 is used for initial liquid/solid separation and final extract filtration.

4.3 Filtration Devices: It is recommended that all filtrations be performed in a hood.

4.3.1 Zero-Headspace Extractor Vessel (ZHE): When the waste is evaluated for volatiles, the zero-headspace extraction vessel described in section 4.2.1 is used for filtration. The device shall be capable of supporting and keeping in place the glass fiber filter and be able to withstand the pressure needed to accomplish separation (50 psi).

Note: When it is suspected that the glass fiber filter has been ruptured, an in-line glass fiber filter may be used to filter the material within the ZHE.

4.3.2 Filter Holder: When the waste is evaluated for other than volatile compounds, any filter holder capable of supporting a glass fiber filter and able to withstand the pressure needed to accomplish separation may be used. Suitable filter holders range from simple vacuum units to relatively complex systems capable of exerting pressures of up to 80 psi or more. The type of filter holder used depends on the properties of the material to be filtered (see Step 4.3.3). These devices shall have a minimum internal volume of 300 mL and be equipped to accommodate a minimum filter size of 47 mm (filter holders having an internal capacity of 1.5 L or greater and equipped to accommodate a 142 mm diameter filter are recommended). Vacuum filtration can only be used for wastes with low solids content (<10 percent) and for highly granular liquid-containing wastes. All other types of wastes should be filtered using positive pressure filtration. Suitable filter holders known to EPA are shown in Table 4.

4.3.3 Materials of Construction: Extraction vessels and filtration devices shall be made of inert materials which will not leach or absorb waste components. Glass, polytetrafluoroethylene (PTFE), or type 316 stainless steel equipment may be used when evaluating the mobility of both organic and inorganic components. Devices made of high-density polyethylene (HDPE), polypropylene, or polyvinyl chloride may be used only when evaluating the mobility of metals. Borosilicate glass bottles are recommended for use over other types of glass bottles, especially when inorganics are constituents of concern.

TABLE 4.—SUITABLE FILTER HOLDERS [1]

Company	Location	Model/Catalogue no.	Size (mm)
Nuclepore Corporation	Pleasanton, CA (800) 882-7711	420010 410400	142 mm 47 mm
Micro Filtration Systems	Dublin, CA (800) 334-7132 (415) 828-6010	300400 311400	142 mm 47 mm
Millipore Corporation	Bedford, MA (800) 225-3384	YT30142HW XX1004700	142 mm 47 mm

[1] Any device capable of separating the liquid from the solid phase of the waste is suitable, provided that it is chemically compatible with the waste and the constituents to be analyzed. Plastic devices (not listed above) may be used when only inorganic constituents are of concern. The 142 mm size filter holder is recommended.

4.4 Filters: Filters shall be made of borosilicate glass fiber, shall contain no binder materials, and shall have an effective pore size of 0.6 to 0.8-um or equivalent. Filters known to EPA which meet these specifications are identified in Table 5. Pre-filters must not be used. When evaluating the mobility of metals, filters shall be acid-washed prior to use by rinsing with 1N nitric acid followed by three consecutive rinses with deionized distilled water (a minimum of 1-L per rinse is recommended). Glass fiber filters are fragile and should be handled with care.

4.5 pH meter: The meter should be accurate to ±0.05 units at 25 °C.

TABLE 5.—SUITABLE FILTER MEDIA [1]

Company	Location	Model	Pore size
Millipore Corporation	Bedford, MA (800) 225-3384	AP40	0.7
Nuclepore Corporation	Pleasanton, CA (415) 463-2530	211625	0.7
Whatman Laboratory Products, Inc	Clifton, NJ (201) 773-5800	GF/F	0.7
Micro Filtration Systems	Dublin, CA (800) 334-7132 (415) 828-6010	GF75	0.7

[1] Any filter that meets the specifications in Section 4.4 of the Method is suitable.

4.6 ZHE extract collection devices: TEDLAR®[2] bags or glass, stainless steel or PTFE gas-tight syringes are used to collect the initial liquid phase and the final extract of the waste when using the ZHE device. The devices listed are recommended for use under the following conditions:

4.6.1 If a waste contains an aqueous liquid phase or if a waste does not contain a significant amount of nonaqueous liquid (i.e., <1 percent of total waste), the TEDLAR® bag or a 500 mL syringe should be used to collect and combine the initial liquid and solid extract.

4.6.2 If a waste contains a significant amount of nonaqueous liquid in the initial liquid phase (i.e., >1 percent of total waste), the syringe or the TEDLAR® bag may be used for both the initial solid/liquid separation and the final extract filtration. However, analysts should use one or the other, not both.

4.6.3 If the waste contains no initial liquid phase (is 100 percent solid) or has no significant solid phase (is 100 percent liquid), either the TEDLAR® bag or the syringe may be used. If the syringe is used, discard the first 5 mL of liquid expressed from the device. The remaining aliquots are used for analysis.

4.7 ZHE extraction fluid transfer devices: Any device capable of transferring the extraction fluid into the ZHE without changing the nature of the extraction fluid is acceptable (e.g., a positive displacement or peristaltic pump, a gas tight syringe, pressure filtration unit (See Step 4.3.2), or other ZHE device).

4.8 Laboratory balance: Any laboratory balance accurate to within ±0.01 grams may be used (all weight measurements are to be within ±0.1 grams).

5.0 Reagents

5.1 Reagent water. Reagent water is defined as water in which an interferent is not observed at or above the methods detection limit of the analyte(s) of interest. For nonvolatile extractions, ASTM Type II water or equivalent meets the definition of reagent water. For volatile extractions, it is recommended that reagent water be generated by any of the following methods. Reagent water should be monitored periodically for impurities.

5.1.1 Reagent water for volatile extractions may be generated by passing tap water through a carbon filter bed containing about 500 grams of activated carbon (Calgon Corp., Filtrasorb-300 or equivalent).

5.1.2 A water purification system (Millipore Super-Q or equivalent) may also be used to generate reagent water for volatile extractions.

5.1.3 Reagent water for volatile extractions may also be prepared by boiling water for 15 minutes. Subsequently, while maintaining the water temperature at 90 ±5 °C, bubble a contaminant-free inert gas (e.g., nitrogen) through the water for 1 hour. While still hot, transfer the water to a narrow mouth screw-cap bottle under zero-headspace and seal with a Teflon-lined septum and cap.

5.2 Hydrochloric acid (1N), HCL made from ACS reagent grade.

5.3 Nitric acid (1N), HNO_3, made from ACS reagent grade.

5.4 Sodium hydroxide (1N), NaOH, made from ACS reagent grade.

5.5 Glacial acetic acid, HOAc, ACS reagent grade.

5.6 Extraction fluid.

5.6.1 Extraction fluid #1: Add 5.7 mL glacial HOAc to 500 mL of the appropriate water (See Step 5.1), add 64.3 mL of 1N NaOH, and dilute to a volume of 1 liter. When correctly prepared, the pH of this fluid will be 4.93 ±0.05.

5.6.2 Extraction fluid #2: Dilute 5.7 mL glacial HOAc with ASTM Type II water (See Step 5.1) to a volume of 1 liter. When correctly prepared, the pH of this fluid will be 2.88 ±0.05.

Note: These extraction fluids should be monitored frequently for impurities. The pH should be checked prior to use to ensure that these fluids are made up accurately. If impurities are found or the pH is not within the above specifications, the fluid shall be discarded and fresh extraction fluid prepared.

5.7 Analytical standards prepared according to the appropriate analytical method.

6.0 Sample Collection, Preservation, and Handling

6.1 All samples shall be collected using an appropriate sampling plan.

6.2 The TCLP may place requirements on the minimal size of the field sample depending upon the physical state or states of the waste and the contaminants of concern. An aliquot is needed for preliminary evaluation of which extraction fluid is to be used for the nonvolatile contaminant extraction procedure. Another aliquot may be needed to actually conduct the nonvolatile extraction (see section 1.4 concerning the use of this extract for volatile organics). If volatile organics are of concern, another aliquot may be needed. Quality control measures may require additional aliquots. Further, it is always wise to collect more sample just in case something goes wrong with the initial attempt to conduct the test.

6.3 Preservatives shall not be added to samples.

6.4 Samples may be refrigerated unless refrigeration results in irreversible physical change to the waste. If precipitation occurs, the entire sample (including precipitate) should be extracted.

6.5 When the waste is to be evaluated for volatile contaminants, care shall be taken to minimize the loss of volatiles. Samples shall be taken and stored in a manner to prevent the loss of volatile contaminants (e.g., samples should be collected in Teflon-lined septum capped vials and stored at 4 °C, until ready to be opened prior to extraction).

6.6 TCLP extracts should be prepared for analysis and analyzed as soon as possible following extraction. Extracts or portions of extracts for metallic contaminant determinations must be acidified with nitric acid to a pH <2, unless precipitation occurs (see section 6.14 if precipitation occurs). Extracts or portions of extracts for organic contaminant determinations shall not be allowed to come into contact with the atmosphere (i.e., no headspace) to prevent losses. See section 10.6 (QA requirements) for acceptable sample and extract holding times.

7.0 Preliminary Evaluations

Perform preliminary TCLP evaluations on a minimum 100 gram aliquot of waste. This aliquot may not actually undergo TCLP extraction. These preliminary evaluations include: (1) determination of the percent solids; (2) determination of whether the waste contains insignificant solids and is, therefore, its own extract after filtration; (3) determination of whether the solid portion of the waste requires particle size reduction; and (4) determination of which of the two extraction fluids are to be used for the nonvolatile TCLP extraction of the waste.

7.1 Preliminary determination of percent solids: Percent solids is defined as that fraction of a waste sample (as a percentage of the total sample) from which no liquid may be forced out by an applied pressure, as described below.

7.1.1 If the waste will obviously yield no free liquid when subjected to pressure filtration (i.e., is 100% solids) proceed to Step 7.2.

7.1.2 If the sample is liquid or multiphasic, liquid/solid separation to make a preliminary determination of percent solids is required. This involves the filtration device described in Step 4.5.2 and is outlined in Steps 7.1.3 through 7.1.8.

7.1.3 Pre-weigh the filter and the container that will receive the filtrate.

7.1.4 Assemble the filter holder and filter following the manufacturer's instructions. Place the filter on the support screen and secure.

[2] TEDLAR® is a registered trademark of Du Pont.

7.1.5 Weigh out a subsample of the waste (100 gram minimum) and record the weight.

7.1.6 Allow slurries to stand to permit the solid phase to settle. Wastes that settle slowly may be centrifuged prior to filtration. Centrifugation is to be used only as an aid to filtration. If used, the liquid should be decanted and filtered followed by filtration of the solid portion of the waste through the same filtration system.

7.1.7 Quantitatively transfer the waste sample to the filter holder (liquid and solid phases). Spread the waste sample evenly over the surface of the filter. If filtration of the waste at 4 °C reduces the amount of expressed liquid over what would be expressed at room temperature then allow the sample to warm up to room temperature in the device before filtering.

Note: If waste material (>1 percent of original sample weight) has obviously adhered to the container used to transfer the sample to the filtration apparatus, determine the weight of this residue and subtract it from the sample weight determined in Step 7.1.5 to determine the weight of the waste sample that will be filtered.

Gradually apply vacuum or gentle pressure of 1–10 psi, until air or pressurizing gas moves through the filter. If this point is not reached under 10 psi, and if no additional liquid has passed through the filter in any 2-minute interval, slowly increase the pressure in 10-psi increments to a maximum of 80 psi. After each incremental increase of 10-psi, if the pressurizing gas has not moved through the filter, and if no additional liquid has passed through the filter in any 2-minute interval, proceed to the next 10-psi increment. When the pressurizing gas begins to move through the filter, or when liquid flow has ceased at 80 psi (i.e., filtration does not result in any additional filtrate within any 2-minute period), stop the filtration.

Note: Instantaneous application of high pressure can degrade the glass fiber filter and may cause premature plugging.

7.1.8 The material in the filter holder is defined as the solid phase of the waste, and the filtrate is defined as the liquid phase.

Note: Some wastes, such as oily wastes and some paint wastes, will obviously contain some material that appears to be a liquid. Even after applying vacuum or pressure filtration, as outlined in Step 7.1.7, this material may not filter. If this is the case the material within the filtration device is defined as a solid. Do not replace the original filter with a fresh filter under any circumstances. Use only one filter.

7.1.9 Determine the weight of the liquid phase by subtracting the weight of the filtre container (see Step 7.1.3) from the total weight of the filtrate-filled container. Determine the weight of the solid phase of the waste sample by subtracting the weight of the liquid phase from the weight of the total waste sample, as determined in Step 7.1.5 or 7.1.7.

Record the weight of the liquid and solid phases. Calculate the percent solids as follows:

$$\text{Percent solids} = \frac{\text{Weight of solid (Step 7.1.9)}}{\text{Total weight of waste (Step 7.1.5 or 7.1.7)}} \times 100$$

7.2 If the percent solids determined in Step 7.1.9 is equal to or greater than 0.5%, then proceed either to Step 7.3 to determine whether the solid material requires particle size reduction or to Step 7.2.1 if it is noticed that a small amount of the filtrate is entrained in wetting of the filter. If the percent solids determined in Step 7.1.9 is less than 0.5%, then proceed to Step 8.0 if the nonvolatile TCLP is to be performed and to section 9.0 with a fresh portion of the waste if the volatile TCLP is to be performed.

7.2.1 Remove the solid phase and filter from the filtration apparatus.

7.2.2 Dry the filter and solid phase at 100 ±20 °C until two successive weighing yield the same value within ±1 percent. Record the final weight.

Note: Caution should be taken to ensure that the subject solid will not flash upon heating. It is recommended that the drying oven be vented to a hood or other appropriate device.

7.2.3 Calculate the percent dry solids as follows:

$$\text{Percent dry solids} = \frac{\text{(Weight of dry waste + filter)} - \text{tared weight of filter}}{\text{Initial weight of waste (Step 7.1.5 or 7.1.7)}} \times 100$$

7.2.4 If the percent dry solids is less than 0.5 percent, then proceed to Step 8.0 if the nonvolatile TCLP is to be performed, and to Section 9.0 if the volatile TCLP is to be performed. If the percent dry solids is greater than or equal to 0.5%, and if the nonvolatile TCLP is to be performed, return to the beginning of this Section (7.0) and, with a fresh portion of waste, determine whether particle size reduction is necessary (Step 7.3) and determine the appropriate extraction fluid (Step 7.4). If only the volatile TCLP is to be performed, see the note in Step 7.4.

7.3 Determination of whether the waste requires particle-size reduction (particle-size is reduced during this step): Using the solid portion of the waste, evaluate the solid for particle size. Particle-size reduction is required, unless the solid has a surface area per gram of material equal to or greater than 3.1 cm^2, or is smaller than 1 cm in its narrowest dimension (i.e., is capable of passing through a 9.5 mm (0.375 inch) standard sieve). If the surface area is smaller or the particle size larger than described above, prepare the solid portion of the waste for extraction by crushing, cutting, or grinding the waste to a surface area or particle-size as described above. If the solids are prepared for organic volatiles extraction, special precautions must be taken, see Step 9.6.

Note: Surface area criteria are meant for filamentous (e.g., paper, cloth, and similar) waste materials. Actual measurement of surface area is not required, nor is it recommended. For materials that do not obviously meet the criteria, sample-specific methods would need to be developed and employed to measure the surface area. Such methodology is currently not available.

7.4 Determination of appropriate extraction fluid: If the solid content of the waste is greater than or equal to 0.5 percent and if TCLP extraction for nonvolatile constituents will take place (Section 8.0), perform the determination of the appropriate fluid (Step 8.0) to use for the nonvolatile extraction as follows:

Note: TCLP extraction for volatile constituents uses only extraction fluid #1 (Step 9.0.1). Therefore, if TCLP extraction for nonvolatiles is not required, proceed to Section 9.0.

7.4.1 Weigh out a small subsample of the solid phase of the waste, reduce the solid (if necessary) to a particle-size of approximately 1 mm in diameter or less, and transfer 5.0 grams of the solid phase of the waste to a 500-mL beaker or Erlenmeyer flask.

7.4.2 Add 96.5 mL of reagent water (ASTM Type II) to the beaker, cover with a watchglass, and stir vigorously for 5 minutes using a magnetic stirrer. Measure and record the pH. If the pH is <5.0, use extraction fluid #1. Proceed to Section 8.0.

7.4.3 If the pH from Step 7.4.2 is >5.0, add 3.5 mL 1N HCl, slurry briefly, cover with a watchglass, heat to 50 °C, and hold at 50 °C for 10 minutes.

7.4.4 Let the solution cool to room temperature and record the pH. If the pH is <5.0, use extraction fluid #1. If the pH is >5.0, use extraction fluid #2. Proceed to Section 8.0.

7.5 If the aliquot of the waste used for the preliminary evaluation (Steps 7.1–7.4) was determined to be 100% solid at Step 7.1.1, then it can be used for the Section 8.0 extraction (assuming at least 100 grams

remain), and the section 8.0 extraction (assuming at least 25 grams remain). If the aliquot was subjected to the procedure in Step 7.1.7, then another aliquot shall be used for the volatile extraction procedure in Section 8.0. The aliquot of the waste subjected to the procedure in Step 7.1.7 might be appropriate for use for the section 8.0 extraction if an adequate amount of solid (as determined by Step 7.1.9) was obtained. The amount of solid necessary is dependent upon whether a sufficient amount of extract will be produced to support the analyses. If an adequate amount of solid remains, proceed to Step 8.10 of the nonvolatile TCLP extraction.

8.0 Procedure When Volatiles Are Not Involved

A minimum sample size of 100 grams (solid and liquid phases) is required. In some cases, a larger sample size may be appropriate, depending on the solids content of the waste sample (percent solids, See Step 7.1), whether the initial liquid phase of the waste will be miscible with the aqueous extract of the solid, and whether inorganics, semivolatile organics, pesticides, and herbicides are all analytes of concern. Enough solids should be generated for extraction such that the volume of TCLP extract will be sufficient to support all of the analyses required. If the amount of extract generated by a single TCLP extraction will not be sufficient to perform all of the analyses, more than one extraction may be performed and the extracts from each combined and aliquoted for analysis.

8.1 If the waste will obviously yield no liquid when subjected to pressure filtration (i.e., is 100 percent solid, see Step 7.1), weigh out a subsample of the waste (100 gram minimum) and proceed to Step 8.8.

8.2 If the sample is liquid or multiphasic, liquid/solid separation is required. This involves the filtration device described in Step 4.3.2 and is outlined in Steps 8.3 to 8.8.

8.3 Pre-weigh the container that will receive the filtrate.

8.4 Assemble the filter holder and filter following the manufacturer's instructions. Place the filter on the support screen and secure. Acid wash the filter if evaluating the mobility of metals (see Step 4.4).

Note: Acid washed filters may be used for all nonvolatile extractions even when metals are not of concern.

8.5 Weigh out a subsample of the waste (100 gram minimum) and record the weight. If the waste contains <0.5 percent dry solids (Step 7.2), the liquid portion of the waste, after filtration, is defined as the TCLP extract. Therefore, enough of the sample should be filtered so that the amount of filtered liquid will support all of the analyses required of the TCLP extract. For wastes containing >0.5 percent dry solids (Step 7.2), use the percent solids information obtained in Step 7.1 to determine the optimum sample size (100 gram minimum) for filtration. Enough solids should be generated by filtration to support the analyses to be performed on the TCLP extract.

8.6 Allow slurries to stand to permit the solid phase to settle. Wastes that settle slowly may be centrifuged prior to filtration. Use centrifugation only as an aid to filtration. If the waste is centrifuged, the liquid should be decanted and filtered followed by filtration of the solid portion of the waste through the same filtration system.

8.7 Quantitatively transfer the waste sample (liquid and solid phases) to the filter holder (see Step 4.3.2). Spread the waste sample evenly over the surface of the filter. If filtration of the waste at 4 °C reduces the amount of expressed liquid over what would be expressed at room temperature, then allow the sample to warm up to room temperature in the device before filtering.

Note: If waste material (>1 percent of the original sample weight) has obviously adhered to the container used to transfer the sample to the filtration apparatus, determine the weight of this residue and subtract it from the sample weight determined in Step 8.5, to determine the weight of the waste sample that will be filtered.

Gradually apply vacuum or gentle pressure of 1–10 psi, until air or pressurizing gas moves through the filter. If this point is not reached under 10 psi, and if no additional liquid has passed through the filter in any 2-minute interval, slowly increase the pressure in 10-psi increments to a maximum of 50 psi. After each incremental increase of 10 psi, if the pressurizing gas has not moved through the filter, and if no additional liquid has passed through the filter in any 2-minute interval, proceed to the next 10-psi increment. When the pressurizing gas begins to move through the filter, or when the liquid flow has ceased at 50 psi (i.e., filtration does not result in an additional filtrate within a 2-minute period), stop the filtration.

Note: Instantaneous application of high pressure can degrade the glass fiber filter and may cause premature plugging.

8.8 The material in the filter holder is defined as the solid phase of the waste, and the filtrate is defined as the liquid phase. Weigh the filtrate. The liquid phase may now be either analyzed (See Step 8.12) or stored at 4 °C until time of analysis.

Note: Some wastes, such as oily wastes and some paint wastes, will obviously contain some material that appears to be a liquid. Even after applying vacuum or pressure filtration, as outlined in Step 8.7, the material may not filter. If this is the case, the material within the filtration device is defined as a solid and is carried through the extraction as a solid. Do not replace the original filter with a fresh filter under any circumstances. Use only one filter.

8.9 If the waste contains <0.5 percent dry solids (see Step 7.2), proceed to Step 8.13. If the waste contains >0.5 percent dry solids (see Step 7.1 or 7.2), and if particle-size reduction of the solid was needed in Step 7.1, proceed to Step 8.10. If the waste as received passes a 9.5 mm sieve, quantitatively transfer the solid material into the extractor bottle along with the filter used to separate the initial liquid from the solid phase, and proceed to Step 8.11.

8.10 Prepare the solid portion of the waste for extraction by crushing, cutting, or grinding the waste to a surface area or particle-size described in Step 7.3. When the surface area or particle-size has been appropriately altered, quantitatively transfer the solid material into an extractor bottle. Include the filter used to separate the initial liquid from the solid phase.

Note: Sieving of the waste is not normally required. Surface area requirements are meant for filamentous (e.g., paper, cloth) and similar waste materials. Actual measurement of surface area is not recommended. If sieving is necessary, a Teflon-coated sieve should be used to avoid contamination of the sample.

8.11 Determine the amount of extraction fluid to add to the extractor vessel as follows:

$$\text{Weight of extraction fluid} = \frac{20 \times \text{percent solids (Step 7.1)} \times \text{weight of waste filtered (Step 8.5 or 8.7)}}{100}$$

Slowly add this amount of appropriate extraction fluid (see Step 7.4) to the extractor vessel. Close the extractor bottle tightly (it is recommended that Teflon tape be used to ensure a tight seal), secure in rotary agitation device, and rotate at 30±2 rpm for 18±2 hours. Ambient temperature (i.e., temperature of room in which extraction takes place) shall be maintained at 22 ±3 °C during the extraction period.

Note: As agitation continues, pressure may build up within the extractor bottle for some types of wastes (e.g., limed or calcium carbonate containing wastes may evolve gases such as carbon dioxide). To relieve excess pressure, the extractor bottle may be periodically opened (e.g., after 15 minutes, 30 minutes, and 1 hour) and vented into a hood.

8.12 Following the 18±2 hour extraction, separate the material in the extractor vessel into its component liquid and solid phases by filtering through a new glass fiber filter, as outlined in Step 8.7. For final filtration of the TCLP extract, the glass fiber filter may be changed, if necessary, to facilitate filtration. Filter(s) shall be acid-washed (see Step 4.4) if evaluating the mobility of metals.

8.13 Prepare the TCLP extract as follows:

8.13.1 If the waste contained no initial liquid phase, the filtered liquid material obtained from Step 8.12 is defined as the TCLP extract. Proceed to Step 8.14.

8.13.2 If compatible (e.g., multiple phases will not result on combination), combine the filtered liquid resulting from Step 8.12 with the initial liquid phase of the waste obtained in Step 8.7. This combined liquid is defined as the TCLP extract. Proceed to Step 8.14.

8.13.3 If the initial liquid phase of the waste, as obtained from Step 8.7, is not or may not be compatible with the filtered liquid resulting from Step 8.12, do not combine these liquids. Analyze these liquids, collectively defined as the TCLP extract, and combine the results mathematically, as described in Step 8.14.

8.14 Following collection of the TCLP extract, the pH of the extract should be recorded. Immediately aliquot and preserve the extract for analysis. Metals aliquots must be acidified with nitric acid to pH < 2. If precipitation is observed upon addition of nitric acid to a small aliquot of the extract, then the remaining portion of the extract for metals analyses shall not be acidified and the extract shall be analyzed as soon as possible. All other aliquots must be stored under refrigeration (4 °C) until analyzed. The TCLP extract shall be prepared and analyzed according to appropriate analytical methods. TCLP extracts to be analyzed for metals shall be acid digested except in those instances where digestion causes loss of metallic contaminants. If an analysis of the undigested extract shows that the concentration of any regulated metallic contaminant exceeds the regulatory level, then the waste is hazardous and digestion of the extract is not necessary. However, data on undigested extracts alone cannot be used to demonstrate that the waste is not hazardous. If the individual phases are to be analyzed separately, determine the volume of the individual phases (to ±0.5 percent), conduct the appropriate analyses, and combine the results mathematically by using a simple volume-weighted average:

$$\text{Final analyte concentration} = \frac{(V_1)(C_1)+(V_2)(C_2)}{V_1+V_2}$$

where:

V_1 = The volume of the first phase (L).

C_1 = The concentration of the contaminant of concern in the first phase (mg/L).

V_2 = The volume of the second phase (L).

C_2 = The concentration of the contaminant of concern in the second phase (mg/L).

8.15 Compare the contaminant concentrations in the TCLP extract with the thresholds identified in the appropriate regulations. Refer to § 10.0 for quality assurance requirements.

8.0 Procedure When Volatiles Are Involved

Use the ZHE device to obtain TCLP extract for analysis of volatile compounds only. Extract resulting from the use of the ZHE shall not be used to evaluate the mobility of nonvolatile analytes (e.g., metals, pesticides, etc.).

The ZHE device has approximately a 500-mL internal capacity. The ZHE can thus accommodate a maximum of 25 grams of solid (defined as that fraction of a sample from which no additional liquid may be forced out by an applied pressure of 50 psi), due to the need to add an amount of extraction fluid equal to 20 times the weight of the solid phase.

Charge the ZHE with sample only once and do not open the device until the final extract (of the solid) has been collected. Repeated filling of the ZHE to obtain 25 grams of solid is not permitted.

Do not allow the waste, the initial liquid phase, or the extract to be exposed to the atmosphere for any more time than is absolutely necessary. Any manipulation of these materials should be done when cold (4 °C) to minimize loss of volatiles.

8.1 Pre-weigh the (evacuated) filtrate collection container (See Step 4.8) and set aside. If using a TEDLAR® bag, express all liquid from the ZHE device into the bag, whether for the initial or final liquid/solid separation, and take an aliquot from the liquid in the bag for analysis. The containers listed in Step 4.8 are recommended for use under the conditions stated in 4.8.1–4.8.3.

8.2 Place the ZHE piston within the body of the ZHE (it may be helpful first to moisten the piston O-rings slightly with extraction fluid). Adjust the piston within the ZHE body to a height that will minimize the distance the piston will have to move once the ZHE is charged with sample (based upon sample size requirements determined from Section 8.0, Step 7.1 and/or 7.2). Secure the gas inlet/outlet flange (bottom flange) onto the ZHE body in accordance with the manufacturer's instructions. Secure the glass fiber filter between the support screens and set aside. Set liquid inlet/outlet flange (top flange) aside.

8.3 If the waste is 100 percent solid (see Step 7.1), weigh out a subsample (25 gram maximum) of the waste, record weight, and proceed to Step 8.5.

8.4 If the waste contains < 0.5 percent dry solids (Step 7.2), the liquid portion of waste, after filtration, is defined as the TCLP extract. Filter enough of the sample so that the amount of filtered liquid will support all of the volatile analyses required. For wastes containing > 0.5 percent dry solids (Steps 7.1 and/or 7.2), use the percent solids information obtained in Step 7.1 to determine the optimum sample size to charge into the ZHE. The recommended sample size is as follows:

8.4.1 For wastes containing < 0.5 percent solids (see Step 7.1), weigh out a 500-gram subsample of waste and record the weight.

8.4.2 For wastes containing > 0.5 percent solids (see Step 7.1), determine the amount of waste to charge into the ZHE as follows:

$$\text{Weight of waste to charge ZHE} = \frac{25}{\text{Percent solids (Step 7.1)}} \times 100$$

Weigh out a subsample of the waste of the appropriate size and record the weight.

8.5 If particle-size reduction of the solid portion of the waste was required in Step 7.3, proceed to Step 8.6. If particle-size reduction was not required in Step 7.3, proceed to Step 8.7.

8.6 Prepare the waste for extraction by crushing, cutting, or grinding the solid portion of the waste to a surface area or particle-size as described in Step 7.3.1. Wastes and appropriate reduction equipment should be refrigerated, if possible, to 4 °C prior to particle-size reduction. The means used to effect particle-size reduction must not generate heat in and of itself. If reduction of the solid phase of the waste is necessary, exposure of the waste to the atmosphere should be avoided to the extent possible.

Note: Sieving of the waste is not recommended due to the possibility that volatiles may be lost. The use of an appropriately graduated ruler is recommended as an acceptable alternative. Surface area requirements are meant for filamentous (e.g., paper, cloth) and similar waste materials. Actual measurement of surface area is not recommended.

When the surface area or particle-size has been appropriately altered, proceed to Step 8.7.

8.7 Waste slurries need not be allowed to stand to permit the solid phase to settle. Do not centrifuge wastes prior to filtration.

8.8 Quantitatively transfer the entire sample (liquid and solid phases) quickly to the ZHE. Secure the filter and support screens onto the top flange of the device and secure the top flange to the ZHE body in accordance with the manufacturer's instructions. Tighten all ZHE fittings and place the device in the vertical position (gas

inlet/outlet flange on the bottom). Do not attach the extract collection device to the top plate.

Note: If waste material (>1% of original sample weight) has obviously adhered to the container used to transfer the sample to the ZHE, determine the weight of this residue and subtract it from the sample weight determined in Step 8.4 to determine the weight of the waste sample that will be filtered.

Attach a gas line to the gas inlet/outlet valve (bottom flange) and, with the liquid inlet/outlet valve (top flange) open, begin applying gentle pressure of 1–10 psi (or more if necessary) to force all headspace slowly out of the ZHE device into a hood. At the first appearance of liquid from the liquid inlet/outlet valve, quickly close the valve and discontinue pressure. If filtration of the waste at 4 °C reduces the amount of expressed liquid over what would be expressed at room temperature, then allow the sample to warm up to room temperature in the device before filtering. If the waste is 100 percent solid (see Step 7.1), slowly increase the pressure to a maximum of 50 psi to force most of the headspace out of the device and proceed to Step 8.12.

8.9 Attach the evacuated pre-weighed filtrate collection container to the liquid inlet/outlet valve and open the valve. Begin applying gentle pressure of 1–10 psi to force the liquid phase of the sample into the filtrate collection container. If no additional liquid has passed through the filter in any 2-minute interval, slowly increase the pressure in 10-psi increments to a maximum of 50 psi. After each incremental increase of 10 psi, if no additional liquid has passed through the filter in any 2-minute interval, proceed to the next 10-psi increment. When liquid flow has ceased such that continued pressure filtration at 50 psi does not result in any additional filtrate within a 2-minute period, stop the filtration. Close the liquid inlet/outlet valve, discontinue pressure to the piston, and disconnect and weigh the filtrate collection container.

