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CHEMICALS USED IN HYDRAULIC FRACTURING

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I. EXECUTIVE SUMMARY

Hydraulic fracturing has helped to expand natural gas production in the United States, unlocking large natural gas supplies in shale and other unconventional formations across the country. As a result of hydraulic fracturing and advances in horizontal drilling technology, natural gas production in 2010 reached the highest level in decades. According to new estimates by the Energy Information Administration (EIA), the United States possesses natural gas resources sufficient to supply the United States for approximately 110 years.

As the use of hydraulic fracturing has grown, so have concerns about its environmental and public health impacts. One concern is that hydraulic fracturing fluids used to fracture rock formations contain numerous chemicals that could harm human health and the environment, especially if they enter drinking water supplies. The opposition of many oil and gas companies to public disclosure of the chemicals they use has compounded this concern.

Last Congress, the Committee on Energy and Commerce launched an investigation to examine the practice of hydraulic fracturing in the United States. As part of that inquiry, the Committee asked the 14 leading oil and gas service companies to disclose the types and volumes of the hydraulic fracturing products they used in their fluids between 2005 and 2009 and the chemical contents of those products. This report summarizes the information provided to the Committee.

Between 2005 and 2009, the 14 oil and gas service companies used more than 2,500 hydraulic fracturing products containing 750 chemicals and other components. Overall, these companies used 780 million gallons of hydraulic fracturing products – not including water added at the well site – between 2005 and 2009.

Some of the components used in the hydraulic fracturing products were common and generally harmless, such as salt and citric acid. Some were unexpected, such as instant coffee and walnut hulls. And some were extremely toxic, such as benzene and lead. Appendix A lists each of the 750 chemicals and other components used in hydraulic fracturing products between 2005 and 2009.

The most widely used chemical in hydraulic fracturing during this time period, as measured by the number of compounds containing the chemical, was methanol. Methanol, which was used in 342 hydraulic fracturing products, is a hazardous air pollutant and is on the candidate list for potential regulation under the Safe Drinking Water Act. Some of the other most widely used chemicals were isopropyl alcohol (used in 274 products), 2-butoxyethanol (used in 126 products), and ethylene glycol (used in 119 products).

Between 2005 and 2009, the oil and gas service companies used hydraulic fracturing products containing 29 chemicals that are (1) known or possible human carcinogens, (2) regulated under the Safe Drinking Water Act for their risks to human health, or (3) listed as hazardous air pollutants under the Clean Air Act. These 29 chemicals were components of more than 650 different products used in hydraulic fracturing.

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The BTEX compounds – benzene, toluene, xylene, and ethylbenzene – appeared in 60 of the hydraulic fracturing products used between 2005 and 2009. Each BTEX compound is a regulated contaminant under the Safe Drinking Water Act and a hazardous air pollutant under the Clean Air Act. Benzene also is a known human carcinogen. The hydraulic fracturing companies injected 11.4 million gallons of products containing at least one BTEX chemical over the five year period.

In many instances, the oil and gas service companies were unable to provide the Committee with a complete chemical makeup of the hydraulic fracturing fluids they used. Between 2005 and 2009, the companies used 94 million gallons of 279 products that contained at least one chemical or component that the manufacturers deemed proprietary or a trade secret. Committee staff requested that these companies disclose this proprietary information. Although some companies did provide information about these proprietary fluids, in most cases the companies stated that they did not have access to proprietary information about products they purchased "off the shelf" from chemical suppliers. In these cases, the companies are injecting fluids containing chemicals that they themselves cannot identify.

II. BACKGROUND

Hydraulic fracturing – a method by which oil and gas service companies provide access to domestic energy trapped in hard-to-reach geologic formations — has been the subject of both enthusiasm and increasing environmental and health concerns in recent years. Hydraulic fracturing, used in combination with horizontal drilling, has allowed industry to access natural gas reserves previously considered uneconomical, particularly in shale formations. As a result of the growing use of hydraulic fracturing, natural gas production in the United States reached 21,577 billion cubic feet in 2010, a level not achieved since a period of high natural gas production between 1970 and 1974.[1] Overall, the Energy Information Administration now projects that the United States possesses 2,552 trillion cubic feet of potential natural gas resources, enough to supply the United States for approximately 110 years. Natural gas from shale resources accounts for 827 trillion cubic feet of this total, which is more than double what the EIA estimated just a year ago.[2]

Hydraulic fracturing creates access to more natural gas supplies, but the process requires the use of large quantities of water and fracturing fluids, which are injected underground at high volumes and pressure. Oil and gas service companies design fracturing fluids to create fractures and transport sand or other granular substances to prop open the fractures. The composition of these fluids varies by formation, ranging from a simple mixture of water and sand to more complex mixtures with a multitude of chemical additives. The companies may use these

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[1] Energy Information Administration (EIA), *Natural Gas Monthly (Mar. 2011)*, Table 1, U.S. Natural Gas Monthly Supply and Disposition Balance (online at www.eia.gov/dnav/ng/hist/n9070us1A.htm) (accessed Mar. 30, 2011).

[2] EIA, *Annual Energy Outlook 2011 Early Release* (Dec. 16, 2010); EIA, *What is shale gas and why is it important?* (online at www.eia.doe.gov/energy_in_brief/about_shale_gas.cfm) (accessed Mar. 30, 2011).

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chemical additives to thicken or thin the fluids, improve the flow of the fluid, or kill bacteria that can reduce fracturing performance.[3]

Some of these chemicals, if not disposed of safely or allowed to leach into the drinking water supply, could damage the environment or pose a risk to human health. During hydraulic fracturing, fluids containing chemicals are injected deep underground, where their migration is not entirely predictable. Well failures, such as the use of insufficient well casing, could lead to their release at shallower depths, closer to drinking water supplies.[4] Although some fracturing fluids are removed from the well at the end of the fracturing process, a substantial amount remains underground.[5]

While most underground injections of chemicals are subject to the protections of the Safe Drinking Water Act (SDWA), Congress in 2005 modified the law to exclude "the underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities" from the Act's protections.[6] Unless oil and gas service companies use diesel in the hydraulic fracturing process, the permanent underground injection of chemicals used for hydraulic fracturing is not regulated by the Environmental Protection Agency (EPA).

Concerns also have been raised about the ultimate outcome of chemicals that are recovered and disposed of as wastewater. This wastewater is stored in tanks or pits at the well site, where spills are possible.[7] For final disposal, well operators must either recycle the fluids for use in future fracturing jobs, inject it into underground storage wells (which, unlike the fracturing process itself, are subject to the Safe Drinking Water Act), discharge it to nearby surface water, or transport it to wastewater treatment facilities.[8] A recent report in the *New York*

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[3] U.S. Environmental Protection Agency, *Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs* (June 2004) (EPA 816-R-04-003) at 4-1 and 4-2.

[4] For instance, Pennsylvania's Department of Environmental Protection has cited Cabot Oil & Gas Corporation for contamination of drinking water wells with seepage caused by weak casing or improper cementing of a natural gas well. *See Officials in Three States Pin Water Woes on Gas Drilling*, ProPublica (Apr. 26, 2009) (online at www.propublica.org/article/officials-in-three-states-pin- water-woes-on-gas -drilling-426) (accessed Mar. 24, 2011).

[5] John A. Veil, Argonne National Laboratory, *Water Management Technologies Used by Marcellus Shale Gas Producers*, prepared for the Department of Energy (July 2010), at 13 (hereinafter "*Water Management Technologies*").

[6] 42 U.S.C. § 300h(d). Many dubbed this provision the "Halliburton loophole" because of Halliburton's ties to then-Vice President Cheney and its role as one of the largest providers of hydraulic fracturing services. *See The Halliburton Loophole*, New York Times (Nov. 9. 2009).

[7] *See* EPA, *Draft Hydraulic Fracturing Study Plan* (Feb. 7, 2011), at 37; *Regulation Lax as Gas Wells' Tainted Water Hits Rivers*, New York Times (Feb. 26, 2011).

[8] *Water Management Technologies*, at 13.

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Times raised questions about the safety of surface water discharge and the ability of water treatment facilities to process wastewater from natural gas drilling operations.[9]

Any risk to the environment and human health posed by fracturing fluids depends in large part on their contents. Federal law, however, contains no public disclosure requirements for oil and gas producers or service companies involved in hydraulic fracturing, and state disclosure requirements vary greatly.[10] While the industry has recently announced that it soon will create a public database of fluid components, reporting to this database is strictly voluntary, disclosure will not include the chemical identity of products labeled as proprietary, and there is no way to determine if companies are accurately reporting information for all wells.[11]

The absence of a minimum national baseline for disclosure of fluids injected during the hydraulic fracturing process and the exemption of most hydraulic fracturing injections from regulation under the Safe Drinking Water Act has left an informational void concerning the contents, chemical concentrations, and volumes of fluids that go into the ground during fracturing operations and return to the surface in the form of wastewater. As a result, regulators and the public are unable effectively to assess any impact the use of these fluids may have on the environment or public health.