Note: Instantaneous application of high pressure can degrade the glass fiber filter and may cause premature plugging.

8.10 The material in the ZHE is defined as the solid phase of the waste and the filtrate is defined as the liquid phase.

Note: Some wastes, such as oily wastes and some paint wastes, will obviously contain some material that appears to be a liquid. Even after applying pressure filtration, this material will not filter. If this is the case, the material within the filtration device is defined as a solid and is carried through the TCLP extraction as a solid.

If the original waste contained <0.5 percent dry solids (see Step 7.2), this filtrate is defined as the TCLP extract and is analyzed directly. Proceed to Step 8.18.

8.11 The liquid phase may now be either analyzed immediately (See Steps 8.13 through 8.18) or stored at 4 °C under minimal headspace conditions until time of analysis. Determine the weight of extraction fluid #1 to add to the ZHE as follows:

$$\text{Weight of extraction fluid} = \frac{20 \times \text{percent solids (Step 7.1)} \times \text{weight of waste filtered (Step 8.4 or 8.8)}}{100}$$

8.12 The following steps detail how to add the appropriate amount of extraction fluid to the solid material within the ZHE and agitation of the ZHE vessel. Extraction fluid #1 is used in all cases (See Step 3.6).

8.12.1 With the ZHE in the vertical position, attach a line from the extraction fluid reservoir to the liquid inlet/outlet valve. The line used shall contain fresh extraction fluid and should be preflushed with fluid to eliminate any air pockets in the line. Release gas pressure on the ZHE piston (from the gas inlet/outlet valve), open the liquid inlet/outlet valve, and begin transferring extraction fluid (by pumping or similar means) into the ZHE. Continue pumping extraction fluid into the ZHE until the appropriate amount of fluid has been introduced into the device.

8.12.2 After the extraction fluid has been added, immediately close the liquid inlet/outlet valve and disconnect the extraction fluid line. Check the ZHE to ensure that all valves are in their closed positions. Manually rotate the device in an end-over-end fashion 2 or 3 times. Reposition the ZHE in the vertical position with the liquid inlet/outlet valve on top. Pressurize the ZHE to 5–10 psi (if necessary) and slowly open the liquid inlet/outlet valve to bleed out any headspace (into a hood) that may have been introduced due to the addition of extraction fluid. This bleeding shall be done quickly and shall be stopped at the first appearance of liquid from the valve. Re-pressurize the ZHE with 5–10 psi and check all ZHE fittings to ensure that they are closed.

8.12.3 Place the ZHE in the rotary agitation apparatus (if it is not already there) and rotate at 30 ± 2 rpm for 18 ± 2 hours. Ambient temperature (i.e., temperature of room in which extraction occurs) shall be maintained at 22 ± 3 °C during agitation.

8.13 Following the 18 ± 2 hour agitation period, check the pressure behind the ZHE piston by quickly opening and closing the gas inlet/outlet valve and noting the escape of gas. If the pressure has not been maintained (i.e., no gas release observed), the device is leaking. Check the ZHE for leaking as specified in Step 4.2.1, and perform the extraction again with a new sample of waste. If the pressure within the device has been maintained, the material in the extractor vessel is once again separated into its component liquid and solid phases. If the waste contained an initial liquid phase, the liquid may be filtered directly into the same filtrate collection container (i.e., TEDLAR® bag) holding the initial liquid phase of the waste. A separate filtrate collection container must be used if combining would create multiple phases, or there is not enough volume left within the filtrate collection container. Filter through the glass fiber filter, using the ZHE device as discussed in Step 8.8. All extract shall be filtered and collected if the TEDLAR® bag is used, if the extract is multiphasic, or if the waste contained an initial liquid phase (see steps 4.6 and 8.1).

Note: An in-line glass fiber filter may be used to filter the material within the ZHE if it is suspected that the glass fiber filter has been ruptured.

8.14 If the original waste contained no initial liquid phase, the filtered liquid material obtained from step 8.13 is defined as the TCLP extract. If the waste contained an initial liquid phase, the filtered liquid material obtained from Step 8.13 and the initial liquid phase (Step 8.9) are collectively defined as the TCLP extract.

8.15 Following collection of the TCLP extract, immediately prepare the extract for analysis and store with minimal headspace at 4 °C until analyzed. Analyze the TCLP extract according to the appropriate analytical methods. If the individual phases are to be analyzed separately (i.e., are not miscible), determine the volume of the individual phases (to 0.5%), conduct the appropriate analyses, and combine the results mathematically by using a simple volume-weighted average:

$$\text{Final analyte concentration} \quad \frac{(V_1)(C_1)+(V_2)(C_2)}{V_1+V_2}$$

where:

V_1 = The volume of the first phase (l).

C_1 = The concentration of the contaminant of concern in the first phase (mg/l).

V_2 = The volume of the second phase (l).

C_2 = The concentration of the contaminant of concern in the second phase (mg/l).

8.16 Compare the contaminant concentrations in the TCLP extract with the thresholds identified in the appropriate regulations. Refer to section 10.0 for quality assurance requirements.

10.0 Quality Assurance Requirements

10.1 Maintain all data, including quality assurance data, and keep it available for reference or inspection.

10.2 A minimum of one blank (extraction fluid #1) for every 10 extractions that have been conducted in an extraction vessel shall be employed as a check to determine if any memory effects from the extraction equipment are occurring.

10.3 A matrix spike shall be performed for each waste unless the result exceeds the regulatory level and the data is being used solely to demonstrate that the waste property exceeds the regulatory level. If more than one sample of the same waste is being tested, a matrix spike needs to be performed for every twenty samples and the average percent recovery applied to the waste characterization.

10.3.1 Matrix spikes are to be added after filtration of the TCLP extract and before preservation. Matrix spikes should not be added prior to TCLP extraction of the sample.

10.3.2 Matrix spike levels should be made to the appropriate regulatory threshold limits. However, if the extract contaminant concentration is less than one half the threshold limit, the spike level may be one half the contaminant concentration but not less than the quantitation limit or a fifth of the threshold limit.

10.3.3 The purpose of the matrix spike is to monitor the adequacy of the analytical methods used on the TCLP extract and to determine whether matrix interferences exist in analyte detection. If the matrix spike recoveries are less than 50%, then the analytical methods are not performing adequately or use of the methods is inadequate. Use of internal calibration quantitation methods, modification of the analytical methods, or use of alternate analytical methods may be needed to accurately measure the contaminant concentration in the TCLP extract.

10.3.4 Use of internal quantitation methods is also required when the contaminant concentration is within 20% of the regulatory level. (See section 10.8 concerning the use of internal calibration methods.)

10.3.5 Matrix spike recoveries are calculated by the following formula:

$$\text{Percent recovery} = \frac{A-B}{C} \times 100\%$$

where A = the concentration of the spiked sample,

B = the concentration of the unspiked sample, and

C = the spike level

10.4 All quality control measures described in the appropriate analytical methods shall be followed.

10.5 The use of internal calibration quantitation methods shall be employed for a contaminant if: (1) Recovery of the contaminant from the TCLP extract is not at least 50% and the concentration does not exceed the regulatory level, and (2) The concentration of the contaminant measured in the extract is within 20% of the appropriate regulatory level.

10.5.1 The method of standard additions shall be employed as the internal calibration quantitation method for each metallic contaminant.

10.5.1.1 The method of standard additions requires preparing calibration standards in the sample matrix rather than reagent water or blank solution. It requires taking four identical aliquots of the solution and adding known amounts of standard to three of the aliquots. The fourth aliquot is the unknown. Preferably, the first addition should be prepared so that the resulting concentration is approximately 50% of the expected concentration of the sample. The second and third additions should be prepared so that concentrations are approximately 100% and 150% of the expected concentration of the sample. All four aliquots are maintained at the same final volume by adding reagent water or a blank solution, and may need dilution adjustment to maintain the signals in the linear range of the instrumental technique. All four aliquots are analyzed.

10.5.1.2 Prepare a plot, or subject data to linear regression, of instrumental signals or external-calibration-derived concentrations as the dependent variable (y-axis) versus concentrations of the additions of standard as the independent variable (x-axis). Solve for the intercept of the abscissa (the independent variable, x-axis) which is the concentration in the unknown.

10.5.1.3 Alternately, subtract the instrumental signal or external-calibration-derived concentration of the unknown (unspiked) sample from the instrumental signals or external-calibration-derived concentrations of the standard additions. Plot or subject data to linear regression of the corrected instrumental signals or external-calibration-derived concentrations as the dependent variable versus the independent variable. Derive concentrations for unknowns using the internal calibration curve as if it were an external calibration curve.

10.6 Samples must undergo TCLP extraction within the following time periods

Sample Maximum Holding Times

(Days)

	From: Field extraction To: TCLP extraction	From: TCLP extraction To: Preparative extraction	From: Preparative extraction To: Determinative analysis	Total elapsed time
Volatiles	14	NA	14	28
Semi-volatiles	7	7	40	54
Mercury	28	NA	28	56
Metals, except mercury	180	NA	180	360

NA = Not applicable.

If sample holding times are exceeded, the values obtained will be considered minimal concentrations. Exceeding the holding time is not acceptable in establishing that a waste does not exceed the regulatory level. Exceeding the holding time will not invalidate characterization if the waste exceeds the regulatory level.

PART 264—STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

7. The authority citation for part 264 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912, 6924, and 6925.

8. Section 264.301 is amended by revising paragraph (e)(1) to read as follows:

§ 264.301 Design and operating requirements.

* * * * *

(e) * * *

(1) The monofill contains only hazardous wastes from foundry furnace emission controls or metal casting molding sand, and such wastes do not contain constituents which would render the wastes hazardous for reasons other than the Toxicity Characteristic in § 261.24 of this chapter, with EPA Hazardous Waste Numbers D004 through D017; and

* * * * *

PART 265—INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT STORAGE, AND DISPOSAL FACILITIES

9. The authority citation of part 265 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6924, 6925, and 6935.

10. Section 265.221 is amended by revising paragraph (d)(1) to read as follows:

§ 265.221 Design requirements.

* * * * *

(d) * * *

(1) The monofill contains only hazardous wastes from foundry furnace emission controls or metal casting molding sand, and such wastes do not contain constituents which would render the wastes hazardous for reasons other than the Toxicity Characteristic in § 261.24 of this chapter, with EPA Hazardous Waste Numbers D004 through D017; and

* * * * *

11. Section 265.273 is amended by revising paragraph (a) to read as follows:

§ 265.273 Waste analysis.

* * * * *

(a) Determine the concentrations in the waste of any substances which equal or exceed the maximum concentrations contained in Table 1 of § 261.24 of this chapter that cause a waste to exhibit the Toxicity Characteristic;

* * * * *

PART 268—LAND DISPOSAL RESTRICTIONS

12. The authority citation for part 268 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6921, 6924.

12. Appendix I of part 268 is revised read as follows:

Appendix I—Toxicity Characteristic Leaching Procedure (TCLP)

Note: The TCLP is published in Appendix of part 261.

PART 271—REQUIREMENTS FOR AUTHORIZATION OF STATE HAZARDOUS WASTE PROGRAMS

14. The authority citation for part 271 continues to read as follows:

Authority: 42 U.S.C. 6926, 6912(a), and 6926

15. Section 271.1, paragraph (j), the heading of Table 1 is republished, and Table 1 is amended by adding the following entry in chronological order by date of promulgation to read as follows:

§ 271.1 Purpose and scope.

* * * * *

(j) * * *

TABLE 1.—REGULATIONS IMPLEMENTING THE HAZARDOUS AND SOLID WASTE AMENDMENTS OF 1984

Promulgation date	Title of regulation	Federal Register reference	Effective date
March 29, 1990	Toxicity characteristic	(Insert FR reference on date of publication).	September 29, 1990

PART 302—Ddesignation, REPORTABLE QUANTITIES, AND NOTIFICATION

16. The authority citation for part 302 continues to read as follows:

Authority: 42 U.S.C. 9602; 33 U.S.C. 1321 and 1361.

17. Section 302.4 is amended by revising under the column Hazardous Substance the entry "Unlisted Hazardous Wastes Characteristic of EP Toxicity" to read "Unlisted Hazardous Wastes Characteristics:" and by revising the entry "Characteristic of EP Toxicity" and its sub entries to read as follows:

§ 302.4 Designation of hazardous substances.

* * * * *

TABLE 302.4.—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES

Hazardous substance	CASRN	Regulatory synonyms	Statutory RQ	Statutory Code[a]	Statutory RCRA waste number	Final RQ Category	Final RQ Pounds (Kg)
Characteristic of Toxicity:							
Arsenic (D004)	N.A.		*1	4	D004	X	1 (0.454)
Barium (D005)	N.A.		*1	4	D005	C	1,000 (454)
Benzene (D018)	N.A.		1000	1, 2, 3, 4	D018	A	10 (4.54)
Cadmium (D006)	N.A.		*1	4	D006	A	10 (4.54)
Carbon tetrachloride (D019)	N.A.		5,000	1, 2, 4	D019	A	10 (4.54)
Chlordane (D020)	N.A.		1	1, 2, 4	D020	X	1 (0.454)
Chlorobenzene (D021)	N.A.		100	1, 2, 4	D021	B	100 (45.4)
Chloroform (D022)	N.A.		5,000	1, 2, 4	D022	A	10 (4.54)
Chromium (D007)	N.A.		*1	4	D007	A	10 (4.54)
o-Cresol (D023)	N.A.		1,000	1, 4	D023	C	1,000 (454)
m-Cresol (D024)	N.A.		1,000	1, 4	D024	C	1,000 (454)

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TABLE 302.4.—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

Hazardous substance	CASRN	Regulatory synonyms	Statutory			Final RQ	
			RQ	Codes	RCRA waste number	Category	Pounds (Kg)
p-Cresol (D026)	N.A.		1,000	1, 4	D026	C	1,000 (454)
Cresol (D026)	N.A.		1,000	1, 4	D026	C	1,000 (454)
2,4-D (D016)	N.A.		100	1, 4	D016	B	100 (45.4)
1,4-Dichlorobenzene (D027)	N.A.		100	1, 2, 4	D027	B	100 (45.4)
1,2-Dichloroethane (D028)	N.A.		5,000	1, 2, 4	D028	B	100 (45.4)
1,1-Dichloroethylene (D029)	N.A.		5,000	1, 2, 4	D029	B	100 (45.4)
2,4-Dinitrotoluene (D030)	N.A.		1,000	1, 2, 4	D030	A	10 (4.54)
Endrin (D012)	N.A.		1	1, 4	D012	X	1 (0.454)
Heptachlor (and hydroxide) (D031)	N.A.		1	1, 2, 4	D031	X	1 (0.454)
Hexachlorobenzene (D032)	N.A.		1	2, 4	D032	A	10 (4.54)
Hexachlorobutadiene (D033)	N.A.		1	2, 4	D033	X	1 (0.454)
Hexachloroethane (D034)	N.A.		1	2, 4	D034	B	100 (45.4)
Lead (D008)	N.A.		1	4	D008		(1)
Lindane (D013)	N.A.		1	1, 4	D013	X	1 (0.454)
Mercury (D009)	N.A.		1	4	D009	X	1 (0.4[illegible])
Methoxychlor (D014)	N.A.		1	1, 4	D014	X	1 (0.[illegible])
Methyl ethyl ketone (D035)	N.A.		1	4	D035	D	5,000 ([illegible])
Nitrobenzene (D036)	N.A.		1,000	1, 2, 4	D036	C	1,000 ([illegible])
Pentachlorophenol (D037)	N.A.		10	1, 2, 4	D037	A	10 ([illegible])
Pyridine (D038)	N.A.		1	4	D038	C	1,000 ([illegible])
Selenium (D010)	N.A.		1	4	D010	A	10 ([illegible])
Silver (D011)	N.A.		1	4	D011	X	1 ([illegible])
Tetrachloroethylene (D039)	N.A.		1	2, 4	D039	B	100 ([illegible])
Toxaphene (D015)	N.A.		1	1, 4	D015	X	1 ([illegible])
Trichloroethylene (D040)	N.A.		1000	1, 2, 4	D040	B	100 ([illegible])
2,4,5-Trichlorophenol (D041)	N.A.		10	1, 4	D041	A	10 (4.54)
2,4,6-Trichlorophenol (D042)	N.A.		10	1, 2, 4	D042	A	10 (4.54)
2,4,5-TP (D017)	N.A.		100	1, 4	D017	B	100 (45.4)
Vinyl chloride (D043)	N.A.		1	2, 3, 4	D043	X	1 (0.454)

1—Indicates the statutory source as defined by 1, 2, 3, or 4 below.
*1—Indicates that the 1-pound RQ is a CERCLA statutory RQ.
#—Indicates that the RQ is subject to change when the assessment of potential carcinogenicity is completed.

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ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 261, 264, 265, 268, 271, and 302

[SWH-FRL-3801-1; EPA/OSW-FR-89-026]

RIN 2050-AA76

Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: On June 13, 1986, the Environmental Protection Agency (EPA) proposed to revise the existing toxicity characteristics, which are used to identify those wastes defined as hazardous and which are subject to regulation under subtitle C of the Resource Conservation and Recovery Act (RCRA) due to their potential to leach significant concentrations of specific toxic constituents. The proposed rule was designed to refine and broaden the scope of the hazardous waste regulatory program and to fulfill specific statutory mandates under the Hazardous and Solid Waste Amendments of 1984 (HSWA).

EPA is today promulgating the Toxicity Characteristics (TC). Today's rule retains many of the features of the original proposal: It replaces the Extraction Procedure (EP) leach test with the Toxicity Characteristic Leaching Procedure (TCLP); it adds 25 organic chemicals to the list of toxic constituents of concern; and it establishes regulatory levels for these organic chemicals based on health-based concentration thresholds and a dilution/attenuation factor that was developed using a subsurface fate and transport model. In response to comments received on the proposed rule and related notices, the final rule incorporates a number of modifications in the leaching procedure, the list of toxicants, the chronic toxicity reference levels, and the fate and transport model.

The overall effect of today's action will be to subject additional wastes to regulatory control under subtitle C of RCRA, thereby providing for further protection of human health and the environment.

DATES: Effective Date: September 25, 1990.

Compliance Dates: Large quantity generators, September 25, 1990. Small quantity generators (SQGs): March 29, 1991. Any person that would like to use the Toxicity Characteristic Leaching Procedure (TCLP) before the effective date may do so in order to determine whether the eight heavy metals and six pesticides that are currently regulated under the Extraction Procedure (EP) Toxicity Characteristic leach at levels of regulatory concern.

ADDRESSES: The official record for this rulemaking (Docket Number F-90-TCF-FFFFF) is located in the EPA RCRA Docket (Second Floor, Rm 2427), U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460. The docket is open from 9:00 a.m. to 4:00 p.m., Monday through Friday, excluding federal holidays. The public must make an appointment to review docket materials by calling (202) 475-9327. The public may copy material at a cost of $0.15 per page.

FOR FURTHER INFORMATION CONTACT: For general information about this rulemaking, contact the RCRA/Superfund Hotline at (800) 424-9346 (toll free) or (202) 382-3000 in the Washington, DC metropolitan area. For information on specific aspects of this rule, contact Steve Cochran, Office of Solid Waste (OS-332), U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460, (202) 475-8551.

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I. Authority

The amendments to the hazardous waste regulations in 40 CFR parts 261 and 271 are being promulgated under the authority of sections 1008, 2002(a), 3001, 3002, and 3006 of the Solid Waste Disposal Act of 1970, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912(a), 6921, 6922, and 6926). The amendments to the list of hazardous substances and reportable quantities in 40 CFR part 302 are being promulgated under the authority of section 102 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9602), as amended, and sections 311 and 501(a) of the Federal Water Pollution Control Act (33 U.S.C. 1321 and 1361).

II. Background

A. Definition of Hazardous Waste

Subtitle C of the Resource Conservation and Recovery Act (RCRA), as amended, establishes a federal program for the comprehensive regulation of hazardous waste. Section 1004(5) of RCRA defines hazardous waste, among other things, as solid waste that may ". . . pose a substan present or potential hazard to human health and the environment when improperly treated, stored, transport disposed, or otherwise managed." U RCRA Section 3001, EPA is charged defining which solid wastes are hazardous by either identifying the characteristics of hazardous waste o listing particular hazardous waste. Identifying characteristics of hazard waste and listing hazardous wastes distinct and fundamentally differen mechanisms for defining hazardous wastes.

The hazardous waste characteristi promulgated by EPA designate broa classes of wastes which are clearly hazardous by virtue of an inherent property. In the May 19, 1980 final ru (45 FR 33084) that instituted EPA's general framework for identifying hazardous waste, the Agency established two basic criteria for identifying hazardous waste characteristics: (1) The characteristic should be capable of being defined i terms of physical, chemical, or other properties which cause the waste to meet the statutory definition of hazardous waste; and (2) the propert defining the characteristic must be measurable by standardized and available testing protocols or reasonably detected by generators through their knowledge of the waste CFR 261.10). In the May 19, 1980 final rule, EPA stated that it adopted the second criterion in recognition that th primary responsibility for determinin whether wastes exhibit hazardous characteristics rests with generators, whom standardization and availabilit of testing protocols are essential.

The approach EPA uses to establish hazardous waste characteristics is to determine which properties of a waste would result in harm to human health the environment if a waste is mismanaged. The Agency then establishes test methods and regulato levels for each characteristic property solid waste that exceeds the regulato level for any characteristic property i hazardous waste.

The regulatory levels for characteristics that have been established provide a high degree of certainty that wastes exceeding those regulatory levels would pose hazards human health and the environment if improperly managed and therefore require regulation under subtitle C. Wastes that do not exhibit hazardous waste characteristics are not necessa nonhazardous. The Agency may

evaluate wastes from either specific or nonspecific sources and decide to list them as hazardous wastes based on criteria defined in 40 CFR 261.11.

To list a waste as hazardous, EPA conducts a detailed industry or process study involving literature reviews, engineering analyses, surveys and questionnaires, site visits, and waste sampling. For listing, the Agency places particular emphasis on hazardous constituents contained in specific wastes generated by the industry or process being studied (See 40 CFR 261.11(a)(3)). However, EPA uses a comparatively flexible approach when deciding to list wastes as hazardous; the approach includes consideration of factors such as type of threat posed, plausible ways that the waste might be mismanaged, migration potential and persistence in the environment, waste quantity, and actions of other regulatory programs. The Agency also promulgated two other rules for identifying solid wastes as hazardous wastes—the mixture and derived-from rules. The mixture rule says that any mixture of a listed hazardous waste and a solid waste is the listed hazardous waste (40 CFR 261.3(a)(2)(iii)–(iv)); the derived-from rule says that any solid waste derived from the treatment, storage, or disposal of a listed hazardous waste is considered the listed hazardous waste (40 CFR 261.3(c)–(d)).

B. Existing Extraction Procedure Toxicity Characteristic

The Extraction Procedure (EP) toxicity characteristic is one of four existing hazardous waste characteristics (along with ignitability, corrosivity, and reactivity) that EPA has identified and promulgated (40 CFR 261.24). The Extraction Procedure Toxicity Characteristic (EPTC) defines the toxicity of a waste by measuring the potential for the toxic constituents in the waste not subject to subtitle C controls to leach out and contaminate ground water at levels of health or environmental concern. To determine if a waste exhibits the EPTC, constituents are extracted in a procedure that simulates the leaching action that occurs in municipal landfills. Because a "hazardous waste" is defined as a waste that may pose a substantial hazard "when mismanaged," the EP was designed based on the assumption that wastes not subject to subtitle C controls would be co-disposed with municipal waste in an actively decomposing landfill that overlies an aquifer. Thus, the EP identifies wastes that are likely to leach hazardous concentrations of particular toxic constituents to ground water under conditions of improper management.

The Agency recognized that not all wastes are managed according to the mismanagement scenario postulated for the EP. However, it is necessary to make assumptions about management practices for unregulated wastes in order to determine whether a waste poses a threat to human health and the environment and thus meets the statutory definition of hazardous waste. In addition, the Agency believed that a reasonably conservative mismanagement scenario was warranted in light of the statutory mandate to protect human health and the environment.

Under the existing EPTC, the liquid waste extract obtained from the EP is analyzed to determine whether it possesses any of 14 toxic contaminants that were identified in the National Interim Primary Drinking Water Standards (NIPDWS): eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), four insecticides (endrin, lindane, methoxychlor, and toxaphene), and two herbicides (2,4–D and 2,4,5–TP). NIPDWS levels are used as health-based concentration limits. At the time of promulgation of the EPTC, the NIPDWS were the only available benchmarks for toxicity that were scientifically recognized and that also addressed chronic exposure.

The regulatory levels established for the EPTC were 100 times the NIPDWS. The 100-fold factor is a dilution and attenuation factor (DAF) that estimates the dilution and attenuation of the toxic constituents in a waste as they travel through the subsurface from the point of leachate generation (i.e., the landfill) to the point of human or environmental exposure (i.e., at a drinking-water well). The Agency had originally proposed a DAF of 10 for use in the EP. In light of the fact that there were few empirical data on which to base the DAF and other considerations, the Agency adopted a DAF of 100 in the final rule (45 FR 33084, May 19, 1980). EPA was confident that any waste which exhibited the EPTC using the 100-fold factor would have the potential to present a substantial hazard regardless of the actual site-specific attenuation mechanisms. The Agency also noted that it would adjust the DAF if future studies indicated that another DAF was more appropriate.

C. The Hazardous and Solid Waste Amendments of 1984

On November 8, 1984, the Hazardous and Solid Waste Amendments of 1984 (HSWA) were enacted; these amendments have had far-reaching ramifications for EPA's hazardous waste regulatory program. RCRA sections 3001 (g) and (h), which were among the many provisions added by HSWA, direct EPA to examine and revise the EP Toxicity Characteristic and to identify additional hazardous waste characteristics, including measures of toxicity. Today's rule fulfills these mandates by promulgating an improved leaching procedure that better predicts leaching and an expansion of the Toxicity Characteristics (TC) list to include additional toxicants.

RCRA section 3001(g) specifically directs EPA to examine the EP leach procedure as a predictor of the leaching potential of waste and to make changes necessary to ensure that it accurately predicts the leaching potential of wastes that may pose a threat to human health and the environment when mismanaged. The legislative history for this provision indicates that Congress was specifically concerned about the EP's ability to accurately represent the mobility of toxicants under a wide variety of conditions. The legislative history also suggests that Congress intended for EPA to develop a more aggressive leaching medium for the test and noted that the EP only evaluated the mobility of elemental toxicants and not the mobility of organic toxicants.

Concerned that some wastes posing a threat to human health and the environment were not being brought into the hazardous waste system, Congress adopted RCRA section 3001(h), which directs EPA to promulgate additional characteristics. Of specific concern to Congress was the fact that the existing characteristics did not identify wastes that were hazardous due to toxic levels of organic constituents. Although Congress recognized that the development of such a characteristic would entail technical problems, Congress urged the Agency to make reasonable assumptions for purposes of regulation, rather than await definitive technical answers. In response to the 3001(g) and 3001(h) mandates, EPA issued a proposed rule to revise and expand the TC (51 FR 21648, June 13, 1986) which is discussed below in Section II.D.

D. Previous Federal Register Notices

As indicated above, EPA published a Federal Register notice (June 13, 1986) proposing to expand the existing TC. The proposal specifically identified 52 compounds that could cause a waste to be hazardous via toxicity, including the existing 14 EPTC compounds and 38 additional organic compounds. In

Second, reducing the potential of including wastes that do not, in fact, present a threat conserves hazardous waste management capacity and Agency administrative and enforcement resources for waste management activities that warrant priority attention. Finally, if necessary, a characteristic can be adapted quickly to possible future changes in science or technology, such as lower quantitation limits.

EPA acknowledges that there are also some advantages in using the listing mechanism for identifying hazardous wastes, particularly with respect to ease of implementation; the Agency thus will retain the listing approach as an alternative mechanism for identifying hazardous wastes. The Agency continues to believe that both the characteristic and listing approaches are valid and useful tools in identifying hazardous wastes that are subject to subtitle C regulation.

Finally, the Agency disagrees with commenters who contend that characteristics impose an unfair burden on the regulated community. Since the establishment of the hazardous waste identification framework in 1980, EPA has recognized that the primary responsibility for determining whether wastes exhibit hazardous waste characteristics rests with generators. In accordance with this, one of two criteria for establishing new characteristics is that they must be measurable by standardized and available testing protocols or reasonably detected by generators through their knowledge of the waste (see 40 CFR 261.10). Further, the regulations do not require testing; a generator may apply knowledge of the waste to determine if it is hazardous (40 CFR 262.11).

2. Mismanagement Scenario

Hazardous waste characteristics are designed to identify solid wastes that pose a threat to human health and the environment when *improperly* managed (RCRA section 1004(5)). Therefore, in developing the TC, EPA's first task was to determine how wastes might plausibly be mismanaged. The mismanagement scenario that both was reasonably realistic and presented the greatest environmental risks could then be chosen as the reasonable worst-case scenario and used as the basis for the revised characteristic. Specifically, the characteristic would be designed to identify any wastes from which toxic constituents would be likely to pose a threat to human health and the environment when managed in accordance with the selected scenario. In this way, EPA ensured that wastes would be adequately controlled, regardless of the manner in which they are actually managed.

In the June 13, 1986 proposal, EPA considered several alternative mismanagement scenarios for use in the development of the TC rule, including segregated management, co-disposal with municipal solid waste (the mismanagement scenario evaluated in the existing Toxicity Characteristic), co-disposal with industrial waste in a landfill subject to subtitle D requirements, and co-disposal with industrial waste in a landfill subject to subtitle C requirements that suffers some form of containment-system failure. The Agency rejected the subtitle C scenario as unrealistic because it is unlikely that waste generators would dispose of their wastes in the more expensive subtitle C landfills unless required to do so. Thus, it would not be a realistic scenario.

EPA determined that each of the remaining options was a plausible mismanagement scenario since most wastes are or may be managed in these types of land disposal facilities. The Agency rejected the segregated management or "monofill" scenario on the grounds that it did not represent a realistic worst-case practice. Facilities dedicated to the management of only one waste or the wastes of only one generator (i.e., a "monofill") are likely to pose less of a hazard than general municipal or industrial landfills because the design and operation problems for a monofill are simpler and the operators generally have considerably more information on the properties of the wastes that are managed. Also, industrial monofills generally do not generate organic acids that result in an aggressive leaching medium, as is the case for municipal landfills. Thus, industrial monofills pose less of a potential hazard than municipal solid waste (MSW) landfills. EPA also rejected the general (as opposed to "monofill") industrial landfill scenario on similar grounds (i.e., the generated leaching medium may not, in some cases, be as aggressive as in a municipal landfill). The Agency therefore retained the municipal landfill scenario as the reasonable worst-case mismanagement scenario for the revised TC.

a. Extent to Which Scenario is Reasonable. Several commenters challenged the municipal landfill scenario, claiming that it is based on an unreasonable assumption about the way in which industrial solid wastes are managed. These commenters claimed that industrial wastes are rarely disposed in MSW landfills. If landfilled at all, these wastes are more likely to be disposed in industrial landfills. In addition, industrial wastes are frequently managed in ways other than landfill disposal (e.g., incineration, recycling, treatment on the land, or treatment in surface impoundments). Thus, commenters argued, it is inappropriate to base the TC on the municipal landfill scenario.

EPA fully recognizes that not all industrial wastes are managed in MSW landfills. Nevertheless, the Agency continues to believe that the MSW landfill scenario is reasonable because such landfills have traditionally accepted unregulated industrial wastes. It is for this reason that the MSW landfill scenario was originally established as the basis for the EPTC (see 45 FR 33112, May 19, 1980). Although fewer types of industrial wastes are being disposed in municipal landfills now as compared to a few years ago, EPA's information confirms the continued appropriateness of this scenario. The "State Subtitle D Regulations on Solid Waste Landfills" (Ref. 5), and the "National Survey of Solid Waste (Municipal) Landfill Facilities" (Ref. 6) indicate that most states impose few restrictions, if any, on the types of nonhazardous wastes accepted at these facilities; moreover, a substantial quantity of the wastes received (typically five to eight percent) are industrial wastes. Thus, EPA continues to believe that the municipal solid waste landfill scenario represents the most appropriate reasonable worst-case mismanagement scenario.

Many commenters suggested that EPA grant exceptions or variances for wastes that are not co-disposed with MSW. In this way, the TC would apply only to those wastes that are actually managed in accordance with the underlying mismanagement scenario. The commenters noted that EPA could separately develop alternative characteristics for wastes managed in other ways to ensure adequate protection of human health and the environment.

After careful consideration, EPA has decided not to adopt this suggestion for various reasons. Applying the TC only to wastes actually managed as suggested in the mismanagement scenario would involve the creation of a management-based approach to identifying hazardous wastes. EPA's current approach to establishing characteristics which identify certain wastes as hazardous is not contingent upon the way individual wastes are actually managed. Rather, consistent with the RCRA Section 1004(5) definition of hazardous waste, EPA is

identifying waste " " " that *may pose* a substantial present or potential hazard to human health and the environment *when improperly* " " " *managed*" (emphasis added).

EPA has considered the possibility of developing management-based characteristics, i.e., different characteristics for categories of waste depending on how they are typically managed. However, the Agency believes that such an approach would present a number of difficulties. For instance, a management-based approach to hazardous waste identification could substantially complicate effective implementation of the RCRA regulations. In particular, it is not always possible to determine—at the point of generation, during transport, or even as a waste enters a treatment, storage, or disposal facility—how a solid waste will ultimately be managed. EPA believes that the most effective and appropriate approach is to identify hazardous waste characteristics, not according to the ways in which individual wastes are managed, but by identifying properties of wastes that would pose a threat to human health and the environment if improperly managed. The Agency maintains that co-disposal with MSW is a mismanagement scenario that is reasonably realistic for most industrial solid wastes.

Another group of commenters suggested that EPA exempt broad classes of wastes that, because of their volume or physical properties, cannot reasonably be placed in a municipal landfill. Commenters specifically mentioned wastewaters, mining wastes, and municipal waste combustion ash. They noted that separate characteristics could be developed for each class of wastes that is excluded from the TC, based on the most appropriate mismanagement scenario for each individual category of waste.

After careful consideration of these comments, the Agency agreed that one category of wastes, wastewaters, might warrant special consideration based on the fact that the mismanagement scenario may not be reasonably applicable. Thus, EPA published a Supplemental Notice of Proposed Rulemaking on May 18, 1987 (52 FR 18583), which asked for comment on the development of separate regulatory levels for wastewaters. EPA received considerable information in response to this notice, and reviewed additional information on management of wastewaters in surface impoundments. After analysis of the waste management techniques, attenuative mechanisms, and hydrogeologic processes that govern constituent transport from surface impoundments, the Agency concluded that the DAFs for nondegrading constituents managed in surface impoundments were similar to those for the same constituents managed in landfills. Thus, for today's rule, the Agency determined that there is no technical basis for setting separate regulatory levels for wastewaters. This issue is discussed in more detail in subsection C, and further in sections III.E (Application of a Subsurface Fate and Transport Model) and III.H (Applicability to Wastes Managed in Surface Impoundments).

The Agency also does not agree that the mismanagement scenario is unreasonable for either non-exempt mineral processing wastes or municipal combustion ash. Although large volume wastes from the extraction, beneficiation and processing of ores and minerals are currently exempt from subtitle C regulation and will not be affected by the TC rule, small volume mineral processing wastes which may be subject to subtitle C regulation (see 54 FR 36592) can plausibly be disposed in municipal landfills. Municipal waste combustion ash can also be disposed in municipal landfills; in fact, the Agency estimates that only about 30 percent of municipal waste combustion facilities utilize ash monofills, and rely principally on municipal landfills for ash disposal. Issues related to the regulation of municipal waste combustion ash are discussed further in section III.I.5.

b. *Worst-Case Scenario Selection.* A few commenters agreed with EPA that the municipal landfill scenario is reasonable, but they claimed that the scenario does not represent a reasonable *worst* case. Most of these commenters asserted that co-disposal in a subtitle D industrial landfill poses more of a threat to human health and the environment than disposal in an MSW landfill. They pointed out, for example, that the regulatory standards for subtitle D industrial waste landfills are generally no more stringent than those for municipal landfills. The commenters further claimed that the leaching media in industrial landfills are frequently more aggressive than those in municipal landfills, especially when acids, bases, and solvents are present. Finally, the commenters noted that wastes placed in industrial landfills are not diluted with domestic wastes, as they are in a municipal landfill. The commenters concluded that because the TC proposal was based on a scenario that was less than worst-case, it would not adequately protect human health and the environment.

The Agency believes that the leaching media in a subtitle D municipal landfill is typically more aggressive than leaching media generated in industrial landfills due to the formation of acids during decomposition of putrescible wastes. "State Subtitle D Regulations on Solid Waste Landfills" (Ref. 5) shows that putrescible wastes are accepted at most subtitle D municipal landfills, while "Summary of Data on Industrial Non-Hazardous Waste Disposal Practices" (Ref. 7) shows solvents, acids, and bases (which can also increase the aggressiveness of leachate) are generally not disposed of in subtitle D industrial landfills. The potential for the formation of acids from decomposition of putrescibles in a subtitle D municipal landfill is greater than the potential of acids, bases, or solvents being present in a subtitle D industrial landfill, therefore supporting the municipal landfill scenario as a reasonable worst-case.

EPA acknowledges that, in certain circumstances, industrial wastes may pose more of a threat when placed in a subtitle D industrial landfill than when placed in a subtitle D municipal landfill. However, EPA believes that this situation will only occur in certain circumstances and thus represents a *worst case* rather than a *reasonable worst case*. Should the occurrence of this situation increase in frequency, the Agency will reconsider its approach for regulating these wastes in the future.

c. *Extent to Which the Mismanagement Scenario for Wastes Managed in Surface Impoundments is Appropriate.* In the May 18, 1987 notice, the Agency stated that it is considering developing a separate mismanagement scenario applicable to wastes that are managed in unlined surface impoundments. Developing a surface impoundment scenario, in addition to the landfill scenario, would mean that the TC would have two different sets of regulatory levels. Waste generators would first have to determine which scenario is appropriate and then would be responsible for evaluating whether their waste exceeded the applicable regulatory levels.

In the notice, the Agency requested comments on the appropriate criteria to be used in determining whether the characteristic should apply to a particular waste. The Notice suggested three possible approaches:

1. The "management-based" approach, which would apply only to those wastes actually managed in impoundments.

designated TC toxicants are already listed as CERCLA hazardous substances. The RQs being promulgated are the same as those that already apply to all materials containing these hazardous substances.

Today's rule defers applicability of the TC to one type of waste and exempts another. First, the Agency is deferring the applicability of the TC to petroleum-contaminated media and debris at sites subject to the RCRA Underground Storage Tank (UST) cleanup regulations under part 280. (See section III.I.6.) Second, EPA has decided to exempt from today's rule certain polychlorinated biphenyl (PCB) wastes that are fully regulated under the Toxic Substances and Control Act (TSCA) and would be identified as hazardous because of today's rule (See section III.I.7.).

In portions of the existing codified waste regulation of title 40, chapter I, parts 261 through 265, the EPTC is named. Today's action of promulgating the TC necessitates amendment of these references to the EPTC. This amendment which replaces references to the EPTC with the words "Toxicity Characteristic" applies to the following sections of 40 CFR: 261.4(b)(6)(i) not (A)(B)(C); 261.4(b)(9), 264.301(e)(1), 265.221(d)(1) and 265.273(a).

In §§ 264.301(e)(1) and 265.221(d)(1), in addition to amending reference to the EPTC, the universe of constituents remains the same as the EPTC. To accomplish this, the constituents D004–D017, the EPTC constituents, are specifically named as those constituents which would not render the waste hazardous by the TC.

As discussed below, the Agency will continue to refine the TC in order to provide greater accuracy and comprehensiveness in identifying hazardous waste based on the waste's toxic constituents. However, the Agency believes that today's rule fulfills the statutory mandates under sections 3001(g) and 3001(h).

III. Response to Major Comments and Analysis of Issues

The Agency received many comments on the June 13, 1986 proposed rule and in response to subsequent notices. The Agency has carefully considered all comments in the preparation of this final rule. To facilitate the evaluation and response to comments, the Agency grouped the comments into ten categories. The categories are as follows:

A. General Approach
B. Constituents of Concern
C. Chronic Toxicity Reference Levels
D. Use of Generic DAFs
E. Application of a Subsurface Fate and Transport Model
F. The TCLP
G. Testing and Recordkeeping Requirements
H. Applicability to Wastes Managed in Surface Impoundments
I. Relationship to Other RCRA Regulations
J. Relationship to Other Regulatory Authorities

In this preamble, the Agency provides summaries of and responses to major comments. Readers are invited to refer to background documents (Refs. 1, 2, 3, and 4) for complete summaries and responses to all comments.

A. General Approach

1. Expanded Use of Hazardous Waste Characteristics.

The TC revisions specified in today's rule refine and expand the EPTC. Most commenters stated that increased reliance on hazardous waste characteristics is a reasonable approach to defining hazardous waste. Some commenters stated a preference for the hazardous waste characteristic mechanism over the alternative listing mechanism for identifying hazardous wastes. They noted that the characteristics are designed to measure directly the risks that subtitle C regulations are meant to control. Another advantage mentioned by commenters is that hazardous waste characteristics apply uniformly to all wastes, regardless of source.

A few commenters, however, objected to the expanded use of hazardous waste characteristics. Some of these commenters questioned the Agency's authority to develop the TC. One commenter asserted that RCRA section 3001(h) does not authorize EPA to take the action of adding the proposed organic constituents to the list of TC constituents. Another argued that the legislative history of HSWA indicates that changes in the leaching procedure should address the leaching of toxic metals only. This commenter claimed that the Agency had exceeded its statutory mandate by modifying the TC to include organics.

EPA strongly disagrees with those commenters who argued that the Agency lacks authority to expand the TC. The Agency's approach to identifying hazardous wastes through a self-implementing characteristics procedure was well established in 1984, when Congress passed HSWA. HSWA not only confirmed the validity of EPA's approach to identifying hazardous wastes by characteristics, but also directed the Agency to expand the scope of the TC. RCRA section 3001(h) states "... the Administrator shall promulgate regulations under this section identifying additional characteristics of hazardous waste including measures or indicators of toxicity." Thus, the plain language of the statute authorizes EPA to broaden the TC.

Other commenters acknowledged EPA's authority to expand the TC, but offered policy arguments against the use of this mechanism for identifying hazardous wastes. Most commenters who argued against expanded use of characteristics favored use of the listing mechanism instead of an expanded TC. Some of these commenters noted that listings do not present the same technical problems of precision and accuracy as the characteristics. Others stated that listings are more easily enforced since they are not dependent upon use of a leaching procedure. Finally, some commenters claimed that by expanding the toxicity characteristic instead of listing additional wastes, EPA is unfairly shifting the burden for identifying hazardous wastes onto the shoulders of the regulated community.

The Agency maintains that the expanded use of characteristics, in addition to being consistent with the statutory mandate, offers advantages over listing for identifying broad categories of clearly hazardous waste. Establishing a characteristic allows the Agency to identify through one rule those wastes which are reasonably certain to pose a threat to human health and the environment by virtue of an inherent characteristic without expending vast Federal resources to study, characterize, and list numerous individual wastestreams. Since the Agency sets regulatory levels high enough to assure that wastes exhibiting the characteristic are hazardous, the characteristic approach does not bring wastes into the subtitle C system which do not present a substantial present or potential hazard to human health and the environment. By contrast, a listing, since it applies to all wastes that meet a listing description, may capture some individual wastestreams that do not actually pose a threat to human health and the environment. Generators may petition for delisting if this occurs; however, the delisting process can be burdensome to the petitioner and to EPA.

The Agency believes that the characteristic approach has the following advantages. First, it is less burdensome for the regulated community because the characteristic approach limits over-inclusiveness.

calculated regulatory level (i.e., the chronic toxicity reference level multiplied by the DAF) is below the analytical quantitation limit, the quantitation limit is the final regulatory level. Note that the list of constituents in Table II.2 contains the 14 constituents currently regulated under the existing EPTC. As specified in today's rule these constituents will continue to be regulated at their current levels.

TABLE II.2.—TOXICITY CHARACTERISTIC CONSTITUENTS AND REGULATORY LEVELS

EPA HW No.[1]	Constituent (mg/L)	CAS No.[2]	Chronic toxicity reference level (mg/L)	Regulatory level (mg/L)
D004	Arsenic	7440-38-2	0.05	5.0
D005	Barium	7440-39-3	1.0	100.0
D018	Benzene	71-43-2	0.005	0.5
D006	Cadmium	7440-43-9	0.01	1.0
D019	Carbon tetrachloride	56-23-5	0.005	0.5
D020	Chlordane	57-74-9	0.0003	0.03
D021	Chlorobenzene	108-90-7	1	100.0
D022	Chloroform	67-66-3	0.06	6.0
D007	Chromium	7440-47-3	0.05	5.0
D023	o-Cresol	95-48-7	2	[4] 200.0
D024	m-Cresol	108-39-4	2	[4] 200.0
D025	p-Cresol	106-44-5	2	[4] 200.0
D026	Cresol		2	[4] 200.0
D016	2,4-D	94-75-7	0.1	10.0
D027	1,4-Dichlorobenzene	106-46-7	0.075	7.5
D028	1,2-Dichloroethane	107-06-2	0.005	0.5
D029	1,1-Dichloroethylene	75-35-4	0.007	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.0005	[4] 0.13
D012	Endrin	72-20-8	0.0002	0.02
D031	Heptachlor (and its hydroxide)	76-44-8	0.00008	0.008
D032	Hexachlorobenzene	118-74-1	0.0002	[4] 0.13
D033	Hexachloro-1,3-butadiene	87-68-3	0.005	0.5
D034	Hexachloroethane	67-72-1	0.03	3.0
D008	Lead	7439-92-1	0.05	5.0
D013	Lindane	58-89-9	0.004	0.4
D009	Mercury	7439-97-6	0.002	0.2
D014	Methoxychlor	72-43-5	0.1	10.0
D035	Methyl ethyl ketone	78-93-3	2	200.0
D036	Nitrobenzene	98-95-3	0.02	2.0
D037	Pentachlorophenol	87-86-5	1	100.0
D038	Pyridine	110-86-1	0.04	[4] 5.0
D010	Selenium	7782-49-2	0.01	1.0
D011	Silver	7440-22-4	0.05	5.0
D039	Tetrachloroethylene	127-18-4	0.007	0.7
D015	Toxaphene	8001-35-2	0.005	0.5
D040	Trichloroethylene	79-01-6	0.005	0.5
D041	2,4,5-Trichlorophenol	95-95-4	4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	0.02	2.0
D017	2,4,5-TP (Silvex)	93-72-1	0.01	1.0
D043	Vinyl chloride	75-01-4	0.002	0.2

[1] Hazardous waste number.
[2] Chemical abstracts service number.
[3] Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.
[4] If o-, m-, and p-cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level for total cresol is 200 mg/L.

The regulatory levels reflect modifications to some chronic toxicity reference levels since the original proposal. EPA has revised some of the Maximum Contaminant Levels, Risk-Specific Doses, and Reference Doses to reflect new data and better methods. In response to comments received, EPA has decided not to apportion reference doses of noncarcinogens to account for multiple routes of exposure, as was originally proposed (51 FR 21648). See section IIIC for further discussion of comments on apportionment and the Agency's reasons for not including apportionment of reference doses in the final rule. Today's rule also promulgates the TCLP to replace the EP. The TCLP represents an improvement over the EP in that it more accurately addresses leaching potential for use in evaluating wastes containing organic constituents, and also corrects several minor technical deficiencies in the original EP. The version of the TCLP promulgated today reflects additional improvements and modifications made to the TCLP since the original proposal. The TCLP promulgated today will also replace the earlier version of the TCLP promulgated as part of the land disposal restrictions program.

Today's rule incorporates a schedule for compliance that classifies the universe of potentially affected TC waste handlers into two groups: (1) All generators of greater than 100 kg/month and less than 1,000 kg/month of hazardous waste (small-quantity generators) must come into compliance with the subtitle C requirements for management of their TC waste within 1 year; and (2) all generators of 1,000 kg/month or more of hazardous waste are required to comply with all subtitle C requirements for TC wastes within 6 months. The phased schedule for compliance is further discussed in section V.

Wastes identified as hazardous under the Toxicity Characteristic will also become hazardous substances under section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended. Today's rule amends the list of reportable quantities (RQs) in 40 CFR part 302 by adding appropriate values for each of the new 25 TC toxicants. All of the newly-

generators to describe on their RCRA biennial reports the efforts they have undertaken during the year to reduce the volume and toxicity of their hazardous waste and to compare these efforts to previous years.

As important as the efforts just described is the Agency's commitment to ensuring that regulations under development encourage pollution prevention, whenever possible. The TC (TC), we believe, provides significant incentives for pollution prevention. Currently, there is little incentive for industries to implement pollution prevention efforts for unregulated solid wastes. In particular, there are few controls on units handling solid wastes that have the potential for releases of hazardous constituents to groundwater. Large quantities of solid wastes containing TC constituents currently are managed in unregulated land-based units, such as surface impoundments and landfills. Many of these units are in states that are either highly dependent on groundwater for public water supply or where groundwater is hydraulically connected to surface water, or both. By subjecting management of TC wastes to subtitle C regulation, EPA is in effect requiring that waste managers rethink their practices for solid wastes that contain hazardous constituents. EPA's experience has been that hazardous waste regulations provide significant incentives for pollution prevention. For example, some listed wastestreams (e.g., bottoms from tetrachloroethylene production) are now completely recycled.

The characteristic mechanism used by EPA to identify hazardous waste is especially effective in encouraging pollution prevention because it sets a concentration level or criteria (e.g. test) that determines the point at which the waste is no longer regulated as characteristically hazardous. Because of the high cost of compliance with RCRA subtitle C requirements, members of the regulated community will have significant new incentives to reduce TC waste generation as a result of today's rule. Industries will consider substitutes for the specific chemicals on the TC list of toxicants of concern. Where substitutes are not used, there will be incentive to reduce the use of hazardous substances or otherwise limit their concentrations in wastes, in order to keep concentrations of hazardous chemicals below regulatory levels.

Pollution prevention options range from simple good housekeeping practices, e.g., keeping solvents and oils separate to facilitate recycling of each, to more extensive process reconfigurations and/or raw material substitutions. Even in cases where pollution prevention can not eliminate the need for treatment or disposal of hazardous wastes, it may reduce the generation of waste. For example, tank capacity is constrained by land area, engineering considerations, and cost. Managers of TC wastewaters that switch from surface impoundments to exempt tanks will almost certainly have to reduce volumes of hazardous waste generated, or segregate hazardous portions of their wastestreams.

In order to enhance the pollution preventions effects of this rule, EPA is incorporating pollution prevention into the communication strategy for the TC regulation. EPA will provide information targeted to small businesses specifically and industry in general through pamphlets, industry publications and conferences, on the mechanisms described above. We have found that many small businesses are turning to pollution prevention as a result of implementation of the small quantity generator regulations (see 51 FR 10146, March 24, 1986). For example, PPIC documents relate how one drycleaning operation reduced its solvent wastes to a level well below national industry standards by regularly checking for and sealing any system leaks, and installing a conditioning system and a carbon adsorption unit to recover additional solvent. With the new setup, the plant can clean four times as many clothes per drum of solvent. The Agency believes that other industries may have the potential to substitute less toxic source materials in their processes. EPA will consider whether any technical assistance could aid industry in these efforts. EPA would also be interested in suggestions from industries affected by the TC in ways that the Agency might facilitate these efforts. Inquiries should be directed to the Pollution Prevention Office, U.S. EPA, Washington, DC 20460.

In summary, the TC will alter the management of wastes that contain toxicant at hazardous levels by ending management in unregulated land-based units. As industries reassess their waste generation and management practices, many are likely to seriously consider pollution prevention options, and EPA will take steps to facilitate such efforts.

G. Summary of Final Rule

Today's rule retains many of the features of the June 1986 proposal: it replaces the EP with the TCLP; it adds 25 new organic constituents to the list of toxic constituents of concern; and it establishes regulatory levels for the organic constituents based on health-based concentration limits and a DAF developed using the subsurface fate and transport model. In response to comments received on the proposed rule and related notices, the final rule incorporates a number of modifications to the list of constituents, the leaching procedure, the chronic toxicity reference levels, the subsurface fate and transport model, and the schedule for compliance with the TC rule.

With respect to the list of constituents, the final rule includes 25 of the 26 constituents proposed in 1986. One group that has been excluded in the final rule are constituents that appreciably hydrolyze. EPA has been able to develop scientifically valid DAFs for nondegrading constituents but is still improving its approach for developing DAFs for constituents that are expected to hydrolyze appreciably during transport. In particular, the Agency does not yet have a procedure to address toxic hydrolysis byproducts that may be formed.

Second, in response to comments, the Agency has also evaluated the applicability of the steady-state condition assumed in the subsurface fate and transport model, and has determined that the assumption is valid for most of the originally proposed constituents. However, several of the original proposed constituents have been deferred from the final rule while the Agency continues to evaluate the extent to which the steady-state solution is appropriate in determining their fate and transport.

As a result, all the constituents newly regulated under today's rule are nonhydrolyzing or minimally hydrolyzing constituents, and all are constituents for which the steady-state solution is appropriate. For all these constituents, EPA has determined, based on the results of its subsurface fate and transport model, that use of a DAF of 100 is appropriate for setting regulatory levels. This DAF is sufficient to capture only those wastes that are clearly hazardous. As a result of the Agency's decision to regulate only nonhydrolyzing or minimally hydrolyzing constituents and those for which the steady-state solution is appropriate, 25 additional constituents are being regulated rather than the originally proposed 26. Regulatory levels for hydrolyzing constituents, as well as those constituents for which there remain questions as to whether the steady-state solution is appropriate, will be discussed in future notices.

The list of constituents regulated in today's rule and their respective regulatory levels are presented in Table II.2. As in the proposed rule, where the

EPA's first discussion of the development of regulatory levels through the use of chronic toxicity reference levels in combination with a subsurface fate and transport model was in the proposed rule governing land disposal restrictions for solvents and dioxins (51 FR 1602, January 14, 1986). This proposal introduced the concept involved in "back-calculating" regulatory levels (i.e., multiplying chronic toxicity reference levels by dilution/ attenuation factors) and also discussed the Agency's plan for revising the EP. In the final rule on land disposal restrictions for solvents and dioxins (51 FR 40572, November 7, 1986), EPA decided not to use the "back-calculation approach" for the LDR program in favor of an engineering determination based on the best demonstrated available technology (BDAT). However, the Agency did promulgate the revised TCLP as the leaching procedure to be used in the land disposal restrictions program. Specifically, the TCLP is used to demonstrate that certain wastes meet the best demonstrated available technology standards.

On May 18, 1987, EPA published a Supplemental Notice of Proposed Rulemaking (52 FR 18563) in response to numerous comments on the June 1986 proposal concerning the application of the revised TC to wastewaters. The commenters' main concern was that it may be inappropriate to apply the TC mismanagement scenario (co-disposal of wastes with municipal wastes in an unlined landfill) to wastewaters managed in surface impoundments. The commenters believe that such an approach would result in inappropriately low regulatory levels. The Supplemental Notice outlined several alternatives for the application of the TC to wastewaters that would result in a separate set of regulatory levels for these wastes. The alternative scenario for wastewaters assumed that subject wastes are managed in an unlined impoundment instead of being co-disposed in a municipal landfill. Sections III.A.2, III.E., and III.H provide further discussion of the Supplemental Notice for wastewaters and related issues.

The Agency then published a Notice of Data Availability and Request for Comments on May 19, 1988 (53 FR 18024), as a result of its concern about uncertainties and technical difficulties involved with developing sufficiently representative dilution/attenuation factors (DAFs) for specific constituents. In that notice, the Agency proposed an alternative to the constituent-specific DAFs in the proposed TC. The Agency presented a two-phased approach to implementing DAFs for the TC. In the first phase, the Agency would use generic DAFs for all 38 new TC organic constituents while the development of constituent-specific DAFs proceeded; once the development of the constituent-specific DAFs was completed, these DAFs would be implemented in the second phase. The Agency specifically requested comment on the use of a generic DAF that would initially bring into the hazardous waste regulatory system the most toxic of the wastes subject to the June 1986 proposal. The Agency also updated the chronic toxicity reference levels for a number of constituents based on newly available information. Section III.C discusses the incorporation of the new information into the chronic toxicity reference levels for specific constituents and Section III.D describes in more detail the two-tiered DAF approach.

In response to numerous comments expressing concern as to whether the particle reduction requirement in the TCLP was appropriate, EPA published a proposal (53 FR 18782, May 24, 1988) requesting comment on modifications to the TCLP as promulgated on November 7, 1986. Based on further experimental evaluation of the original testing methodology, the Agency proposed to modify the TCLP to include a cage insert requirement in place of the particle reduction step for certain materials. The specific revisions discussed in the proposal are presented in detail in section III.F of this preamble, and the TCLP protocol is presented in Section VIII of today's final rule. Today's rule does not include a cage requirement, but rather retains the particle reduction step for monolithic or fixated wastes.

In addition to the above-mentioned modifications, on August 1, 1988, the Agency published a Supplemental Notice (53 FR 28882) introducing potential modifications to the subsurface fate and transport model used to calculate constituent-specific DAFs in the proposed TC. In addition, the Agency presented currently available hydrogeological data on municipal waste landfills and proposed to modify the subsurface fate and transport model to more accurately reflect conditions in the universe of municipal waste landfills. Section III.E presents a more detailed description of the subsurface fate and transport model and the modifications made during its development.

F. Pollution Prevention

In section 1003(b) of RCRA, Congress declared waste minimization to be a national policy. Similarly, EPA has made pollution prevention an Agency objective, in both regulatory and nonregulatory programs. (See EPA's policy statement emphasizing the importance of pollution prevention (54 FR 3045, January 26, 1989).) This policy places highest priority on source reduction (i.e., reducing the volume or toxicity of wastes generated) and use of all pollutants for all sectors of society. A reduction in the amount of waste which must be managed (i.e., by source reduction and recycling) provides direct benefits related to protecting human health and the environment from the mismanagement of hazardous wastes. Pollution prevention measures can also reduce waste treatment and disposal costs, decrease costs for raw materials, minimize liability and regulatory burdens for waste generators, and may enhance efficiency, product quality, and public image. The Agency encourages industries affected by this rule to consider achieving compliance through pollution prevention.

The Agency has taken several steps to create pollution prevention incentives. First, EPA is developing institutional structures within each of its offices to ensure that the pollution prevention philosophy is incorporated into every feasible aspect of internal EPA planning and decision-making. Second, EPA is making technical information available to help firms reduce waste generation. EPA is developing the Pollution Prevention Information Clearinghouse (PPIC), a network of people and resources throughout the United States that have direct experience in many industries. PPIC includes the Electronic Information Exchange System (EIES), and a database of bulletins, programs, contacts, and reports related to pollution prevention. Third, the Agency is supporting the development of state programs to assist generators in their waste reduction efforts. Many states are already providing such help. For example, the Alaska Health Project has published technical assistance packets for specific industries; North Carolina has a pollution prevention bibliography; and Oregon conducts a hazardous waste reduction program. Finally, EPA has initiated specific regulatory requirements addressing waste minimization. Under the Resource Conservation and Recovery Act (RCRA) regulations, hazardous waste generators are required to certify on their hazardous waste manifests and annual permit reports that they have a program in place to reduce the volume or quantity and toxicity of their hazardous wastes as much as economically practical. RCRA regulations also require

TABLE E-1.—DILUTION ATTENUATION FACTORS FOR TOXICITY CHARACTERISTIC ORGANIC CONSTITUENTS—Continued

Constituent	LOG Kow [1]	Ka [2]	Kb [2]	Kn [2]	DAF Index
1,4-Dichlorobenzene	[illegible]	NLFG [6]	NLFG	NLFG	[illegible]
1,2-Dichloroethane	1.40	NH	NH	7.2E-6/w	[illegible]
1,1-Dichloroethylene	2.13	NLFG	NLFG	NLFG	[illegible]
2,4-Dinitrotoluene	2.00	NLFG	NLFG	NLFG	[illegible]
Endrin	[illegible] 0.54	>1/yr	>1/yr	>1/yr	[illegible]
Heptachlor (and its hydroxide)	[illegible] 4.61	NLFG	NLFG	NLFG	[illegible]
Hexachlorobenzene	6.42	<1/yr	<1/yr	<1/yr	[illegible]
Hexachlorobutadiene	4.24	NLFG	NLFG	NLFG	[illegible]
Hexachloroethane	4.22	>1/yr	>1/yr	>1/yr	[illegible]
Isobutanol	0.74	>1/yr	>1/yr	>1/yr	[illegible]
Lindane	3.40	>1/yr	>1/yr	>1/yr	[illegible]
Methoxychlor	[illegible] 4.30	NH	1.4/w	7.5E-6/w	[illegible]
Methylene chloride	1.25	NH	NH	1.10E-6/w	[illegible]
Methyl ethyl ketone	0.30	NLFG	NLFG	NLFG	[illegible]
Nitrobenzene	1.90	NLFG	NLFG	NLFG	[illegible]
Pentachlorophenol	5.06	NH	>10E-4/w	NH	[illegible]
Phenol	1.49	NHYF	NHYF	NHYF	[illegible]
Pyridine	0.65	NLFG	NLFG	NLFG	[illegible]
1,1,1,2-Tetrachloroethane	2.81	NH	1.3/w	2.2E-7/w	[illegible]
1,1,2,2-Tetrachloroethane	2.42	NH	2.8E+3/w	NH	[illegible]
Tetrachloroethylene	3.03	NLFG	NLFG	NLFG	[illegible]
2,3,4,6-Tetrachlorophenol	4.33	NH	1E-6/w	NH	[illegible]
Toluene	2.82	NHYF	NHYF	NHYF	[illegible]
Toxaphene	[illegible] 5.50	NH	>10/yr	NH	[illegible]
1,1,1-Trichloroethane	2.50	NH	NH	1.1E-4/w	[illegible]
1,1,2-Trichloroethane	1.91	NH	13/w	4.3E-7/w	[illegible]
Trichloroethylene	2.29	NLFG	NLFG	NLFG	[illegible]
2,4,5-Trichlorophenol	3.86	NH	1E-6/w	NH	[illegible]
2,4,6-Trichlorophenol	3.58	NH	1E-6/w	NH	[illegible]
2,4,5-TP (Silvex)	3.45	NLFG	NLFG	NLFG	[illegible]
Vinyl chloride	1.38	NH	1E-6/w	1E-7/w	[illegible]

[1] Logarithm of the octanol/water partition coefficient.
[2] Acid, base and neutral hydrolysis rate constants.
[3] Dilution/attenuation factor derived from ground water transport system.
[4] NHYF = No Hydrolyzable Functional Group.
[5] NH = Negligible Hydrolysis.
[6] NLFG = No Labile Functional Group.
[7] Estimated value.