III. METHODOLOGY

On February 18, 2010, the Committee commenced an investigation into the practice of hydraulic fracturing and its potential impact on water quality across the United States. This investigation built on work begun by Ranking Member Henry A. Waxman in 2007 as Chairman of the Committee on Oversight and Government Reform. The Committee initially sent letters to eight oil and gas service companies engaged in hydraulic fracturing in the United States. In May 2010, the Committee sent letters to six additional oil and gas service companies to assess a

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[9] *Regulation Lax as Gas Wells' Tainted Water Hits Rivers*, New York Times (Feb. 26, 2011).

[10] Wyoming, for example, recently enacted relatively strong disclosure regulations, requiring disclosure on a well-by-well basis and "for each stage of the well stimulation program," "the chemical additives, compounds and concentrations or rates proposed to be mixed and injected." *See* WCWR 055-000-003 Sec. 45. Similar regulations became effective in Arkansas this year. *See* Arkansas Oil and Gas Commission Rule B-19. In Wyoming, much of this information is, after an initial period of review, available to the public. *See* WCWR 055-000-003 Sec. 21. Other states, however, do not insist on such robust disclosure. For instance, West Virginia has no disclosure requirements for hydraulic fracturing and expressly exempts fluids used during hydraulic fracturing from the disclosure requirements applicable to underground injection of fluids for purposes of waste storage. *See* W. Va. Code St. R. § 34-5-7.

[11] *See Ground Water Protection Council Calls for Disclosure of Chemicals Used in Shale Gas Exploration*, Ground Water Protection Council (Oct. 5, 2010) (online at www.wqpmag.com/Ground-Water-Protection-Council -Calls-for-Disclosur e-of-Chemicals-in-Shale-Gas-Exploration-newsPiece2 1700) (accessed Mar. 24, 2011).

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broader range of industry practices.[12] The February and May letters requested information on the type and volume of chemicals present in the hydraulic fracturing products that each company used in their fluids between 2005 and 2009.

The 14 oil and gas service companies that received the letter voluntarily provided substantial information to the Committee. As requested, the companies reported the names and volumes of the products they used during the five-year period.[13] For each hydraulic fracturing product reported, the companies also provided a Material Safety Data Sheet (MSDS) detailing the product's chemical components. The Occupational Safety and Health Administration (OSHA) requires chemical manufacturers to create a MSDS for every product they sell as a means to communicate potential health and safety hazards to employees and employers. The MSDS must list all hazardous ingredients if they comprise at least 1% of the product; for carcinogens, the reporting threshold is 0.1%.[14]

Under OSHA regulations, manufacturers may withhold the identity of chemical components that constitute "trade secrets."[15] If the MSDS for a particular product used by a company subject to the Committee's investigation reported that the identity of any chemical component was a trade secret, the Committee asked the company that used that product to provide the proprietary information, if available.

IV. HYDRAULIC FRACTURING FLUIDS AND THEIR CONTENTS

Between 2005 and 2009, the 14 oil and gas service companies used more than 2,500 hydraulic fracturing products containing 750 chemicals and other components.[16] Overall, these companies used 780 million gallons of hydraulic fracturing products in their fluids between 2005 and 2009. This volume does not include water that the companies added to the fluids at the well site before injection. The products are comprised of a wide range of chemicals. Some are seemingly harmless like sodium chloride (salt), gelatin, and citric acid. Others could pose a severe risk to human health or the environment.

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[12] The Committee sent letters to Basic Energy Services, BJ Services, Calfrac Well Services, Complete Production Services, Frac Tech Services, Halliburton, Key Energy Services, RPC, Sanjel Corporation, Schlumberger, Superior Well Services, Trican Well Service, Universal Well Services, and Weatherford.

[13] BJ Services, Halliburton, and Schlumberger already had provided the Oversight Committee with data for 2005 through 2007. For BJ Services, the 2005-2007 data is limited to natural gas wells. For Schlumberger, the 2005-2007 data is limited to coalbed methane wells.

[14] 29 CFR 1910.1200(g)(2)(i)(C)(1).

[15] 29 CFR 1910.1200.

[16] Each hydraulic fracturing "product" is a mixture of chemicals or other components designed to achieve a certain performance goal, such as increasing the viscosity of water. Some oil and gas service companies create their own products; most purchase these products from chemical vendors. The service companies then mix these products together at the well site to formulate the hydraulic fracturing fluids that they pump underground.

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Some of the components were surprising. One company told the Committee that it used instant coffee as one of the components in a fluid designed to inhibit acid corrosion. Two companies reported using walnut hulls as part of a breaker—a product used to degrade the fracturing fluid viscosity, which helps to enhance post-fracturing fluid recovery. Another company reported using carbohydrates as a breaker. One company used tallow soap—soap made from beef, sheep, or other animals—to reduce loss of fracturing fluid into the exposed rock.

Appendix A lists each of the 750 chemicals and other components used in the hydraulic fracturing products injected underground between 2005 and 2009.

A. Commonly Used Chemical Components

The most widely used chemical in hydraulic fracturing during this time period, as measured by the number of products containing the chemical, was methanol. Methanol is a hazardous air pollutant and a candidate for regulation under the Safe Drinking Water Act. It was a component in 342 hydraulic fracturing products. Some of the other most widely used chemicals include isopropyl alcohol, which was used in 274 products, and ethylene glycol, which was used in 119 products. Crystalline silica (silicon dioxide) appeared in 207 products, generally proppants used to hold open fractures. Table 1 has a list of the most commonly used compounds in hydraulic fracturing fluids.

Table 1. Chemical Components Appearing Most Often in Hydraulic Fracturing Products Used Between 2005 and 2009

Chemical Component	No. of Products Containing Chemical
Methanol (Methyl alcohol)	342
Isopropanol (Isopropyl alcohol, Propan-2-ol)	274
Crystalline silica - quartz (SiO2)	207
Ethylene glycol monobutyl ether (2-butoxyethanol)	126
Ethylene glycol (1,2-ethanediol)	119
Hydrotreated light petroleum distillates	89
Sodium hydroxide (Caustic soda)	80

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Hydraulic fracturing companies used 2-butoxyethanol (2-BE) as a foaming agent or surfactant in 126 products. According to EPA scientists, 2-BE is easily absorbed and rapidly distributed in humans following inhalation, ingestion, or dermal exposure. Studies have shown that exposure to 2-BE can cause hemolysis (destruction of red blood cells) and damage to the spleen, liver, and bone marrow.[17] The hydraulic fracturing companies injected 21.9 million gallons of products containing 2-BE between 2005 and 2009. They used the highest volume of products containing 2-BE in Texas, which accounted for more than half of the volume used. EPA recently found this chemical in drinking water wells tested in Pavillion, Wyoming.[18] Table 2 shows the use of 2-BE by state.

Table 2. States with the Highest Volume of Hydraulic Fracturing Fluids Containing 2-Butoxyethanol (2005-2009)

State	Fluid Volume (gallons)
Texas	12,031,734
Oklahoma	2,186,613
New Mexico	1,871,501
Colorado	1,147,614
Louisiana	890,068
Pennsylvania	747,416
West Virginia	464,231
Utah	382,874
Montana	362,497
Arkansas	348,959

[17] EPA, *Toxicological Review of Ethylene Glycol Monobutyl Ether* (Mar. 2010) at 4.

[18] EPA, *Fact Sheet: January 2010 Sampling Results and Site Update, Pavillion, Wyoming Groundwater Investigation* (Aug. 2010) (online at www.epa.gov/region8/superfund/wy/pavillion/Pavillionwyomingfactsheet.pdf) (accessed Mar. 1, 2011).

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B. Toxic Chemicals

The oil and gas service companies used hydraulic fracturing products containing 29 chemicals that are (1) known or possible human carcinogens, (2) regulated under the Safe Drinking Water Act for their risks to human health, or (3) listed as hazardous air pollutants under the Clean Air Act. These 29 chemicals were components of 652 different products used in hydraulic fracturing. Table 3 lists these toxic chemicals and their frequency of use.