In the monte carlo simulation, values for each parameter are based upon the frequency distribution for each parameter (where such data exists) rather than the selection of a single value for each parameter. The model is then run a sufficient number of times (typically several thousand) to produce the frequency distribution of the model's output. This overall frequency distribution is, effectively, a combination of the frequency distributions for each individual parameter. This approach avoids the compounding effects of conservatism inherent in choosing single, reasonable-worst-case values for each parameter. Monte carlo simulation was chosen as the preferred method to analyze the full range of possible environmental conditions for the land disposal scenario. The wide range of environmental conditions (e.g., ground water velocities, pH, temperatures, exposure point locations) that can exist in locations across the nation where the wastes in question may be disposed precludes *a priori* specification of a reasonable worst case for these parameters. Another important reason to use the monte carlo method is the very complex manner in which the many model variables and parameters interact. Unless many (hundreds to thousands) combinations of variables are investigated, it is simply not possible to anticipate those physical settings that lead to unacceptably high exposure levels. Accordingly, the monte carlo method was chosen to ensure that a conservative but not physically unrealistic or impossible analysis was completed.

The EPASMOD, as described in the proposed rule, was based on a number of key assumptions pertaining to the features of ground water flow, properties of the porous medium, and the behavior of hazardous wastes in ground water. These assumptions included the following:

- Saturated soil conditions (no attenuation of chemicals in the unsaturated zone);
- Flow regions of infinite extent in the longitudinal direction, semi-infinite extent in the lateral direction, and finite in the vertical direction;
- Aquifer can be characterized by homogeneous and isotropic properties and the aquifer thickness is constant;
- Ground water flow is uniform and continuous in direction and velocity;
- Degradation is limited to hydrolysis and the by-products of hydrolysis are assumed to be nonhazardous;
- Contaminants follow a linear equilibrium adsorption isotherm;
- An infinite source supplies a constant mass flux of chemical into the aquifer;
- Recharge due to precipitation supplies water to the disposal unit and the aquifer;
- The ground water upstream of the disposal site is initially free of contamination;
- The receptor well is directly in line with the source and the ground water flow direction;
- The receptor well is located 500 feet from the unit; and
- Hydraulic conductivity does not vary with temperature.

In the June proposed rule, the Agency also proposed using the 85th cumulative percentile level of the back-calculated dilution attenuation factors obtained using the monte carlo simulation techniques as an appropriate regulatory level for the TC. Selection of this level means that downgradient

TABLE C-1.—CHRONIC TOXICITY REFERENCE LEVELS—Continued

Constituent	Chronic toxicity reference level (mg/L)	Basis
Vinyl chloride	0.002	MCL

All RSDs are calculated at the 10^{-6} risk level.

D. Use of Generic Dilution/Attenuation Factors (DAFs)

In the May 19, 1988 supplemental proposal, EPA requested comment on an alternative strategy for setting DAFs in the TC. The alternative involved setting DAFs for these constituents in two phases. The first phase would use a generic DAF in a manner similar to the existing EPTC, which uses a DAF of 100 for all EP constituents. In the second phase, the Agency would further address the manner in which the DAFs are calculated and would either: (1) Continue to use generic DAFs, (2) employ a subsurface fate and transport model to develop constituent-specific DAFs, or (3) use some combination of the two approaches. The Agency also specifically solicited comment on the use of a generic DAF of 100 or 500 in the first phase.

Many commenters recognized the need to expeditiously promulgate the TC; however, most opposed the two-phased approach, arguing that it would cause undue economic burden by: (1) Forcing industries to design new treatment programs for one group of wastes at certain regulatory levels, and a few years later to redesign in order to accommodate new levels and wastes, and (2) over-regulating certain chemical substances under the first generic-DAF phase that may then not be regulated under the second phase. Some commenters were concerned, on the other hand, that EPA would set the generic DAFs so high (to avoid overregulation) that some substances would be under-regulated.

Most commenters opposed the use of generic DAFs and urged EPA to retain the constituent-specific modeling approach. These commenters argued that a generic DAF would be arbitrary and not scientifically defensible; that use of the generic DAFs would violate the statutory requirements to develop a process that accurately assesses leaching ability and differentiates between hazardous and nonhazardous wastes; and that the diversity in dilution and attenuation attributes across the constituents would cause any generic DAF to either severely under-regulate or severely overregulate a large number of the constituents. Even those few commenters who supported the two-phased approach recommended that the Agency move rapidly to the second phase and employ the modeling approach to set DAFs.

EPA acknowledges that the problems noted by the commenters are important ones. The Agency requested comment on the generic DAF approach because of the likelihood that the issues surrounding the proposed fate and transport model for establishing constituent-specific DAFs would not be resolved in a timely manner. Since the Agency has been able to address the concerns regarding the subsurface fate and transport model for the constituents identified in today's regulation, the Agency has decided to use the model to develop DAFs. Consequently, the DAFs set in today's rule for nonhydrolyzing constituents for which the steady-state solution is appropriate are not viewed by EPA as interim and are supported by the subsurface fate and transport model. The Agency intends to establish DAFs for constituents not addressed in today's rule on a constituent-specific basis, and regulatory levels for those constituents will be proposed or promulgated (as warranted) at a later date.

E. Application of a Subsurface Fate and Transport Model

1. Introduction

On June 13, 1986, EPA proposed an approach (see 51 FR 21648) for estimating regulatory concentration levels in a waste leachate using chronic toxicity reference levels, combined with constituent-specific dilution/attenuation factors (DAFs) derived from the application of a subsurface fate and transport model. The model (EPASMOD) was first described for public comment on January 14, 1986 (51 FR 1602).

A DAF represents a reduction in the concentration of a constituent expected to occur during transport through ground water from the bottom of a disposal unit to a drinking-water source. In response to the proposal and supplemental notices (see Section II, Table II.1), the Agency received numerous comments on the subsurface fate and transport model used for the calculation of DAFs. This section describes the different proposals related to the use of the subsurface fate and transport model, the modifications to the model in response to public comments, and the results obtained with the use of the modified model.

a. June 13, 1986 Proposed Rule (51 FR 21648). The Agency's June 13, 1986 proposal used a subsurface fate and transport model (EPASMOD) to calculate specific DAFs for each of the 44 organic hazardous constituents (see Table E-1). The DAFs for each constituent were calculated using the model, incorporating compound-specific hydrolysis and soil adsorption data coupled with parameters describing the subsurface environment (e.g., ground water flow rate, hydraulic conductivity of the aquifer, ground water pH, etc.). The Agency proposed modeling a scenario of waste mismanagement at a subtitle D municipal landfill. Data were incorporated in the model using a monte carlo simulation.

TABLE E-1.—DILUTION ATTENUATION FACTORS FOR TOXICITY CHARACTERISTIC ORGANIC CONSTITUENTS

Constituent	LOG Kow [1]	Ka [2]	Kb [2]	Kn [2]	D/A factor [3]
Acrylonitrile	0.07	>1/yr	>1/yr	>1/yr	14.4
Benzene	2.13	NHYF [4]	NHYF	NHYF	14.4
Bis(2-chloroethyl)ether	1.04	NH [5]	NH	8E-6/hr	14.4
Carbon disulfide	2.16	NH	>10/yr	NH	14.4
Carbon tetrachloride	2.96	NH	NH	NH	14.4
Chloroform	[1] 5.48	NH	>10/yr	NH	14.4
Chlorobenzene	2.87	NH	1E-6/hr	NH	14.4
Chloroform	1.96	NH	0.23/hr	3E-6/hr	14.4
o-Cresol	2.15	NHYF	NHYF	NHYF	14.4
m-Cresol	2.15	NHYF	NHYF	NHYF	14.4
p-Cresol	2.15	NHYF	NHYF	NHYF	14.4
2,4-D	2.70	NHYF	NHYF	NHYF	14.4
1,2-Dichlorobenzene	3.56	NH	1E-6/hr	NH	14.4

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regulatory levels and which are demonstrated to pose a hazard to human health or the environment still remain subject to waste-specific evaluations under the hazardous waste listing program. Wastes which are determined to require controlled management after consideration of the factors identified in 40 CFR 261.11(a)(3) (e.g., the nature of the toxic constituents, toxicant mobility under various environmental management scenarios, volume of waste generated and potential method of management) are then specifically listed as hazardous wastes and subjected to the appropriate RCRA management controls. This reflects EPA's philosophy, first articulated in May of 1980, that the characteristic defines broad classes of wastes that are clearly hazardous, while the listing process defines some wastes that may not exhibit the characteristics but are nonetheless hazardous wastes (45 FR 33111, May 19, 1980).

The chosen risk level of 10^{-6} is at the midpoint of the reference risk range for carcinogens (10^{-4} to 10^{-9}) targeted in setting MCLs. This risk level also lies within the reference risk range (10^{-4} to 10^{-9}) generally used to evaluate CERCLA actions. Furthermore, by setting the risk level at 10^{-6} for TC carcinogens, EPA believes that this is the highest risk level that is likely to be experienced, and most if not all risk will be below this level due to the generally conservative nature of the exposure scenario and the underlying health criteria. For these reasons, the Agency regards a 10^{-6} risk level for Group A, B, and C carcinogens as adequate to delineate, under the TC, wastes that clearly pose a hazard when mismanaged.

3. Apportionment of Health Limits

EPA proposed to account for potential exposure from sources other than the TC scenario by apportioning the RfD-based chronic toxicity reference levels. The apportionment scheme effectively reduced each such chronic toxicity reference level to 50 percent of its original value, (i.e., 50 percent of the RfD). The Agency also proposed to estimate environmental partitioning of the apportioned health limits in air and water according to a simplified fractionation scheme using Henry's Law Constants (H_c) and octanol-water coefficients (K_{ow}) for individual constituents. The Agency did not propose to apportion the chronic toxicity reference levels based on RSDs or MCLs.

Several commenters addressed the Agency's proposal to apportion the RfDs. Commenters that criticized the Agency's proposed apportionment scheme argued that it was arbitrary, overly conservative, and unnecessary. Several commenters recommended that EPA either use more realistic estimates of exposure based on the available constituent-specific data or not apportion at all.

After a review of comments on the proposed regulation and consideration of the available data, the Agency has decided not to apportion in this rulemaking. Although the concept of apportionment has some scientific basis in that individuals are exposed to many of the chemicals of concern through more than one route of exposure and from more than one source, the implementation of the concept is very difficult when adequate data on the amount of exposure and/or health effects from all routes of exposure do not exist. Thus, due to the lack of sufficient data to determine an appropriate apportionment factor for the various constituents, the Agency now concludes that its proposed apportionment scheme cannot be supported at the present time. Of course, the proposed apportionment would deal with uncertainty by erring on the side of safety; nevertheless the Agency believes that the conservative approach used to deal with uncertainty in the development of the RfD is sufficiently stringent to define those wastes that clearly pose hazards. This approach is in accordance with the Agency's treatment of noncarcinogens. The Agency therefore will not apportion the RfDs for this rulemaking.

A few commenters criticized the Agency's proposed method for fractionating the apportioned RfD between air and water. These commenters questioned the technical basis of the Agency's approach and/or recommended alternative schemes. The Agency agrees with commenters that the technical basis for supporting fractionation as proposed is inadequate to predict media-specific concentrations. The Agency is exploring the development of an appropriate model. Thus, EPA has decided not to apportion the RfD and not to fractionate the RfD between air and water in this rulemaking.

Other commenters addressed the apportionment of RSDs for carcinogenic constituents. Several of these commenters agreed with EPA's decision not to apportion RSDs, stating that doing so would result in very low regulatory thresholds for some constituents. The commenters also pointed out that many conservative assumptions are already incorporated into the development of the RSDs for carcinogens. Others commented that RSDs should be apportioned because humans are exposed to these constituents by multiple routes.

The Agency continues to believe that it is not appropriate to apportion the RSDs for carcinogenic constituents. RSDs are estimated by a procedure that must deal with unavoidable uncertainties and is therefore intentionally conservative. The Agency stated in the preamble to the proposed rule that a difference in dose of a factor of 2 is still well within the margin of uncertainty of the estimated RSD (51 FR 21687, June 13, 1986).

Table C-1 presents chronic toxicity reference levels for the constituents in today's rule. The Agency received a number of comments on specific chronic toxicity reference levels. In some cases, EPA responded to these comments in the notice of proposed changes to the health levels on May 19, 1988 (53 FR 18024). Other chemical specific comments are addressed in the background document (Ref. 3).

TABLE C-1.—CHRONIC TOXICITY REFERENCE LEVELS

Constituent	Chronic toxicity reference level (mg/L)	Basis
Arsenic	0.05	MCL
Barium	1.0	MCL
Benzene	0.005	MCL
Cadmium	0.01	MCL
Carbon tetrachloride	0.005	MCL
Chlordane	0.0003	RSD
Chlorobenzene	1	RfD
Chloroform	0.06	RSD
Chromium	0.05	MCL
o-Cresol	2	RfD
m-Cresol	2	RfD
p-Cresol	2	RfD
2,4-D	0.1	MCL
1,4-Dichlorobenzene	0.075	MCL
1,2-Dichloroethane	0.005	MCL
1,1-Dichloroethylene	0.007	MCL
2,4-Dinitrotoluene	0.0005	RSD
Endrin	0.0002	MCL
Heptachlor (and its hydroxide)	0.00008	RSD
Hexachlorobenzene	0.0002	RSD
Hexachloro-1,3-butadiene	0.005	RSD
Hexachloroethane	0.03	RSD
Lead	0.05	MCL
Lindane	0.004	MCL
Mercury	0.002	MCL
Methoxychlor	0.1	MCL
Methyl ethyl ketone	2	RfD
Nitrobenzene	0.02	RfD
Pentachlorophenol	1	RfD
Pyridine	0.04	RfD
Selenium	0.01	MCL
Silver	0.05	MCL
Tetrachloroethylene	0.007	RSD
Toxaphene	0.005	MCL
Trichloroethylene	0.005	MCL
2,4,5-Trichlorophenol	4	RfD
2,4,6-Trichlorophenol	0.02	RSD
2,4,5-TP acid (Silvex)	0.01	MCL

levels that would be calculated using the RSD methodology. An example of this situation arises when the health criteria are at such low levels that analytical methods are not available to measure these levels. In cases where the MCL is higher than a purely health-based level, the Agency notes that use of the MCL is not inconsistent with today's rule since the purpose of the rule is to identify wastes that clearly pose hazards, not to identify the lowest level of hazard. However, regardless of whether they are higher or lower than the levels calculated using the RfD or RSD methodologies, EPA believes that MCLs are the appropriate starting point for developing regulatory levels for the TC.

For the constituents lacking MCLs, EPA must rely on the available methodologies to provide chronic toxicity reference levels that are scientifically defensible and protective of human health. EPA believes that the RfD and RSD methodologies meet these two criteria. EPA also realizes that inconsistencies will exist when different methodologies are employed for developing regulatory levels. The Agency intends to evaluate newly promulgated MCLs to determine on a case-by-case basis whether the TC regulatory level will change significantly if the new MCL is used, and to revise the regulatory levels, as appropriate. In the long run, this should provide internal consistency for the TC, as well as consistency with other regulatory programs.

Some commenters supported the use of MCLGs as the basis for chronic toxicity reference levels under the TC because the MCLGs are based on health effects alone, whereas the MCLs consider other factors as well, such as economic and technical feasibility.

EPA disagrees with the commenters who stated that MCLGs are more appropriate than MCLs for use in the TC. MCLGs are nonenforceable health goals for drinking water, which are to be set at levels that would result in no known or anticipated adverse health effects with an adequate margin of safety. The Agency has adopted the policy of setting the MCLGs for probable human carcinogens (Group A and B carcinogens) at zero. If the Agency were to use MCLGs rather than MCLs in the TC, the regulatory levels for defining a waste as hazardous would be based on health criteria that, at least for carcinogens, are more stringent than the criteria used to set concentrations acceptable for direct human ingestion of drinking water. In addition, the regulatory levels would be virtually impossible to detect analytically. This would mean that any waste that contains detectable levels of carcinogens would be hazardous regardless of the potency of the carcinogen or the risk presented by that waste. EPA believes that this is an inappropriate approach for the TC because it would result in the regulation of wastes which are not necessarily hazardous.

2. Risk-Specific Doses for Carcinogenic Constituents

For constituents for which no MCLs have been established, EPA uses oral RSDs to develop chronic toxicity reference levels for carcinogens. The RSD is an upper-bound estimate of the average daily dose of a carcinogenic substance that corresponds to a specified excess cancer risk for lifetime exposure. A predetermined risk level and the oral carcinogenic slope factor estimated by EPA's Carcinogen Risk Assessment Verification Endeavor (CRAVE) Workgroup or Carcinogen Assessment Group (CAG) are used to calculate the RSD.

The Agency proposed a risk level of concern based on the weight of evidence regarding carcinogenicity of each constituent. Constituents classified as known or probable human carcinogens (Group A or B) were assigned a risk level of 1 in 100,000 (i.e., 10^{-5}), while constituents classified as possible human carcinogens (Group C) were assigned a risk level of 1 in 10,000 (i.e., 10^{-4}).

The Agency received comments regarding both the weight-of-evidence approach for establishing risk levels and the risk levels selected. In particular, one commenter supported the Agency's proposal, stating that a single risk level is not appropriate for all constituents, and that use of the weight-of-evidence approach avoids making regulatory decisions based on insufficient data. Another commenter also supported the use of weight-of-evidence to assign risk levels, but stated that it is inappropriate to regulate both known and probable human carcinogens at the same level of risk. Alternatively, a third commenter asserted that the weight-of-evidence approach is inappropriate because (1) new information is constantly being developed on the health effects of toxic constituents, so the weight of evidence is constantly changing, and (2) the classification scheme does not take into account the potency of the carcinogen or risk.

The Agency also received specific comments regarding both the weight-of-evidence approach and the selection of specific risk levels. Several commenters addressed the risk level at which the Agency proposed to regulate carcinogens. Some commenters specifically expressed support for the proposal to regulate Class A and B constituents at a 10^{-5} risk level and Class C constituents at a 10^{-4} risk level. One commenter stated that because the procedure for developing risk estimates is extremely conservative, the proposed risk levels would not adversely affect human health and the environment. Another commenter noted that the stated risk levels are estimates of the upper confidence bound of risk and not the maximum likelihood estimate; thus, the actual risk to the public would be less than the stated level.

Other commenters supported the use of a 10^{-6} risk level for all carcinogens. These commenters argued that the use of the proposed risk levels represents a serious weakening in EPA's regulation of carcinogens and is inconsistent with other policies in effect in other EPA programs.

With respect to the weight-of-evidence approach, the Agency has decided to establish a single risk level of concern for all potential carcinogens (i.e., the Agency will not assign a specific risk level to a specific weight-of-evidence carcinogenicity classification for this rulemaking). The weight-of-evidence approach for classifying a constituent as carcinogenic is based primarily on the amount and quality of data that are available rather than the strength of the toxic response in animal or humans. In effect, it is a qualitative assessment that takes into account the uncertainty in the data for determining whether an agent is carcinogenic to humans. This means that the actual quantitative difference in risk between an "A" and "B" carcinogen as classified by the weight of evidence may either be zero or may be orders of magnitude. Thus, EPA believes that both the weight of-evidence and the strength of the toxic response (i.e., potency) should be considered in making regulatory decisions within the context of the TC.

With regard to the specific risk level chosen, the Agency has decided to set the level for carcinogens (Groups A, B, and C) at 1 in 100,000 (i.e., 10^{-5}) for the final rulemaking. Characteristics are established at levels at which the Agency has a very high level of certainty that a waste which exhibits these properties needs to be managed in a controlled manner (i.e., as a hazardous waste). The Agency realizes that not all wastes which exhibit properties at concentrations below the regulatory levels are necessarily safe for disposal as nonhazardous wastes. Rather, those wastes having properties lower than the

EPA has decided not to add more metals to the TC constituent list at this time because technical issues remain as to their subsurface fate and transport. The regulatory levels for the toxicity characteristic metals are not changed in this rule (i.e., EPA is retaining the regulatory levels set under the previous EP) pending further Agency validation and study of the fate and transport of metals. These validation and study efforts are focusing on the development of the metal speciation model (MINTEQ).

The Agency is developing MINTEQ for the evaluation of the mobility of arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and thallium in ground water. A modified version of MINTEQ will be used in combination with a set of generic ground water specifications and subsurface conditions to determine metal solubility limitations. EPA will then use these results, in conjunction with the subsurface fate and transport model, to estimate dilution during transport to the down-gradient exposure point. (See discussion of the development of the subsurface fate and transport of metals at 51 FR 1653, January 14, 1986.) The Agency is not specifically proposing an approach for evaluating the fate and transport of metals in today's rule, but does expect to propose, at a later time, DAFs specific to metals, including nickel and thallium, and will address comments relating to the toxicity of nickel and thallium at that time.

C. Chronic Toxicity Reference Levels. The Agency proposed to use chronic toxicity reference levels (combined with DAFs) to calculate leachate concentration limits for individual constituents; a waste containing constituents equal to or above those levels would be a hazardous waste under the TC. Specifically, EPA proposed to use the MCLs promulgated as part of the National Interim Primary Drinking Water Standard (NIPDWS), where available, as the starting point for establishing the regulatory levels for each of the constituents. For those constituents for which no MCLs had been promulgated, the Agency proposed to use oral Reference Doses (RfDs) and Risk-Specific Doses (RSDs) to develop chronic toxicity reference levels for the noncarcinogens and carcinogens, respectively. Because exposure to toxic constituents can occur by multiple pathways, the Agency also proposed to apportion the acceptable health risk level of each noncarcinogenic constituent among the various possible routes of exposure. The Agency solicited public comment on: (1) Whether RfDs and RSDs are appropriate to use when MCLs are available; (2) the health levels proposed for RfDs and RSDs; (3) the associated risk levels; and (4) the assumptions used to apportion exposure to the different possible routes. The Agency's decisions regarding the health-related issues for which it solicited comments are presented below.

1. Maximum Contaminant Levels

The original toxicity characteristic—the EPTC (40 CFR 261.24)—used the NIPDWS developed under the Safe Drinking Water Act as the toxicity levels to derive the regulatory levels for the eight metals, four insecticides, and two herbicides then regulated. (For ease of discussion, the acronym "MCLs" will be used in subsequent sections to refer collectively to both MCLs and the existing NIPDWS.) EPA plans to continue this approach in the expanded TC for those constituents for which MCLs are available.

A number of commenters expressed support for the use of MCLs, when they exist, as the starting point for calculating regulatory levels for the TC. Most of these commenters argued that the MCLs provide adequate protection of human health. These commenters stated that MCLs are reliable, scientifically defensible, and recognized and understood by the general public.

Several commenters supported the use of MCLs because factors relating to cost and available treatment technology may be considered along with health effects in the development of the standards. These commenters asserted that MCLs represent a reasonable balance among the factors EPA must consider, while RfDs and RSDs are more limited. A number of commenters also felt that the use of MCLs provides a level of protection consistent with other regulatory programs.

In contrast, other commenters supported the use of RfDs and RSDs as the basis for the chronic toxicity reference levels even when MCLs are available for those constituents. These commenters stated that health-based levels are an appropriate starting point for the regulation. Because the MCLs consider other factors relating to technical and economic feasibility in addition to toxicity, they contend that the RfDs and RSDs are preferable. Many of these commenters also supported a consistent approach for all constituents regulated by the TC, rather than using MCLs for some and RfDs and RSDs for others.

Several commenters asserted that because the MCLs were developed for the purpose of regulating the concentrations of constituents in treated water "at the tap," it is not appropriate to use the same standards for defining hazardous wastes. Several commenters also expressed concern that the MCLs developed under the Safe Drinking Water Act are potentially more stringent than RfDs and RSDs. This concern was most strongly expressed regarding carcinogens, for which Maximum Contaminant Level Goals (MCLGs), previously referred to as Recommended Maximum Contaminant Levels (RMCLs), are set at zero, and MCLs are set at technically achievable levels that most closely approach this zero goal.

EPA maintains that the MCLs, when they exist, are the most appropriate health criterion to use as the starting point for developing the regulatory levels. The exposure scenario developed for the TC is based on ingesting contaminated drinking water, and because MCLs are developed for regulation of drinking water, they clearly are relevant. In addition, the development of the MCLs follows a rigorous methodology in which all available health information is evaluated in establishing the MCLGs. The MCLs are set as close to the MCLGs as is feasible, and the Agency believes that MCLs are protective of human health.

It should be noted that EPA evaluates the health risks that are associated with various contaminant levels in order to insure that the MCL adequately protects the public health. For drinking water contaminants, EPA sets a reference risk range for carcinogens at 10^{-4} to 10^{-6} excess individual risk from lifetime exposure. Most regulatory actions in a variety of EPA programs have generally targeted this range using conservative models which are not likely to underestimate the risk. Since the underlying goal of the Safe Drinking Water Act is to protect the public from adverse effects due to drinking water contaminants, EPA seeks to insure that the health risks associated with MCLs for carcinogenic contaminants are in the general range of 10^{-4} to 10^{-6}.

EPA acknowledges that use of MCLs will, in some cases, result in chronic toxicity reference levels that are lower than those that would be calculated using the RfD methodology. For example, many of the non-carcinogenic compounds have MCLs which are approximately 10 to 20 percent of their respective RfDs because exposure sources other than contaminated drinking water are considered in setting the MCLs. On the other hand, the MCLs for some of the constituents addressed in the proposal are higher than the

e. Pentachlorophenol. The Agency is considering revisions to the regulatory level for pentachlorophenol (PCP) because new health data indicate that PCP is more toxic than originally assumed. Two studies of different grades of PCP material were conducted by the National Toxicology Program, and the new data indicate that PCP is carcinogenic in male and female mice under the conditions of the bioassay. These studies were used to support the proposal to list additional wastes from the wood preserving industry (53 FR 53282, December 30, 1988).

The Agency is today finalizing the higher regulatory level for PCP although the Agency expects that the regulatory level will decrease in the future. EPA has determined that it is more prudent to effect control at a higher level during the period necessary to take comment on the appropriateness of modifying the TC level.

5. Specific Inorganic Constituents

As noted earlier, EPA did not propose to add any new inorganic TC constituents in the June 13, 1986 proposal. Nevertheless, the Agency received a large number of comments addressing the eight metallic species that were already covered by the EPTC. The Agency also received many comments on the possibility of proposing TC regulatory levels for nickel and thallium (mentioned in the June 13 proposal). The principal comments are discussed below.

a. Silver. A number of commenters urged EPA to delete silver from the list of TC constituents of concern. They pointed out that a variety of studies have demonstrated that the chief effect of silver on humans is argyria, a blue-gray discoloration of the skin and internal organs. The commenters also stated that argyria is generally considered a cosmetic effect, rather than a health effect, because it does not impair the functioning of the body. While the commenters acknowledged that free silver ions may be toxic to aquatic life, they claimed that such ions are rarely discharged into the environment. Moreover, they argued that even if such ions were discharged, they would quickly be converted into insoluble salts, such as chlorides, sulfides, and phosphates. Finally, the commenters asserted that deleting silver from the TC list would be consistent with current EPA policy. They pointed out that the Agency has not proposed a Recommended Maximum Contaminant Level (RMCL) for silver in drinking water, on the grounds that silver does not cause adverse health effects.

EPA acknowledges that an RMCL (now referred to as a Maximum Contaminant Level Goal, or MCLG) has not been proposed for silver because the only known adverse effect from exposure to silver is argyria. However, the Agency has specifically requested comments on whether it is appropriate to consider argyria a cosmetic effect as opposed to a health effect (see 50 FR 46879, November 13, 1985). EPA believes it would be inappropriate to remove silver from the list of TC constituents until this issue is resolved. If EPA determines, within the scope of the Safe Drinking Water Act rulemaking, that silver does not pose a threat to human health and the environment, the Agency will consider proposing the deletion of silver from the list of TC constituents.

b. Chromium. Several commenters objected to the inclusion of total chromium as a TC constituent of concern. They argued that only hexavalent chromium (Cr(VI)) has been demonstrated to pose a threat to human health and the environment. Although they acknowledged that trivalent chromium (Cr(III)) can be oxidized to hexavalent chromium under certain conditions, they contend that such conversion is unlikely to occur in ground water environments. The commenters, in fact, claimed that iron-bearing soils are likely to effect the opposite transformation, from Cr(VI) to Cr(III). Finally, they stated that even if the oxidation reaction did occur, the resulting Cr(VI) concentrations would be so low as not to present a significant danger to human health and the environment.

EPA continues to believe that total chromium concentrations should be considered in determining whether solid wastes qualify as characteristic hazardous wastes. The Agency has long been aware of the fact that trivalent chromium is less toxic than hexavalent chromium. Nevertheless, the Agency also has been concerned that trivalent chromium could be converted to the hexavalent form under certain plausible mismanagement conditions. It is for this reason as well as the fact that the NIPDWS was developed for total chromium that the regulatory level for chromium in the EPTC was originally established on the basis of total chromium concentrations (see 45 FR 33084, May 19, 1980).

The Agency later proposed to amend the EPTC so that it would apply to hexavalent chromium rather than total chromium (45 FR 72028, October 30, 1980; see also 48 FR 22170, May 17, 1983). This proposal was based on the fact that trivalent chromium has significantly lower migratory potential than hexavalent chromium and is less mobile if it does migrate from a waste matrix. At that time, the Agency also believed that there was little likelihood that Cr(III) could oxidize to Cr(VI) under most plausible types of improper waste management.

More recent evidence, however, suggests that the conversion from trivalent to hexavalent chromium may occur in a number of environmental situations (see 51 FR 28420, July 23, 1986, fn. 6). For example, Cr(III) has been found to oxidize readily to Cr(VI) under conditions found in many field soils. This reaction is catalyzed by manganese dioxide, which is commonly present in both soils and sediments. Moreover, it has been shown that water treatment involving chlorination will effectively transform Cr(III) to Cr(VI). The normal presence of residual oxidizing capacity in treated water is capable of maintaining dissolved chromium in the higher valence state (50 FR 46936, November 13, 1985). Thus, if trivalent chromium is present in high concentrations in well water, chlorination can result in correspondingly high concentrations of hexavalent chromium at the point of exposure (i.e., at the tap).

For these reasons, EPA's original concerns regarding the potential for trivalent chromium to be converted to hexavalent chromium remain. Thus, the Agency believes that the prudent course is to regulate total chromium concentrations under the TC. It should be noted that because of this, the Agency is considering proposing the deletion of the exclusion for specific chromium wastes that contain virtually no hexavalent chromium (see 40 CFR 261.4(b)(6)(i)). Such a change would affect certain wastes from the leather tanning and finishing industry (as well as certain sludges from the production of TiO_2 pigment using chromium-bearing ores by the chloride process).

c. Nickel and Thallium. Several commenters expressed support for incorporating nickel and thallium into the list of TC analytes. One commenter emphasized that unless such a step is taken, a major inequity will continue to exist in the regulation of listed and unlisted wastes that contain comparable levels of nickel. Many other commenters, however, objected to the inclusion of nickel and thallium in the TC. Most of these commenters doubted whether either element poses a threat to human health and the environment, noting that neither one is on the Primary or Secondary Drinking Water Standards list.

unused products and off-specification variants of products that are generically identified using the name of a single toxic constituent; however, the listings would not cover other wastestreams containing the same constituent. The listings in 40 CFR 261.32 specify only a limited number of wastestreams that contain TC constituents. As another example, the spent solvent listings in 40 CFR 261.31 cover only those solvents that are used for their "solvent" properties (i.e., to solubilize or mobilize other constituents). The current listings do not encompass process wastes where solvent constituents are used as reactants or ingredients in the formulation of commercial chemical products. The Agency has previously stated that it is expanding the TC to bring these wastestreams into the hazardous waste management system (see 50 FR 53317, December 31, 1985). Thus, the Agency is appropriately promulgating TC regulatory levels for some constituents that have been used as the basis for listings.

One commenter argued that EPA's approach in selecting TC constituents was too restrictive, ensuring that many toxic constituents may never be regulated. The commenter emphasized that reliance on MCLs, RfDs, and RSDs does not provide a comprehensive list of constituents for which reliable toxicological data exist. In addition, the commenter noted that reliance on human health data does not necessarily address hazards to the environment.

EPA disagrees with the commenter's first point. Reliance on MCLs, RfDs, and RSDs uses the most sound toxicologic data base available to the Agency. At present, there are more than 365 constituents with verified toxicity levels available for EPA use. In regard to the second point, the Agency recognizes that factors other than human health effects are also important to the overall protection of the environment, but points out that the purpose of this characteristic is to identify wastes that pose hazards to human health via a ground water contamination route. In regard to the other factors, the Agency is supporting a research effort focusing on the determination of action levels for ecological effects and evaluating appropriate exposure assessment tools. When sufficient information concerning these ecological risks is available, the Agency will compare the ecological-risk-based levels to the TC regulatory levels to determine whether further revisions to these levels, based on ecological risk, are necessary.

4. Specific Organic Constituents

Many commenters expressed concern over several of the specific organic constituents that EPA proposed to include in the TC. The comments focusing on specific toxicants are discussed below.

a. Vinyl Chloride. A few commenters objected to the inclusion of vinyl chloride in the TC. They suggested that the constituent is already adequately regulated under the Clean Air Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and the Food, Drug, and Cosmetic Act (for food contact applications).

The commenters are correct in stating that vinyl chloride and polyvinyl chloride are already regulated under other environmental health and safety statutes. However, none of these other regulatory authorities address the specific problem of ensuring against releases of vinyl chloride caused by the improper management of solid wastes containing this constituent. Most importantly, none of the authorities directly protect ground water supplies from vinyl chloride contamination. Because vinyl chloride is known to be toxic to humans and has been detected in ground water supplies, EPA believes that regulating the constituent under RCRA will add significantly to the protection of human health and the environment. An analysis completed as part of the Regulatory Impact Analysis (Ref. 8) of this regulation indicates that large quantities of wastes currently not regulated as hazardous contain concentrations of vinyl chloride above the regulatory levels. Therefore, the Agency believes that RCRA regulation under the TC is an important expansion of the overall regulatory coverage of this constituent which poses a threat to human health and the environment.

b. Bis(2-chloroethyl) Ether. One commenter questioned whether incorporating bis(2-chloroethyl) ether into the TC is appropriate, since only an extremely limited quantity of the constituent could potentially be released into the environment. The commenter noted that the constituent is used almost exclusively as an intermediate in the production of ionene polymers. Moreover, it is handled primarily by a single facility, which either recycles the material or destroys it by biodegradation prior to discharge under a National Pollutant Discharge Elimination System (NPDES) permit.

The Agency is not promulgating standards for bis(2-chloroethyl) ether today. As discussed in section III.E.2.a.7, bis(2-chloroethyl ether) is expected to hydrolyze significantly during transport. EPA does not have sufficient data to address the formation and toxicity of hydrolysis products. Thus, the Agency expects to address appropriate regulatory action for this constituent, along with the other hydrolyzing constituents, in a future *Federal Register* notice.

c. Toxaphene. One commenter questioned the need to include toxaphene in the list of TC analytes. The commenter argued that toxaphene has not been produced in the United States for several years and that generators should not be required to test their wastes for "phantom" constituents that are unlikely to be present.

EPA recognizes that toxaphene is no longer produced domestically. However, because previously generated toxaphene wastes are still being managed in treatment, storage, and disposal facilities there is still a potential threat to human health and the environment from improper management of wastes containing this constituent. Thus, wastes containing toxaphene above the regulatory level should be managed as hazardous wastes.

Moreover, toxaphene has been regulated as an EP constituent since 1980 and today's rule retains the existing regulatory level. Thus, today's rule does not alter any regulatory requirements with respect to toxaphene. The Agency does not believe that maintaining toxaphene as a TC constituent is unnecessarily burdensome to the regulated community. The final TC rule does not require solid waste generators to test their wastes. Instead, generators may continue to determine whether their wastes exhibit the hazardous waste characteristics by relying on their knowledge of the materials and processes that they employ (see 40 CFR 262.11(c)(2)). Accordingly, generators who have reason to believe that their wastes contain no toxaphene are not specifically required to test for that constituent.

d. Phenol. One commenter urged EPA to delete phenol from the list of TC constituents of concern because phenol biodegrades under both aerobic and anaerobic conditions.

The Agency is not including phenol in today's rule because the steady-state assumption used in the model to calculate DAFs in this final rule may not be appropriate for phenol. The Agency will promulgate a TC regulatory level for phenol at a later date.

The issue of biodegradation is discussed in section III.E.2.a.9 as it pertains to phenol and other constituents.

would render the waste "hazardous" under RCRA subtitle C. Fourteen of the constituents were already encompassed by the existing EPTC. The selection of the remaining 38 constituents was based on the availability of adequate and verified data necessary for establishing (1) a chronic toxicity reference level and (2) a constituent-specific DAF. Thus, the Agency focused on those constituents for which there existed a promulgated or proposed Maximum Contaminant Level (MCL), a Reference Dose (RfD), or a Risk-Specific Dose (RSD), and for which there were sufficient data on environmental fate and transport processes to support modeling of a constituent-specific DAF. The June 13, 1986 proposal also announced EPA's intention to expand the list of TC constituents as additional data became available.

1. Final List of Constituents

The Agency is finalizing the regulatory levels for 25 of the proposed organic constituents (see Table B-1) that do not readily hydrolyze and for which a steady-state subsurface fate and transport model is appropriate. EPA may promulgate or repropose (as warranted) regulatory levels for the other organic constituents at a future date.

TABLE B-1.—LIST OF ORGANIC CONSTITUENTS INCLUDED IN THE EXPANDED TC RULE

Benzene	Hexachloro-1,3-butadiene
Carbon tetrachloride	Hexachlorobenzene
Chlordane	Hexachloroethane
Chlorobenzene	Methyl ethyl ketone
Chloroform	Nitrobenzene
m-Cresol	Pentachlorophenol
o-Cresol	Pyridine
p-Cresol	Tetrachloroethylene
1,4-Dichlorobenzene	Trichloroethylene
1,2-Dichloroethane	2,4,5-Trichlorophenol
1,1-Dichloroethylene	2,4,6-Trichlorophenol
2,4-Dinitrotoluene	Vinyl chloride
Heptachlor (and its hydroxide).	

Constituents with regulatory levels established under the EPTC will continue to be regulated at previously established levels, but will require application of the new TCLP instead of the EP.

2. Toxicants Versus Indicator Parameters

A few commenters recommended that EPA abandon its current focus on individual toxicants and rely instead on such indicator parameters as total organic carbon or total organic halogens. The commenters argued that such an approach would broaden the effective scope of the rule and reduce the burdens associated with making hazardous waste determinations.

The Agency does not believe it would be appropriate to use indicators as part of the TC. Indicators generally are used as screening levels or to set priorities for further investigations. They do not achieve sufficient specificity for the regulatory purposes of the TC. For instance, the two indicators suggested by the commenters do not in any way reflect differences in toxicities among organic constituents. Consequently, use of these indicators could lead to both nonhazardous wastes registering as hazardous and wastes that are clearly hazardous registering as nonhazardous.

3. Method for Selecting Constituents

Several commenters questioned the manner in which EPA selected toxicants for inclusion in the TC proposal. Some of these commenters charged that the Agency's choice of toxicants was entirely arbitrary. Others claimed that EPA had based its selections solely on the availability of toxicologic and hydrogeologic data, without considering the magnitude of the hazards presented by the constituents.

The commenters, in general, encouraged EPA to develop specific procedures and criteria for deciding which constituents should be included in the TC. A few commenters offered particular suggestions for the types of factors that might be considered in evaluating toxicants. The recommended factors included (1) the mobility and persistence of the constituents, (2) the frequency with which particular constituents have been found in industrial wastes or leachates from such wastes, and (3) the extent to which various constituents have been detected in ground water supplies in concentrations capable of posing a threat to human health and the environment.

EPA believes that its method for selecting TC constituents is both rational and consistent with the statutory mandate. While selection of constituents in today's rule is in part based on available toxicological data, it should be noted that both the fate and transport of constituents and the magnitude of hazards posed were also given consideration. The toxicants for which regulatory levels are being promulgated today are persistent and can represent a substantial threat to human health and the environment. Because of the lack of reliable data on the frequency with which certain toxic pollutants are found in leachates or ground water, an approach relying on such information would not provide an accurate and valid basis for selecting constituents. Further, where data do exist concerning the frequency at which certain constituents are found in the environment, accompanying information about risk posed in the environment is often absent.

Although the Agency proposed levels only for toxicants for which it has adequate and verified data, generally these data are available because these toxicants do represent a substantial threat to human health and the environment. The Agency will consider adding constituents as additional toxicological data and other supporting data become available; in making such decisions, the Agency will consider the factors identified by the commenters. Until such data are available, there is no technical basis to determine at what level a waste is hazardous under the TC.

A number of commenters argued that EPA was needlessly "cluttering" the characteristic with low-priority constituents that are either not being produced in the United States or are primarily found in wastes that are already subject to regulation.

The Agency does not agree that a substance no longer manufactured in the U.S. will not pose a threat from waste disposal. Some such substances may be contained in products imported into the U.S. Also, wastes generated during cleanup at Superfund sites or RCRA corrective action sites may exhibit the TC due to the presence of these constituents in wastes disposed at some time in the past. Further, the constituents could be manufactured again in the future.

Several of the toxicants listed in today's rule also appear among the list of discarded commercial chemical products, off-specification products, and container and spill residues, as listed in 40 CFR 261.33. A group of commenters argued that it would be redundant to establish regulatory levels for these toxicants because they are already regulated as listed hazardous wastes. Similarly, several commenters argued that some other listed wastes are regulated as hazardous wastes primarily because they contain constituents that will be regulated under the new TC.

EPA does not agree that setting levels for the selected toxicants would be redundant. While it is true that many of the newly designated TC constituents are constituents in wastes that are specifically listed as RCRA hazardous wastes, the current listings do not cover all of the wastestreams that may contain the TC constituents. For example, the commercial chemical product listings in 40 CFR 261.33 primarily encompass

and transport model used to establish the dilution/attenuation factors (DAFs), requires the selection of numerical values for many parameters. Rather than selecting values for each parameter based upon isolated judgments as to what constitutes a "reasonable worst case" value, the Agency used the full range and distribution of values for all parameters for which such data was available. By implementing these data sets through a monte carlo simulation, the model output (i.e., the frequency distribution of DAFs) is as realistic as possible and spans the range of all possible outcomes rather than representing only the "best case," "reasonable worst-case," etc. That is, the model output represents all cases, arrayed according to their frequency of occurrence, and does not reflect any qualitative judgement as to what constitutes a "reasonable worst case" or any other "case." Accordingly, the determination as to which DAF value represents any particular "case" is solely dependent upon the selection of the cumulative frequency level. The Agency's selection of the cumulative frequency level is discussed in section III.E.4.d.

EPA does agree with commenters who recommended that the originally proposed subsurface fate and transport model could be revised to more realistically represent land disposal settings. Accordingly, EPA has modified the original model (EPASMOD) and has collected and incorporated new data into the model. These modifications and data are described in greater detail below (section III.E). The reader is referred to the Response-to-Comments Background Document for the Subsurface Fate and Transport Module (Ref. 1), which presents in detail each of the technical issues raised by public comments on the model and the Agency's responses to these issues. EPA believes that with these changes, the final TC rule represents a reasonable approach to the identification of hazardous wastes.

5. Solvent Override

In the June 13, 1988 TC proposal, the Agency discussed the possibility of incorporating a solvent "override" criterion into the TC because the presence of large amounts of solvents in a waste may result in leachate from the waste mobilizing hazardous constituents from co-disposed nonhazardous waste. The Agency considered setting regulatory levels for solvents based on the total concentration of solvent found in the TCLP extract.

Many commenters claimed that mobilization of toxicants in municipal landfills by industrial solvents is improbable. Commenters argued that there are no data to support the hypothesis that industrial solvents would alter the solubility of hazardous constituents in municipal waste. These commenters asserted that, at levels below their solubility in water, organic solvents exert very little influence on the solubility of other organics. Given the low concentrations of solvent wastes permitted for land disposal, the commenters contended that there is little probability that mobilization will occur. Commenters emphasized that, in general, subtitle D landfills do not accept organic solvents or liquids. Most industrial solvents already are listed hazardous wastes under 40 CFR 261.32 and 261.33 and will be managed in subtitle C hazardous waste facilities. Also, commenters contended that the contribution that industrial solvents will have on the solvent power of a solid-waste-landfill leachate is small compared to the contribution from solvents in household and small quantity generator waste.

Other commenters, however, expressed their support for EPA's proposal to characterize a waste by its ability to leach hazardous constituents from co-disposed wastes. They urged that a method be devised to monitor the influence that solvents have on the solubility of other waste constituents. One commenter suggested that the TCLP leachate could be tested for its ability to dissolve hazardous waste.

After careful consideration of the comments on this issue, EPA has decided not to include a solvent override in today's revision of the TC. EPA is not convinced by commenters who stated conclusively that mobilization of toxicants in municipal landfills by industrial solvents is improbable. EPA also is not convinced that the solvent contribution of industrial wastes at municipal landfills is small compared to that of household waste and small quantity generator waste. Moreover, the comparison to household waste and small quantity generator waste is not relevant to the issue of whether industrial wastes should be regulated based on solvent properties. However, the Agency does agree that there is insufficient data concerning the degree to which industrial solvents would mobilize other hazardous constituents and the amount of solvent wastes that are actually land disposed. Given this lack of data, a solvent override has not been included in today's rule. However, an override may be considered in future rulemakings if information becomes available that indicates a characteristic based on solvent properties is warranted.

One commenter claimed that RCRA does not authorize the imposition of restrictions based on toxicity simply because a substance can mobilize other constituents. The commenter asserted that the authority may reside elsewhere in RCRA, but in that case, a separate rulemaking, not involving the TC, should take place.

EPA does not agree; RCRA clearly authorizes EPA to regulate a waste as hazardous on the basis of its ability to mobilize other constituents. Further, regulating a waste as hazardous based on its ability to mobilize other constituents could be appropriately achieved through the characteristic mechanism. A solid waste is defined as hazardous if its "physical" or "chemical" characteristics "may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed" (RCRA section 1004(5)). The capacity to mobilize toxic constituents falls within the definition of a physical or chemical characteristic of a waste which may pose a substantial environmental or health hazard. Thus, EPA may incorporate this approach into its characteristic waste identification scheme in the future.

Related to the issue of solubilization, another commenter asserted that if a chemical's capacity for mobilization is considered, treatment implemented to prevent mobilization (e.g., stabilization, containment, and chemical conversion) should be given equal consideration.

The TCLP does consider immobilization in the context of the co-disposal mismanagement scenario. The TCLP was developed to simulate leaching in a municipal landfill, addressing the degree of mobility (or, conversely, immobility) of both organic and inorganic compounds. Wastes that have been treated to prevent mobilization are less likely to leach toxic constituents. Such wastes may cease to exhibit the TC and would therefore no longer be considered hazardous wastes. Thus, the TCLP already accounts for immobilization of toxic constituents in a waste. However, if wastes that have been treated to prevent mobilization fail the TC, EPA believes that the wastes in question should be managed as hazardous wastes.

B. Constituents of Concern

As noted above, the proposed TC rule identified 52 constituents that, if present at specified levels in a waste extract,

2. The "physical property-based" approach, which would apply to those wastes having a certain physical property indicating that they are likely to be managed in surface impoundments (e.g., percent solids less than 5 percent); and

3. The "definition-based" approach, which would apply to those discharged wastewaters that are subject to regulation under either section 402 or section 307(b) of the Clean Water Act.

Commenters from various industries generally supported a separate mismanagement scenario because they do not believe that the landfill mismanagement scenario is appropriate for aqueous wastes managed in surface impoundments. Most of these commenters requested that EPA adopt either the management-based approach or the definition-based approach.

Other commenters, however, opposed a separate mismanagement scenario for wastes managed in surface impoundments. These commenters contended that the surface impoundment mismanagement scenario would not be a reasonable worst-case scenario, particularly if the scenario modeled biodegradation, because significant biodegradation does not occur in all impoundments. In addition, the commenters stated that if the development of a surface impoundment mismanagement scenario results in two sets of regulatory levels, requirements for storage, handling, and transportation of a waste would be based on the management practice that the generator assumes or expects will actually occur. These commenters were opposed to this result and noted that wastes may not always be ultimately disposed in the manner originally intended by the generator.

After receiving these comments, the Agency decided to revisit the issue of whether or not a separate mismanagement scenario is necessary for surface impoundments due to inappropriately low regulatory levels. As described in section III.E.2, the Agency believes that evaluation of the physical phenomena that affect dilution/attenuation factors (DAFs) indicates that the DAFs generated for landfills are similar, if not greater than, DAFs for surface impoundments (i.e., the regulatory levels for surface impoundments would be equal to or more stringent than those for landfills). To confirm this conclusion, EPA then investigated whether results from modeling a surface impoundment scenario would in fact be significantly different from modeling a landfill scenario. As described later in this preamble, for nondegrading constituents, EPA calculated the 85th and 90th percentile DAFs for landfills (which ranged from 134 to [illegible]) and the 85th and 90th percentile DAFs for surface impoundments (which ranged from 111 to 51). The surface impoundment results were obtained by using the updated model (EPACML) for the landfill scenario with leachate generation and environmental parameters (e.g., well distances, facility areas) derived from surface impoundment data.

As a result of this analysis, EPA is confident that the results from modeling of the landfill mismanagement scenario are also appropriate for wastes managed in surface impoundments (i.e., the DAFs are of the same order of magnitude). The Agency therefore does not plan to develop a separate surface impoundment mismanagement scenario at this time. Since the modeling results indicate that the dilution/attenuation factors for non- and minimally degrading constituents are all on the order of 100, the Agency has concluded that a single value of 100 is an appropriate choice for use in establishing the regulatory levels for all of the constituents addressed in today's rule. (See section III.E. of this preamble for an additional explanation of EPA's modeling efforts and choice of DAFs.)

3. Targeted Risks

Several commenters argued that, even if the co-disposal mismanagement scenario was appropriate, EPA improperly focused on a few selected risks from this scenario. Specifically, they claimed that the Agency restricted its consideration to human health risks resulting from ground water contamination. A number of commenters stated that the Agency should consider additional routes of human exposure, such as air volatilization, surface runoff, and direct contact. One commenter questioned why EPA was not employing the same multimedia risk and exposure models that were originally proposed for use in the land disposal restrictions program (see 51 FR 1602, January 14, 1986).

A few commenters further suggested that EPA take environmental risks (e.g., aquatic toxicity) into account, rather than concentrating exclusively on human health risks. They noted that RCRA section 3001(g), on which the TC rule is based, directs EPA to make changes in the EPTC so that it "accurately predicts the leaching potential of wastes which pose a threat to human health *and the environment* when mismanaged" (emphasis added).

EPA acknowledges that the characteristic being promulgated today focuses on human health risks from ground water contamination. However, the Agency does not believe that a single characteristic is capable of identifying all wastes that present a threat to human health and the environment. The present TC revisions are only the first step in a long-term strategy to refine and expand the hazardous waste identification program. Future characteristics may address hazards other than human health risks resulting from ground water contamination. EPA continues to believe, however, that ground water contamination, as a route of human exposure, is a priority concern.

4. Accuracy

Several commenters asserted that the proposed TC revisions failed to fulfill the statutory mandate to improve the "accuracy" of the characteristic as a predictor of the leaching potential of solid wastes. Specifically, these commenters argued that, even if EPA selected the proper mismanagement scenario, the Agency failed to model the targeted risks in a reasonable or appropriate manner. (Many of the commenters addressing this issue also focused on the accuracy of individual elements of the characteristic, such as the TCLP, the subsurface fate and transport model, or the chronic toxicity reference levels. These specific concerns are considered in sections III.B through III.F of today's preamble.)

A number of the commenters on the issue of accuracy concentrated on the interrelationship between the various elements of the TC. These commenters pointed out that EPA had employed conservative assumptions at each step in the development of the revised characteristic. They argued that even if these assumptions were reasonable in isolation, they would not be reasonable in combination. According to these commenters, the effect of compounding multiple conservative assumptions would be a characteristic that is unreasonably conservative, thereby resulting in costly overregulation.

Other commenters maintained the opposite position and stated that EPA had employed non-conservative assumptions for many elements of the characteristic. These commenters believe that these assumptions result in a characteristic that is not conservative enough and, thus, not sufficiently protective of human health and the environment.

The Agency disagrees with commenters' assertions that the elements of the TC are either too conservative or not conservative enough. The TC, in particular the fate

concentrations will not exceed the allowable health-based concentrations in more than 15 percent of all possible analyzed settings of subtitle D disposal units. (This proposal referenced other proposals dealing with the ground water transport model, such as the January 14, 1986 Land Disposal Restrictions notice, and notices published by the delisting program; relevant comments received in response to those notices are also discussed in this rulemaking.)

b. *August 1, 1988 Notice of Data Availability and Request for Comments; Supplement to Proposed Rule (32 FR 28892).* On August 1, 1988, the Agency presented new data related to subtitle D municipal landfills, soil characteristics, and chemical-specific hydrolysis rates to be used with the subsurface fate and transport model to calculate DAFs for each of the organic constituents in the TC. These new data became available to the Agency after the June 13, 1988 proposal. The August 1, 1988 Notice also requested comments on several major revisions to EPASMOD that were being considered by the Agency, subsequently referred to as EPA's Composite Model for Landfills (EPACML). As a result of comments received on the January 14, 1986, and June 13, 1988 proposals, as well as the August 1, 1988 Notice, the Agency has used EPACML to support the choice of appropriate DAFs for this rulemaking.

These modifications and data are described in greater detail below (section III.E.2). The reader is referred to the Response-to-Comments Background Document for the Subsurface Fate and Transport Module (Ref. 1), which presents, in detail, each of the technical issues addressed in the public comments on the model and the Agency's response to these issues.

2. Modifications of the Subsurface Fate and Transport Model (EPASMOD) in Response to Comments

In today's rule, the Agency has used EPACML to estimate the attenuation and dilution of specific constituents during their migration through the unsaturated zone beneath a municipal landfill and their transport through the saturated zone to a potential drinking water source (exposure point). EPACML accounts for dispersion in the longitudinal, lateral, and vertical directions; one-dimensional steady and uniform advective flow; sorption; and chemical degradation from hydrolysis. The major enhancements that were made to EPASMOD to produce EPACML, the substantive comments that led to these changes, and important assumptions made to develop analytical solutions are described in subsection (a) below.

In addition, the Agency used the EPACML model to corroborate its conclusions on dilution/attenuation factors for surface impoundments. For this exercise, data inputs typical of surface impoundments rather than landfills were used. These procedures are described in subsection (b) below.

a. *General Modifications—i. Unsaturated Zone.* The EPASMOD model discussed in the June 13, 1988 proposal assumed that there was no unsaturated zone (i.e., the bottom of the landfill is directly connected to the top of the aquifer). Several commenters stated that the assumption that the facility is located directly at the top of the saturated zone is unrealistic because an unsaturated zone usually exists above the aquifer and that retardation, dilution, and degradation effects in the unsaturated zone should be considered. The commenters also suggested that, when incorporating the unsaturated zone, the depth to the water table should be incorporated as part of the monte carlo analysis.

The Agency is in agreement with the commenters and has now included an unsaturated zone as part of the subsurface model. The Agency believes that this modification to the model is reasonable, based in part on a survey of existing municipal landfills that indicated that an unsaturated zone exists beneath 95 percent of the surveyed landfills. Incorporating an unsaturated zone into the model accounts for any retardation and degradation of chemicals in the unsaturated zone and provides a more realistic scenario.

To account for the unsaturated zone, the Agency developed unsaturated zone flow and transport modules and implemented them using the monte carlo (probabilistic) framework that has already been used in conjunction with the saturated zone modeling approach in EPASMOD; these unsaturated zone modules are incorporated into EPACML. The input concentration to the unsaturated zone transport module of EPACML corresponds to the leachate concentration at the bottom of the landfill.

The unsaturated zone model was reviewed by EPA's Science Advisory Board (SAB). The SAB endorsed the use of the model for applications for the development of regulations; however, the SAB recommended that it not be used for site-specific applications because the model has limitations imposed by the simplifying assumptions (those necessary for regulatory use), and the limitations of the use of site-spe[illegible] data. The unsaturated zone model consists of two modules: a flow component and solute transport component. These two components developed in a form to allow for the incorporation in the monte carlo simulation. The major assumptions [illegible] consequences of the flow module ar[illegible]

• *Flow is steady in the vertical direction, and lateral and transverse movement of the leachate is negligib[illegible]* Because there is little or no lateral fl[illegible] in the unsaturated zone, these assumptions are appropriate. In any case, this procedure will tend to maximize the concentration of leach[illegible] leaving the unsaturated zone and therefore represents a conservative assumption.

• *No vapor phase or immiscible liquid flow occurs, and the water ph[illegible] is the only flowing material.* EPA acknowledges that some constituent[illegible] some situations may undergo phase shifts and be emitted in vapors. Beca[illegible] this rule is essentially directed to ris[illegible] from drinking water and because of [illegible] uncertainties in accurately computin[illegible] emissions and their relationship to th[illegible] currently available leaching tests, th[illegible] conservative assumption was adopte[illegible] Under certain conditions, particularl[illegible] very high constituent concentrations, immiscible liquid flow can occur. For such situations, the model's inability account for the immiscible flow condition may lead to higher downgradient concentrations (i.e., th[illegible] model would underestimate the rece[illegible] well concentrations).

• *Flow is isothermal (not affected temperature variations).* In reality, temperature variations at any given [illegible] are not dramatic because the source infiltrating liquid is precipitation. Th[illegible] this assumption is not expected to influence the results to any apprecia[illegible] degree.

• *Effects of variations in the unsaturated zone hydraulic propertie[illegible] caused by alternating moisture conditions are negligible (i.e., hystere[illegible] effects).* Many soils, especially the mo[illegible] porous ones for which infiltration rat[illegible] are high, do not present important hysteresis effects. In other cases, littl[illegible] and often no data are available to characterize the effects. Failure to include hysteresis is not expected to affect the results to any appreciable extent.

• *The flow field is uniform and continuous in direction and velocity.* Precipitation-driven infiltration can [illegible] dynamic process where much of the vertical movement occurs during relatively short periods of time. Tim[illegible]

averaged values of infiltration derived from dynamic water balance calculations (as described in the Background Technical Support Document) are often used to enable solution of analytical, steady-flow models. The unsteady-flow conditions could lead to higher downgradient concentrations than predicted by EPACML. However, the effect is expected to be significant only for rapidly degrading constituents. For the constituents regulated in this rule, no appreciable impact is expected because none of the constituents are expected to hydrolyze to any significant extent during transport.

• *The unsaturated zone is homogeneous and isotropic.* This assumption is typically required to enable mathematical solutions amenable to exhaustive sensitivity analyses and monte carlo implementation. In any one application (one model run) of this assumption, the result can either under- or over-predict downgradient concentrations. The monte carlo implementation, however, results in a very wide range of possible conditions, and thus the total analysis, when taken together, accounts for a wide variety of unsaturated zone conditions.

The major assumptions and consequences of the unsaturated zone transport module are:

• *Chemical transport is vertical: lateral and transverse movement of the chemical is negligible.* This follows from the first assumption for the flow module described above.

• *Chemical sorption is modeled as a reversible, linear equilibrium process.* This is a standard modeling assumption which is accurate for systems having relatively low solute concentrations, and conservative at higher concentrations.

• *Degradation is limited to hydrolysis.* This assumption was made to be consistent with the similar approach adopted for the saturated zone. Thus, the model includes only those degradation mechanisms that can be reliably characterized in laboratory studies of each individual constituent. This assumption remains a major conservative component of the overall model.

• *Chemical transport in the vapor phase has been assumed to be negligible.* This follows from the second assumption for the flow module described above.

• *The unsaturated zone transport model is solved for the steady-state condition.* This is a conservative assumption that has been investigated for its impact on all the originally proposed constituents. The extent to which this assumption is appropriate is discussed in section III.E.4(b)(iii).

The details of the unsaturated zone module are provided in the background documents (*Ref.* 1, 9), which also describe the data sources and analyses that were performed to obtain the data distributions.

ii. Source Characterization. In EPASMOD, the input leachate to the saturated zone was assumed to be instantaneously mixed in the vertical direction over a pre-specified depth of source penetration, and the concentration in the leachate was equal to the maximum source contaminant concentration in the saturated zone below the facility. Mass balance considerations required that the lateral extent of the leachate directly underneath the facility be adjusted to ensure that leachate was neither gained nor lost in the transition from the facility (or unsaturated zone) to the aquifer. A number of commenters criticized the treatment of the source. A major concern was that the method was inadequate because of an overly conservative assumption, which equated the concentration of the contaminant in the saturated zone to the landfill leachate concentration. Thus, commenters argued that EPA had not given adequate consideration to mixing and dispersion under the landfill. The commenters also pointed out that this treatment of the source could result in modeling physically unrealistic boundary conditions (e.g., by modeling a source of small cross-sectional area with a very large width of the Gaussian source, and vice versa).

The Agency agrees with the commenters that the method used to characterize the source-boundary conditions for the saturated zone transport needed to be improved. Thus, the method has been revised to consider the mass balance requirements, geometrical configurations, and physical processes that are occurring in the mixing zone below the facility and within the saturated zone. An important characteristic of the revised method is the plume restriction in the lateral extent. That is, the method no longer permits physically unrealistic situations where the plume source width exceeds the facility width. In addition, the current method of computing the source-boundary conditions represents the mixing and dilution effect on the leachate below the source and ensures that the concentration of the contaminant in the saturated zone will be less than or equal to the landfill leachate concentration.

iii. Treatment of Dilution from Recharge. In EPASMOD, the dilution effect of ground water recharge on contaminant transport in the saturated zone was taken into account by including recharge as a dilution term in the governing equation. Dilution of leachate concentrations from recharge was calculated by dividing the infiltration (recharge) rate by the source penetration depth. A number of commenters were concerned that the influence of recharge on the ground water flow field had not been properly accounted for in the model. In addition, several commenters alerted the Agency to an error in the equation used to evaluate the recharge dilution parameter.

In response to these comments, the Agency has modified the model to calculate dilution from recharge by dividing the recharge rate by the total saturated thickness of the aquifer, the aquifer porosity, and the effective retardation factor in this zone. This revision represents a more realistic assessment of the dilution potential of recharge by considering changes in the entire volume of water in the contaminated aquifer and the effectiveness of contaminant and recharge flow and mixing in the aquifer.