Table 3. Chemicals Components of Concern: Carcinogens, SDWA-Regulated Chemicals, and Hazardous Air Pollutants

Chemical Component	Chemical Category	No. of Products
Methanol (Methyl alcohol)	HAP	342
Ethylene glycol (1,2-ethanediol)	HAP	119
Diesel[19]	Carcinogen, SDWA, HAP	51
Naphthalene	Carcinogen, HAP	44
Xylene	SDWA, HAP	44
Hydrogen chloride (Hydrochloric acid)	HAP	42
Toluene	SDWA, HAP	29
Ethylbenzene	SDWA, HAP	28
Diethanolamine (2,2-iminodiethanol)	HAP	14
Formaldehyde	Carcinogen, HAP	12
Sulfuric acid	Carcinogen	9
Thiourea	Carcinogen	9
Benzyl chloride	Carcinogen, HAP	8
Cumene	HAP	6
Nitrilotriacetic acid	Carcinogen	6
Dimethyl formamide	HAP	5
Phenol	HAP	5
Benzene	Carcinogen, SDWA, HAP	3
Di (2-ethylhexyl) phthalate	Carcinogen, SDWA, HAP	3
Acrylamide	Carcinogen, SDWA, HAP	2
Hydrogen fluoride (Hydrofluoric acid)	HAP	2
Phthalic anhydride	HAP	2
Acetaldehyde	Carcinogen, HAP	1
Acetophenone	HAP	1
Copper	SDWA	1
Ethylene oxide	Carcinogen, HAP	1
Lead	Carcinogen, SDWA, HAP	1
Propylene oxide	Carcinogen, HAP	1
p-Xylene	HAP	1
Number of Products Containing a Component of Concern		**652**

[19] According to EPA, diesel contains benzene, toluene, ethylbenzene, and xylenes. *See* EPA, *Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs* (June 2004) (EPA 816-R-04-003) at 4-11.

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1. *Carcinogens*

Between 2005 and 2009, the hydraulic fracturing companies used 95 products containing 13 different carcinogens.[20] These included naphthalene (a possible human carcinogen), benzene (a known human carcinogen), and acrylamide (a probable human carcinogen). Overall, these companies injected 10.2 million gallons of fracturing products containing at least one carcinogen. The companies used the highest volume of fluids containing one or more carcinogens in Texas, Colorado, and Oklahoma. Table 4 shows the use of these chemicals by state.

Table 4. States with at Least 100,000 Gallons of Hydraulic Fracturing Fluids Containing a Carcinogen (2005-2009)

State	Fluid Volume (gallons)
Texas	3,877,273
Colorado	1,544,388
Oklahoma	1,098,746
Louisiana	777,945
Wyoming	759,898
North Dakota	557,519
New Mexico	511,186
Montana	394,873
Utah	382,338

2. *Safe Drinking Water Act Chemicals*

Under the Safe Drinking Water Act, EPA regulates 53 chemicals that may have an adverse effect on human health and are known to or likely to occur in public drinking water systems at levels of public health concern. Between 2005 and 2009, the hydraulic fracturing companies used 67 products containing at least one of eight SDWA-regulated chemicals. Overall, they injected 11.7 million gallons of fracturing products containing at least one chemical regulated under SDWA. Most of these chemicals were injected in Texas. Table 5 shows the use of these chemicals by state.

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[20] For purposes of this report, a chemical is considered a "carcinogen" if it is on one of two lists: (1) substances identified by the National Toxicology Program as "known to be human carcinogens" or as "reasonably anticipated to be human carcinogens"; and (2) substances identified by the International Agency for Research on Cancer, part of the World Health Organization, as "carcinogenic" or "probably carcinogenic" to humans. See U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program, *Report on Carcinogens, Eleventh Edition* (Jan. 31, 2005) and World Health Organization, International Agency for Research on Cancer, *Agents Classified by the IARC Monographs* (online at http://monographs.iarc.fr/ENG/Classificat ion/index.php) (accessed Feb. 28, 2011).

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The vast majority of these SDWA-regulated chemicals were the BTEX compounds – benzene, toluene, xylene, and ethylbenzene. The BTEX compounds appeared in 60 hydraulic fracturing products used between 2005 and 2009 and were used in 11.4 million gallons of hydraulic fracturing fluids. The Department of Health and Human Services, the International Agency for Research on Cancer, and EPA have determined that benzene is a human carcinogen.[21] Chronic exposure to toluene, ethylbenzene, or xylenes also can damage the central nervous system, liver, and kidneys.[22]

Table 5. States with at Least 100,000 Gallons of Hydraulic Fracturing Fluids Containing a SDWA-Regulated Chemical (2005-2009)

State	Fluid Volume (gallons)
Texas	9,474,631
New Mexico	1,157,721
Colorado	375,817
Oklahoma	202,562
Mississippi	108,809
North Dakota	100,479

In addition, the hydraulic fracturing companies injected more than 30 million gallons of diesel fuel or hydraulic fracturing fluids containing diesel fuel in wells in 19 states.[23] In a 2004 report, EPA stated that the "use of diesel fuel in fracturing fluids poses the greatest threat" to underground sources of drinking water.[24] Diesel fuel contains toxic constituents, including BTEX compounds.[25]

EPA also has created a Candidate Contaminant List (CCL), which is a list of contaminants that are currently not subject to national primary drinking water regulations but are known or anticipated to occur in public water systems and may require regulation under the Safe Drinking Water Act in the future.[26] Nine chemicals on that list—1-butanol, acetaldehyde, benzyl

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[21] U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, *Public Health Statement for Benzene* (Aug. 2007).

[22] EPA, *Basic Information about Toluene in Drinking Water*, *Basic Information about Ethylbenzene in Drinking Water*, and *Basic Information about Xylenes in Drinking Water* (online at http://water.epa.gov/drink/contaminants/basicinformation/index.cfm) (accessed Oct. 14, 2010).

[23] Letter from Reps. Henry A. Waxman, Edward J. Markey, and Diana DeGette to the Honorable Lisa Jackson, Administrator, U.S. Environmental Protection Agency (Jan. 31, 2011).

[24] EPA, *Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs* (June 2004) (EPA 816-R-04-003) at 4-11.

[25] *Id.*

[26] EPA, *Contaminant Candidate List 3* (online at http://water.epa.gov/scitech/drinkingwater/dws/ccl/ccl3.cfm) (accessed Mar. 31, 2011).

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chloride, ethylene glycol, ethylene oxide, formaldehyde, methanol, n-methyl-2-pyrrolidone, and propylene oxide—were used in hydraulic fracturing products between 2005 and 2009.

3. *Hazardous Air Pollutants*

The Clean Air Act requires EPA to control the emission of 187 hazardous air pollutants, which are pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects.[27] Between 2005 and 2009, the hydraulic fracturing companies used 595 products containing 24 different hazardous air pollutants.

Hydrogen fluoride is a hazardous air pollutant that is a highly corrosive and systemic poison that causes severe and sometimes delayed health effects due to deep tissue penetration. Absorption of substantial amounts of hydrogen fluoride by any route may be fatal.[28] One of the hydraulic fracturing companies used 67,222 gallons of two products containing hydrogen fluoride in 2008 and 2009.

Lead is a hazardous air pollutant that is a heavy metal that is particularly harmful to children's neurological development. It also can cause health problems in adults, including reproductive problems, high blood pressure, and nerve disorders.[29] One of the hydraulic fracturing companies used 780 gallons of a product containing lead in this five-year period.

Methanol is the hazardous air pollutant that appeared most often in hydraulic fracturing products. Other hazardous air pollutants used in hydraulic fracturing fluids included formaldehyde, hydrogen chloride, and ethylene glycol.

V. USE OF PROPRIETARY AND "TRADE SECRET" CHEMICALS

Many chemical components of hydraulic fracturing fluids used by the companies were listed on the MSDSs as "proprietary" or "trade secret." The hydraulic fracturing companies used 93.6 million gallons of 279 products containing at least one proprietary component between 2005 and 2009.[30]

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[27] Clean Air Act Section 112(b), 42 U.S.C. § 7412.

[28] HHS, Agency for Toxic Substances and Disease Registry, *Medical Management Guidelines for Hydrogen Fluoride* (online at www.atsdr.cdc.gov/mhmi/mmg11.pdf) (accessed Mar. 24, 2011).

[29] EPA, *Basic Information about Lead* (online at www.epa.gov/lead/pubs/leadinfo.htm) (accessed Mar. 30, 2011).

[30] This is likely a conservative estimate. We included only those products for which the MSDS says "proprietary" or "trade secret" instead of listing a component by name or providing the CAS number. If the MSDS listed a component's CAS as N.A. or left it blank, we did not count that as a trade secret claim, unless the company specified as such in follow-up correspondence.