The Agency recognizes that recharge effects on ground water flow fields are not rigorously considered in the model and that the assumption of uniform, constant, horizontal ground water velocity neglects the possible effects of local mounding of the water table underneath the land disposal unit. However, the constant velocity assumption can be interpreted as an averaging of the velocity field over the spatial area affected by recharge: in addition, the uniform, horizontal flow assumption was necessary to make the three-dimensional transport equation analytically solvable. The effect of recharge on ground water velocity is difficult to account for directly in the model. To assist in the analysis, EPA has conducted a sensitivity analysis comparing EPACML results with recharge effects as predicted by a two-dimensional numerical model that rigorously accounts for recharge. The results (which can be found in *Ref.* 9) indicated that as long as recharge values are significantly less than the natural flow velocity, there was no major effect on the ground water flow fields. Based on this analysis, and on evidence of typically low rates of ground water recharge, the Agency believes that the revised treatment of the dilution effect from recharge is reasonable. In addition, the error, as pointed out by several commenters, in the equation used to evaluate the recharge dilution

parameters was corrected, and the correction is included in EPACML.

iv. *Location of the Receptor Well.* In EPASMOD, the receptor well was assumed to be located downgradient from the landfill along the centerline of the plume (direction of ground water-flow) at a fixed distance of 500 feet (152.4 m). In addition, the receptor well was assumed to be tapping water from the top of the aquifer, and no mixing of water in the well or effects of drawdown in the well were considered in EPASMOD.

Many commenters argued that the assumptions concerning the location of the receptor well were too conservative and suggested that well locations should be considered in a probabilistic manner as part of the monte carlo simulation in the model. These commenters noted that well locations other than on the centerline should be considered. Several commenters also stated that the well locations should not be restricted to lying within the areal extent of the plume and suggested that wells located outside of the plume should be considered in the calculation of the dilution/attenuation factors.

The Agency agrees that the proposed location of the well was unrealistic and that affected wells located at points other than on the centerline should be considered. Therefore, the model now considers well locations anywhere within the areal extent of the contaminant plume. In order to incorporate these locations, a distribution of distances to downgradient wells was develop based upon a subtitle D municipa landfill survey (Ref. 6). These dist were used as part of the monte ca analysis. Also, to incorporate loc other than on the centerline, the Y values (see Figure 1) were selecte randomly over a 180° domain but Y pairs were constrained to value were located within the areal ext the plume.

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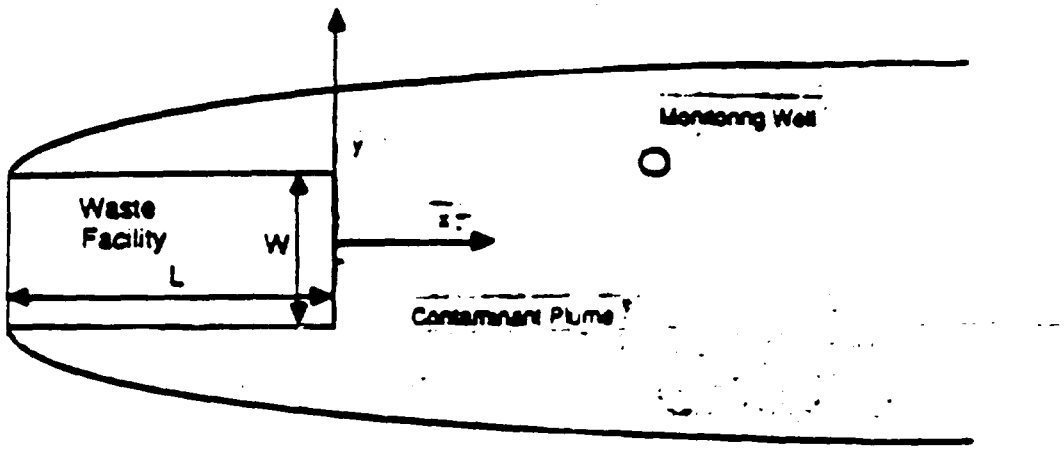
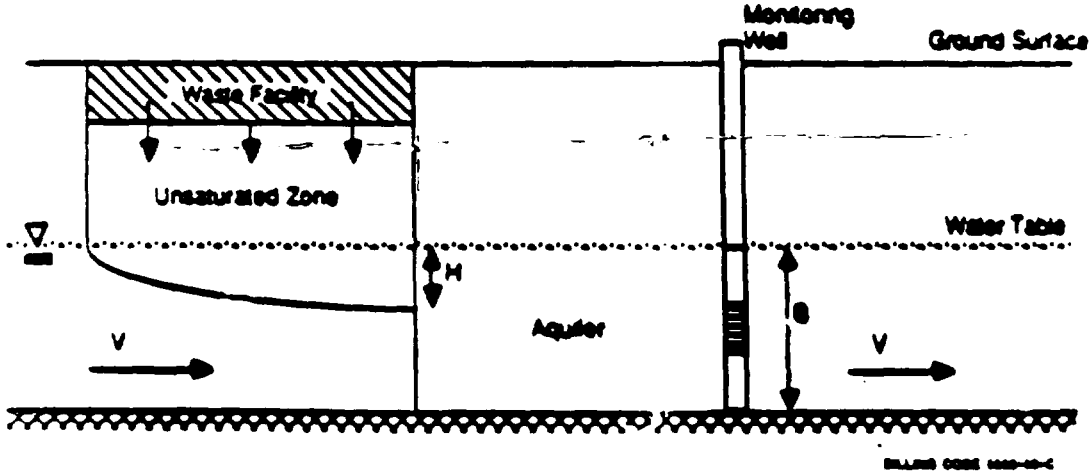
FIGURE 1

A SCHEMATIC OF THE WASTE FACILITY SOURCE BOUNDARY CONDITION AND LEACHATE MIGRATION THROUGH THE UNSATURATED AND SATURATED ZONE

PLAN VIEW



SECTION VIEW



The Agency disagrees with those commenters who stated that well locations outside of the areal extent of the plume should be considered. The purpose of the Toxicity Characteristic is to answer the question "If the management of this waste continues to be uncontrolled, what are the consequences in terms of human exposure via ingestion of contaminated drinking water?" In performing the exposure assessment to answer this question, the Agency believes it appropriate to consider only wells that could be affected by the disposal of the waste. Wells that could not be affected by the migration of constituents from the wastes are obviously irrelevant to the exposure assessment and, thus, not considered.

Commenters also stated that it was unrealistic to assume that the well tapped water from only the uppermost point of the aquifer. These commenters stated that, in practice, the intake portion of a well is located below the top of the water table and that mixing and drawdown will occur.

The Agency agrees that the proposed well intake location was unrealistic and that it ignored the effects of vertical mixing and the possibility that the well intake would likely be at some point other than the top of the aquifer. In response, the assumption has been modified to consider well intake at any point throughout the depth of the aquifer. This modification largely takes into account the above-described mixing and drawdown effects.

In determining how to account for well drawdown more realistically in the model, the Agency considered the mechanics of well construction. Generally, wells are screened from near the top of the aquifer to a sufficient depth (into the aquifer) to allow delivery of the needed water supply. Thus, the ranges of values for the length of the screens and their locations relative to the top of the aquifer are very large. In recognition of this variability, especially in screen length, the Agency has employed a simplifying assumption that the concentrations of constituents at various depths of the aquifer represent the concentrations at the exposure point. That is, the concentration of constituents in the water drawn from the well is assumed to be equal to the concentration of the constituents at the depth which is selected in the monte carlo simulation. (The well depth is randomly selected from all points within the vertical range of the aquifer's thickness.)

To evaluate the model's sensitivity to this assumption, the Agency evaluated the case in which wells were assumed to be screened from the top of the aquifer to the monte-carlo-selected depth. The exposure point concentration was then calculated as the average concentration over the screened depth. This case is considered to be more representative of the most likely well design, although in many cases the well will not extend to the bottom of the aquifer nor will it always be constrained to intersect the plume as is implemented in the monte carlo simulation. This scenario is considered to be more conservative (i.e., resulting in lower DAFs) than the EPACML-as-implemented scenario. When one considers other possibilities like well location factors up gradient and outside the plume, the range of DAFs from the two scenarios can be expected to bound the actual exposures.

In evaluating the model predictions over the range of cumulative frequency values considered in interpreting the model's results in today's rule (see Section III.E.4—DAF Evaluation), the dilution/attenuation factors for the two scenarios are not sufficiently different to warrant separate conclusions regarding the appropriate value for use in today's rule. (Model results for the two scenarios are compared in the background document for the model—Ref. 8.)

v. Dispersivity Values. Dispersivity controls the degree of spreading of dissolved contaminants in the subsurface. The saturated-zone fate and transport model includes dispersion in the longitudinal, transverse (horizontal), and vertical directions. The model thus requires values of the longitudinal, transverse, and vertical dispersivities in the saturated zone. In EPASMOD, the distance x from the downgradient edge of the landfill to the receptor well was assumed to be fixed at 152 m (500 feet). Consequently, fixed values of the longitudinal and transverse dispersivities were used in the model. The values of vertical dispersivity were assumed to vary uniformly.

Several commenters criticized the assumption that dispersivity values did not vary and reflected only the fixed distance selected in the model. They also suggested that the ratio of longitudinal to transverse dispersivity used in the model was too low. The basis of their comments is that field values of dispersivities have been shown to depend on, and usually increase with, the travel distance.

The Agency agrees with the commenters and now calculates the three components of dispersivity based on a detailed analysis of data gathered from field tests (the model background document (Ref. 9) presents a detailed discussion on dispersivity values and provides references to the fi[illegible] The Agency believes that the [illegible] approach, reflecting the distance dependent nature of the disp[illegible] values and different relations between the dimensional dis[illegible] is more realistic and consists [illegible] available data.

EPACML also requires the specification of a dispersivity for transport in the unsaturated [illegible] Since the transport equation [illegible] unsaturated zone is one-dim[illegible] only the longitudinal (vertical) dispersivity value is required [illegible] calculated as a function of th[illegible] (i.e., the depth to water table) in the unsaturated zone.

vi. Hydraulic Conductivity. [illegible] EPASMOD, the value of hydr[illegible] conductivity in the saturated [illegible] estimated using the Kozeny-C[illegible] (Ref. 9) expression, which rel[illegible] hydraulic conductivity to por[illegible] mean particle diameter of the [illegible] material, and the fluid proper[illegible] (density and viscosity). This [illegible] was based on an assumed gr[illegible] temperature of 15 degrees C [illegible] reflect changes in the fluid pr[illegible] with temperature.

Commenters expressed co[illegible] this assumption because grou[illegible] temperature is known to typi[illegible] in temperature from 4 degrees [illegible] degrees C. A few commenter[illegible] expressed concern regarding [illegible] of using this empirical relatio[illegible]

In response to these comm[illegible] Agency generalized the expre[illegible] include the effects of changes [illegible] temperature on fluid viscosity [illegible] density. That is, the fluid visc[illegible] density are now considered [illegible] of temperature rather than as [illegible] The Agency realizes that the [illegible] conductivity also depends on [illegible] properties, such as grain shap[illegible] size distribution, packing, an[illegible] of the porous media. Porosity [illegible] measurements reflect the com[illegible] result of these textural charac[illegible] on the structural arrangement [illegible] porous media. The range of po[illegible] values derived in EPACML in[illegible] reflect the impact of these pro[illegible] Therefore, in view of the Age[illegible] objective to represent the wo[illegible] variations expected from site [illegible] Agency decided to retain the [illegible] Carman equation [illegible] modification described above.

vii. Hydrolysis. As already [illegible] in section III.E.2., the EPACM[illegible] accounts for reduction in con[illegible] concentrations due to hydrol[illegible] results in higher DAFs for co[illegible] that hydrolyze during transp[illegible]

constituents that do not. The DAF predicted by the model for some of these constituents ranges up to one million. Thus, in some cases, wastes would not be considered hazardous unless they contain large amounts of these toxicants; still, in other cases, no amount of toxicant in the waste would define it as hazardous under this scenario. Therefore, the Agency did not believe it appropriate to include these constituents in the TC (see Table E-2 for list of constituents that appreciably hydrolyze). Furthermore, the model does not account for the degradation products that are produced as the original constituents hydrolyze. That is, while the decrease in the concentration of the original constituent is accounted for, the resultant increase in concentration of the hydrolysis products is not. Several commenters stated that the toxicity and transport of the potential hydrolysis products should be considered to fully assess the hazards posed by the constituents that hydrolyze.

The Agency agrees with the commenters and is (1) determining which byproducts result from hydrolysis and (2) developing an appropriate protocol for predicting the concentration of hydrolysis byproducts (see Table E-2). Once this protocol is developed, the Agency will determine whether any of these toxicants should be added to the list of constituents. While the Agency considered including these constituents at a higher dilution and attenuation factor until this work was completed, the Agency does not have sufficient information at this time to determine which of the constituents listed in Table E-2 will eventually be added to the TC and at what level.

TABLE E-2—HYDROLYZING CONSTITUENTS LISTED IN THE JUNE 13, 1986 PROPOSED RULE

Acrylonitrile
Bis(2-chloroethyl) ether
Methylene chloride
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2-Trichloroethane

viii. Steady-State Assumption. As implemented for today's rule, EPACML was solved for the steady-state condition. Thus, the solution represents the case where leaching has occurred for a period of time that is sufficiently long to allow the concentration at the receptor well to become constant. Several commenters noted that, in certain circumstances, use of the steady-state solution would lead to unreasonably low DAFs. In particular, in situations where the mass of a constituent is relatively low in the source facility (i.e., the landfill has a very limited quantity of the constituent available to contaminate leachate), the steady-state model will continue to assume the existence of a very large quantity of the constituent and, hence, over-predict the resulting concentration at the downgradient well. Under such circumstances, the commenters argue, the Agency should accommodate this phenomenon by using a transient solution in deriving appropriate DAFs.

The Agency agrees with the commenters and has initiated a study to thoroughly investigate the problem described above. Based upon preliminary investigations already complete, however, the Agency continues to believe that application of the steady-state model to many constituents is appropriate and is promulgating regulatory levels for those constituents based upon the results of the steady-state model. The preliminary investigations have also led to a decision to postpone the promulgation of regulatory levels for constituents that are believed to be more appropriately evaluated with a transient solution. The Agency is continuing to refine the approach required to implement the transient solution but results to date suggest that this latter group of constituents require unreasonably large quantities in the source facility to insure that the steady-state solution is appropriate. For example, under some conditions even when the constituents exist at concentrations in excess of 1000 ppm of the solid waste within the entire volume of the landfill, the steady-state condition is not realized. Therefore, based upon the preliminary analysis, regulation of these constituents based upon the DAFs predicted by the steady-state model may not be appropriate.

Preliminary investigation of this condition was completed for all of the originally proposed constituents. All constituents were assumed to exist in the "tested" waste at 1000 ppm. Furthermore, the "tested" waste was assumed to occupy 100% of the available facility capacity (i.e., the "tested" waste is the only solid waste in the facility). As a reasonable worst case scenario, the DAF was derived by the transient model for each constituent under these conditions. Because the above assumptions are very conservative, most of the DAFs derived for the constituents were found to coincide with the steady-state values. That is, sufficient mass was available to insure that steady-state conditions were reached. Accordingly, regulatory levels for these constituents are being promulgated in this rule. For the following constituents, however, the steady-state condition was not achieved under this scenario:

phenol
1,2-dichlorobenzene
carbon disulfide
isobutanol
2,3,4,6-tetrachlorophenol
toluene

Accordingly, the Agency is postponing the promulgation of regulatory levels for these six constituents until such time as the investigations are complete. Once these investigations are completed, the Agency will take the appropriate action.

ix. Biodegradation. The subsurface fate and transport model does not account for biodegradation processes in the subsurface environment. EPA recognizes, however, that biodegradation is an important process that can reduce concentrations under either aerobic or anaerobic conditions. Accordingly, the EPA has constructed the model so that it can theoretically be modified to include these processes for experimentally derived biodegradation rates. Biodegradation processes have not been included because the data bases to support this portion of the model are currently insufficient.

The first major data deficiency is that the model incorporates many diverse subsurface environmental conditions where as constituent-specific biodegradation rate data typically exist for only a few (if any) subsurface environments. EPA also recognizes that although the kinetic equations describing the degradation of hazardous organic chemicals in many environments are available, these equations have not been sufficiently evaluated in the subsurface environment (Ref. 10, 11, 12). Second, the Agency considers data on the formation of transformation products to be insufficient. Third, the key processes that can affect the subsurface biodegradation rate are not well understood. These processes include sorption, pH, temperature, nutrient availability, toxicity, and others. For example, while nutrient levels in the environment are generally considered sufficient for low populations of microorganisms, the microorganic population at which the nutrient availability in the environment becomes a limiting factor is not known. Additionally, while sorption is well understood for hydrophobic compounds at low concentrations (Ref. 13), at concentrations where the compounds can form small droplets or become entrained in the micropores of the

subsurface matrix, sorption effects are not well understood. The effects of temperature have been characterized in innumerable studies of isolated microorganisms, but the kinetics of these effects have only recently been investigated in environmental samples (Ref. 14). Finally, the toxicity of hazardous chemicals to the microorganisms themselves is only now being investigated (Ref. 15).

Accordingly, the Agency is continuing to gather data to refine the modeling of biodegradation, but has not been able to include biodegradation in the ground water transport model at this time. In this regard, EPA has published guidelines for developing anaerobic microbiological biodegradation rate data for chemicals in the subsurface environment (see 40 CFR 795.54). Results developed under these guidelines will provide data on kinetic rates of degradation, and to a lesser extent, on the effects of pH and temperature on these rates. Similar guidelines have not been developed for aerobic systems at this time. Data developed under 40 CFR 795.54 may be considered for use in the model at some future time.

x. Summary of General Modifications. The Technical Background Document (Ref. 9) describes in detail the model revisions, including options developed but not implemented for the purposes of establishing the regulatory levels for today's rule. A summary of the major model options and procedures implemented for the rule follows:

- The model was run for the steady-state case. The initial condition was a constant concentration. The equations were solved for infinite time.
- The unsaturated zone module was included in the analysis.
- Concentrations can be predicted at wells placed at any position. The wells can be allowed to draw from any selected depth.
- The updated method of computing dispersivities as a function of random longitudinal well locations was used (designated in the model as the "Gelhar procedure").
- The option implemented for setting the boundary conditions between the unsaturated zone and the aquifer was the one that limits the lateral extent of the plume to the downgradient facility width, computes vertical mixing and dispersion underneath the facility, and estimates the maximum source concentration within the plume based on mass balance requirements. Any combination of conditions that violated these requirements and, thus is not physically realistic, was rejected.

The above options and additional options are listed in the background document for the model (Ref. [illegible]). Specifically, the model input and control variables, as required and accepted by the computer code, are listed for each computer run used to set regulatory levels in today's rule.

By incorporating these modifications, the EPACML, as applied to landfills, models the following basic features:

- The landfills are filled to capacity and covered with native soil.
- Caps are characterized as being in a failed or deteriorated state. Thus, permeabilities are set to be higher than would be typical of landfills with an undamaged cap. It is assumed that liners are not present.
- All wells (exposure points) are considered to be downgradient in every model run. The longitudinal distance parallel to the direction of ground water flow is determined from data described later in section III.E.3.
- Lateral well location is determined by allowing the position to uniformly vary at random within the plume width and with the additional constraint that the location also must be within an area defined by lines at 90-degree angles from the direction of ground water flow at the midpoint of the downgradient boundary of the facility.
- Vertical well location is determined by allowing the position of the well intake point to uniformly vary at random over the entire aquifer depth.
- The landfill storage capacity is assumed to be sufficient to accommodate sufficient mass of each constituent to allow a steady-state condition to exist. This produces an infinite source initial condition.
- Constituents contained within the landfill do not degrade.
- Infiltration rates are represented as annually averaged flows based on 20-year climatic records and concomitant water balance calculations.

b. Use of the EPACML for Surface Impoundments. Because some wastes are managed in surface impoundments rather than landfills, several commenters indicated the need to analyze and include the results obtained by considering a surface impoundment mismanagement scenario. They argued that dilution/attenuation factors (DAFs) generated by modeling a landfill scenario would be too stringent for wastes managed in surface impoundments. Based upon these comments, the Agency decided to investigate whether surface impoundment DAFs would be significantly different from landfill DAFs. EPA requested comment on the use of this data in the August 1, 1988 notice.

Based upon this investigation, the Agency has concluded that the use of DAFs based on a landfill scenario is appropriate in establishing the regulatory levels for wastes managed in surface impoundments. EPA used the EPACML model to confirm this analysis by modeling a surface impoundment mismanagement scenario.

This conclusion is based on the Agency's evaluation of the physical parameters that would lead to different DAFs for surface impoundments than for landfills. A key factor that could lead to differences in the DAFs from these two types of management units (surface impoundments and landfills) is the difference in total leachate infiltration rates. The infiltration rate is equal to the product of the leachate mass flux (mass per unit area per unit time) and the area of the management unit. For surface impoundments, the mass flux can be considerably greater than for landfills. However, to the extent that the area of surface impoundments is typically smaller than the area of landfills (although some atypical surface impoundments can be as large, if not larger than landfills), the effects of the greater leachate flux are somewhat offset. That is, while the flux is greater, the area is smaller, resulting in relatively similar leachate infiltration rates.

A second factor that affects the DAFs is the situation in which the leachate flux is large and the ground water velocity is relatively small. In these situations, a ground water mound may form below the management unit. This effect is more typically associated with surface impoundments because of their higher leachate fluxes; this effect should result in smaller DAFs (and, thus, more stringent regulatory levels) than would be predicted if the mounding did not occur. As a result of these factors, the Agency concluded that DAFs from a surface impoundment scenario would be equivalent to or less than DAFs from a landfill scenario.

To confirm this conclusion, EPA used EPACML to evaluate a surface impoundment scenario. The main features of the surface impoundment scenario, as simulated using EPACML, are as follows:

- The surface impoundments are filled to their fluid capacity and are assumed to operate on a continuous basis.
- Bottom layers are characterized as being in a more permeable state (typically ten times greater) than those found in field studies.
- Location rules for downgradient well positions and lateral and vertical

locations are identical to landfills. The data base for longitudinal distances is different, however.

• The operating life of the surface impoundment is assumed to be sufficient to accommodate a sufficient mass of constituent to allow a steady-state condition to exist. This assumption produces an infinite source initial condition.

• The leaching rate from a surface impoundment depends on, among other factors, the ponding depth in the impoundment and the characteristics of the bottom materials. The Hydrologic Evaluation of Landfill Performance (HELP) model used in evaluating the landfill data is inadequate to determine the leaching rates from surface impoundments. Therefore, the leaching rates from subtitle D surface impoundments were estimated by considering the relationship between the velocity in the vertical direction and the substrate's porosity and permeability and the solution of the nonlinear steady state flow problem. To be conservative, the Agency used a permeability value ten times higher than the value typically reported in field studies as an input for calculating leaching rates (the source of these data are discussed below).

• The Agency has not yet conducted a detailed survey for subtitle D surface impoundments, but the Agency conducted a review and analysis of data on subtitle D units in RCRA Facility Assessment (RFA) Reports (Ref 18). A set of data on subtitle D surface impoundments was obtained from this analysis and used as inputs to the EPACML. Additional data were compiled from aerial photographs by EPA's Environmental Photographic Interpretation Center (EPIC).

• The data extracted from RFSs included the area of the surface impoundments and the distance to downgradient drinking water wells as determined by EPIC.

• The ponding depth data for the subtitle D surface impoundments were reported by E. C. Jordan (Ref. 9). The hydraulic conductivity of the bottom materials was [illegible] as 1.0 E-6 cm/sec. This value reflects the effect of gradual settlement and compaction of sediments at the bottom, because surface impoundments tend to fill up with sediments over a period of about 20 years or so. The Agency believes that the hydraulic conductivity value of 1.0 E-6 cm/sec represents a reasonable worst-case value. These values were used in conjunction with EPACML to estimate DAFs for the surface impoundment data.

As expected, DAFs predicted for surface impoundments are somewhat smaller than the corresponding values for landfills (see section III.E.4). However, because the EPACML does not incorporate the mounding effect, the surface impoundment evaluation was restricted to include only those cases where mounding would be minimal and, thus, reasonably ignored. As a consequence of limiting the evaluation to these cases, the modeling results tend to omit some worst case scenarios. That is, if all possible cases were included, rather than just the "no mounding" cases, the DAFs for surface impoundments could be somewhat lower and, thus, the downgradient concentrations may be higher than those estimated by the EPACML model. The Agency thus believes that the omitted surface impoundment conditions should be further investigated and may result in more stringent regulatory levels. The Agency believes, however, that the DAFs produced by the EPACML analysis properly delineate wastes that are clearly hazardous wastes.

3. Newly Acquired Data

As previously described, the DAFs proposed on June 13, 1988, were calculated based on the subtitle D landfill scenario. However, subtitle D landfill data were not available to the Agency at that time, and instead, subtitle C landfill data were used.

Several commenters criticized the use of subtitle C (hazardous waste) landfill data. The Agency agreed with the commenters and has based the final rule on data from a survey of solid waste subtitle D landfills.

a. Landfill Data. The Agency conducted a survey of municipal solid waste landfills in the U.S. (Ref. 6). The survey used a stratified design based on facility size. The results were tabulated based on 1,102 completed questionnaires. The survey yielded data on area of landfills, distance to the nearest downgradient drinking water wells, and thickness of the unsaturated zone. These data are site-specific, corresponding to individual solid waste landfills located throughout the United States. The survey data were analyzed to develop distributions of these site-specific parameters and used as inputs to EPACML, as described in the model background document (Ref. 9). The input frequency distributions are also presented in the background document.

EPA also collected additional data on leachate generation at municipal landfills. EPASMOD requires, as input, the leachate distribution from the bottom of the landfill. The leaching rate distributions for the June 13, 1988, proposal were based on the use of a single soil type, loam, as the cover soil for the landfill. These distributions were estimated using climatologic data for a total of 30 cities nationwide, representing the median range for each of 18 climatological conditions or zones identified in the 48 contiguous states.

The assumptions of a single soil type and 18 climatic zones were criticized as not being realistic and resulting in an overly optimistic cap performance. The commenters suggested enhancing the data base by including simulation of different soil covers.

In response to these comments, the Agency has implemented a number of changes. The Agency believes that these modifications significantly improve the validity of the leachate flux distribution and make it more realistic.

Soil Type

The Soil Conservation Service (SCS) has a county-by-county soil mapping program underway. More than 90 percent of the land area in the U.S. has been mapped, and soil data representing approximately 51 percent of the total land area in the U.S. have been entered into a computer data base. Using this data base, the soil classifications were grouped according to the U.S. Department of Agriculture's definitions of coarse, medium, and fine textures. These three categories are represented in EPACML by soils equivalent in properties to sandy loam, silt loam, and silty clay loam for the landfill cover materials. The latest results show that coarse grained soils, medium grained soils, and fine grained soils represent 15.4, 56.8, and 28.0 percent, respectively, of the soils that have been mapped thus far.

Climatic Zones

The number of cities representing climatic variations that were used to develop frequency distributions for the leachate generation has been increased from 30 to 100. The reason for this change was to reduce the chance that any one city would provide an unrepresentative percolation rate in its climatic range.

The climatic data base used in EPACML was enhanced to include six precipitation ranges and five ranges of pan evaporation rates, thereby resulting in 30 climatic ranges as opposed to the 18 described in the earlier proposal. For the climatic ranges so defined, the percentage of the area of the 48 states represented by each range was calculated, and the percent areal average was used to weight the percolation (recharge and/or infiltration) rate estimated for the selected cities in each range according

to probable relative occurrence in the U.S. The effect of these changes is to provide more representative values of the overall national distribution of the leachate flux.

After the percolation data for the landfill were calculated using the HELP model (Ref. 9), the climatic ranges were further subdivided to account for wide variations in percolation within a range. This resulted in separate subranges being established for some California cities (Los Angeles, Sacramento, San Diego, and Santa Maria), and two Oregon cities (Medford and Astoria).

Percolation rates for each of the selected cities in the 48 contiguous states were determined using silt loam, sandy loam, and silty clay loam cover soils. These soils, based [illegible] obtained from the SCS, appear to represent the most common soil types in the U.S., and thus the most common soil to be used as covers for landfills. They also span the range of likely cover soils, from fine-grained to coarse-grained, or from low to high percolation rates. Simulations were performed for each of these soil types, and the results weighted according to the frequency of occurrence for each type.

The leaching rate flux was determined by using the average, weighted percolation rate from the cities in each climatic range. The model background document (Ref. 9) presents the data used and the accompanying changes to the June 13, 1988 proposal runs.

b. Chemical-Specific Parameters. In the EPASMOD proposal, chemical parameters, such as hydrolysis rates, were used to calculate the relative retardation factors and degradation rates for selected compounds. Some of the chemical-specific parameters used in that model were estimated based on a brief review of the existing chemical data. Some commenters criticized some of the parameter values selected and used for that proposal as being nonrepresentative of the range of parameter values.

The Agency has an ongoing program for the measurement of constituent-specific parameters and for the review of new constituent-specific data as reported in the current scientific literature. Some hydrolysis rate constants and octanol-water partition coefficients used in the proposal have been revised to reflect the most recent laboratory measurements and recent values reported in the literature. The updated parameter values are given in the background document (Ref. 9) and represent either measured or best available values.

4. DAF Evaluation

a. Selection of an Appropriate Percentile. As described earlier, the EPACML was used to investigate the expected range of DAFs associated with mismanagement of solid wastes. As generated by EPACML, the DAF represents the expected reduction in the concentration of a constituent during transport through soil and ground water from the leachate release point (bottom of the waste management unit) to an exposure point (a well serving as a drinking-water supply). The wide range of possible environmental settings (e.g., ground water velocities, pH, temperatures, etc.) and the multitude of possible scenario configurations (e.g., facility area, distance to downgradient wells, etc.) result in an extremely wide range of DAFs. Monte carlo simulation was used to implement EPACML, and the resulting cumulative frequency distribution can be viewed as a ranked order of increasingly higher downgradient concentrations expected from the "best-case" situations (large DAFs) to the "worst-case" situations (small DAFs) for the scenario being investigated.

The Agency's proposed approach was to define DAFs representative of reasonable worst-case conditions as those corresponding to the 85th percentile of the cumulative frequency distribution. The Agency received numerous comments on the selection of the 85th percentile, which are addressed in Section d, following.

b. Resulting DAFs for Landfills. The DAF values corresponding to various cumulative frequency levels for landfills are as follows:

Percentile	80	85	90	95
All nondegrading constituents	329	134	47	12
Chloroform[1]	385	152	52	14

[1] The DAFs for chloroform are slightly higher than for the other nondegrading constituents because chloroform is expected to hydrolyze slightly during transport.

The similar DAF values for nondegrading constituents and chloroform arises because all these constituents either do not degrade at all or only degrade slightly.

c. Resulting DAFs for Surface Impoundments. The DAF values corresponding to various cumulative frequency levels for the surface impoundment investigations described in E.2.b of this section are as follows:

Percentile	80	85	[illegible]
All nondegrading constituents	228	111	[illegible]
Chloroform	227	111	[illegible]

As with the landfills, the constan[illegible] DAF for all constituents reflects the[illegible] that nondegraders and very slow degraders have virtually identical environmental fate for the scenario investigated. As the resulting numb[illegible] indicate, within a reasonable degree accuracy, the DAFs for waste mana[illegible] in surface impoundments are equiv[illegible] to the corresponding landfill DAFs.

d. Final DAF Selection. The Agen[illegible] purpose in developing dilution/attenuation factors (DAFs) is to ide[illegible] wastes whose leaching behavior indicates that they may pose a haza[illegible] human health unless they are contr[illegible] under subtitle C management stand[illegible] Thus, the Agency developed a subsurface fate and transport model simulates a subtitle D management (i.e., a municipal landfill) and the subsurface environment that would encountered by toxic constituents a[illegible] they migrate from the management [illegible] to a drinking-water well. In order to make the model's output (DAFs) as realistic as possible, the Agency implemented the model using real-w[illegible] distributions for parameter values (e[illegible] areas of landfills, properties of the subsurface environment, etc.) when[illegible] possible. The monte carlo structure the simulation allowed the modeling results to be presented as a cumulat[illegible] frequency distribution or probability That is, the model expresses the probability that a toxic constituent disposed of in a municipal solid was[illegible] landfill will undergo certain dilution attenuation as it moves through a subsurface environment to an expos[illegible] point. Thus, there is a different DAF each selected probability.

In its June 13, 1988 proposal notice Agency proposed the use of the DAF corresponding to the 85th percentile cumulative frequency level and requested comment on the use of oth[illegible] percentile levels. Comments were received urging the use of both higher and lower levels. Recommendations using the 80th percentile cumulative frequency were justified by assertion that the assumptions used in the mo[illegible] were already unduly conservative. C[illegible] commenter noted that EPA could sti[illegible] rely on the listing program to regulat[illegible] wastes whose leachate concentratio[illegible] would not exceed the regulatory lev[illegible] derived from the lower percentile D[illegible] but that are still considered hazardo[illegible]

Other commenters argued that the 85th percentile was not adequately protective of human health and the environment. One commenter, claiming that assumptions in the model were not conservative enough, recommended that the 95th percentile be used.

In selecting the appropriate level, the Agency recognizes that there is no consensus "correct" level for interpreting modeling results. This has resulted in a particular challenge in developing today's rule, wherein a quantitative approach is being used for guidance in answering what is a partly qualitative question—namely, "what is the human health impact of unregulated management of certain types of wastes in a 'reasonable worst-case' disposal scenario?" While the Agency believes that the 85th percentile is an appropriate choice to represent a reasonable worst-case result, consideration of the relationship of the 85th percentile DAF to other percentile DAFs is also appropriate. That is, the Agency believes that the behavior, or shape, of the upper portion of the cumulative frequency distribution curve should also be evaluated in order to determine how critical the selection of a particular frequency level is to the DAF.

Another consideration in determining the appropriate DAF value, independent of the selected cumulative frequency level, is the accuracy inherent in the data set used. Given that there is some uncertainty associated with any data set used to represent possible values for any parameter, and that the model requires values for many parameters, the Agency believes that the selected DAF value should not imply an undue degree of accuracy.

After considering the above factors, the Agency has concluded that a DAF value of 100 is appropriate for establishing the regulatory levels for the constituents included in today's rule.[1] First, the Agency believes that, considering the number of parameters for which distributions of values were established (in order to represent a "generalized" example), a DAF with an order-of-magnitude precision is appropriate.[2] Second, in selecting this DAF value of 100, the Agency noted that the 80th and 90th percentile DAFs, as well as the 85th percentile DAFs, indicate that constituents migrating in the modeled disposal scenario will be diluted by approximately two orders of magnitude. This is also true of the predicted DAFs from the data used for surface impoundments. Thus, EPA believes that a DAF data used for indicating dilution by two orders of magnitude (i.e. 100) is appropriate. Moreover, as the data indicate, on an order-of-magnitude scale, the predicted DAF is not extremely sensitive to the exact cumulative frequency value that was selected.

The Agency points out that the considerations leading to the use of 100 to represent the model-predicted dilution/attenuation factors are unique to today's promulgation. In other cases, different conclusions may be more appropriate. For example, when parameter values can be more narrowly defined (as in site-specific evaluations), the higher degree of precision may be appropriately ascribed to the model-predicted DAFs. Likewise, where the program goals are different (i.e. other than to identify levels that are indicative of wastes that clearly are hazardous), the selection of a value that represents a cumulative frequency value other than the 85th percentile may be warranted.

F. Toxicity Characteristic Leaching Procedure (TCLP) (Method 1311)

1. Introduction

The development of the TCLP and the role of the test in identifying a waste as hazardous were discussed at length in the June 1986 proposal (51 FR 21648). Today, EPA is promulgating the TCLP, with some improvements and modifications, as a replacement to the EP for use in the identification of hazardous waste. (The revised TCLP is promulgated in Appendix II to 40 CFR part 261 and has been designated as EPA Method 1311 and will be incorporated in "Test Methods for Evaluating Solid Waste Physical/Chemical Methods—SW-846".)

The Agency received numerous comments in response to the Federal Register notices (51 FR 1602, 51 FR 21648, 51 FR 24666, 51 FR 35287, 51 FR 40662, 51 FR 40943 and 53 FR 18782) related to the TCLP procedure. In particular, EPA received close to 140 comments on the application of the TCLP in response to the June 1986 proposal. The comments covered general issues such as the relationship to the EP, the adequacy of research supporting TCLP development and specifically, the statistical treatment of data. Commenters also addressed technical issues including the suitability of the zero head space extraction (ZHE) vessel; the types of filters, reagents, and leaching media; the quality assurance requirements; and the multiple extraction and oily waste extraction procedures. In addition, comments were received on the use of quantitation limits for establishing regulatory levels. All the comments were categorized and summarized by issue and are presented in the technical background document along with the Agency's response to these comments (Ref. 4).

In this preamble, only certain comments are discussed, which include (a) the applicability of the TCLP to specific types of waste (i.e., solidified wastes); (b) the analytical difficulties encountered during the analysis of the TCLP extract for phenolic compounds and phenoxy acid herbicides; and (c) the use of quantitation limits. The first two comment issues are presented below while the last comment and the Agency's response is given in section IV.C. of this preamble.

2. Adoption in the LDR Rulemaking and Modification from the Proposed Rule

The TCLP was promulgated in Appendix I to 40 CFR part 268 on November 7, 1986 (51 FR 40643), as part of the Land Disposal Restrictions Rule for Solvents and Dioxins. The TCLP is used in the Land Disposal Restrictions (LDR) program to determine whether certain wastes require treatment prior to land disposal and to determine whether certain treated wastes meet the applicable treatment standards. In today's rule, the Agency has incorporated two other clarifications to the TCLP as proposed on May 24, 1988 (53 FR 18782) for use in both the LDR and the TC programs.

The Agency modified the proposed TCLP as a result of the Agency's own research and comments received on the January 14, 1988 (53 FR 1602) proposal for the LDR program and the June 13, 1986 (51 FR 21648) proposal for the TC. These modifications to the TCLP were promulgated on November 7, 1986 for the LDR program. On May 24, 1988, the Agency proposed additional modifications to the TCLP for both the LDR and the TC. In today's rule, the Agency has adopted two of these proposed changes, and is promulgating the revised TCLP for use in both the LDR and TC programs.

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[1] As explained previously, the Agency is not, in today's rule, promulgating regulatory levels for several of the constituents for which regulatory levels were proposed. These constituents include those that are expected to hydrolyze apparently and those for which it has not yet been determined whether the steady-state solution to the subsurface fate and transport model is appropriate. Once the issues associated with these constituents are resolved, the Agency will promulgate or reproposes (as warranted) regulatory levels for these constituents. For cases where regulatory levels are reproposed, they may incorporate dilution/attenuation factors other than 100.

[2] The health data is only valid to one order of magnitude precision and thus may control the total number of significant figures.

The first change is the insertion of a more detailed method flow chart to explain how analysts are to perform the test. Comments expressed confusion regarding the original flow chart (e.g., that it was difficult to follow), so the Agency has added this new chart to eliminate confusion. The second change is the addition of new equipment suppliers to provide more information on the availability of suitable testing equipment. The new equipment suppliers include two manufacturers of rotary agitation devices, Environmental Machine and Design, Inc., of Lynchburg, VA, and Millipore Corporation of Bedford, MA; two manufacturers of a zero-headspace extractor (ZHE) vessel, Lars Lande of Whitmore Lake, MI and Environmental Machine and Design, Inc., of Lynchburg, VA; and three manufacturers of filter media, Millipore Corporation of Bedford, MA; Nuclepore Corporation of Pleasanton, CA; and Micro Filtration Systems of Dublin, CA. These manufacturers are listed in Tables 2, 3, and 5, respectively, of the method (i.e., Appendix II of 40 CFR 261), along with company telephone numbers and equipment model numbers.

Another more substantial proposed modification, the addition of a stainless steel cage insert to the bottle extractor, will not be added by the Agency at this time for the reasons discussed below. The Agency had proposed this modification to eliminate the requirement for particle size reduction for certain types of wastes (e.g., solidified materials).

3. Applicability of TCLP to Solidified Wastes

Some commenters expressed reservations regarding the applicability of the TCLP to specific types of wastes. The wastes of concern were solidified wastes. Numerous commenters supported the reinstatement of the structural integrity procedure (SIP) or some other stability criterion for solidified wastes. They argued that particle size reduction (i.e., "grinding") would be inappropriate in those instances where solidification of the waste is cited to meet the best demonstrated available technology (BDAT) provisions of the law and that grinding may not adequately represent the weathering process or the effect of vehicular traffic. Commenters recommended that the Agency retain the SIP. Others agreed that particle size reduction is inappropriate for stabilized monolithic wastes and produces unrepresentative results. Specifically, commenters stated that particle size reduction alters the physical character of many solidified wastes by destroying the cementitious property of these wastes in such a way that the leaching rate increases unrealistically. By increasing the surface area that is available to attack by a leaching medium, the amount and rate at which substances may be leached increases. Inasmuch as waste grinding is not normally employed in municipal landfills, particle size reduction renders the TCLP a less accurate model of leaching in a municipal landfill environment.

Since the June 13, 1988, proposal, the Agency has reviewed the use of the SIP, which uses a drop-hammer to test the integrity of the waste and to reduce its size if it fractures. The Agency found that although the SIP may simulate the potential of a monolithic waste to be degraded by vehicular traffic on a landfill, it cannot address certain other stresses acting on the waste (e.g., wet-dry and freeze-thaw cycles). In addition, the SIP can only be used for wastes that can be prepared in a sample of specified dimensions.

While evaluating the use of the SIP, the Agency found that dense, hard materials would occasionally break the glass extractor bottle. To prevent breakage of the bottles, the Agency developed a cage insert for the extractor bottle. The cage, which is designed to prevent contact between the hard sample and the sides of the bottle, is constructed of 0.25-inch stainless steel woven mesh. Experiments have shown that the use of the cage prevents bottle breakage.

While evaluating the utility of the cage, the Agency noticed that wastes that were believed to be well-solidified retained their monolithic nature in the cage during extraction, whereas wastes that were believed to be less well-stabilized (even though some of them had passed the SIP) were broken into small pieces during the extraction. Thus, these experiments led to the proposed use of the stainless steel wire cage in the extraction apparatus (53 FR 20792, May 24, 1988). The use of this device, the Agency believed, tested the physical integrity of the sample and reduces particle size appropriately.

Commenters expressed support for the cage modification—that it is a step in the appropriate direction toward a more realistic assessment of the environmental leaching potential of solidified waste. However, commenters also had concerns that the cage was proposed prematurely—that not enough evaluation of waste samples using the cage had been done. Specifically, commenters argued that the cage could possibly leach significant quantities of nickel and chromium to contam[illegible] metals analysis; that it would b[illegible] difficult to collect representativ[illegible] samples in some cases; that the problems with the configuration [illegible] cage so that it could not be accommodated to fit a large arr[illegible] bottles; that the cage's construc[illegible] provided numerous crevices an[illegible] significant amount of surface ar[illegible] waste residue to collect, making [illegible] effective cage cleaning difficult; [illegible] solidified samples could be mad[illegible] a shape that would cause less s[illegible] to be sloughed off during extract[illegible] leading to a less aggressive test. [illegible] Agency agrees with these comm[illegible] and has decided not to go forwa[illegible] the cage modification at this tim[illegible] Agency currently has work und[illegible] evaluate all these concerns, and [illegible] continue to evaluate modificatio[illegible] the TCLP and will propose furth[illegible] improvements as they are devel[illegible]

4. Analytical Methods

Several comments addressed [illegible] analytical difficulties of analyzi[illegible] TCLP extract for phenolic comp[illegible] and phenoxy acid herbicides by [illegible] chromatography/mass spectro[illegible] SW-846 Method 8250 (GC/MS). [illegible] analytical difficulties include th[illegible] interference of the acetate ion i[illegible] TCLP leach fluid with the colum[illegible] packing material of Method 825[illegible] Removal of the acetate ion is oft[illegible] difficult, and equipment damag[illegible] result if the acetate is not remov[illegible] the acetate ion can destroy the [illegible] packing material).

The Agency agrees that analy[illegible] acidic compounds by GC metho[illegible] be difficult, but not impossible. [illegible] Agency suggests the use of a bo[illegible] phase capillary column (Method [illegible] reduce the interference from ace[illegible] addition, the Agency is investig[illegible] other methods for removal of th[illegible] ion from the extract before anal[illegible] the phenolics and herbicide and [illegible] welcomes alternative suggestion[illegible] especially when accompanied by [illegible] supporting data.

The Agency had suggested the [illegible] HPLC as an alternative to GC/M[illegible] analysis of phenolics and phenox[illegible] herbicides. However, several [illegible] commenters believed that an HP[illegible] method is generally regarded as [illegible] expensive and not as readily av[illegible] as GC/MS. In addition, some [illegible] commenters indicated that GC/[illegible] better method analytically than [illegible] and that HPLC would be more d[illegible] to implement. The commenters [illegible] expressed that, at the very least [illegible] lengthy verification process wo[illegible]

required to determine an HPLC method's ruggedness and reproducibility and to determine the most effective cleanup steps. The commenters further suggested that even if an effective HPLC cleanup procedure is developed and approved by the Agency, it is bound to increase the analytical costs and slow down the analytical throughput. Even without considering this restriction, the procedure of leaching the organics into an aqueous medium, followed by extraction, recovery, and concentration, is bound to require more manpower and thus more money than a more direct solvent extraction of the solid itself. The commenters indicated that methods for analyzing solid waste for semi-volatile organics and phenoxyacid herbicides are already described in SW-846 and should be the preferred methods, both for practicality and as a way of providing a reliable test.

The Agency agrees that the GC/MS or GC/electron capture (GC/EC) analysis is more advantageous for the analysis of phenolics and phenoxy acid herbicides because the equipment is more readily and widely available than HPLC, despite the associated difficulties. HPLC methods for phenolic compounds are not included in the third edition of SW-846 because of a lack of validation data. The Agency will allow only the use of the GC/MS method until such time that the Agency proposes an HPLC method.

G. Testing and Recordkeeping Requirements

1. Existing Requirements for Generators

Under existing regulations, persons who generate solid waste are not specifically required to test their wastes to determine whether they exhibit the characteristic of EP toxicity or any other characteristic. Instead, solid waste generators are required to make a determination as to whether or not their wastes are hazardous (40 CFR 262.11).

If a waste is found to be excluded from regulation under § 261.4, or if it is found to be a listed hazardous waste under subpart D of 40 CFR part 261, no further determination of hazardousness is necessary. On the other hand, if a waste is neither excluded nor listed, the solid waste generator must determine whether it exhibits any of the hazardous waste characteristics in subpart C of 40 CFR part 261. This determination may be made by either testing the waste or applying knowledge of the waste, the raw materials, and the processes used in its generation.

If a waste is determined to be hazardous, the generator must keep records establishing the basis for that determination (40 CFR 262.40(c)). These records must be maintained for at least 3 years after the generator no longer handles the waste in question. Neither of these recordkeeping requirements, however, applies to solid waste generators who do not generate hazardous wastes.

Other provisions in the hazardous waste regulations make generators responsible for knowing the properties of their wastes and for documenting that knowledge. For example, generators who declare that their wastes are hazardous must nevertheless have sufficient knowledge of their wastes to complete the Uniform Hazardous Waste Manifest, to use proper labels, containers, and placards, and to satisfy all applicable reporting and recordkeeping requirements (see 45 FR 12728, February 26, 1980). In addition, all generators of hazardous waste are required under 40 CFR part 268 to determine whether their wastes are restricted from land disposal.

2. Changes Considered

In the June 13, 1988 proposal, EPA expressed concern that the current system for determining whether a solid waste is hazardous may be inadequate to ensure that wastes are characterized properly as hazardous or nonhazardous. Because of the importance of accurate hazard determinations to the RCRA subtitle C program, the Agency discussed the possibility of requiring solid waste generators to test their wastes periodically.

In the proposed rule, EPA identified three general approaches that might be adopted in the TC final rule. In the first approach, the Agency would retain the current approach, allowing generators to rely on their knowledge of materials and processes used in generating wastes as a basis for their determination. In the second approach, EPA would require the testing of wastes, at a frequency specified by regulation. Finally, in the third approach, the Agency would require testing but without specifying a particular testing frequency. Under this third approach, generators would be required to develop an appropriate testing frequency, based on Agency guidance, and to document the basis for their choice.

Commenters were heavily divided on the issue of testing and recordkeeping requirements. Many commenters, including waste management firms and a few generators, favored mandatory testing of solid wastes. Most of these commenters argued that generators typically lack sufficient information to determine accurately the composition of their wastes without testing. Indeed, one commenter claimed that with 32 constituents regulated at the part-per-million level or lower, a generator could never be sure whether a waste exhibits the TC without performing the TCLP test. The commenters concluded that testing is the only reliable method for ensuring that potentially hazardous wastes are properly identified and managed.

A few commenters offered somewhat different reasons for supporting testing requirements. For example, some commenters pointed out that mandatory testing would facilitate EPA enforcement efforts. Others claimed that mandatory testing would reduce uncertainty by making it clear to generators precisely what EPA expects of them with respect to performing hazardous waste determinations.

Another group of commenters, however, opposed the imposition of a formal testing requirement. These commenters argued that mandatory testing would place an inordinate burden on the regulated community without providing significant benefit for human health and the environment. In particular, the commenters claimed that mandatory testing is unlikely to identify wastes that were improperly characterized as nonhazardous when generators relied exclusively on their knowledge. According to these commenters, generators rely on their knowledge only when the wastes they produce are clearly hazardous or clearly nonhazardous. Whenever uncertainty exists, these commenters stated, generators either declare their wastes hazardous or perform appropriate tests. The commenters emphasized that this cautioned response results from generators' liability for making incorrect determinations, regardless of whether they test their wastes. The commenters concluded that requiring testing of all wastes would deplete resources and place a strain on limited laboratory capacity.

The Agency recognizes that there are many difficult issues related to the imposition of a testing requirement, both for the Toxicity Characteristic and the other hazardous waste characteristics. While the Agency believes that a testing requirement could improve the Agency's enforcement tools, the Agency believes that the current requirements for hazardous waste determinations are not ineffective because many generators do have sufficient knowledge to make a determination without a test. The Agency further believes that liability for incorrect determinations provides a strong incentive for not misclassifying hazardous wastes as non-hazardous. Although EPA thinks that the current

system set forth in 40 CFR 262.11 is effective, the Agency believes that imposing a testing requirement does have some merit, in that it could increase the accuracy of determinations, could clarify the responsibilities of generators, and could facilitate compliance monitoring.

The Agency will continue to evaluate the comments on this issue as well as explore other options for a testing requirement. At present, however, the Agency is not yet ready to go forward with a testing requirement based on any of the options it has evaluated thus far. Should the Agency decide that an appropriate approach is available, it will propose and solicit comment upon the details of that approach in a separate rulemaking. In the meantime, the Agency believes that the existing determination requirement (as specified at 40 CFR 262.11), as well as the liability for incorrect determinations, is effective and practical.

H. Applicability to Wastes Managed in Surface Impoundments

As discussed above, in response to the proposed TC, EPA received many comments questioning the validity of applying the TC to wastes, including wastewaters, likely to be managed in surface impoundments. In response to commenters' concerns, on May 18, 1987, EPA published a Supplemental Notice of Proposed Rulemaking in the Federal Register, which requested comments and data on several issues related to the regulation of wastes managed in surface impoundments under the TC rule. The Agency also requested comment (assuming such an approach) on: (1) The criteria to be used to determine whether the surface impoundment scenario should apply to a particular waste, (2) the point at which concentration measurements should be made (e.g., at the point of generation or within the impoundment), and (3) how multiple surface impoundments should be handled under the TC rule.

Comments received in response to the notice concerning the surface impoundment management scenario are summarized and addressed in section III.A.2.c. Comments received in response to the notice, which addressed sampling point and multiple impoundment issues, are discussed below.

1. Sampling Point

In the May 18, 1987 notice, EPA requested comments on whether evaluations of wastes managed in surface impoundments should be based on measurements of the concentration in the impoundment or at the inlet to the impoundment. In response, some commenters supported sampling at the inlet to the impoundment and stated that sampling the waste within the impoundment is not only contrary to Congressional intent, but conflicts with EPA's own regulations that require the determination of hazard to be made at the point of generation.

Other commenters, however, argued that wastes should be sampled within the impoundment or that the impoundment effluent should be sampled. Many of these commenters argued that measuring the concentrations in the impoundment more accurately represents the concentrations of hazardous constituents that pose a threat to ground water. Some commenters argued that evaluation of hazard should be based on impoundment effluent because concentrations of the wastewaters within the impoundment are approximately the same as the concentrations in the impoundment effluent.

If the Agency were to allow persons to make their determinations on the waste in the impoundment, it would raise questions that the Agency has not yet evaluated completely nor taken comment on. For example, in this situation, should the Agency actually require testing; if so, how often and what should be tested? Would such a result allow persons to land dispose of wastes that (but for the point of hazard determination) would be hazardous, contrary to Congressional intent? Would such a result allow persons to treat wastes without a permit and thus be inconsistent with Congressional intent? EPA concedes that, for some activities (e.g., closure), leachate quality may be more appropriately assessed by measuring concentrations at multiple sites within the impoundment.

The current rules require that the determination of whether a waste is hazardous be made at the point of generation (i.e., when the waste becomes a solid waste). (A waste must be a solid waste before it can be classified as a hazardous waste under RCRA.) EPA believes that determination of the regulatory status of a waste at the point of generation continues to be appropriate, especially since the Agency is not developing a separate mismanagement scenario or set of regulatory levels for wastewaters. To be consistent with other hazardous waste regulations and until the Agency addresses the above questions, EPA is retaining the existing approach of requiring sampling at the point of generation.

2. Multiple Surface Impoundments

In the May 18, 1987 notice, EPA requested comment on how multiple surface impoundments or "treatment trains" should be handled under the rule. Some commenters favored regulating all surface impoundments treatment train as a single unit of 2 first impoundment treats a hazardous waste, all impoundments would be required to comply with the RCRA regulations for hazardous waste treatment facilities. Other commenters, however, suggested that each impoundment should be regulated individually. Still other commenters stated that owners and operators should be required to determine whether the most upstream surface impoundment treating wastes that exhibit the TC, but they should only be required to evaluate downstream impoundments if an upstream impoundment exhibits the T

As discussed above, the Agency has decided not to develop a separate regulatory scheme for surface impoundments. Thus, the Agency will continue to regulate all surface impoundments as individual units and will not pursue any of the other options discussed by commenters. Currently, under 40 CFR part 261, each surface impoundment in a series of multiple surface impoundments is regulated separately. If a surface impoundment receives or generates a hazardous waste, the owner or operator of the impoundment is required to comply with the RCRA regulations governing hazardous waste treatment, storage, and disposal facilities. On the other hand, if a downstream impoundment is not treating or generating a characteristically hazardous waste and upstream units have not managed listed wastes, then the downstream unit is not subject to RCRA subtitle C requirements.

I. Relationship to Other RCRA Regulations

1. Hazardous Waste Identification Regulations

a. Hazardous Waste Listings. Under the June 13, 1988, proposal, the hazardous waste listings in subpart D of 40 CFR part 261 would not be affected. All the listings would remain in effect, including those listings that were based on the presence of TC constituents. It is EPA's intention that the hazardous waste listings would continue to complement the revised TC as they had the EPTC.

A number of commenters, however, argued that the TC should supersede certain hazardous waste listings. In

particular, they suggested that the TC should be the only basis for regulating wastes that have been identified as hazardous solely because of the presence of a TC constituent. Such an approach, according to the commenters, would establish a more rational basis for identifying hazardous wastes. Wastes failing the TC test would be regulated as hazardous wastes, whether or not they have previously been listed, because they have demonstrated the potential to pose a threat to human health and the environment. Wastes passing the TC test, in contrast, would not be subject to subtitle C regulation. The commenters claimed that, by definition, if the extract from a waste that was listed because of the presence of a TC constituent does not contain the constituent in a concentration greater than or equal to the regulatory level, the waste can safely be managed at a subtitle D facility.

EPA does not agree that the TC revisions justify elimination of any of the hazardous waste listings. The Agency has consistently maintained that individual waste streams may be listed regardless of whether the waste is defined as hazardous by the TC. Exhibiting a characteristic can constitute the basis for listing a waste. In fact, prior to today's action, approximately 25 listings were based on the presence of metals or pesticides covered by the EPTC.

There are a number of reasons for continuing this approach. First, listed wastes frequently contain hazardous constituents other than the ones cited in Appendix VII of 40 CFR part 261 as the basis for the listings. It is for this reason that Congress directed EPA, in evaluating delisting petitions, to consider constituents other than those for which the wastes were listed, assuming that there is a reasonable basis to believe that such constituents might render the wastes hazardous (see RCRA section 3001(f)). In many cases, the additional hazardous constituents that are present in a waste may not be on the list of TC constituents. The listings may therefore serve to identify wastes that pass the TC test but are nevertheless hazardous. Removing wastes from a hazardous waste listing without an evaluation of additional constituents would appear to be inconsistent with the intent of section 3001(f).

Another reason for retaining the hazardous waste listings is that TC constituents may continue to pose a threat to human health and the environment even when they are present in concentrations lower than the regulatory levels. The regulatory levels have not been designed to address the problems of phytotoxicity, aquatic toxicity, or bioaccumulation potential. Moreover, they have not been designed to identify the full range of wastes that may be toxic to human beings. Instead, the characteristic levels have been established at concentrations where there is a high degree of certainty that any wastes with constituents at levels equal to or exceeding the regulatory levels pose a potential threat to human health. Individual wastes may continue to be hazardous, despite the fact that they may contain TC constituents in concentrations below the regulatory levels. This is particularly true for wastes that have the potential to be exposed to more aggressive leaching conditions than those modeled in the TCLP. As a result, EPA believes that wastes previously listed as hazardous should continue to be considered hazardous, whether or not they exhibit the characteristic.

b. *"Mixture" and "Derived From" Rules.* Because the TC will not supersede the listings for hazardous wastes, it also will not affect the regulatory status of wastes that are hazardous by virtue of the "mixture" rule of 40 CFR 261.3(a)(2)(iv) or the "derived from" rule of 40 CFR 261.3(c). The "mixture" rule provides that any mixture of a listed hazardous waste and a solid waste is itself a RCRA hazardous waste.[1] The "derived from" rule states that any waste derived from the treatment, storage, or disposal of a listed hazardous waste is hazardous.

Several commenters contended that the current regulatory scheme encompasses wastes that contain *de minimis* quantities of leachable organic chemicals. The commenters acknowledged that mixtures and treatment residues posing insignificant threats to human health and the environment may be excluded from regulation through the delisting process. However, they claimed that delisting is unduly expensive, time-consuming, and, in some cases, impractical. The commenters suggested as an alternative that mixtures and treatment residues from listed wastes containing TCLP constituents not be considered hazardous unless they fail the TC test. They contended that this approach would adequately protect human health and the environment. Moreover, it would be "self-implementing," in the sense that it would eliminate the need for the current process of petitions and Agency review for delisting.

EPA recognizes that the "mixture" and "derived from" rules may create some inequities by including wastes that contain very small amounts of hazardous wastes that have been mixed so as to render them nonhazardous. However, the Agency has consistently maintained that the mixture and derived from rules are an appropriate regulatory approach for dealing with waste mixtures and treatment residues.

When the rules were promulgated in 1980, EPA stated that it was essential to regulate waste mixtures to prevent generators from evading subtitle C requirements by simply co-mingling listed wastes with nonhazardous wastes. The Agency also determined that because of the infinite potential combinations of listed wastes and other wastes, it was unable at that time to devise any workable, broadly applicable formula that was capable of distinguishing between hazardous and nonhazardous mixtures. The Agency acknowledged that the "mixture" rule might be overly broad, but noted that generators could avoid any inequities either by segregating their wastes or by obtaining a waste-specific exclusion under the delisting program (see 45 FR 33066, May 19, 1980).

EPA also believed that it was important to regulate wastes from the treatment, storage, or disposal of listed hazardous wastes on the basis that these "derived from" wastes might themselves be hazardous. Once again, however, the Agency found that because of the large number of listed wastes and treatment processes (some of which introduce new hazardous constituents into the treatment residues), it was unable to prescribe standards that could properly distinguish between hazardous and nonhazardous residues. (It should be noted that the definition of treatment is not confined to rendering a waste non-hazardous, but also includes any method designed to change the nature of a waste to render the waste (1) less hazardous; (2) safer to transport, store, or dispose; (3) amenable for recovery; or (4) reduced in volume (see 40 CFR 260.10).) Therefore, the Agency concluded that wastes generated during the treatment of listed wastes should be presumed to be hazardous. Delisting was provided as the mechanism for excluding these wastes from subtitle C regulation (45 FR 33066, May 19, 1980).

EPA is sympathetic to the commenters' concerns regarding use of delisting to exclude wastes that are

[1] The exception to this rule is a mixture of solid waste and a waste that is listed solely because it exhibits a characteristic of hazardous waste. If such a mixture does not exhibit any characteristic of hazardous waste, the mixture is not defined as hazardous (40 CFR 261.3(a)(2)(iii)).

hazardous under the "mixture" and "derived from" rules. The Agency does not believe, however, that the alternative suggested by the commenters (i.e., relying on the TC to regulate mixtures and treatment residues) would adequately protect human health and the environment. As noted above, wastes that pass the characteristic test may nevertheless be hazardous, either because they contain listed constituents at concentrations below the TC regulatory levels but at levels and under circumstances that nevertheless render the waste hazardous or because they contain hazardous constituents that are not covered by the TC rule. As noted above, the TC regulatory levels are not threshold levels defining all hazardous waste, but are levels that are set to clearly define hazardous waste. Wastes containing constituents falling below these levels may still present a hazard in more limited situations.

Nevertheless, the Agency recognizes that some inequities may result by the application of the "mixture" and "derived from" rules to certain dilute listed wastes. The Agency therefore is considering proposing an amendment to the definition of hazardous waste which would establish self-implementing *de minimis* exemption levels for hazardous constituents found in listed wastes. Listed wastes that meet these exemption levels would no longer be listed hazardous wastes and thus would not need to be managed as hazardous wastes unless they exhibit a hazardous waste characteristic.

c. *Mixture Rule Exemption.* The mixture rule under 40 CFR 261.3(a)(2)(iv) provides an exemption from RCRA subtitle C regulation for mixtures of wastewaters and certain listed spent solvents. The mixture rule exemption is applicable only if the maximum weekly usage of the solvents (other than solvents that can be demonstrated not to be discharged to wastewater) divided by the average weekly flow of wastewater does not exceed specified values. The mixture rule exemption does not apply to wastewaters that exhibit a characteristic of hazardous waste or to wastewaters that contain listed hazardous wastes not specified in the mixture rule exemption.

A number of commenters claimed that the proposed TC conflicts with the mixture rule exemption. The commenters noted that the mixture rule exemption levels are higher than the corresponding TC regulatory levels for solvent constituents. Because of this difference in regulatory levels, the commenters stated that the proposed TC rule will bring large quantities of currently exempted wastewaters into the hazardous waste management system. In effect, the commenters argued that the TC rule will revoke the mixture rule exemption. Commenters disapproved of this result, stating that the mixture rule exemption was promulgated in recognition that small amounts of certain spent solvents are often most efficiently managed by being discharged to a plant's wastewater treatment system and that this method of management does not pose risks to human health and the environment.