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The Committee requested that these companies disclose this proprietary information. Although a few companies were able to provide additional information to the Committee about some of the fracturing products, in most cases the companies stated that they did not have access to proprietary information about products they purchased "off the shelf" from chemical suppliers. The proprietary information belongs to the suppliers, not the users of the chemicals.

Universal Well Services, for example, told the Committee that it "obtains hydraulic fracturing products from third-party manufacturers, and to the extent not publicly disclosed, product composition is proprietary to the respective vendor and not to the Company."[31] Complete Production Services noted that the company always uses fluids from third-party suppliers who provide an MSDS for each product. Complete confirmed that it is "not aware of any circumstances in which the vendors who provided the products have disclosed this proprietary information" to the company, further noting that "such information is highly proprietary for these vendors, and would not generally be disclosed to service providers" like Complete.[32] Key Energy Services similarly stated that it "generally does not have access to the trade secret information as a purchaser of the chemical(s)."[33] Trican also told the Committee that it has limited knowledge of "off the shelf" products purchased from a chemical distributor or manufacturer, noting that "Trican does not have any information in its possession about the components of such products beyond what the distributor of each product provided Trican in the MSDS sheet."[34]

In these cases, it appears that the companies are injecting fluids containing unknown chemicals about which they may have limited understanding of the potential risks posed to human health and the environment.

VI. CONCLUSION

Hydraulic fracturing has opened access to vast domestic reserves of natural gas that could provide an important stepping stone to a clean energy future. Yet questions about the safety of hydraulic fracturing persist, which are compounded by the secrecy surrounding the chemicals used in hydraulic fracturing fluids. This analysis is the most comprehensive national assessment to date of the types and volumes of chemical used in the hydraulic fracturing process. It shows that between 2005 and 2009, the 14 leading hydraulic fracturing companies in the United States used over 2,500 hydraulic fracturing products containing 750 compounds. More than 650 of these products contained chemicals that are known or possible human carcinogens, regulated under the Safe Drinking Water Act, or listed as hazardous air pollutants.

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[31] Letter from Reginald J. Brown to Henry A. Waxman, Chairman, Committee on Energy and Commerce, and Edward J. Markey, Chairman, Subcommittee on Energy and Environment (Apr. 16, 2010).

[32] Letter from Philip Perry to Henry A. Waxman, Chairman, Committee Energy and Commerce, and Edward J. Markey, Chairman, Subcommittee on Energy and Environment (Aug. 6, 2010).

[33] E-mail from Peter Spivack to Committee Staff (Aug. 5, 2010).

[34] E-mail from Lee Blalack to Committee Staff (July 29, 2010).

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Appendix A. Chemical Components of Hydraulic Fracturing Products, 2005-2009[35]

Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
1-(1-naphthylmethyl)quinolinium chloride	65322-65-8	1
1,2,3-propanetricarboxylic acid, 2-hydroxy-, trisodium salt, dihydrate	6132-04-3	1
1,2,3-trimethylbenzene	526-73-8	1
1,2,4-trimethylbenzene	95-63-6	21
1,2-benzisothiazol-3	2634-33-5	1
1,2-dibromo-2,4-dicyanobutane	35691-65-7	1
1,2-ethanediaminium, N, N'-bis[2-[bis(2-hydroxyethyl)methylammonio]ethyl]-N,N'-bis(2-hydroxyethyl)-N,N'-dimethyl-,tetrachloride	138879-94-4	2
1,3,5-trimethylbenzene	108-67-8	3
1,6-hexanediamine dihydrochloride	6055-52-3	1
1,8-diamino-3,6-dioxaoctane	929-59-9	1
1-hexanol	111-27-3	1
1-methoxy-2-propanol	107-98-2	3
2,2`-azobis (2-amidopropane) dihydrochloride	2997-92-4	1
2,2-dibromo-3-nitrilopropionamide	10222-01-2	27
2-acrylamido-2-methylpropanesulphonic acid sodium salt polymer	*	1
2-bromo-2-nitropropane-1,3-diol	52-51-7	4
2-butanone oxime	96-29-7	1
2-hydroxypropionic acid	79-33-4	2
2-mercaptoethanol (Thioglycol)	60-24-2	13
2-methyl-4-isothiazolin-3-one	2682-20-4	4
2-monobromo-3-nitrilopropionamide	1113-55-9	1
2-phosphonobutane-1,2,4-tricarboxylic acid	37971-36-1	2
2-phosphonobutane-1,2,4-tricarboxylic acid, potassium salt	93858-78-7	1
2-substituted aromatic amine salt	*	1
4,4'-diaminodiphenyl sulfone	80-08-0	3
5-chloro-2-methyl-4-isothiazolin-3-one	26172-55-4	5
Acetaldehyde	75-07-0	1
Acetic acid	64-19-7	56
Acetic anhydride	108-24-7	7
Acetone	67-64-1	3
Acetophenone	98-86-2	1
Acetylenic alcohol	*	1
Acetyltriethyl citrate	77-89-4	1
Acrylamide	79-06-1	2
Acrylamide copolymer	*	1
Acrylamide copolymer	38193-60-1	1

[35] To compile this list of chemicals, Committee staff reviewed each Material Safety Data Sheet provided to the Committee for hydraulic fracturing products used between 2005 and 2009. Committee staff transcribed the names and CAS numbers as written in the MSDSs; as such, any inaccuracies on this list reflect inaccuracies on the MSDSs themselves.

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Acrylate copolymer	*	1
Acrylic acid, 2-hydroxyethyl ester	818-61-1	1
Acrylic acid/2-acrylamido-methylpropylsulfonic acid copolymer	37350-42-8	1
Acrylic copolymer	403730-32-5	1
Acrylic polymers	*	1
Acrylic polymers	26006-22-4	2
Acyclic hydrocarbon blend	*	1
Adipic acid	124-04-9	6
Alcohol alkoxylate	*	5
Alcohol ethoxylates	*	2
Alcohols	*	9
Alcohols, C11-15-secondary, ethoxylated	68131-40-8	1
Alcohols, C12-14-secondary	126950-60-5	4
Alcohols, C12-14-secondary, ethoxylated	84133-50-6	19
Alcohols, C12-15, ethoxylated	68131-39-5	2
Alcohols, C12-16, ethoxylated	103331-86-8	1
Alcohols, C12-16, ethoxylated	68551-12-2	3
Alcohols, C14-15, ethoxylated	68951-67-7	5
Alcohols, C9-11-iso-, C10-rich, ethoxylated	78330-20-8	4
Alcohols, C9-C22	*	1
Aldehyde	*	4
Aldol	107-89-1	1
Alfa-Alumina	*	5
Aliphatic acid	*	1
Aliphatic alcohol polyglycol ether	68015-67-8	1
Aliphatic amine derivative	120086-58-0	2
Alkaline bromide salts	*	2
Alkanes, C10-14	93924-07-3	2
Alkanes, C13-16-iso	68551-20-2	2
Alkanolamine	150-25-4	3
Alkanolamine chelate of zirconium alkoxide (Zirconium complex)	197980-53-3	4
Alkanolamine/aldehyde condensate	*	1
Alkenes	*	1
Alkenes, C>10 alpha-	64743-02-8	3
Alkenes, C>8	68411-00-7	2
Alkoxylated alcohols	*	1
Alkoxylated amines	*	6
Alkoxylated phenol formaldehyde resin	63428-92-2	1
Alkyaryl sulfonate	*	1
Alkyl (C12-16) dimethyl benzyl ammonium chloride	68424-85-1	7
Alkyl (C6-C12) alcohol, ethoxylated	68439-45-2	2
Alkyl (C9-11) alcohol, ethoxylated	68439-46-3	1
Alkyl alkoxylate	*	9
Alkyl amine	*	2

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Alkyl amine blend in a metal salt solution	*	1
Alkyl aryl amine sulfonate	255043-08-04	1
Alkyl benzenesulfonic acid	68584-22-5	2
Alkyl esters	*	2
Alkyl hexanol	*	1
Alkyl ortho phosphate ester	*	1
Alkyl phosphate ester	*	3
Alkyl quaternary ammonium chlorides	*	4
Alkylaryl sulfonate	*	1
Alkylaryl sulphonic acid	27176-93-9	1
Alkylated quaternary chloride	*	5
Alkylbenzenesulfonic acid	*	1
Alkylethoammonium sulfates	*	1
Alkylphenol ethoxylates	*	1
Almandite and pyrope garnet	1302-62-1	1
Aluminium isopropoxide	555-31-7	1
Aluminum	7429-90-5	2
Aluminum chloride	*	3
Aluminum chloride	1327-41-9	2
Aluminum oxide (alpha-Alumina)	1344-28-1	24
Aluminum oxide silicate	12068-56-3	1
Aluminum silicate (mullite)	1302-76-7	38
Aluminum sulfate hydrate	10043-01-3	1
Amides, tallow, n-[3-(dimethylamino)propyl],n-oxides	68647-77-8	4
Amidoamine	*	1
Amine	*	7
Amine bisulfite	13427-63-9	1
Amine oxides	*	1
Amine phosphonate	*	3
Amine salt	*	2
Amines, C14-18; C16-18-unsaturated, alkyl, ethoxylated	68155-39-5	1
Amines, coco alkyl, acetate	61790-57-6	3
Amines, polyethylenepoly-, ethoxylated, phosphonomethylated	68966-36-9	1
Amines, tallow alkyl, ethoxylated	61791-26-2	2
Amino compounds	*	1
Amino methylene phosphonic acid salt	*	1
Amino trimethylene phosphonic acid	6419-19-8	2
Ammonia	7664-41-7	7
Ammonium acetate	631-61-8	4
Ammonium alcohol ether sulfate	68037-05-8	1
Ammonium bicarbonate	1066-33-7	1
Ammonium bifluoride (Ammonium hydrogen difluoride)	1341-49-7	10
Ammonium bisulfate	7783-20-2	3
Ammonium bisulfite	10192-30-0	15

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Ammonium C6-C10 alcohol ethoxysulfate	68187-17-7	4
Ammonium C8-C10 alkyl ether sulfate	68891-29-2	4
Ammonium chloride	12125-02-9	29
Ammonium fluoride	12125-01-8	9
Ammonium hydroxide	1336-21-6	4
Ammonium nitrate	6484-52-2	2
Ammonium persulfate (Diammonium peroxidisulfate)	7727-54-0	37
Ammonium salt	*	1
Ammonium salt of ethoxylated alcohol sulfate	*	1
Amorphous silica	99439-28-8	1
Amphoteric alkyl amine	61789-39-7	1
Anionic copolymer	*	3
Anionic polyacrylamide	*	1
Anionic polyacrylamide	25085-02-3	6
Anionic polyacrylamide copolymer	*	3
Anionic polymer	*	2
Anionic polymer in solution	*	1
Anionic polymer, sodium salt	9003-04-7	1
Anionic water-soluble polymer	*	2
Antifoulant	*	1
Antimonate salt	*	1
Antimony pentoxide	1314-60-9	2
Antimony potassium oxide	29638-69-5	4
Antimony trichloride	10025-91-9	2
a-organic surfactants	61790-29-8	1
Aromatic alcohol glycol ether	*	2
Aromatic aldehyde	*	2
Aromatic ketones	224635-63-6	2
Aromatic polyglycol ether	*	1
Barium sulfate	7727-43-7	3
Bauxite	1318-16-7	16
Bentonite	1302-78-9	2
Benzene	71-43-2	3
Benzene, C10-16, alkyl derivatives	68648-87-3	1
Benzenecarboperoxoic acid, 1,1-dimethylethyl ester	614-45-9	1
Benzenemethanaminium	3844-45-9	1
Benzenesulfonic acid, C10-16-alkyl derivs., potassium salts	68584-27-0	1
Benzoic acid	65-85-0	11
Benzyl chloride	100-44-7	8
Biocide component	*	3
Bis(1-methylethyl)naphthalenesulfonic acid, cyclohexylamine salt	68425-61-6	1
Bishexamethylenetriamine penta methylene phosphonic acid	35657-77-3	1
Bisphenol A/Epichlorohydrin resin	25068-38-6	5
Bisphenol A/Novolac epoxy resin	28906-96-9	1

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Borate	12280-03-4	2
Borate salts	*	5
Boric acid	10043-35-3	18
Boric acid, potassium salt	20786-60-1	1
Boric acid, sodium salt	1333-73-9	2
Boric oxide	1303-86-2	1
b-tricalcium phosphate	7758-87-4	1
Butanedioic acid	2373-38-8	4
Butanol	71-36-3	3
Butyl glycidyl ether	2426-08-6	5
Butyl lactate	138-22-7	4
C10-C16 ethoxylated alcohol	68002-97-1	4
C-11 to C-14 n-alkanes, mixed	*	1
C12-C14 alcohol, ethoxylated	68439-50-9	3
Calcium carbonate	471-34-1	1
Calcium carbonate (Limestone)	1317-65-3	9
Calcium chloride	10043-52-4	17
Calcium chloride, dihydrate	10035-04-8	1
Calcium fluoride	7789-75-5	2
Calcium hydroxide	1305-62-0	9
Calcium hypochlorite	7778-54-3	1
Calcium oxide	1305-78-8	6
Calcium peroxide	1305-79-9	5
Carbohydrates	*	3
Carbon dioxide	124-38-9	4
Carboxymethyl guar gum, sodium salt	39346-76-4	7
Carboxymethyl hydroxypropyl guar	68130-15-4	11
Cellophane	9005-81-6	2
Cellulase	9012-54-8	7
Cellulase enzyme	*	1
Cellulose	9004-34-6	1
Cellulose derivative	*	2
Chloromethylnaphthalene quinoline quaternary amine	15619-48-4	3
Chlorous ion solution	*	2
Choline chloride	67-48-1	3
Chromates	*	1
Chromium (iii) acetate	1066-30-4	1
Cinnamaldehyde (3-phenyl-2-propenal)	104-55-2	5
Citric acid (2-hydroxy-1,2,3 propanetricarboxylic acid)	77-92-9	29
Citrus terpenes	94266-47-4	11
Coal, granular	50815-10-6	1
Cobalt acetate	71-48-7	1
Cocaidopropyl betaine	61789-40-0	2
Cocamidopropylamine oxide	68155-09-9	1

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Coco bis-(2-hydroxyethyl) amine oxide	61791-47-7	1
Cocoamidopropyl betaine	70851-07-9	1
Cocomidopropyl dimethylamine	68140-01-2	1
Coconut fatty acid diethanolamide	68603-42-9	1
Collagen (Gelatin)	9000-70-8	6
Complex alkylaryl polyo-ester	*	1
Complex aluminum salt	*	2
Complex organometallic salt	*	2
Complex substituted keto-amine	143106-84-7	1
Complex substituted keto-amine hydrochloride	*	1
Copolymer of acrylamide and sodium acrylate	25987-30-8	1
Copper	7440-50-8	1
Copper iodide	7681-65-4	1
Copper sulfate	7758-98-7	3
Corundum (Aluminum oxide)	1302-74-5	48
Crotonaldehyde	123-73-9	1
Crystalline silica - cristobalite	14464-46-1	44
Crystalline silica - quartz (SiO2)	14808-60-7	207
Crystalline silica, tridymite	15468-32-3	2
Cumene	98-82-8	6
Cupric chloride	7447-39-4	10
Cupric chloride dihydrate	10125-13-0	7
Cuprous chloride	7758-89-6	1
Cured acrylic resin	*	7
Cured resin	*	4
Cured silicone rubber-polydimethylsiloxane	63148-62-9	1
Cured urethane resin	*	3
Cyclic alkanes	*	1
Cyclohexane	110-82-7	1
Cyclohexanone	108-94-1	1
Decanol	112-30-1	2
Decyl-dimethyl amine oxide	2605-79-0	4
Dextrose monohydrate	50-99-7	1
D-Glucitol	50-70-4	1
Di (2-ethylhexyl) phthalate	117-81-7	3
Di (ethylene glycol) ethyl ether acetate	112-15-2	4
Diatomaceous earth	61790-53-2	3
Diatomaceous earth, calcined	91053-39-3	7
Dibromoacetonitrile	3252-43-5	1
Dibutylaminoethanol (2-dibutylaminoethanol)	102-81-8	4
Di-calcium silicate	10034-77-2	1
Dicarboxylic acid	*	1
Didecyl dimethyl ammonium chloride	7173-51-5	1
Diesel	*	1

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Diesel	68334-30-5	3
Diesel	68476-30-2	4
Diesel	68476-34-6	43
Diethanolamine (2,2-iminodiethanol)	111-42-2	14
Diethylbenzene	25340-17-4	1
Diethylene glycol	111-46-6	8
Diethylene glycol monomethyl ether	111-77-3	4
Diethylene triaminepenta (methylene phosphonic acid)	15827-60-8	1
Diethylenetriamine	111-40-0	2
Diethylenetriamine, tall oil fatty acids reaction product	61790-69-0	1
Diisopropylnaphthalenesulfonic acid	28757-00-8	2
Dimethyl formamide	68-12-2	5
Dimethyl glutarate	1119-40-0	1
Dimethyl silicone	*	2
Dioctyl sodium sulfosuccinate	577-11-7	1
Dipropylene glycol	25265-71-8	1
Dipropylene glycol monomethyl ether (2-methoxymethylethoxy propanol)	34590-94-8	12
Di-secondary-butylphenol	53964-94-6	3
Disodium EDTA	139-33-3	1
Disodium ethylenediamin ediacetate	38011-25-5	1
Disodium ethylenedi aminetetraacetate dihydrate	6381-92-6	1
Disodium octaborate tetrahydrate	12008-41-2	1
Dispersing agent	*	1
d-Limonene	5989-27-5	11
Dodecyl alcohol ammonium sulfate	32612-48-9	2
Dodecylbenzene sulfonic acid	27176-87-0	14
Dodecylbenzene sulfonic acid salts	42615-29-2	2
Dodecylbenzene sulfonic acid salts	68648-81-7	7
Dodecylbenzene sulfonic acid salts	90218-35-2	1
Dodecylbenzenesulfonate isopropanolamine	42504-46-1	1
Dodecylbenzenesulfonic acid, monoethanolamine salt	26836-07-7	1
Dodecylbenzenesulphonic acid, morpholine salt	12068-08-5	1
EDTA/Copper chelate	*	2
EO-C7-9-iso-, C8-rich alcohols	78330-19-5	5
Epichlorohydrin	25085-99-8	5
Epoxy resin	*	5
Erucic amidopropyl dimethyl betaine	149879-98-1	3
Erythorbic acid	89-65-6	2
Essential oils	*	6
Ethanaminium, n,n,n-trimethyl-2-[(1-oxo-2-propenyl)oxy]-,chloride, polymer with 2-propenamide	69418-26-4	4
Ethanol (Ethyl alcohol)	64-17-5	36
Ethanol, 2-(hydroxymethylamino)-	34375-28-5	1
Ethanol, 2, 2'-(Octadecylamino) bis-	10213-78-2	1

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Ethanoldiglycine disodium salt	135-37-5	1
Ether salt	25446-78-0	2
Ethoxylated 4-nonylphenol (Nonyl phenol ethoxylate)	26027-38-3	9
Ethoxylated alcohol	104780-82-7	1
Ethoxylated alcohol	78330-21-9	2
Ethoxylated alcohols	*	3
Ethoxylated alkyl amines	*	1
Ethoxylated amine	*	1
Ethoxylated amines	61791-44-4	1
Ethoxylated fatty acid ester	*	1
Ethoxylated nonionic surfactant	*	1
Ethoxylated nonyl phenol	*	8
Ethoxylated nonyl phenol	68412-54-4	10
Ethoxylated nonyl phenol	9016-45-9	38
Ethoxylated octyl phenol	68987-90-6	1
Ethoxylated octyl phenol	9002-93-1	1
Ethoxylated octyl phenol	9036-19-5	3
Ethoxylated oleyl amine	13127-82-7	2
Ethoxylated oleyl amine	26635-93-8	1
Ethoxylated sorbitol esters	*	1
Ethoxylated tridecyl alcohol phosphate	9046-01-9	2
Ethoxylated undecyl alcohol	127036-24-2	2
Ethyl acetate	141-78-6	4
Ethyl acetoacetate	141-97-9	1
Ethyl octynol (1-octyn-3-ol,4-ethyl-)	5877-42-9	5
Ethylbenzene	100-41-4	28
Ethylene glycol (1,2-ethanediol)	107-21-1	119
Ethylene glycol monobutyl ether (2-butoxyethanol)	111-76-2	126
Ethylene oxide	75-21-8	1
Ethylene oxide-nonylphenol polymer	*	1
Ethylenediaminetetraacetic acid	60-00-4	1
Ethylene-vinyl acetate copolymer	24937-78-8	1
Ethylhexanol (2-ethylhexanol)	104-76-7	18
Fatty acid ester	*	1
Fatty acid, tall oil, hexa esters with sorbitol, ethoxylated	61790-90-7	1
Fatty acids	*	1
Fatty alcohol alkoxylate	*	1
Fatty alkyl amine salt	*	1
Fatty amine carboxylates	*	1
Fatty quaternary ammonium chloride	61789-68-2	1
Ferric chloride	7705-08-0	3
Ferric sulfate	10028-22-5	7
Ferrous sulfate, heptahydrate	7782-63-0	4
Fluoroaliphatic polymeric esters	*	1

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Formaldehyde	50-00-0	12
Formaldehyde polymer	*	2
Formaldehyde, polymer with 4-(1,1-dimethyl)phenol, methyloxirane and oxirane	30704-64-4	3
Formaldehyde, polymer with 4-nonylphenol and oxirane	30846-35-6	1
Formaldehyde, polymer with ammonia and phenol	35297-54-2	2
Formamide	75-12-7	5
Formic acid	64-18-6	24
Fumaric acid	110-17-8	8
Furfural	98-01-1	1
Furfuryl alcohol	98-00-0	3
Glass fiber	65997-17-3	3
Gluconic acid	526-95-4	1
Glutaraldehyde	111-30-8	20
Glycerol (1,2,3-Propanetriol, Glycerine)	56-81-5	16
Glycol ethers	*	9
Glycol ethers	9004-77-7	4
Glyoxal	107-22-2	3
Glyoxylic acid	298-12-4	1
Guar gum	9000-30-0	41
Guar gum derivative	*	12
Haloalkyl heteropolycycle salt	*	6
Heavy aromatic distillate	68132-00-3	1
Heavy aromatic petroleum naphtha	64742-94-5	45
Heavy catalytic reformed petroleum naphtha	64741-68-0	10
Hematite	*	5
Hemicellulase	9025-56-3	2
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine (Triazine)	4719-04-4	4
Hexamethylenetetramine	100-97-0	37
Hexanediamine	124-09-4	1
Hexanes	*	1
Hexylene glycol	107-41-5	5
Hydrated aluminum silicate	1332-58-7	4
Hydrocarbon mixtures	8002-05-9	1
Hydrocarbons	*	3
Hydrodesulfurized kerosine (petroleum)	64742-81-0	3
Hydrodesulfurized light catalytic cracked distillate (petroleum)	68333-25-5	1
Hydrodesulfurized middle distillate (petroleum)	64742-80-9	1
Hydrogen chloride (Hydrochloric acid)	7647-01-0	42
Hydrogen fluoride (Hydrofluoric acid)	7664-39-3	2
Hydrogen peroxide	7722-84-1	4
Hydrogen sulfide	7783-06-4	1
Hydrotreated and hydrocracked base oil	*	2
Hydrotreated heavy naphthenic distillate	64742-52-5	3
Hydrotreated heavy paraffinic petroleum distillates	64742-54-7	1

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Hydrotreated heavy petroleum naphtha	64742-48-9	7
Hydrotreated light petroleum distillates	64742-47-8	89
Hydrotreated middle petroleum distillates	64742-46-7	3
Hydroxyacetic acid (Glycolic acid)	79-14-1	6
Hydroxyethylcellulose	9004-62-0	1
Hydroxyethylethylenediaminetriacetic acid, trisodium salt	139-89-9	1
Hydroxylamine hydrochloride	5470-11-1	1
Hydroxypropyl guar gum	39421-75-5	2
Hydroxysultaine	*	1
Inner salt of alkyl amines	*	2
Inorganic borate	*	3
Inorganic particulate	*	1
Inorganic salt	*	1
Inorganic salt	533-96-0	1
Inorganic salt	7446-70-0	1
Instant coffee purchased off the shelf	*	1
Inulin, carboxymethyl ether, sodium salt	430439-54-6	1
Iron oxide	1332-37-2	2
Iron oxide (Ferric oxide)	1309-37-1	18
Iso amyl alcohol	123-51-3	1
Iso-alkanes/n-alkanes	*	10
Isobutanol (Isobutyl alcohol)	78-83-1	4
Isomeric aromatic ammonium salt	*	1
Isooctanol	26952-21-6	1
Isooctyl alcohol	68526-88-0	1
Isooctyl alcohol bottoms	68526-88-5	1
Isopropanol (Isopropyl alcohol, Propan-2-ol)	67-63-0	274
Isopropylamine	75-31-0	1
Isotridecanol, ethoxylated	9043-30-5	1
Kerosene	8008-20-6	13
Lactic acid	10326-41-7	1
Lactic acid	50-21-5	1
L-Dilactide	4511-42-6	1
Lead	7439-92-1	1
Light aromatic solvent naphtha	64742-95-6	11
Light catalytic cracked petroleum distillates	64741-59-9	1
Light naphtha distillate, hydrotreated	64742-53-6	1
Low toxicity base oils	*	1
Maghemite	*	2
Magnesium carbonate	546-93-0	1
Magnesium chloride	7786-30-3	4
Magnesium hydroxide	1309-42-8	4
Magnesium iron silicate	1317-71-1	3
Magnesium nitrate	10377-60-3	5

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Magnesium oxide	1309-48-4	18
Magnesium peroxide	1335-26-8	2
Magnesium peroxide	14452-57-4	4
Magnesium phosphide	12057-74-8	1
Magnesium silicate	1343-88-0	3
Magnesium silicate hydrate (talc)	14807-96-6	2
Magnetite	*	3
Medium aliphatic solvent petroleum naphtha	64742-88-7	10
Metal salt	*	2
Metal salt solution	*	1
Methanol (Methyl alcohol)	67-56-1	342
Methyl isobutyl carbinol (Methyl amyl alcohol)	108-11-2	3
Methyl salicylate	119-36-8	6
Methyl vinyl ketone	78-94-4	2
Methylcyclohexane	108-87-2	1
Mica	12001-26-2	3
Microcrystalline silica	1317-95-9	1
Mineral	*	1
Mineral Filler	*	1
Mineral spirits (stoddard solvent)	8052-41-3	2
Mixed titanium ortho ester complexes	*	1
Modified alkane	*	1
Modified cycloaliphatic amine adduct	*	3
Modified lignosulfonate	*	1
Monoethanolamine (Ethanolamine)	141-43-5	17
Monoethanolamine borate	26038-87-9	1
Morpholine	110-91-8	2
Mullite	1302-93-8	55
n,n-dibutylthiourea	109-46-6	1
N,N-dimethyl-1-octadecanamine-HCl	*	1
N,N-dimethyloctadecylamine	124-28-7	3
N,N-dimethyloctadecylamine hydrochloride	1613-17-8	2
n,n'-Methylenebisacrylamide	110-26-9	1
n-alkyl dimethyl benzyl ammonium chloride	139-08-2	1
Naphthalene	91-20-3	44
Naphthalene derivatives	*	1
Naphthalenesulphonic acid, bis (1-methylethyl)-methyl derivatives	99811-86-6	1
Natural asphalt	12002-43-6	1
n-cocoamidopropyl-n, n-dimethyl-n-2-hyd roxypropylsulfobeta ine	68139-30-0	1
n-dodecyl-2-pyrrolidone	2687-96-9	1
N-heptane	142-82-5	1
Nickel sulfate hexahydrate	10101-97-0	2
Nitrilotriacetamid e	4862-18-4	4
Nitrilotriacetic acid	139-13-9	6

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Nitrilotriacetonitr ile	7327-60-8	3
Nitrogen	7727-37-9	9
n-Methylpyrrolidone	872-50-4	1
Nonane, all isomers	*	1
Non-hazardous salt	*	1
Nonionic surfactant	*	1
Nonyl phenol ethoxylate	*	2
Nonyl phenol ethoxylate	9016-45-6	2
Nonyl phenol ethoxylate	9018-45-9	1
Nonylphenol	25154-52-3	1
Nonylphenol, ethoxylated and sulfated	9081-17-8	1
N-propyl zirconate	*	1
N-tallowalkyltrimethylenediamines	*	1
Nuisance particulates	*	2
Nylon fibers	25038-54-4	2
Octanol	111-87-5	2
Octyltrimethylammonium bromide	57-09-0	1
Olefinic sulfonate	*	1
Olefins	*	1
Organic acid salt	*	3
Organic acids	*	1
Organic phosphonate	*	1
Organic phosphonate salts	*	1
Organic phosphonic acid salts	*	6
Organic salt	*	1
Organic sulfur compound	*	2
Organic titanate	*	2
Organiophilic clay	*	2
Organo-metallic ammonium complex	*	1
Other inorganic compounds	*	1
Oxirane, methyl-, polymer with oxirane, mono-C10-16-alkyl ethers, phosphates	68649-29-6	1
Oxyalkylated alcohol	*	6
Oxyalkylated alcohols	228414-35-5	1
Oxyalkylated alkyl alcohol	*	1
Oxyalkylated alkylphenol	*	1
Oxyalkylated fatty acid	*	2
Oxyalkylated phenol	*	1
Oxyalkylated polyamine	*	1
Oxylated alcohol	*	1
Paraffin wax	8002-74-2	1
Paraffinic naphthenic solvent	*	1
Paraffinic solvent	*	5
Paraffins	*	1
Perlite	93763-70-3	1

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Petroleum distillates	*	26
Petroleum distillates	64742-65-0	1
Petroleum distillates	64742-97-5	1
Petroleum distillates	68477-31-6	3
Petroleum gas oils	*	1
Petroleum gas oils	64741-43-1	1
Phenol	108-95-2	5
Phenol-formaldehyde resin	9003-35-4	32
Phosphate ester	*	6
Phosphate esters of alkyl phenyl ethoxylate	68412-53-3	1
Phosphine	*	1
Phosphonic acid	*	1
Phosphonic acid	129828-36-0	1
Phosphonic acid	13598-36-2	3
Phosphonic acid (dimethlamino(methylene))	29712-30-9	1
Phosphonic acid, [nitrilotris(methylene)]tris-, pentasodium salt	2235-43-0	1
Phosphoric acid	7664-38-2	7
Phosphoric acid ammonium salt	*	1
Phosphoric acid, mixed decyl, octyl and ethyl esters	68412-60-2	3
Phosphorous acid	10294-56-1	1
Phthalic anhydride	85-44-9	2
Pine oil	8002-09-3	5
Plasticizer	*	1
Poly(oxy-1,2-ethanediyl)	24938-91-8	1
Poly(oxy-1,2-ethanediyl), alpha-(4-nonylphenyl)-omega-hydroxy-, branched (Nonylphenol ethoxylate)	127087-87-0	3
Poly(oxy-1,2-ethanediyl), alpha-hydro-omega-hydroxy	65545-80-4	1
Poly(oxy-1,2-ethanediyl), alpha-sulfo-omega-(hexyloxy)-, ammonium salt	63428-86-4	3
Poly(oxy-1,2-ethanediyl),a-(nonylphenyl)-w-hydroxy-, phosphate	51811-79-1	1
Poly-(oxy-1,2-ethanediyl)-alpha-undecyl-omega-hydroxy	34398-01-1	6
Poly(sodium-p-styrenesulfonate)	25704-18-1	1
Poly(vinyl alcohol)	25213-24-5	2
Polyacrylamides	9003-05-8	2
Polyacrylamides	*	1
Polyacrylate	*	1
Polyamine	*	2
Polyanionic cellulose	*	2
Polyepichlorohydrin, trimethylamine quaternized	51838-31-4	1
Polyetheramine	9046-10-0	3
Polyether-modified trisiloxane	27306-78-1	1
Polyethylene glycol	25322-68-3	20
Polyethylene glycol ester with tall oil fatty acid	9005-02-1	1
Polyethylene polyammonium salt	68603-67-8	2
Polyethylene-polypropylene glycol	9003-11-6	5

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Polylactide resin	*	3
Polyoxyalkylenes	*	1
Polyoxyethylene castor oil	61791-12-6	1
Polyphosphoric acid, esters with triethanolamine, sodium salts	68131-72-6	1
Polypropylene glycol	25322-69-4	1
Polysaccharide	*	20
Polyvinyl alcohol	*	1
Polyvinyl alcohol	9002-89-5	2
Polyvinyl alcohol/polyvinylacetate copolymer	*	1
Potassium acetate	127-08-2	1
Potassium carbonate	584-08-7	12
Potassium chloride	7447-40-7	29
Potassium formate	590-29-4	3
Potassium hydroxide	1310-58-3	25
Potassium iodide	7681-11-0	6
Potassium metaborate	13709-94-9	3
Potassium metaborate	16481-66-6	3
Potassium oxide	12136-45-7	1
Potassium pentaborate	*	1
Potassium persulfate	7727-21-1	9
Propanol (Propyl alcohol)	71-23-8	18
Propanol, [2(2-methoxy-methylethoxy) methylethoxyl]	20324-33-8	1
Propargyl alcohol (2-propyn-1-ol)	107-19-7	46
Propylene carbonate (1,3-dioxolan-2-one, methyl-)	108-32-7	2
Propylene glycol (1,2-propanediol)	57-55-6	18
Propylene oxide	75-56-9	1
Propylene pentamer	15220-87-8	1
p-Xylene	106-42-3	1
Pyridinium, 1-(phenylmethyl)-, ethyl methyl derivatives, chlorides	68909-18-2	9
Pyrogenic silica	112945-52-5	3
Quaternary amine compounds	*	3
Quaternary amine compounds	61789-18-2	1
Quaternary ammonium compounds	*	9
Quaternary ammonium compounds	19277-88-4	1
Quaternary ammonium compounds	68989-00-4	1
Quaternary ammonium compounds	8030-78-2	1
Quaternary ammonium compounds, dicoco alkyldimethyl, chlorides	61789-77-3	2
Quaternary ammonium salts	*	2
Quaternary compound	*	1
Quaternary salt	*	2
Quaternized alkyl nitrogenated compound	68391-11-7	2
Rafinnates (petroleum), sorption process	64741-85-1	2
Residues (petroleum), catalytic reformer fractionator	64741-67-9	10
Resin	8050-09-7	2

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Rutile	1317-80-2	2
Salt of phosphate ester	*	3
Salt of phosphono-methylated diamine	*	1
Salts of oxyalkylated fatty amines	68551-33-7	1
Secondary alcohol	*	7
Silica (Silicon dioxide)	7631-86-9	47
Silica, amorphous	*	3
Silica, amorphous precipitated	67762-90-7	1
Silicon carboxylate	681-84-5	1
Silicon dioxide (Fused silica)	60676-86-0	7
Silicone emulsion	*	1
Sodium (C14-16) olefin sulfonate	68439-57-6	4
Sodium 2-ethylhexyl sulfate	126-92-1	1
Sodium acetate	127-09-3	6
Sodium acid pyrophosphate	7758-16-9	5
Sodium alkyl diphenyl oxide sulfonate	28519-02-0	1
Sodium aluminate	1302-42-7	1
Sodium aluminum phosphate	7785-88-8	1
Sodium bicarbonate (Sodium hydrogen carbonate)	144-55-8	10
Sodium bisulfite	7631-90-5	6
Sodium bromate	7789-38-0	10
Sodium bromide	7647-15-6	1
Sodium carbonate	497-19-8	14
Sodium chlorate	7775-09-9	1
Sodium chloride	7647-14-5	48
Sodium chlorite	7758-19-2	8
Sodium cocaminopropionate	68608-68-4	2
Sodium diacetate	126-96-5	2
Sodium erythorbate	6381-77-7	4
Sodium glycolate	2836-32-0	2
Sodium hydroxide (Caustic soda)	1310-73-2	80
Sodium hypochlorite	7681-52-9	14
Sodium lauryl-ether sulfate	68891-38-3	3
Sodium metabisulfite	7681-57-4	1
Sodium metaborate	7775-19-1	2
Sodium metaborate tetrahydrate	35585-58-1	6
Sodium metasilicate, anhydrous	6834-92-0	2
Sodium nitrite	7632-00-0	1
Sodium oxide (Na2O)	1313-59-3	1
Sodium perborate	1113-47-9	1
Sodium perborate	7632-04-4	1
Sodium perborate tetrahydrate	10486-00-7	4
Sodium persulfate	7775-27-1	6
Sodium phosphate	*	2

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Sodium polyphosphate	68915-31-1	1
Sodium salicylate	54-21-7	1
Sodium silicate	1344-09-8	2
Sodium sulfate	7757-82-6	7
Sodium tetraborate	1330-43-4	7
Sodium tetraborate decahydrate	1303-96-4	10
Sodium thiosulfate	7772-98-7	10
Sodium thiosulfate pentahydrate	10102-17-7	3
Sodium trichloroacetate	650-51-1	1
Sodium tripolyphosphate	7758-29-4	2
Sodium xylene sulfonate	1300-72-7	3
Sodium zirconium lactate	174206-15-6	1
Solvent refined heavy naphthenic petroleum distillates	64741-96-4	1
Sorbitan monooleate	1338-43-8	1
Stabilized aqueous chlorine dioxide	10049-04-4	1
Stannous chloride	7772-99-8	1
Stannous chloride dihydrate	10025-69-1	6
Starch	9005-25-8	5
Steam cracked distillate, cyclodiene dimer, dicyclopentadiene polymer	68131-87-3	1
Steam-cracked petroleum distillates	64742-91-2	6
Straight run middle petroleum distillates	64741-44-2	5
Substituted alcohol	*	2
Substituted alkene	*	1
Substituted alkylamine	*	2
Sucrose	57-50-1	1
Sulfamic acid	5329-14-6	6
Sulfate	*	1
Sulfonate acids	*	1
Sulfonate surfactants	*	1
Sulfonic acid salts	*	1
Sulfonic acids, petroleum	61789-85-3	1
Sulfur compound	*	1
Sulfuric acid	7664-93-9	9
Sulfuric acid, monodecyl ester, sodium salt	142-87-0	2
Sulfuric acid, monooctyl ester, sodium salt	142-31-4	2
Surfactants	*	13
Sweetened middle distillate	64741-86-2	1
Synthetic organic polymer	9051-89-2	2
Tall oil (Fatty acids)	61790-12-3	4
Tall oil, compound with diethanolamine	68092-28-4	1
Tallow soap	*	2
Tar bases, quinoline derivatives, benzyl chloride-quaternized	72480-70-7	5
Tergitol	68439-51-0	1
Terpene hydrocarbon byproducts	68956-56-9	3

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Terpenes	*	1
Terpenes and terpenoids, sweet orange-oil	68647-72-3	2
Terpineol	8000-41-7	1
Tert-butyl hydroperoxide	75-91-2	6
Tetra-calcium-alumino-ferrite	12068-35-8	1
Tetraethylene glycol	112-60-7	1
Tetraethylenepentamine	112-57-2	2
Tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione (Dazomet)	533-74-4	13
Tetrakis (hydroxymethyl) phosphonium sulfate	55566-30-8	12
Tetramethyl ammonium chloride	75-57-0	14
Tetrasodium 1-hydroxyethylidene-1,1-diphosphonic acid	3794-83-0	1
Tetrasodium ethylenediaminetetraacetate	64-02-8	10
Thiocyanate sodium	540-72-7	1
Thioglycolic acid	68-11-1	6
Thiourea	62-56-6	9
Thiourea polymer	68527-49-1	3
Titanium complex	*	1
Titanium oxide	13463-67-7	19
Titanium, isopropoxy (triethanolaminate)	74665-17-1	2
Toluene	108-88-3	29
Treated ammonium chloride (with anti-caking agent a or b)	12125-02-9	1
Tributyl tetradecyl phosphonium chloride	81741-28-8	5
Tri-calcium silicate	12168-85-3	1
Tridecyl alcohol	112-70-9	1
Triethanolamine (2,2,2-nitrilotriethanol)	102-71-6	21
Triethanolamine polyphosphate ester	68131-71-5	3
Triethanolamine titanate	36673-16-2	1
Triethanolamine zirconate	101033-44-7	6
Triethanolamine zirconium chelate	*	1
Triethyl citrate	77-93-0	1
Triethyl phosphate	78-40-0	1
Triethylene glycol	112-27-6	3
Triisopropanolamine	122-20-3	5
Trimethylammonium chloride	593-81-7	1
Trimethylbenzene	25551-13-7	5
Trimethyloctadecylammonium (1-octadecanaminium, N,N,N-trimethyl-, chloride)	112-03-8	6
Tris(hydroxymethyl)aminomethane	77-86-1	1
Trisodium ethylenediaminetetraacetate	150-38-9	1
Trisodium ethylenediaminetriacetate	19019-43-3	1
Trisodium nitrilotriacetate	18662-53-8	8
Trisodium nitrilotriacetate (Nitrilotriacetic acid, trisodium salt monohydrate)	5064-31-3	9
Trisodium ortho phosphate	7601-54-9	1
Trisodium phosphate dodecahydrate	10101-89-0	1
Ulexite	1319-33-1	1

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Chemical Component	Chemical Abstract Service Number	No. of Products Containing Chemical
Urea	57-13-6	3
Wall material	*	1
Walnut hulls	*	2
White mineral oil	8042-47-5	8
Xanthan gum	11138-66-2	6
Xylene	1330-20-7	44
Zinc chloride	7646-85-7	1
Zinc oxide	1314-13-2	2
Zirconium complex	*	10
Zirconium dichloride oxide	7699-43-6	1
Zirconium oxide sulfate	62010-10-0	2
Zirconium sodium hydroxy lactate complex (Sodium zirconium lactate)	113184-20-6	2

** Components marked with an asterisk appeared on at least one MSDS without an identifying CAS number. The MSDSs in these cases marked the CAS as proprietary, noted that the CAS was not available, or left the CAS field blank. Components marked with an asterisk may be duplicative of other components on this list, but Committee staff have no way of identifying such duplicates without the identifying CAS number.*

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