EPA acknowledges that the TC rule may bring some currently exempted wastewaters into the subtitle C regulatory system; however, the mixture rule exemption is an exemption from the hazardous waste listings, not the characteristics. Thus, there is no inconsistency between this rule and the mixture rule exemption. In addition, it should be noted that the TC regulatory levels are based on state-of-the-art toxicological data and risk assessment methodologies. Consequently, EPA believes that the TC regulatory levels are the best measures available to identify wastewater mixtures that pose a threat to human health and the environment. In contrast, the mixture rule exemption levels are based upon less current risk information.

Even though some wastewaters presently covered by the mixture rule exemption will become hazardous wastes as a result of the TC rule, EPA believes that the exemption will continue to serve an important purpose by ensuring that mixtures of wastewaters and certain listed spent solvents will not be considered hazardous unless they exhibit a characteristic of hazardous waste. To clarify the mixture rule exemption and make it more consistent with current risk information, EPA is considering proposing in the future that the mixture rule exemption levels be reduced so that they are equivalent to the TC regulatory levels.

d. *Delisting.* While the June 13, 1989 proposal did not specifically address the effect that the TC might have on the hazardous waste delisting program under 40 CFR 260.22, a number of comments were received claiming that the TC rule would be inconsistent with existing EPA policies regarding case-by-case exclusions. In the August 1, 1989 proposal, however, the Agency solicited comment on the use of the EPACMS model in the delisting program.

The commenters noted that each major element of the delisting program is different from the corresponding element in the original TC program. For example, the chronic toxicity reference levels that are used to establish "hazard" levels under the delisting program appear to differ from the [illegible] that were used to establish the TC regulatory standards. In addition, the delisting program uses (as opposed to) a different ground water transport model (i.e., the Vertical and Horizontal Spread (VHS) Model), which generates DAFs rather than site-specific factors. Finally, the delisting program employs (as appropriate) the Organic Leachate Model (OLM) rather than the EP or the TCLP to determine the degree to which various organic constituents are likely to leach from solid wastes. The commenters asked the Agency to use the same reference DAFs, and leaching procedures in the characteristic and delisting programs. A few commenters expressed a particular preference for adopting delisting elements as part of the TC.

There were a number of differences between the various elements of the proposed TC and the corresponding elements in the delisting program. However, regarding Chronic Toxicity Reference Levels, the only difference between the levels used in the delisting program and those in the TC Rule is the use of different risk levels for carcinogens (i.e., delisting uses a conservative risk factor of 10^{-6} for carcinogens, compared to the use of 10^{-5} risk factor in the TC rule). Most of the differences between the chronic toxicity reference levels used in the TC rule and those in the delisting program have been eliminated as a result of decisions concerning risk levels and apportionment. Furthermore, the risk based levels used in the delisting program and in the TC rule have been updated to incorporate recent Agency evaluations (see 53 FR 19954).

EPA believes that the risk factors being used for each program are appropriate, and does not think the levels used to set regulatory levels should necessarily be the same in two programs because each serves a separate purpose. Delisting evaluates the hazard posed by specific individual wastestreams that have been listed as hazardous. Characteristics identify broad classes of clearly hazardous wastes; specific wastes that may pose substantial identified hazard in a risk range may be listed as hazardous. As discussed below, EPA believes it appropriate that the delisting program in certain cases, more stringent than the characteristic program.

A number of commenters focused on the overall stringency of the characteristic and delisting programs. In particular, the commenters stated that the proposed TC regulatory levels were sometimes greater than and sometimes less than the concentration standards used by the Agency's delisting program in determining when listed wastes may properly be managed in subtitle D facilities. Most of the commenters argued that EPA, in the interest of consistency, should adopt the same concentration standards under the characteristic and delisting programs. Other commenters, however, urged the Agency to establish higher concentration standards under the revised characteristic. The latter group of commenters noted that characteristics are designed to identify broad classes of solid wastes that are "clearly" hazardous, while listings are designed to identify wastes that may not exhibit a characteristic, yet are nevertheless hazardous. The commenters concluded that, in light of the different functions of listings and characteristics, it should be more difficult for a waste to pass the delisting standards (i.e., to be eligible for delisting) than for the same waste to pass the characteristic test.

EPA does not agree with those commenters who argued that the Agency must use the same concentration standards in the characteristic and delisting programs or, that the concentration standards for characteristics must be higher than those for delisting. These programs have very different purposes. While hazardous waste characteristic levels are those equal to or above which a waste is clearly hazardous due to a particular property, delisting levels are those below which a waste is not hazardous. Thus, it is reasonable that these two levels may or may not coincide. Delisting decisions are based on an extensive evaluation of a particular waste which requires specific information on the waste. The characteristics approach to defining a hazardous waste is much more broad. Only one mismanagement scenario is used and it is based on "reasonable worse-case" assumptions resulting in a "generic" regulatory level to be applied to all solid waste. And, of course, section 260.22 of the RCRA regulations specifies that a waste may not be delisted if it exhibits a characteristic of hazardous waste (e.g., the characteristic of EP toxicity). Thus, the delisting program could never be less stringent than the characteristic program.

In regard to the use of different models in the delisting and characteristic programs, in the August 1, 1988 Federal Register notice, the Agency specifically solicited comment on the use of the Toxicity Characteristics model (EPACML) in place of the model currently used in the delisting program (the VHS model). All of the commenters supported the use of EPACML instead of the VHS model in the delisting program, although one commenter supported this only if it would not add complexity and thereby increase the time required for delisting petition evaluation. Another commenter stated that the EPACML model should be used in the delisting program but that petition evaluations should not be restricted to the use of any single specific model. Finally, several of the commenters stated that the Agency should present details as to how the EPACML model would be used for delisting in a separate Federal Register notice.

In response to these comments, the Agency will use the EPACML model and the TCLP in the delisting program. Also, as suggested, the Agency will explain how the model and the TCLP will be used in a future Federal Register notice.

A few commenters expressed concern about the applicability of the TC to wastes that have previously been delisted. The commenters argued that once EPA has ruled (through the waste-specific delisting process) that a particular waste stream poses no threat to human health and the environment, the Agency should be barred from using a generic rule to declare the same waste as being "clearly" hazardous. One commenter claimed that it would be especially unfair to alter the regulatory status of a waste stream after the person managing it has been granted an exclusion and has acted in reliance on that exclusion (e.g., by changing the production process or waste management practices).

EPA has consistently maintained that wastes "excluded" from subtitle C regulation under the delisting program may nevertheless be hazardous if they exhibit a characteristic of hazardous waste (see 40 CFR 260.22). While the TC rule will apply to previously delisted waste, EPA does not, in general, expect that such wastes will become hazardous because of application of the revised TC. The Agency believes that, because delisting levels are more stringent than the final TC levels, the impact of the TC rule on previously delisted wastes will be minimal. Nevertheless, if a previously delisted waste exhibits the TC, it will again be subject to subtitle C requirements (i.e., delisted wastes are treated no differently than any other solid waste).

2. Land Disposal Restrictions

a. Risk Levels and Frequency Interval. The approach used to develop regulatory levels in the proposed TC rule was similar to the original approach suggested for developing treatment standards in the proposed Land Disposal Restrictions (LDR) rule (51 FR 1602, January 14, 1986). Both proposals began with health-based concentration thresholds at the point of exposure and used subsurface fate and transport models to back-calculate allowable constituent concentrations in the leachate. In the June 13, 1988 TC proposal, the Agency requested comments on whether the risk levels and cumulative frequency level used in the TC should be the same as those used to develop the treatment standards in the proposed LDR rule.

Several commenters supported the use of different risk levels and cumulative frequency levels in the two proposals. These commenters stressed that different statutory mandates for the two rules and the entirely different functions of the TC regulatory levels and the LDR treatment standards warranted different approaches. However, other commenters contended that the frequency level and risk levels in the TC rule should be the same as or more stringent than those used in the LDR proposal. Some of these commenters argued that the more stringent risk levels and frequency level in the LDR proposal provided a more appropriate degree of protection for human health and the environment than the corresponding levels and frequency interval in the TC proposal.

The issue of consistency of risk level and frequency level for the TC and the LDR program is now moot. The LDR final rule (51 FR 40572, November 7, 1986) abandoned the use of screening levels based on risk methodology and subsurface fate and transport modeling, and promulgated an approach to establishing treatment standards based entirely on technology-based standards expressed as Best Demonstrated Available Technology (BDAT). Today's rule continues to be based upon health based concentration levels and dilution attenuation factors, the values for which are based upon the predictions of a subsurface fate and transport model.

b. Treatment Standards for TC Wastes. Under RCRA section 3004(g)(4), EPA is required to make an LDR determination for all TC wastes within months of today's action, as discussed in the following section. Several commenters were concerned that the LDR treatment standards that will

eventually be established for the TC wastes may be inconsistent with TC regulatory levels. Some of these commenters noted that the proposed LDR treatment standards for listed spent solvents were in many cases lower than the proposed TC regulatory levels for the identical constituents in unlisted characteristic wastes. The commenters feared that if LDR treatment standards are applied to unlisted TC wastes in the same manner as they are applied to similar listed wastes, the characteristic wastes may require treatment to below the TC level before subtitle C land disposal is permissible. This means that unlisted wastes no longer exhibiting the TC must continue to be managed as hazardous wastes. Some commenters who voiced concerns over potential differences between TC regulatory levels and LDR treatment standards suggested that there should be a clear continuum of regulatory levels, with the higher standards being those that deem a waste hazardous in the first place (i.e., the TC regulatory levels).

Wastes deemed hazardous under the TC will not immediately become subject to the LDR program on the effective date of the TC rule, except perhaps by operation of the California List restrictions (i.e., halogenated organic compounds are subject to the LDR if they exhibit a characteristic, see 52 FR 25770, July 8, 1987). However, the Agency has not yet determined whether the existing LDR California List restrictions should be applicable to newly identified TC wastes. The Agency specifically requested comment on the appropriateness of applying the California List prohibitions to newly identified hazardous wastes in the November 22, 1989 proposed rule for the "Third Third" of scheduled wastes (54 FR 48[illegible]). The Agency will fully address this issue as part of the "Third Third" final rule.

Since the Agency is not today proposing LDR treatment standards for the TC wastes, the Agency believes that it is more appropriate to address these comments when the LDR treatment standards are proposed. However, in response to comments that proposed treatment standards for listed solvents were lower than proposed TC levels, the Agency would like to point out that the treatment standards for TC wastes will not necessarily be the same as the corresponding LDR treatment standards for spent solvents. Indeed, if the TC wastes belong to a different treatability group, one can expect that the treatment standards will be different.

c. *Schedule for LDR Determinations.* For wastes already listed or identified at the time of enactment of HSWA, the Agency must make LDR determinations according to the schedule set forth in RCRA section 3004(g)(4). If EPA fails to make the determinations by the established schedule, the wastes are automatically subject to the land disposal restrictions on the scheduled date. EPA must also make LDR determinations for all wastes that are identified or listed as hazardous after November 1984 (when HSWA was enacted) within six months after the wastes are identified or listed.

On November 22, 1989 (54 FR 48372), EPA proposed treatment standards for those wastes that exhibit the EPTC, as well as any of the other characteristics. Upon the effective date of today's rule, the TC will include the 14 EPTC constituents in addition to the 25 organics, and the TCLP will replace the EP. EPA proposed that the BDAT levels for wastes that exhibit the EPTC for the 14 constituents remain the same when the TC becomes effective. By May 8, 1990 the Agency will establish the final BDAT levels for the 14 constituent currently identified by the EPTC. Newly identified TC wastes are subject to the six-month listing deadline. However, wastes are not automatically prohibited from land disposal if EPA fails to make this required determination within six months.

Some commenters argued that the six-month deadline would accelerate the LDR determinations for listed wastes that contain TC constituents. For example, some commercial chemical products are currently scheduled to be reviewed by May 8, 1990 (51 FR 1[illegible], May 28, 1986). However, these wastes also may exhibit the TC. Commenters were concerned that these wastes may be subject to the six-month deadline and claimed that this would effectively accelerate the determinations in a manner that would be contrary to Congressional intent.

Wastes that are newly identified as hazardous by today's rule will be subject to the six-month deadline for LDR determinations. However, even if EPA were to complete LDR determinations for TC wastes before May, 1990, the Agency disagrees with commenters that this has the potential to accelerate the determinations in a manner that would be contrary to Congressional intent. The dates set forth in RCRA section 3004(g)(4) are deadlines by which EPA must make LDR determinations or the wastes are automatically restricted from land disposal. EPA is in no way prevented or discouraged by the statute from making LDR determinations before any of its deadlines. RCRA section 3004(g)("Not later than [illegible]"), indeed, oth determinations are being made ab schedule; the final rule for restrict "second third" wastes includes treatment standards and prohibiti some "third third" wastes (54 FR 2

3. RCRA Corrective [illegible] Requirements

Today's rule will have no direct on either the action levels of RCRA corrective action or the cleanup standards of RCRA closure requirements. However, to the exte that the TC brings more facilities u the RCRA program as hazardous w management facilities, additional facilities will be newly subject to th subtitle C corrective action and clo requirements.

Although the corrective action program under subtitle C addresses remediation of releases of hazardou constituents from waste at facilities subject to RCRA permitting, the TC levels will be neither action levels (i concentrations that, if exceeded, sig the need for corrective action) nor cleanup standards. Rather, correctiv action, as a process, encompasses trigger levels and cleanup standards are developed from site-specific information gathered during the investigatory and evaluative phases the process (i.e., the RCRA Facility Investigation and the Corrective Measures Study).

Thus, the levels or concentrations associated with today's TC rule are largely independent from levels associated with corrective action. Similarly, the closure requirements ar unaffected by today's rule. The TC is used to determine whether a facility h met the requirements for clean closur However, it must be noted that solid wastes generated as a result of remediation of releases or in pursuanc of closure requirements that exhibit th TC must be handled as a hazardous waste.

4. Minimum Technology Requirements

a. *Applicability.* HSWA added secti 3004(o) to RCRA which imposes minimum technology requirements on owners and operators of certain landfil and surface impoundments seeking permits. HSWA also added a new section 3015 imposing similar requirements on certain interim status waste piles, landfills, and surface impoundments. Finally, HSWA section 3005(j) requires surface impoundments to be retrofitted to meet minimum technology requirements. EPA codified the statutory language in the Agency's

Codification Rule promulgated on July 25, 1985 (50 FR 28706). Facilities that will face new RCRA regulation following the promulgation of the TC will need to comply with the minimum technology requirements in order to remain in operation.

b. Scope of Minimum Technology Requirements—1. Permitted Facilities. Section 3004(o)(1)(A) requires that after November 8, 1984, certain landfills and surface impoundments must meet minimum technology requirements. The minimum technology requirements for landfills and surface impoundments appear in 40 CFR 264.301(c) and 264.221(c), respectively. They require the owner or operator of each new unit and each replacement unit or lateral expansion of an existing unit to install two or more liners and a leachate collection system between and, for landfills, above the liners.

2. Interim Status Facilities. Section 3015 of RCRA requires that certain waste piles, landfills, and surface impoundments meet minimum technology requirements. The minimum technology requirements for interim status waste piles, landfills, and surface impoundments appear in 40 CFR 265.254, 265.301, and 265.221, respectively. They require that the owner or operator of each new unit, replacement of an existing unit, or lateral expansion of an existing unit that is within the area identified in the part A permit application install liners and a leachate collection system or equivalent protection. Existing surface impoundments (i.e., surface impoundments regulated under subtitle C prior to November 8, 1984) had to be retrofitted to meet the minimum technology requirements by November 8, 1988.

c. Compliance with Minimum Technology Requirements. Facilities or units newly regulated as a result of the TC will have to meet the minimum technology requirements of sections 3004(o) and 3015 if and when they add a new unit, replace an existing unit, or laterally expand an existing unit. Surface impoundments that comply with the retrofitting requirement in section 3004(l)(1)(B) [illegible] which requires the owner or operator of a newly-regulated surface impoundment to retrofit that impoundment 4 years from the date of promulgation of the additional listings or characteristics, that made it subject to regulation. Thus, surface impoundments that become regulated under subtitle C because of the TC will need to meet the minimum technology requirements on March 29, 1994. (However, retrofitting may be expedited due to the minimum technology requirements imposed under the capacity variance for land disposal under section 3004.) This extension applies only to those impoundments that contain solely the newly listed/characteristic wastes. Any impoundments that already contained listed/characteristic wastes currently are subject to RCRA regulations, including the minimum technology requirements. Other existing land disposal units (besides surface impoundments) that already contained wastes that exhibit the TC will not require retrofitting unless they are expanded or are replacement units.

5. RCRA Subtitle D (Solid Wastes)

a. Municipal Waste Combustion Ash. Several commenters requested that ash from municipal waste combustion (MWC) units be exempt from regulation under the TC. Many of these commenters argued that the regulation of MWC ash would be in direct conflict with RCRA section 3001(i), which provides that resource recovery facilities engaging in MWC "shall not be deemed to be treating, storing, disposing of, or otherwise managing hazardous wastes." Other commenters indicated that the high costs associated with subtitle C regulation would discourage the recovery of energy values from MSW. They claimed that this result would run counter to the clear Congressional intent to encourage resource recovery as a beneficial alternative to the landfilling of MSW.

EPA articulated its position on the scope of section 3001(i) when the Agency codified the 1984 HSWA (see 50 FR 28702, July 15, 1985). However, two recent Court decisions have rejected EPA's 1985 interpretation. *EDF* v. *City of Chicago*, No. 88C769 (N.D. Ill.) (slip op. Nov. 28, 1989) and *EDF* v. *Wheelabrator Technologies Inc.*, No. 88Civ.5580 (S.D. N.Y.) (slip op. Nov. 21, 1989). The Agency is considering the appropriate response to these two decisions.

b. Impact on Wastes Excluded from Subtitle C Regulation. Another group of commenters asked for assurances that the TC rule would not affect the existing exclusions for specific wastes under 40 CFR 261.4(b). One commenter expressed particular concern about the exclusion for mixtures of household and other nonhazardous solid wastes. Another commenter raised questions about applying the TC to wastes that are usually considered to be non-hazardous solid wastes. Other commenters focused on the exemptions for "special wastes," primarily mining and mineral processing wastes and oil and gas production wastes. A utility company consortium addressed the exemption for wood treated with arsenic, commonly used as a fungicide for utility poles. The commenter noted that creosote and pentachlorophenol, also used as fungicides for wood, are proposed as TC constituents; the commenter asserted that the exemption for arsenic-treated wood should be extended to creosote- and pentachlorophenol-treated wood as well.

The TC rule will not apply to wastes that are already excluded from subtitle C regulation under § 261.4(b). These wastes will continue to be exempt from regulation as hazardous wastes, even if they would exhibit the TC. Likewise, the TC rule does not add any exclusions to the applicability of previously promulgated hazardous waste characteristics. With respect to the issue of creosote- and pentachlorophenol-treated wood, EPA does not at this time intend to expand the list of exemptions under § 261.4(b) to include these wastes. This is discussed further in section III.J.4.b.

It should be noted, however, that the special waste exclusions are currently being reevaluated in accordance with the criteria and procedures mandated by Congress. After completing the studies required by RCRA section 8002, EPA may determine that one or more special wastes should be regulated under RCRA subtitle C (see RCRA section 3001(b)). Such wastes would then be listed or the generators required to determine whether the wastes exhibit a hazardous waste characteristic.

A few commenters argued that even if special wastes are brought into the subtitle C system, they should not be subject to the TC. These commenters claimed that codisposal of special wastes with MSW is implausible because special wastes, by definition, are generated in very large quantities. The commenters recommended that EPA develop a separate mismanagement scenario and leaching procedure for special wastes.

At this time, the Agency cannot agree that the TC should not be applicable to special wastes; rather, the applicability to these wastes will be determined on a case-by-case basis. If EPA makes a determination that any special wastes should be regulated under RCRA subtitle C, the Agency will at that time make a separate determination concerning the applicability of the TC to such wastes.

6. RCRA Subtitle I (Underground Storage Tanks)

a. Scope of the Underground Storage Tank Program. Subtitle I of RCRA provides for the establishment of a

regulatory program for underground storage tanks containing "regulated substances." Regulated substances are defined under RCRA section 9001(2) as (1) petroleum and (2) hazardous substances listed under section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), excluding hazardous wastes regulated under subtitle C of RCRA.

Except as discussed below, today's action will change the regulatory status of TC wastes that were previously subject to RCRA subtitle I. Because these wastes will be RCRA hazardous wastes, they are excluded from regulation under subtitle I (see 40 CFR part 280.10(b)(1)). For this reason, underground storage tanks that contain TC wastes will be subject to the subtitle C tank requirements rather than those promulgated under subtitle I.

b. Deferral for Petroleum-Contaminated Media and Debris Subject to Part 280 Corrective Action Requirements. As part of its underground storage tank (UST) program, the Agency has recently promulgated regulations which address releases from USTs containing petroleum (see 53 FR 37082, September 23, 1988 and 53 FR 43322, October 28, 1988). Among other requirements, these rules require petroleum UST owners and operators to install leak detection, to report leaks from their tanks and piping, to undertake corrective action to address such releases, and to demonstrate financial assurance for corrective action and third party liability resulting from such releases. These requirements started going into effect in December, 1988, and the Agency estimates that over the next few years more than 300,000 petroleum UST releases will be discovered and be subject to the subtitle I corrective action requirements. In addition, the Agency has, through cooperative agreements, provided funding to states from the Leaking Underground Storage Tank (LUST) Trust Fund under RCRA to undertake the necessary response actions where petroleum UST owners and operators are unable or unwilling to do so. Hundreds of petroleum UST cleanups have been initiated to date under this program.

As noted in the preamble to the final UST rules, due to the large regulated community affected by the UST regulations, the UST program is based on self-implementing requirements and is highly dependent upon voluntary compliance to attain the environmental performance objectives of the program. However, because petroleum contains several of the hazardous constituents for which regulatory levels are being established today (e.g., benzene) some of the petroleum-contaminated media and debris may exhibit the Toxicity Characteristic under today's rule. While the amount and type of media and debris that may exhibit the characteristic at any particular UST site will depend upon the petroleum product, soil type, and the size of the release, it is likely that many sites where petroleum UST releases have occurred will contain some media that exhibits the Toxicity Characteristic. The management of any such media and debris would be subject to subtitle C requirements for hazardous waste management.

The Agency has insufficient information concerning the full impact of this rule on UST cleanups, but the information available to date suggests that the impact may be severe in terms of the administrative feasibility of both the subtitle C and subtitle I programs. Thus, the Agency has decided to defer a final decision on the application of the TC to media and debris contaminated with petroleum from USTs subject to the part 280 requirements. The application of today's rule to these cleanups will be delayed while the Agency evaluates the extent and nature of the impact and alternative administrative mechanisms for implementing the UST cleanups in accordance with subtitle C requirements. The Agency believes that the UST regulations governing cleanups at these sites will be adequate in the interim to protect human health and the environment.

The deferral of a final decision concerning application of this rule to UST cleanups is necessary for several reasons. First, while the actual number of sites and amount of media and debris at each site that would exhibit the toxicity characteristic under today's rule is unclear, based on a preliminary assessment, the number and amount could be extremely high. As noted above, EPA expects hundreds of thousands of UST releases to be uncovered in the next few years. Subjecting each of these sites to subtitle C requirements could overwhelm the hazardous waste permitting program and the capacity of existing hazardous waste treatment, storage, and disposal facilities. Imposition of the subtitle C requirements is also likely to delay cleanups significantly and severely discourage the self-monitoring and voluntary reporting essential to implementation of the UST program. Moreover, the UST cleanup activities involving the most contaminated media and debris are also likely to involve free product recovery. Free prod[illegible] would not be subject to subt[illegible] requirements because the m[illegible] recovered is not a waste.

Because of the uncertainti[illegible] impacts on the UST cleanup[illegible] of this rule, including the am[illegible] contaminated media that wo[illegible] hazardous waste and the typ[illegible] management feasible and ap[illegible] for such waste (i.e., on-site tr[illegible] off-site disposal), EPA cannot [illegible] whether the application of th[illegible] these cleanups will have the [illegible] consequences on implementat[illegible] these RCRA programs that pr[illegible] information suggests. Also, b[illegible] issue did not come to the Age[illegible] attention until late in the deve[illegible] of this rulemaking, the Agency [illegible] had an opportunity to obtain [illegible] input on this issue, the implica[illegible] the subtitle C requirements wi[illegible] applied to UST cleanups, or a[illegible] alternative regulatory mechan[illegible] make feasible the implementa[illegible] UST cleanups while meeting [illegible] hazardous waste requirements [illegible] the Agency believes that furth[illegible] evaluation of the impacts of ap[illegible] TC to soils and ground water [illegible] contaminated by petroleum fro[illegible] and subject to the subtitle I pr[illegible] necessary in order to determin[illegible] an exemption for such materia[illegible] warranted or whether addition[illegible] regulatory or administrative ch[illegible] can or should be made in order [illegible] the application of the TC to US[illegible] cleanups feasible.

In order to make a final decis[illegible] concerning the applicability of [illegible] to UST sites, the Agency intend[illegible] undertake several activities. Fir[illegible] Agency will attempt to more sp[illegible] define the impact of the TC thro[illegible] studies of petroleum UST sites, [illegible] upon the potential hazard from [illegible] sites. More specifically, the Age[illegible] study the characteristics of UST [illegible] (number of UST sites by media [illegible] volumes of media and debris typ[illegible] removed, fraction of this media [illegible] debris that exhibits the TC, if any [illegible] current practices and requiremen[illegible] management of these media and [illegible] and how contaminated media an[illegible] debris from these sites are mana[illegible] under the new subtitle I state pr[illegible] As currently envisioned, these s[illegible] will include: (1) A survey of tank [illegible] vendors, contractors, and others [illegible] knowledgeable about UST site [illegible] characteristics and contaminate[illegible] and debris management practice[illegible] survey of current state and local [illegible] programs; and (3) a sampling pro[illegible] conducted in conjunction with o[illegible]

more selected states. The Agency also plans to evaluate the impact that subtitle C management of petroleum-contaminated media and debris from USTs would have on the Agency's and states' hazardous waste management programs. In addition, the inclusion of these media and debris in the subtitle C management system will be evaluated in comparison to the available capacity for commercial hazardous waste treatment, storage, and disposal.

Second, the Agency will evaluate whether and how the subtitle C requirements can be feasibly implemented for UST cleanups. This evaluation will include an investigation of regulatory streamlining, phased compliance, or other administrative changes to increase the feasibility of implementing UST cleanups in accordance with subtitle C requirements. As part of this effort and the larger issue of the application of subtitle C requirements to contaminated media, EPA intends to convene a public forum to discuss the relationship between subtitle C and subtitle I requirements, the impacts of the subtitle C program on UST cleanups, and how the subtitle C requirements can feasibly be applied to the UST cleanups.

EPA requests data and comment from the public on these issues. Upon completion of the evaluations described above, EPA will determine whether to retain the temporary exemption for UST cleanups provided in this rule or to remove the exemption and make the TC fully applicable to corrective actions under subtitle I.

7. RCRA Section 3004(n) Air Regulations

In HSWA, Congress directed EPA to "* * * promulgate such regulations for the monitoring and control of air emissions at hazardous waste treatment, storage, and disposal facilities, including but not limited to open tanks, surface impoundments, and landfills, as may be necessary to protect human health and the environment." This provision was added as section 3004(n) of RCRA. In response, the Agency proposed the first of a multi-phased [illegible] air regulations for TSDFs on February 5, 1987 (53 FR 3748). This first phase is intended to apply to equipment that would be used to treat wastes that would first be subject to the Land Disposal Restrictions (LDR) standards to ensure that the LDR treatment did not result in cross-media transfer of hazardous constituents to the air (see III.I.2., above, for a discussion of the LDR program). This first phase is to be followed by proposals for more comprehensive air regulations for TSDFs. Once these air standards are promulgated, they are expected to apply to many of the wastes newly regulated by today's rule.

The February 5, 1987 proposal would limit air emissions of organics as a class from certain treatment units. The proposed rule would apply to specified equipment that contains or is in contact with certain hazardous wastes, which are identified based upon their potential to emit organics. The proposed standards contain two major features. First, a 99% reduction in process emissions from units distilling or stripping (air or steam) organic wastes would be required. Second, leak detection and repair programs would be required for certain valves, pumps, compressors, pressure relief devices, and closed-vent systems. If wastes that exhibit the TC also have concentrations of organic constituents exceeding the regulatory threshold, they will be subject to this first phase of regulation for air emissions.

J. Relationship to Other Regulatory Authorities

1. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Although promulgated in fulfillment of a RCRA mandate, today's rule may affect, to varying degrees, remediations performed under CERCLA authority. Such effects or interactions, when they arise, will be associated with section 121(d) of CERCLA, which requires CERCLA remedial actions to comply with all applicable or relevant and appropriate requirements (ARARs) of other federal and state laws, including RCRA.

Several commenters questioned the applicability of the TC to CERCLA sites and argued that the TC would constrain the discretion of Remedial Project Managers and On-Scene Coordinators. However, CERCLA section 121(d) is clear that CERCLA remediations must comply with Federal and State ARARs. Accordingly, RCRA regulations, including today's TC, are incorporated into the CERCLA decision-making and remediation process to augment controls already in place under the CERCLA program.

In addition, a few commenters argued that as a result of today's rule, a greater number of hazardous waste determinations would be made during CERCLA remediations. Consequently, "thousands of additional Superfund sites" would be created, attributable in large part, one commenter notes, to petroleum and petrochemical waste that will exceed TC levels. The Agency disagrees with the commenters. While it is clear that CERCLA remediations must comply with Federal and State ARARs, the TC is not used by CERCLA to determine whether or not to undertake a clean-up action. Rather, the TC will apply to decisions concerning the management of solid wastes (e.g., soil and debris) generated during cleanup activities.

2. Clean Water Act

a. Conflict with NPDES Effluent Guidelines and Pretreatment Standards. Many commenters argued that the regulatory levels in the proposed TC conflict with NPDES effluent guidelines and pretreatment standards under the Clean Water Act (CWA). Several commenters stated that in many cases, the proposed TC regulatory levels are lower than the concentrations allowed in wastewaters directly discharged to surface waters in compliance with NPDES effluent guidelines. Commenters also stated that many wastewaters that are indirectly discharged to publicly owned treatment works in compliance with pretreatment standards will exhibit the TC.

Most of the commenters argued that it would be difficult to justify labeling a wastewater as "hazardous" under RCRA, but "safe" under the CWA. One commenter claimed that differential treatment of identical wastewaters is particularly difficult to justify because leaks from on-site wastewater management operations normally migrate to the same bodies of water that receive NPDES-permitted discharges.

EPA acknowledges the possibility that some wastewaters that meet NPDES effluent guidelines or pretreatment standards may exhibit the TC. However, because the statutory bases for setting regulatory levels are different under the CWA and RCRA, the treatment standards and effluent limitations established under the CWA are not inconsistent with the TC rule. The CWA requires EPA to set effluent limitations to control discharges of toxic pollutants "* * * which shall require application of the best available technology economically achievable * * *" and to set more stringent effluent limitations where necessary to meet applicable water quality standards (see CWA section 301(b)). RCRA, however, mandates that EPA identify wastes which may be a threat to human health or the environment. The criteria for the identification and listing of hazardous waste requires EPA to take into account "* * * toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous