SUMMARY OF X-RAY FLUORESCENCE CALIBRATION DATA SOUTH CAVALCADE SITE

FOR

KOPPERS COMPANY, INC.

PITTSBURGH, PENNSYLVANIA

PREPARED BY

MCBRIDE-RATCLIFF AND ASSOCIATES, INC.

HOUSTON, TEXAS

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McBride-Ratcliff and Associates, Inc.

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Koppers Company, Inc., Science and Technology
436 Seventh Avenue, Pittsburgh, PA 15219
Telephone 412-227-2000

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SUPERFUND BRANCH

KOPPERS

May 23, 1986

Mr. Larry Wright
Chief, Superfund Enforcement Section
US Environmental Protection Agency
Region VI
1201 Elm Street
6AW-SE
Dallas, TX 75270

Re: South Cavalcade Site
Surrogate Testing Program for Metals

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Dear Mr. Wright:

As part of the RI/FS Work at the South Cavalcade and Texarkana sites, Koppers is required to perform surrogate testing of selected soil samples for arsenic, chromium, copper, lead, and zinc using X-ray fluorescence analysis. Surrogate testing for metals is required for soil samples collected during both power auge ing and hollow stem augering. Ideally, the surrogate test results are to be used to help determine the nature and extent of soil contamination at the sites as well as to help make well informed decisions as to which samples should be sent to the laboratory for ICP analysis.

To comply with this requirement Koppers contractor, McBride-Ratcliff and Associates, Inc. (MRA) has spent considerable time developing a methodology for sample handling and analysis.

MRA has worked extensively with the manufacturers of the X-ray fluorescence equipment, Columbia Scientific Industries Corporation (CSI), to establish the metals surrogate program. CSI was familiar with use of their equipment for environmental analyses in sludges and liquids, but had never before worked with environmental analyses in heterogeneous mixtures such as soils. Nevertheless, CSI and MRA worked together to establish a calibration model for the equipment and a preparation technique for the samples.

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Development activities included the following:

- MRA chemist attended a Three-Day Training Course provided by CSI.

- Calibration model was developed based on analytical data from 20 soil samples collected at the South Cavalcade site.

- Calibration model verified for Texarkana site soils using analytical results from 10 soil samples.

- Standard Operating Procedure for sample preparation and analysis by X-ray fluorescence developed by MRA.

These activities are described in greater detail in a report prepared by MRA which is appended to this letter.

As field work at the Texarkana site is essentially complete and work at South Cavalcade is in progress, we have accumulated a data base from which we can evaluate the utility of the metals surrogate program.

The data base includes 54 samples from the Texarkana site analyzed for four metals for a total of 216 X-ray/ICP data pairs. An additional 15 samples from the South Cavalcade site have been analyzed for five metals yielding 75 more X-ray/ICP data pairs, for a total 291 X-ray/ICP data pairs. Because only a small fraction (16%) of the data pairs showed above detection limit values for both analytical techniques, the evaluation necessarily proceeds on a qualitative basis.

Table One provides a breakdown of sample results. The data are displayed from the point of view of X-ray accuracy. For example, of 20 samples at the Texarkana site showing positive X-ray results (i.e. above detection limits) only 9 showed positive ICP results. The 1 sample at South Cavalcade yielding a positive X-ray response was not detected by the ICP method. The data, therefore, show that of 21 positive X-ray responses to zinc, only 43% were verified by ICP. On the other hand, of the 48 negative X-ray readings for zinc, 46% were below the detection limit for ICP analysis, leaving 54% of the samples as showing above detection limit results.

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Data for arsenic, copper, chromium also show a poor performance of X-ray for predicting the actual presence of the metals, 0%, 13%, 40% correct, respectively. Data for arsenic, copper, chromium indicate a favorable prediction of the absence of the metals (90% cumulative), however we feel that this correlation may be more a result of the absence of arsenic, copper, and chromium in the samples than a reflection of good X-ray performance. Arsenic, copper, and chromium were identified by ICP in only 22 of 207 analyses. Note that for the case of zinc and lead, identified by ICP in 40 of 81 analyses, X-ray fluorescence correctly predicts the absence of zinc and lead only 44% of the time.

The bottom line in Table One provides a cumulative summary of X-ray fluorescence performance as a surrogate for zinc, arsenic, copper, chromium and lead. The data show that of 75 positive X-ray responses only 24% were verified by ICP. Of 216 negative X-ray responses 78% were below the ICP detection limit.

Koppers feels that the data show clearly that X-ray fluorescence is not an adequate surrogate method for identifying the presence of zinc, arsenic, copper, chromium, and lead in soil samples at the Texarkana and South Cavalcade sites. The data indicate that X-ray fluorescence may be an adequate surrogate method for showing the absence of the metals, however, the bias introduced by a lack of ICP identification of arsenic, copper, and chromium leave this conclusion in doubt.

Given the conclusions stated above, we feel that the X-ray fluorescence data will not help us to delineate the nature and extent of metal contamination at the two sites. Indeed, the data developed so far cast doubt on the applicability of X-ray fluorescence as a metal surrogate technique for environmental investigations in general. Further, Koppers does not feel comfortable using the X-ray data in the RI/FS decision making process. Hence, we formally propose that the metals surrogate X-ray fluorescence program be discontinued at the South Cavalcade site. We will continue to perform surrogate testing for organics and we will provide an analysis of the metals surrogate data collected to date in the RI report.

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As a separate issue, Koppers would like to discontinue analysis for iron in soil samples collected at the South Cavalcade site. We feel that the data collected to date adequately describe native levels of iron in the soil, especially because iron is not an environmentally significant metal.

Should you have questions concerning the surrogate program at South Cavalcade or wish to discuss these issues further, please call Jim Campbell, at (412)-227-2689.

Sincerely yours,

S. M. Tymiak

S. Michael Tymiak, P.E.
Manager, Previously Operated Properties

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JRC:m
cc: D. Sorrells (TWC) (w/attach).

TABLE ONE

Metals Surrogate Program Summary

ent	X-Ray Pos. ICP neg.	X-Ray Pos. ICP pos.	X-Ray Neg. ICP neg.	X-Ray Neg. ICP pos.	
:					
Texarkana	11	9	17	17	69
S. Cavalcade	1	-	5	9	
% Correct	-	43%	46%	--	
ENIC					
Texarkana	15	-	36	3	
S. Cavalcade	6	-	5	4	
% Correct	-	0%	85%	--	
PER					
Texarkana	11	1	42	--	
S. Cavalcade	2	1	10	2	
% Correct	-	13%	96%	--	
OMIUM					
Texarkana	6	1	44	3	
S. Cavalcade	-	3	8	4	
% Correct	-	40%	88%	--	
D (1)					
S. Cavalcade	5	3	2	5	
% Correct	-	38%	29%	--	
AL % CORRECT	76 %	24% (n=75)	78% (n=216)	33 %	

X-ray false positive

X-ray false negative

: (1) Lead analysis not required at Texarkana

McBride-Ratcliff and Associates, Inc.
Geotechnical Consultants
7220 Langley Houston, Texas 77040 713-460-3766

May 14, 1986
MRA Project No. 85-317

Koppers Company, Inc.
436 Seventh Avenue
1940 Koppers Company
Pittsburgh, Pennsylvania 15219

ATTENTION: Dr. James R. Campbell
Previously Operated Properties

SUBJECT: Summary of X-Ray Fluorescence Calibration Data
South Cavalcade Site
Houston, Texas

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In response to your request on May 7, 1986, we are submitting a summary of procedures used to calibrate the X-ray fluorescence analyzer with respect to soil metals surrogate testing. Also included are supporting laboratory and analytical data.

Training

The equipment used for the soil metals surrogate testing was the X-Met 840 portable X-ray analyzer manufactured by Columbia Scientific Industries Corporation (CSI) in Austin, Texas. CSI provides a three-day training course which was attended by our project chemist. The training course covers the following topics:

1. Theory
2. Operation
3. Calibration

Operating Procedures

Because the X-Met 840 is primarily designed for alloys analysis, no standard operating procedures have been developed for soil metals analysis. Therefore, standard operating procedures had to be developed specifically for the South Cavalcade and Texarkana projects that would provide a high degree of representativeness and quality assurance/quality control (QA/QC). Standard Operating Procedure SOP-HWCL-03 (Method of X-Ray Fluorescence Analysis of Metals in Soil) is referenced in Appendix A, and includes:

1. Sample Preparation
2. Operation
3. Reporting
4. Quality Assurance/Quality Control

Calibration

Calibration of the X-Met 840 basically involves measurement of known standards in a soil matrix at varying concentrations and determining a spectral response for each standard. The individual responses are then reduced by linear regression analysis to obtain a calibration curve for each metal of interest. The calibration data are stored in memory and are used to calculate metals concentration from unknown spectral responses.

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Calibration No. 1. An initial calibration was conducted using 20 soil samples at 10 different locations at the South Cavalcade Site. At each location, a surficial sample (0 to 0.5 ft) and a near-surface (0.5 to 1.0 ft) were obtained. The 20 soil samples were homogenized and split and submitted to Spectrix Corporation and CSI for analysis. Quantitative analysis of the 20 split soil samples was conducted by Spectrix using nitric acid digestion and atomic absorption techniques to determine arsenic, chromium, copper, lead, and zinc concentrations. A copy of the Spectrix report dated November 22, 1985 is included in Appendix B.

In addition, 20 split soil samples were also submitted to CSI for X-ray analysis and equipment calibration. The samples were oven-dried and grinded to a very fine powder. Analysis was conducted by a high resolution X-ray spectrometer. The X-ray spectrometer also checks for additional metals that may provide interferences.

Results of the X-ray analyses were compared to the atomic absorption test results from Spectrix to develop calibration curves for each of the five metals (Model 1). A report, dated December 23, 1985, of the CSI calibration is also included in Appendix B.

Calibration No. 2. A review of the laboratory data and calibration plots from Calibration No. 1 indicated poor coefficient of correlation (r-value) for the chromium analyses. Therefore, another calibration was performed based on a second set of analyses by Spectrix to more closely duplicate sample preparation techniques by CSI. In this case, the initial samples prepared by CSI for Calibration No. 1 were split and sent to Spectrix for atomic adsorption

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analysis. Using this approach, analytical results of the actual samples used by CSI were used to obtain the calibration curves (Model 2).

A copy of the Spectrix report dated December 13, 1985 containing the results of 10 selected soil samples is included in Appendix C. A comparison of the results from the sample splits from the first analysis (Appendix B) shows generally consistent results. Three additional spiked soil samples were also analyzed to obtain a better range of lead concentrations and are included in Appendix C (Spectrix report dated December 19, 1985). A copy of the CSI data and laboratory notes for the second calibration (Model 2) are also included in Appendix C.

Texarkana Calibration

The calibration models developed from the South Cavalcade soil samples should ideally apply to samples from the Texarkana site for analysis of the five selected metals in a soil matrix. However, the presence of potential interference compounds (i.e., Calcium, Iron, Rubidium, Zirconium, etc.) indigenous to specific areas may influence the calibration models. Therefore, additional soil samples from the Texarkana site were checked for interfering metals.

A set of 10 selected soil samples was obtained from the Texarkana site at power auger boring locations throughout the site. The samples were prepared by drying and fine grinding, consistent with the South Cavalcade site soil samples. The 10 Texarkana samples were analyzed by CSI using a high resolution X-ray spectrometer. Results of the Texarkana samples are included in CSI Analytical Report No. 516 dated January 14, 1986 (see Appendix D). Verbal

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results from CSI identified interfering metals at the Texarkana site which were also present at the South Cavalcade site and are therefore included in both calibrations (Model 1 and Model 2).

Quality Control/Quality Assurance

Quality Control/Quality Assurance (QA/QC) testing was performed by McBride-Ratcliff and Associates (MRA) to evaluate:

1. Detection Limits
2. Standard Values
3. Standard Deviation

Six soil samples were selected that have low metals concentrations based on Spectrix analytical data. Responses were obtained for each of the five metals from the Model 2 calibration. The measured responses were used to obtain the detection limits for each of the five selected metals. A copy of the detection limit analytical results is included in Appendix E.

In addition, 10 replicate analyses of one selected soil standard were conducted to evaluate the soil standard concentration and a corresponding machine standard deviation for each of the five selected metals. Results of the replicate analyses are also included in Appendix E.

Summary

Based on conversations with several representatives with CSI, very little experience exists with soil matrix metals determination using the X-Met 840. Substantial efforts have been made for this project to develop specific operating procedures and soil matrix calibration models for

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qualitative measurement of soil metals concentrations. We estimate that approximately 300 man-hours have been devoted in these efforts.

We appreciate this opportunity to be of service to Koppers. Please contact us if you have any questions or require additional information.

Sincerely,

McBRIDE-RATCLIFF AND ASSOCIATES, INC.

Paul Wild

Paul R. Wild
Project Chemist

William R. Tobin

William R. Tobin, P.E.
Project Manager

WRT:PRW:kc
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APPENDIX A

STANDARD OPERATING PROCEDURE

FOR

X-RAY FLUORESCENCE ANALYSIS
OF SOILS METALS

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STANDARD OPERATING PROCEDURE

Number:	SOP-HWCL-03	Page:	1 of 7
Originated By:	PRW	Date:	Jan. 1986
Approved By:	WRT	Status:	Final
		Rev.:	0

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METHOD OF X-RAY FLUORESCENCE ANALYSIS OF METALS IN SOIL

1.0 Scope and Application

1.1 This procedure is for the qualitative analysis of metals in soil using an X-ray fluorescence analyzer. A radioactive source is chosen which emits X-rays to obtain spectral responses from metal compounds in a soil media. Metals can be identified and quantified by the characteristic energies which they re-emit. Typical lower detection limits are 25 to 50 ppm in complex soil media.

2.0 Summary of Method

2.1 A dried and homogenized soil sample is placed in a calibrated X-ray fluorescence analyzer and subjected to X-rays. Re-emitted X-rays are detected and analyzed to identify metals and their concentrations.

3.0 Apparatus and Materials

3.1 A Columbia Scientific Industries X-Met 840 Portable X-Ray Analyzer with powder/liquid sample probe.

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3.2 Analytical balance capable of weighing to 0.1gm.

3.3 Plastic sample cups and mylar film from Columbia Scientific Industries.

3.4 Drying oven capable of maintaining a constant temperature of 105° C.

3.5 Grinder, ball mill grinder, mortar and pestle, or similar apparatus capable of reducing dry soils to fine powders.

3.6 Glass cutting board and stainless steel knife or device to grate the sample.

3.7 U.S. Standard Sieve No. 10 (2.00 mm) and U.S. Standard Sieve No. 200 (0.075 mm).

4.0 Sample, Preservation, and Handling

4.1 Samples shall be stored in detergent washed, tap water rinsed 8 oz. or 16 oz. glass jars with Teflon-lined lids at 4°C. Maximum holding time for soil samples is 6 months. At least 100 gm of soil is required.

5.0 Procedure

5.1 Remove the sample from the jar and place it on a glass cutting board. With a stainless steel knife or grating device, break the sample down to 1/4-in. pieces or less and thoroughly mix the samples.

5.2 Fill a weighing dish with about 50 gm of soil and record the weight of the soil. Dry the soil for 24 hours at a constant temperature of 105°C. Weigh the dried soil and compute the moisture content on a dry weight basis, in accordance with ASTM D 2216.

5.3 Grind the samples in the grinding apparatus until they are fine powders. Samples with gravel and large organic materials should be sieved first with a U.S. Standard Sieve No. 10. Weigh and record the weight of material retained on the sieve. After grinding is complete, the powders should be sieved with a U.S. Standard Sieve No. 200. Materials passing the U.S. Standard Sieve No. 200 are to be used for the analysis. Samples with high concentrations of organic compounds may not pass the No. 200 sieve and should be sieved with a U.S. Standard Sieve No. 10 if less than 5 gm pass the No. 200 sieve.

5.4 Prepare the sample cup by placing a piece of the mylar film over the bottom of the larger half of the sample cup. Snap the smaller half of the sample cup over the bottom of the larger half. This clamps the mylar film in place. The film should be tight, without wrinkles.

5.5 Fill the cup with the dried, pulverized samples. Tap the cup on a hard surface until no more settling is observed to occur and the sample surface is visually flat and uniform. A 1/4 in. to 1/2 in. layer of sample should be in each cup.

5.6 Turn the X-MET 840 on. The LCD should read "SELF TEST COMPLETE" and the ">" sign should be displayed. This display may be replaced by "GAIN CONTROL: COUNT RATE TOO LOW". This is normal. Allow the machine to warm up for at least 1/2 hour with the probe lid closed. Open up the lid and wait an additional 5 minutes for gain control stabilization. The instrument is ready to measure samples. Keep the lid of the probe open for gain control between the sample analyses.

5.7 Place the sample cup in the probe, making sure the lid is completely closed, and press "START".

After it has finished scanning, "ASSAYS" will appear and the metals of interest and their concentrations (mg/kg dry weight basis) will appear on the screen. Record the results on the X-ray Analysis Data Sheet. Enter "STD" on the keypad after each measurement and record the standard deviation of counting statistics for each metal. Store the samples in glass storage vials for future reference. Report results by total wet weight. Calculations are as follows:

$$\frac{\text{Sample Dry wt.}}{\text{Sample Wet wt.}} \times \text{Results (mg/kg)} = \text{Corrected Results (mg/kg)}$$

For samples that were sieved with a U.S. Standard Sieve No. 10, the weight of materials retained should be subtracted from the sample dry weight in the calculations:

$$\frac{\text{Sample Dry wt.} - \text{Retained Sample wt.}}{\text{Sample Wet wt.}} \times \text{Results (mg/kg)} = \text{Corrected Results (mg/kg)}$$

6.0 Equipment Cleanup

6.1 The knife, grating device, and cutting board should be detergent washed and tap water rinsed to

remove all dirt and air dried between samples. The cups should be detergent washed and tap water rinsed between samples and air dried. Replace the mylar film between each analysis.

7.0 Quality Assurance/Quality Control Measures

7.1 Ten percent of the samples will have a replicate analysis to evaluate analytical precision. Randomly choose 1 sample and prepare a separate aliquot and perform analysis in accordance with Section 5.0. Record the results on the X-Ray Analysis Data Sheet. Record the respective standard deviations of counting statistics.

7.2 Compute the differences for each metal concentration between the original analysis and the replicate analysis. If any values differ by greater than 2 reportable standard deviations, then conduct a second relicate analysis on a third aliquot from the same sample. Reportable standard deviation is defined as the greater of the two values of the standard deviation of counting statistics and the calibration model standard deviation.

7.3 To check for instrument precision, perform an analysis of a known standard. This should be performed once per day. If the average of the standard results vary greater than 2 reportable standard deviations, then open the lid of the probe to allow it to undergo gain control for 15 minutes. Remeasure the sample.

8.0 References

8.1 Operating Instructions: X Met 840 Portable XRF Analyzer, Columbia Scientific Industries, 1985.

X-RAY ANALYSIS DATA SHEET

PROJECT NO.:	PROJECT:	CLIENT:

DATE TESTED:	BY:						METALS CONCENTRATION/SAMPLE STANDARD DEVIATION				
			TARE	CAN PLUS	CAN PLUS	WATER	ARSENIC	CHROMIUM	COPPER	LEAD	ZINC
SAMPLE NO.	DEPTH	SAMPLE DATE	WEIGHT	WET SOIL	DRY SOIL	CONTENT	MODEL SD=32 MODEL DL=88	MODEL SD=204 MODEL DL=88	MODEL SD=42 MODEL DL=26	MODEL SD=162 MODEL DL=101	MODEL SD=58 MODEL DL=30

REPLICATE SAMPLE NO.	METAL	STANDARD VALUE / END-OF-DAY VALUE	DEV.						
				REPLICATE 1 RESULTS					
STANDARD SAMPLE NO.	As	1676 ± 67		DIFFERENCE					
	Cr	1438 ± 20C		LESS THAN 2 STANDARD DEVIATIONS ?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
CHECKED BY:	Cu	427 ± 37		REPLICATE 2 RESULTS					
DATE:	Pb	174 ± 63		DIFFERENCE					
STATUS: ☐ DRAFT ☐ FINAL	Zn	2612 ± 56		LESS THAN 2 STANDARD DEVIATIONS ?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO

McBride-Ratcliff and Associates, Inc.

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APPENDIX B

CALIBRATION NO. 1 LABORATORY
DATA

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COLUMBIA SCIENTIFIC INDUSTRIES CORPORATION

December 23, 1985

Koppers Co., Inc.
c/o McBride Radcliff Assoc.
P.O. Box 40850
Houston, TX 77040

Attn: Bill Tobin

Dear Bill,

Here are the results of the feasibility study performed on your samples of hazardous waste, using our Model 840 Portable X-ray Analyzer with a laboratory Xe/CO_2 probe.

As agreed during our earlier telephone conversations, extensive preparation of your samples has been performed in order to make them suitable for subsequent x-ray analysis.

First the samples were oven-dried over the weekend at a temperature of 55 to 60°C. Moisture loss for each was determined by weighing it before and after drying (see Table 1). Then all samples were each transferred into a glass jar (baby food jars are excellent for this) with a ceramic barrel or ball inside and rolled for at least four hours. The purpose of this operation is to disintegrate any agglomerates and lumps rather than to grind the samples. Each rolled sample was then transferred onto a 200 mesh sieve and the material passing through was collected as the final sample for further studies. Corrections were not made to the concentration data due to any segregation between coarse and fine fractions.

The fine fractions were all analyzed quantitatively on our laboratory high resolution x-ray spectrometer in order to see what elements are present in the samples which could possibly interfere with the determination. For your information twenty x-ray spectra are enclosed as taken on your samples in the interesting range of elements. As can be seen, the samples contain polluting elements Cr, As, Cu, Pb, and Zn and also "crustal" elements such as Ca, Fe, Rb, Sr, Y, Zr, and Mo. Based on these findings a Laboratory Probe with Xe/CO_2 filled detector and a 100 mCi Cm-244 source was set up to record net x-ray intensities of Fe, Cu, As, Rb, Ca, Cr, Pb, Zn, and backscattered radiation (BS). Each of 20 samples was measured for 200 seconds. Then concentration data for As, Cu, Cr, Pb, and Zn were entered into the 840 memory for subsequent derivation of the calibration equations. Details of the modeling are shown in Table 1.

The figures enclosed with this report show the plots of x-ray intensities versus given element concentration. As can be seen, some samples do not line on

Telephone AC 512-258-5191, TWX 910-874-1364, 11950 Jollyville Road, P.O. Box 203190, Austin, Texas 78720

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the calibration and those were rejected from the calibration. Generally for the range of concentrations occurring one can expect a linear relationship between given element concentration and its x-ray intensity.

Since your samples did not cover a wide enough concentration range to determine reliably the slope of a lead calibration curve, we used two of our Pb-spiked soil samples which contained 2000 ppm lead.

That is how we arrived at precision and RMS data for lead, although no measurements for Pb were actually made. In order to obtain a more realistic lead calibration curve sample #15 was selected for spiking with PbO. Three aliquots of sample #15 were spiked in order to provide find concentrations of Pb at about 1000, 1500, and 2000 ppm. I believe Paul Wild is in possession of the lead data now.

The nonhomogeneity of the samples was tested using sample #10 by measuring 8 different aliquots of this sample and calculating the standard deviation of the series for each element. This standard deviation, when corrected for the precision of measurement, is a measure of sample nonhomogeneity.

I hope these results will be helpful in your further work.

Yours sincerely,

Stanislaw Piórek, Ph.D.
Manager, X-ray Applications Laboratory

Encl.

cc: J. Pasmore

SP/jc

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TABLE I. RESULTS OF CALIBRATION AND MEASUREMENTS – XMET 840.

SAMPLE # AS ON THE PLOTS	SAMPLE CODE	INITIAL MOISTURE CONTENT	COPPER [ppm]		ARSENIC [ppm]		CHROMIUM [ppm]		ZINC [ppm]		LEAD [ppm]	
		%REL	by AAS	with 840	by AAS	with 840	by AAS	with 840	by AAS	with 840	by AAS	with 840
1	SCK-XC-01,-01	17.2	177	130	1140	1000	591	877	982	1129	110	NOT MEASURED
2	01-02	18.4	374	356	1800	2137	2100	2058	4390	4404	147	
3	02-01	9.2	417	732	2270 *	3890	1400 *	3530	2740 *	5703	200	
4	02-02	16.2	1220 *	733	3870	3619	3660	3518	7740	7756	330	
5	03-01	10.6	56	89	1160 *	125.5	62	342	191	0	422	
6	03-02	15.8	31	66	27	186	14	54	38	0	57	
7	04-01	24.8	548	376	1730	1467	1510	1589	2330	2372	221	
8	04-02	22.2	292	513	1830	1996	653 *	2074	978 *	4270	162	
9	05-01	30.3	989	938	3510	3694	3280	3629	4900	4457	234	
10	05-02	24.2	1110	838	3680	3610	4010	3670	6900	7032	296	
11	06-01	6.2	<9	1.4	21	78	28	26	175	109	176	
12	06-02	5.6	33	23	22	191	28	76	154	97	112	
13	07-01	10.0	<9	8.4	18	90	37	128	202	64	95	
14	07-02	8.0	37	12.6	21	116	40	124	251	113	90	
15	08-01	9.3	116	36	19	0	<4	0	338	460	505	
16	08-02	9.1	63	43	22	90	21	4	334	649	222	
17	09-01	8.5	<9	83	17	0	58	0	427	624	184	
18	09-02	8.8	44	58	16	0	173	0	255	570	184	
19	10-01	11.9	51	29	15	0	31	0	264	273	129	
20	10-02	11.0	44	51	20	0	25	0	294	295	144	
	PRECISION OF MEAS. AT 200 SEC MEAS. TIME		±30 ppm at 1000 ppm ±10 ppm at 0 ppm		±40 ppm at 4000 ppm ±30 ppm at 0 ppm		±80 ppm at 5000 ppm ±50 ppm at 0 ppm		±40 ppm at 8000 ppm ±15 ppm at 0 ppm		±45 ppm at 500 ppm ±40 ppm at 0 ppm	
	RMS ERROR OF CALIBRATION		±130 ppm		±169 ppm		±200 ppm		±210 ppm		±120 ppm	
	NONHOMOGENEITY ERROR		±100 ppm		±127 ppm		±185 ppm		±200 ppm		±60 ppm	

* SAMPLE OMITTED FROM CALIBRATION

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FIG. 1 CSI MODEL 840 PORTABLE XRF ANALYZER

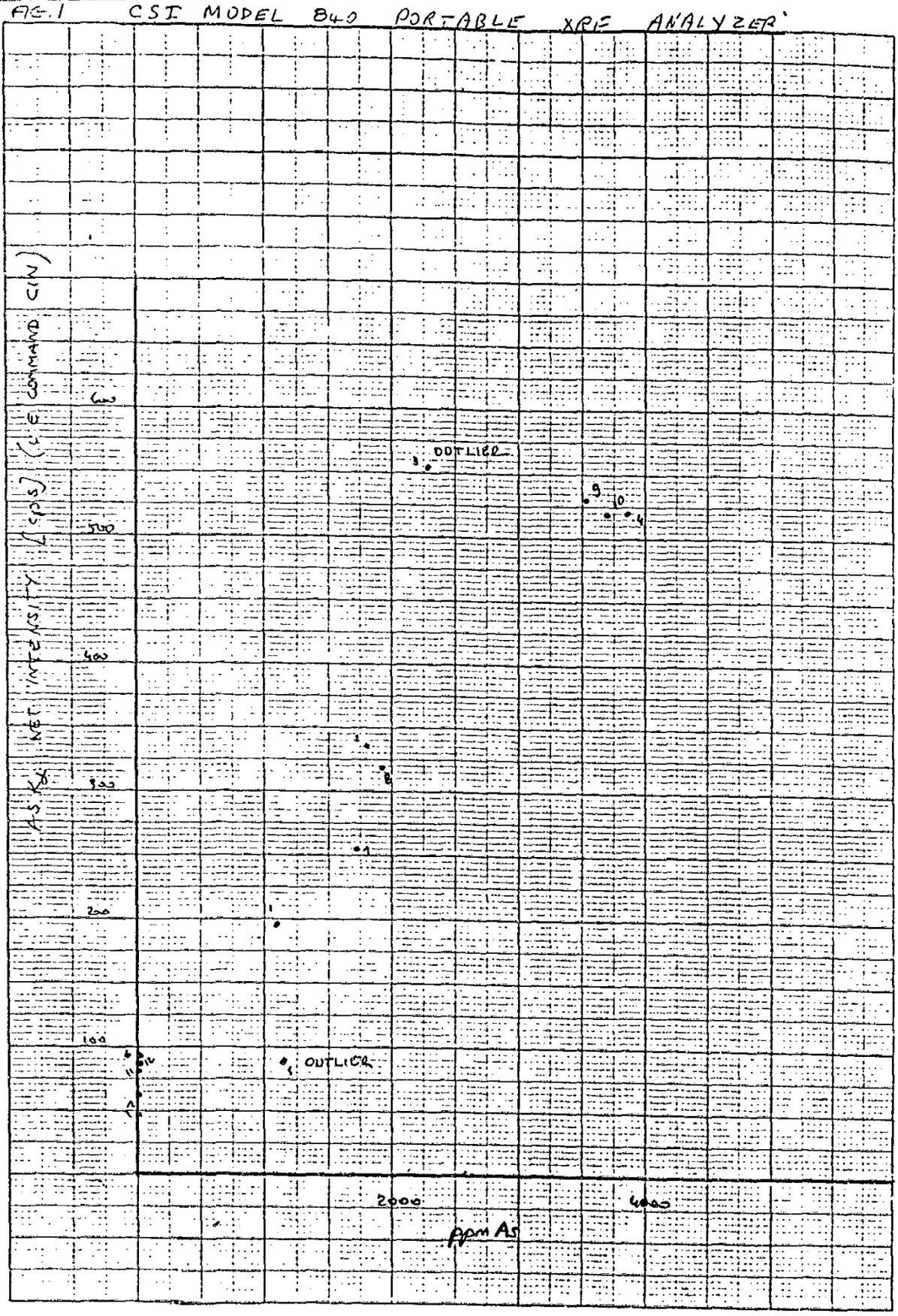

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FIG. 2 CSI MODEL 840 PORTABLE XRF ANALYZER

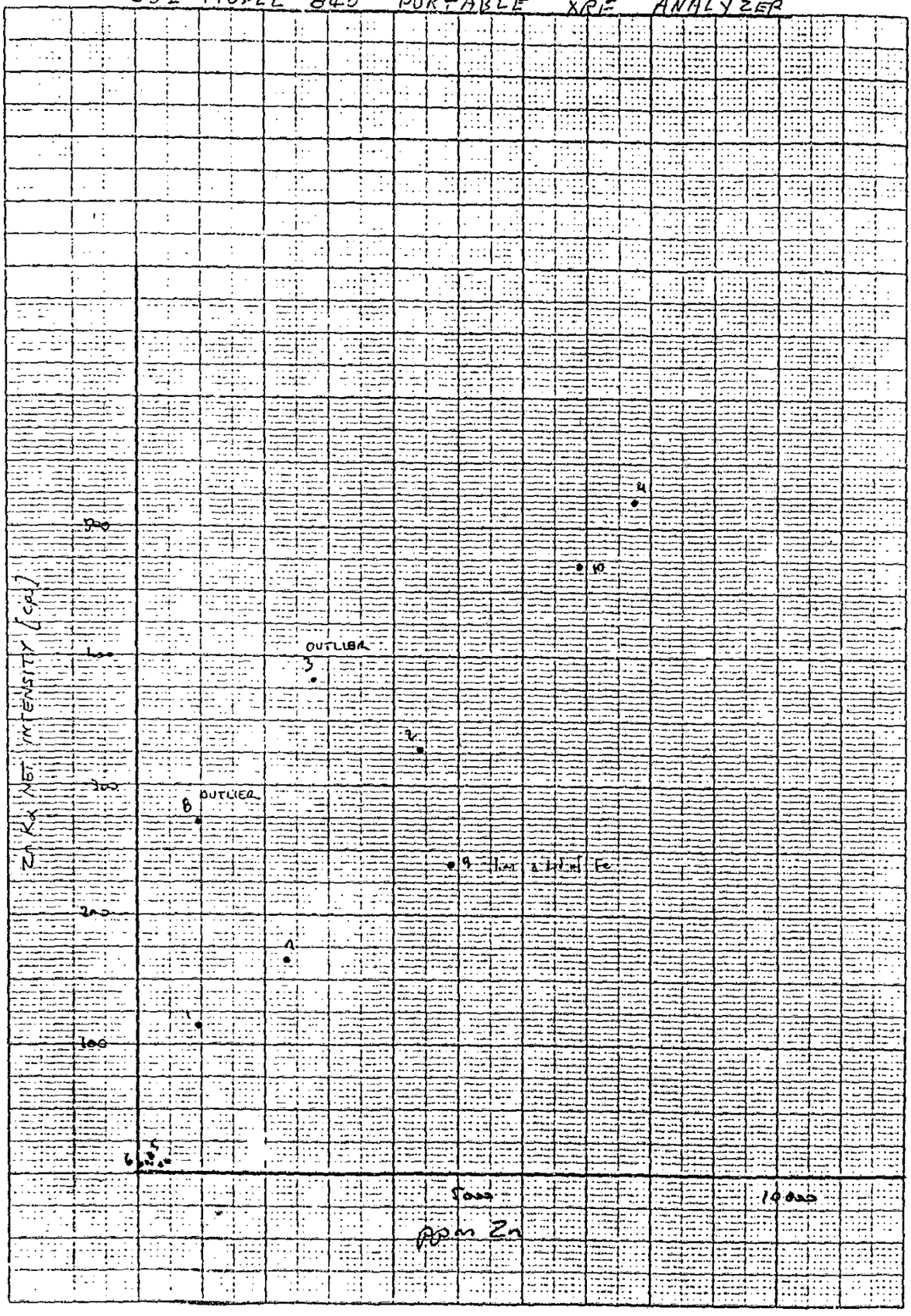

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FIG. 3 CSI MODEL 840 PORTABLE XRE ANALYZER

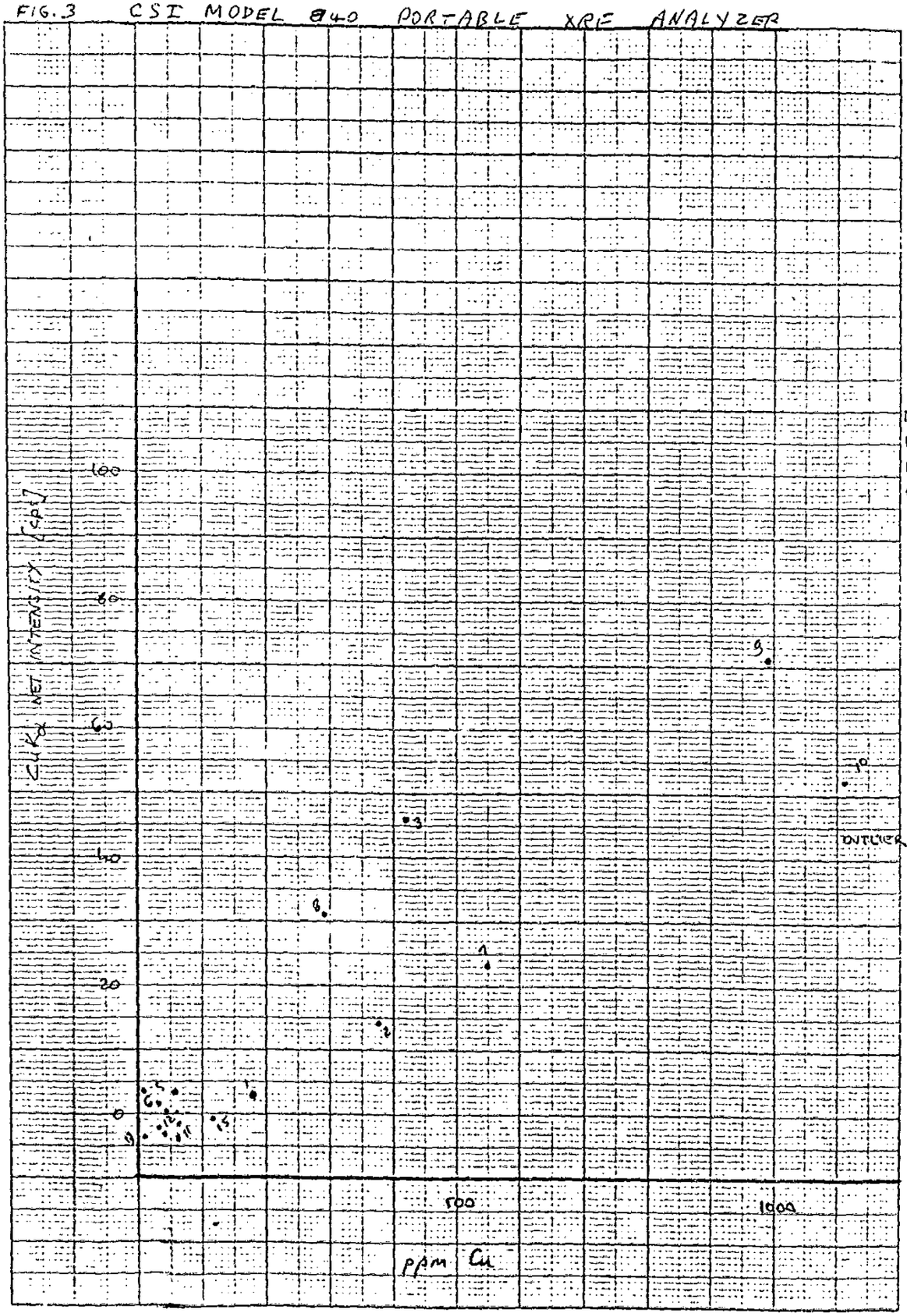

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FIG. 4 CSI MODEL 840 PORTABLE XRF ANALYZER

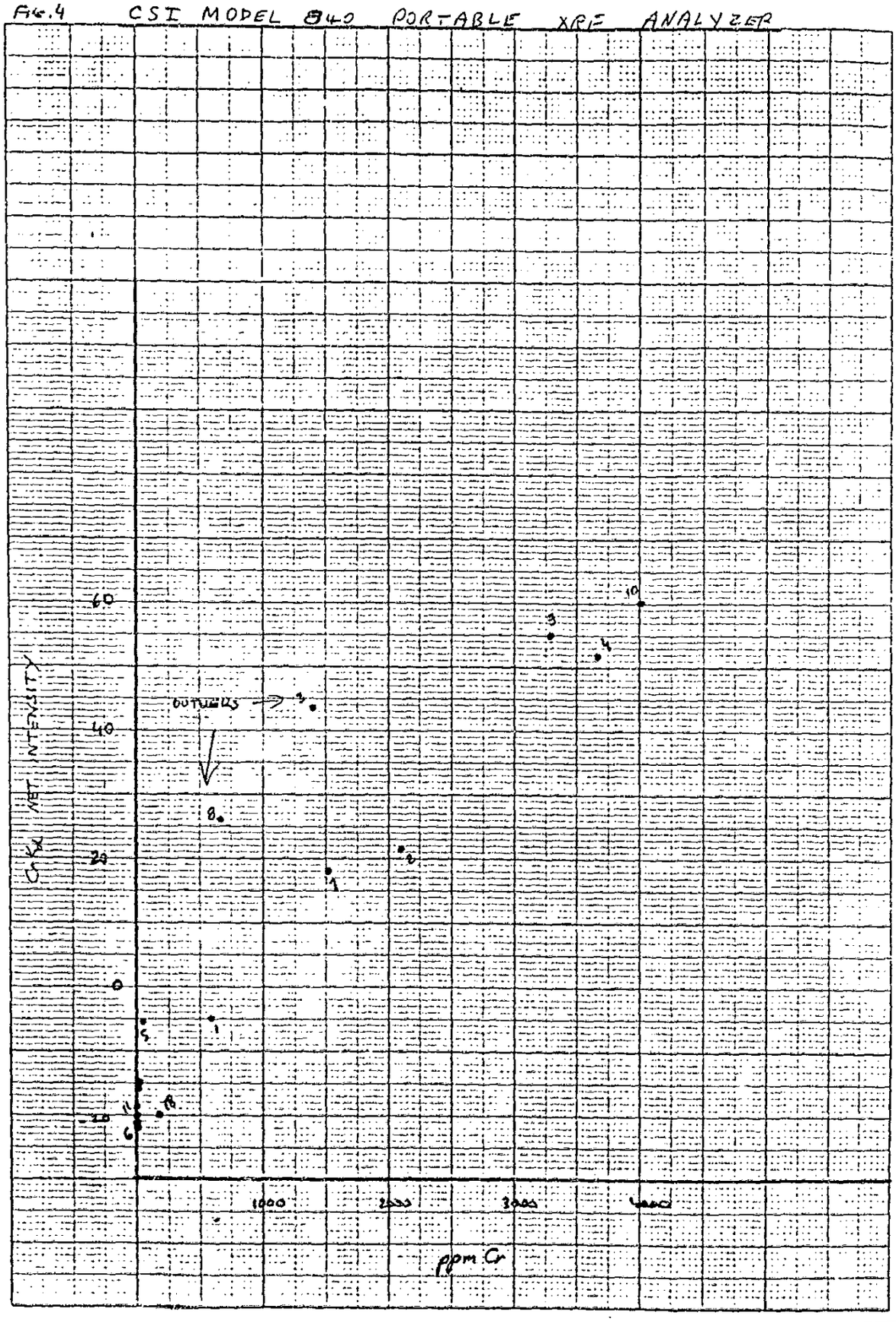

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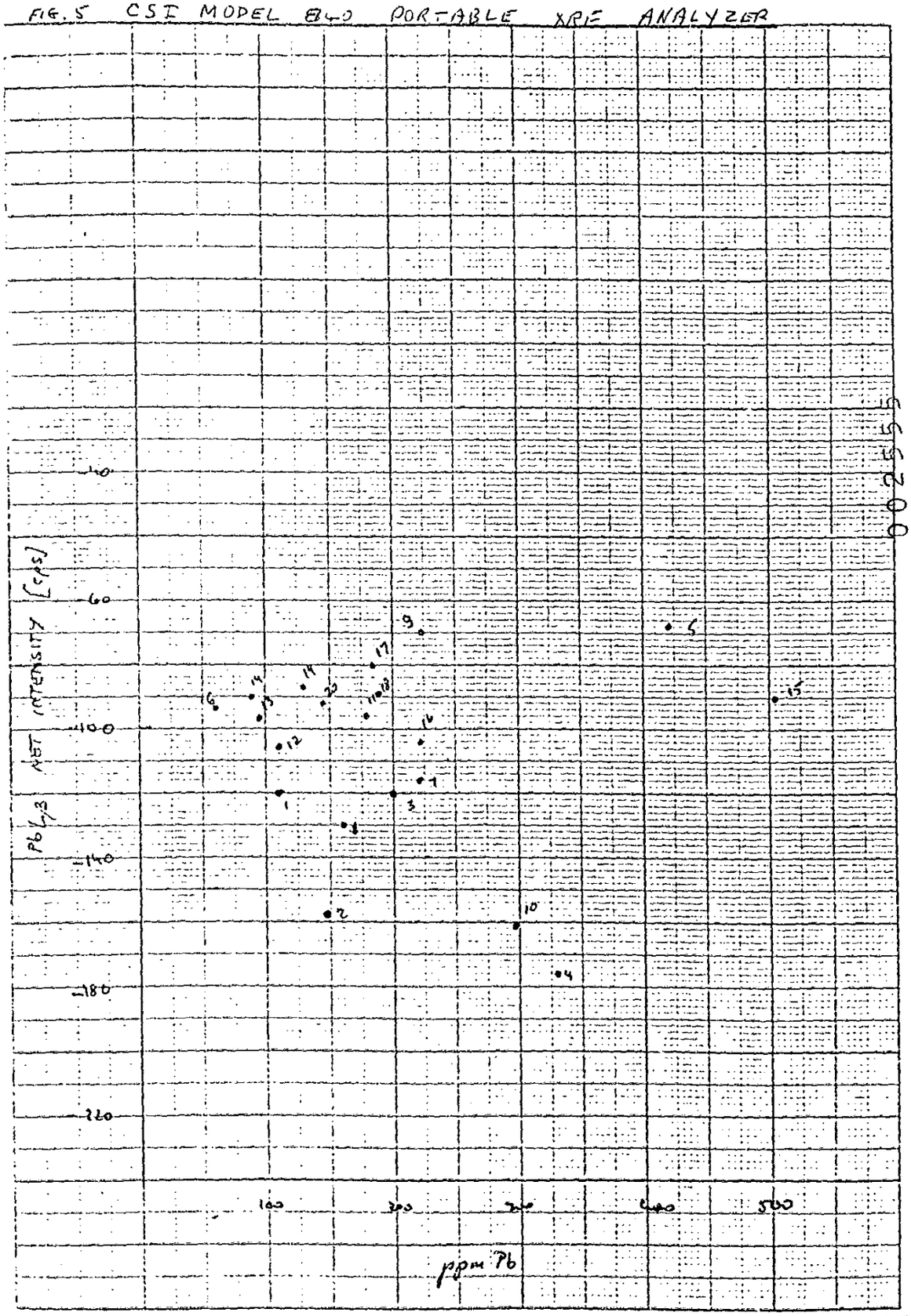
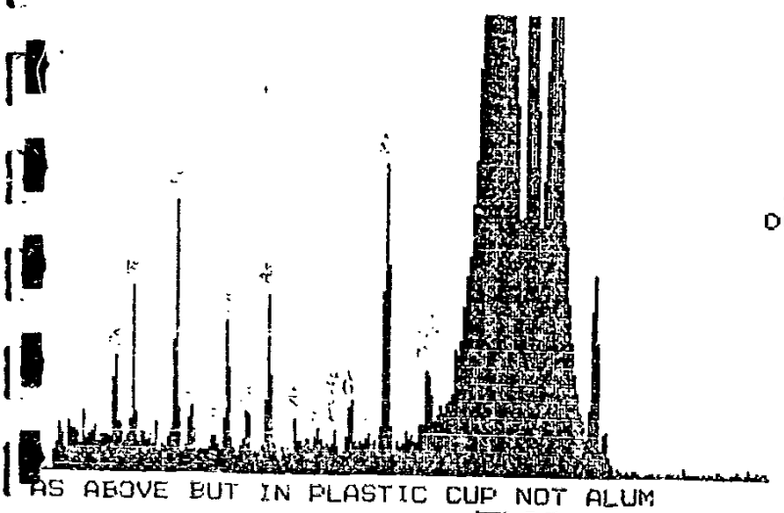
FIG. 5 CSI MODEL 840 PORTABLE XRF ANALYZER



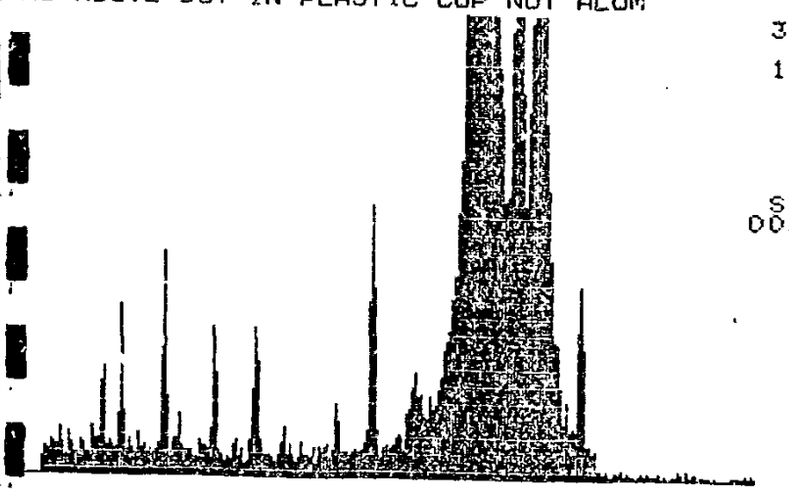
46 1242
20 X 20 TO THE INCH
KEUFFEL & ESSER CO. MADE IN U.S.A.

JPR#0
SOIL 1

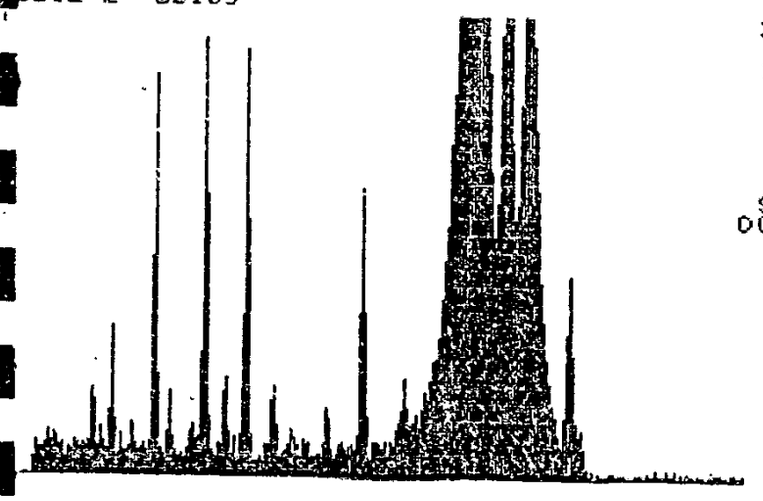


NOTE:
Ti peak is present mainly as constructional element (reference foil on the radioactive source).

AS ABOVE BUT IN PLASTIC CUP NOT ALUM



SOIL 2 CD109



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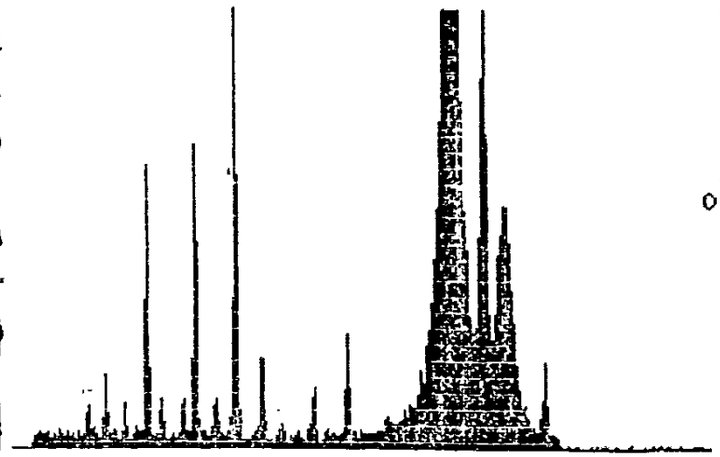
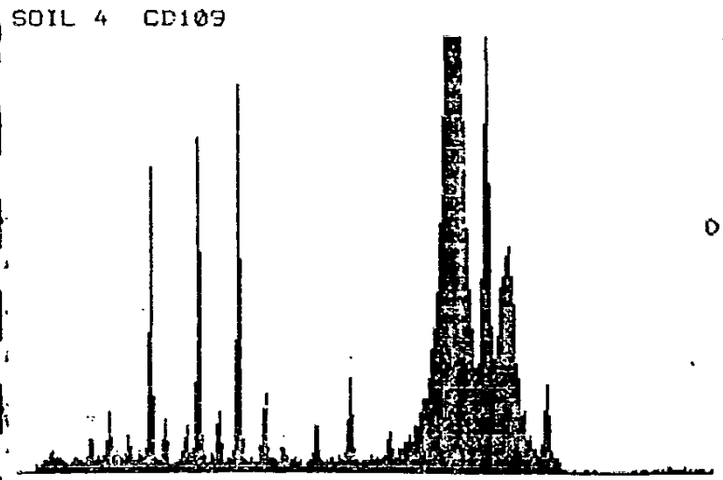
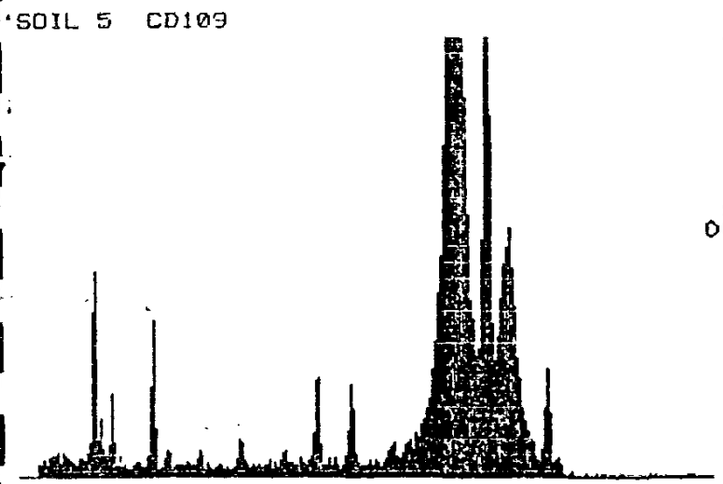
SOIL 3 CD109



SOIL 4 CD109



SOIL 5 CD109



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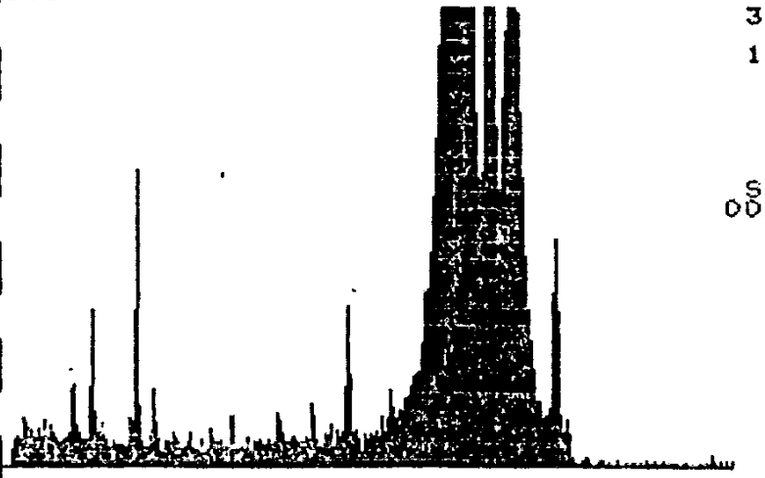
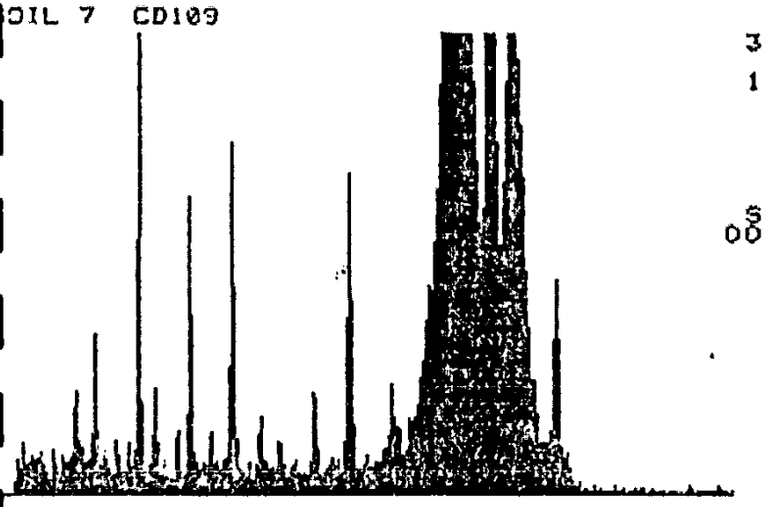
OIL 6 CD109



384
1/1

SEC
0020

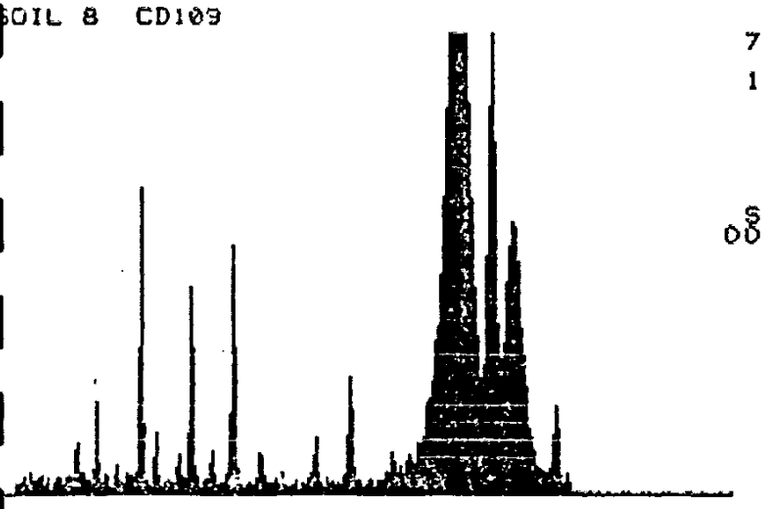
OIL 7 CD109



384
1/1

SEC
0020

OIL 8 CD109

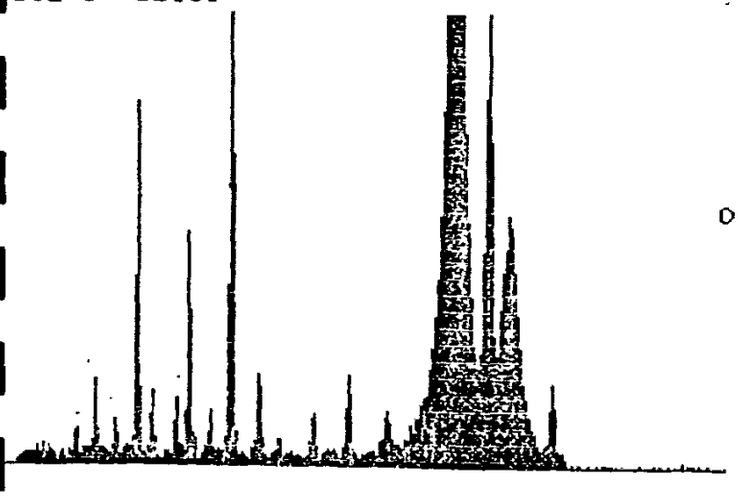


768
1/1

SEC
0020

002558

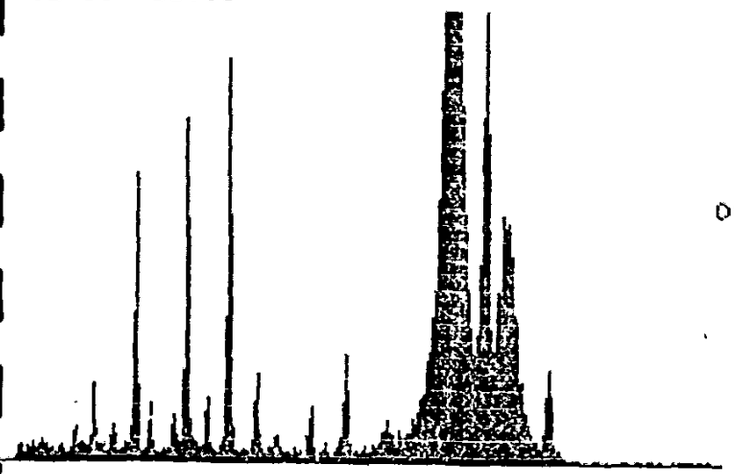
SOIL 9 CD109



768
1/1

SEC
0020

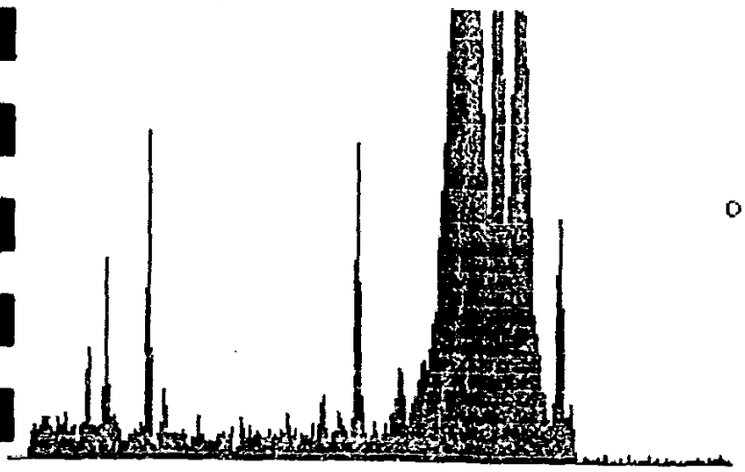
SOIL 10 CD109



768
1/1

SEC
0020

SOIL 11 CD109



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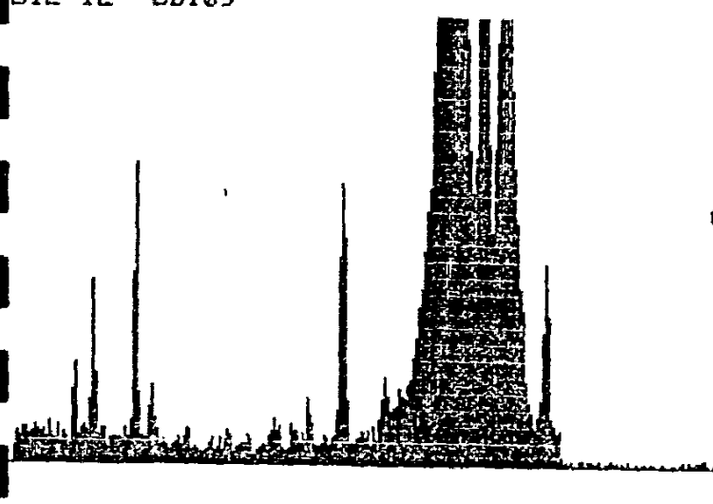
1/1

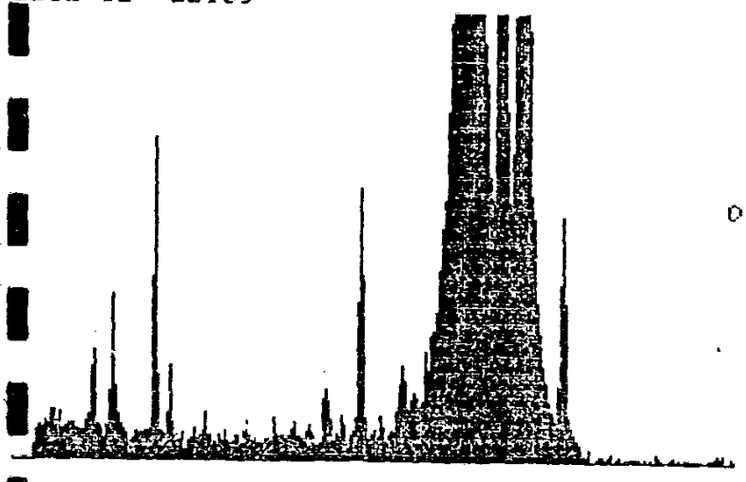
SEC
0020

002559

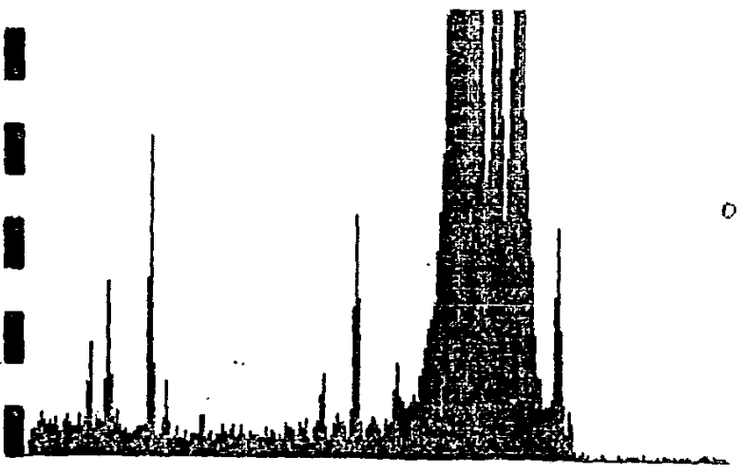
OIL 12 CD109



SOIL 13 CD109

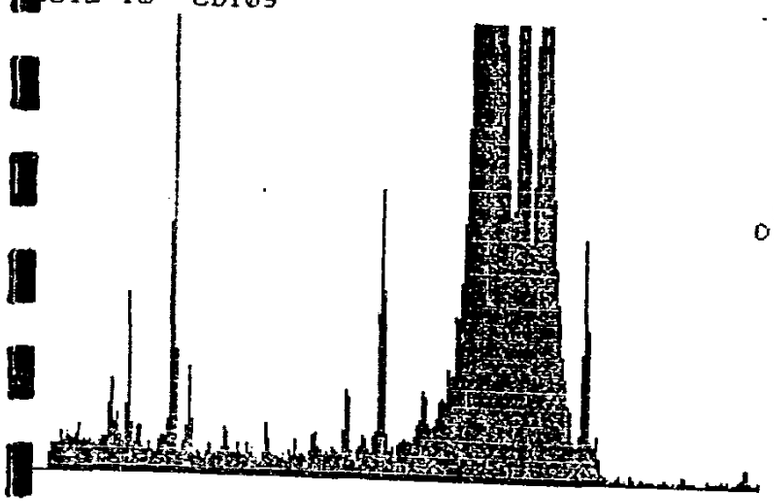


SOIL 14 CD109

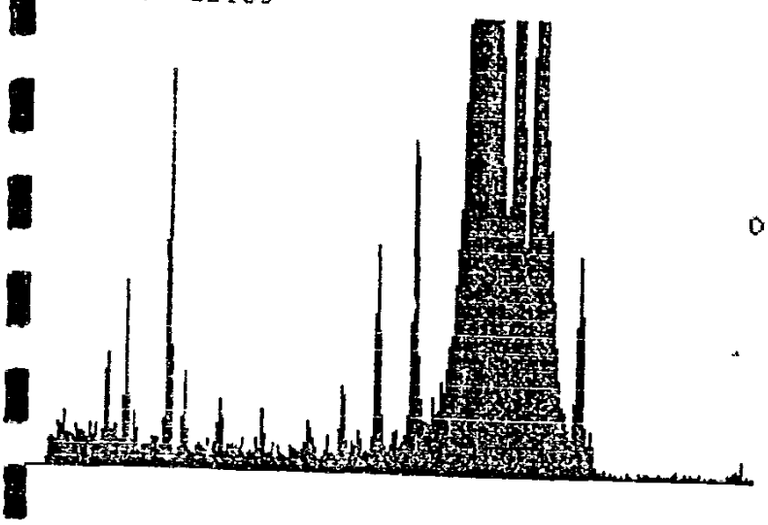


002560

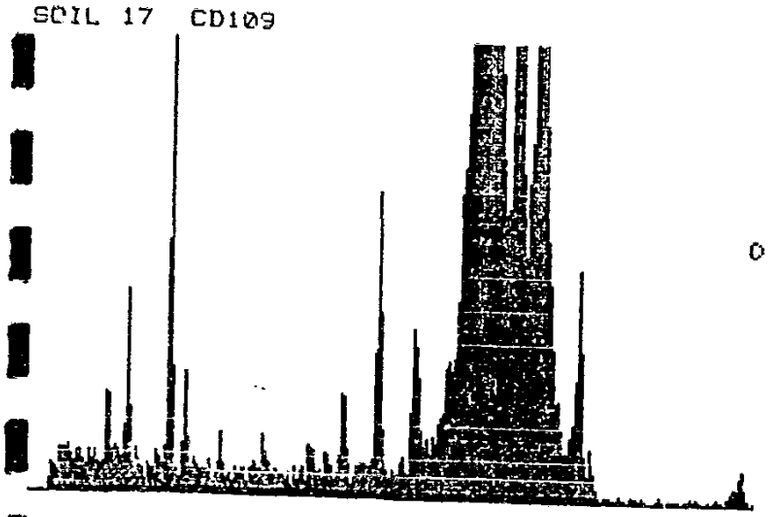
SOIL 15 CD109



SOIL 16 CD109



SOIL 17 CD109



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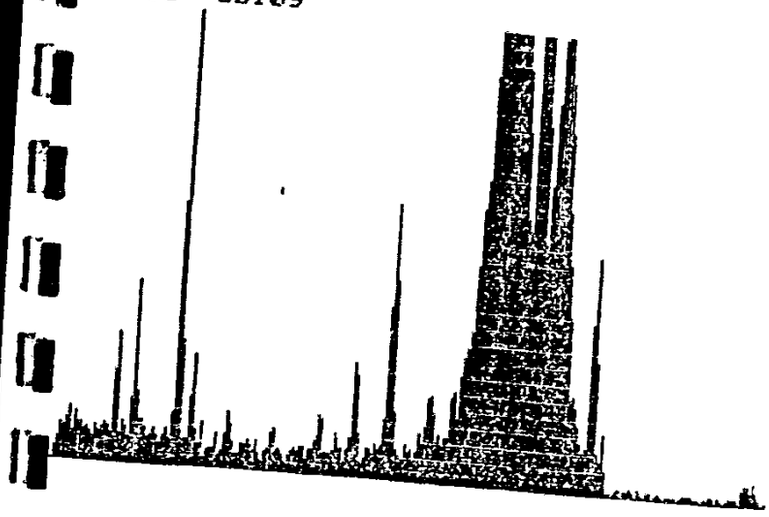
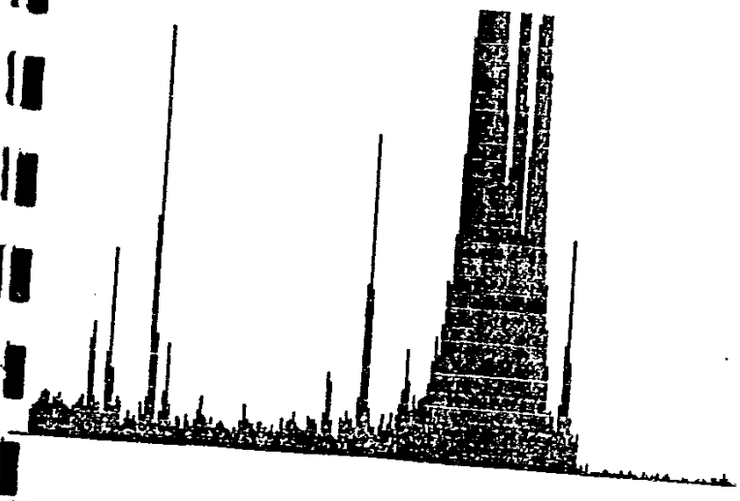
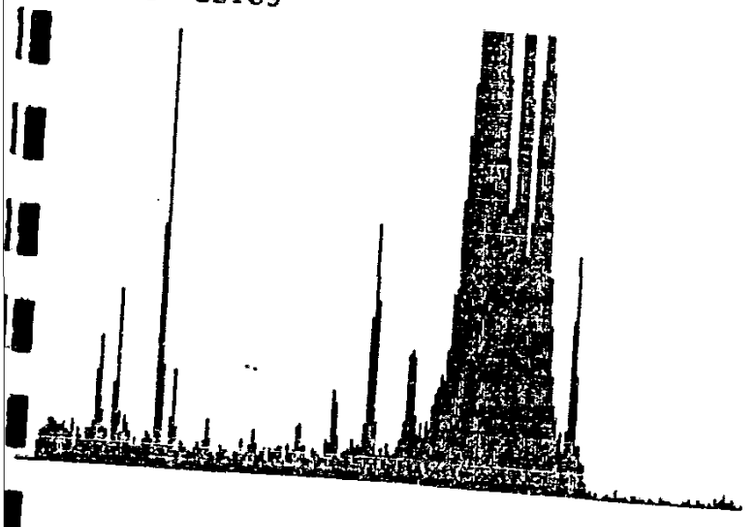
SOIL 18 CD109



SOIL 19 CD109



SOIL 20 CD109



002562

SPECTRIX

CORPORATION

November 22, 1985

Mr. Bill Tobin
Koppers Company, Inc.
c/o McBride-Ratcliff & Associates
P.O. Box 40850
Houston, Texas 77040

Dear Bill:

The concentration of all five (5) elements are so high that matrix spike recoveries are meaningless. The spike recovery control limit for all elements is 75% to 125% per CLP.

However, if the recovery in the sample is greater than four (4) times the spike level, the sample result is not considered out of control even if it does not fall within the control limit.

The duplicate analysis for all elements, except Arsenic (As) and percent solids determination, fall within the control limit of ± 20 percent per CLP.

Please contact me if you have any questions about this report.

Sincerely yours,

Ken U. Erondu
Co-Project Officer

KUE/sn
Enclosure
cc: George J. McGinley, Koppers, PA

3911 Fondren, Suite 100 Houston, Texas 77063-5821 (713) 266-6800

002563

REPORT TO Koppers Company, Inc.
c/o McBride-Ratcliff & Assoc.
P.O. Box 40850
Houston, Texas 77040
ATTEN Bill Tobin

CLIENT KOPPERS SAMPLES 22
COMPANY Koppers Company, Inc.
FACILITY McBride-Ratcliff & Assoc.

WORK ID Soil
TAKEN Client
TRANS Client
TYPE Soil
P.O. # 14-5-50106
INV. # 1019

PREPARED BY Spectrix Corporation
3911 Fondren
Suite 100
Houston, Texas 77063-5821
ATTEN Sample Control
PHONE (713) 266-6800

Ken U. Ende
CERTIFIED BY

CONTACT FOSTER

Please call the above number if you have any questions.
NOTE: ALL SAMPLES WILL BE RETAINED FOR 90 DAYS AND THEN DISCARDED. IF YOU WISH YOUR SAMPLES RETURNED TO YOUR FACILITY CALL SAMPLE CONTROL AT THE ABOVE NUMBER.

Previously Reported on 11/21/85.

SAMPLE IDENTIFICATION

01	SCJ-XC-01-01
02	SCK-XC-01-02
02	SCK-XC-01-02 Duplicate
02	SCK-XC-01-02 Spike
03	SCK-XC-02-01
04	SCK-XC-02-02
05	SCK-XC-03-01
06	SCK-XC-03-02
07	SCK-XC-04-01
08	SCK-XC-04-02
09	SCK-XC-05-01
10	SCK-XC-05-02
11	SCK-XC-06-01
12	SCK-XC-06-02
13	SCK-XC-07-01
14	SCK-XC-07-02
15	SCK-XC-08-01
16	SCK-XC-08-02
17	SCK-XC-09-01
18	SCK-XC-09-02
19	SCK-XC-10-01

TEST CODES and NAMES used on this report

AS S	Arsenic - Soil
CR S	Chromium (Soil)
CU S	Copper - Soil
PB S	Lead - Soil
PSOL	Percent Solid
ZN S	Zinc - Soil

SAMPLE IDENTIFICATION

21 Reagent Blank 1
22 Reagent Blank 2

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Received: 1_14/85 Results By[redacted]st

TEST CODE default units	Sample 01 (entered units)	Sample 02 (entered units)	Sample 03 (entered units)	Sample 04 (entered units)	Sample 05 (entered units)
AS_S mg/kg	1140 mg/kg dry wt.	1800 mg/kg dry wt.	2270 mg/kg dry wt.	3870 mg/kg dry wt.	1160 mg/kg dry wt.
		2840 mg/kg dry wt.			
		3250 mg/kg dry wt.			
CR_S mg/kg	591 mg/kg dry wt.	2100 mg/kg dry wt.	1400 mg/kg dry wt.	3660 mg/kg dry wt.	62.3 mg/kg dry wt.
		2380 mg/kg dry wt.			
		2870 mg/kg dry wt.			
CU_S mg/kg	177 mg/kg dry wt.	374 mg/kg dry wt.	417 mg/kg dry wt.	1220 mg/kg dry wt.	56.3 mg/kg dry wt.
		347 mg/kg dry wt.			
		614 mg/kg dry wt.			
PB_S mg/kg	110 mg/kg dry wt.	147 mg/kg dry wt.	200 mg/kg dry wt.	330 mg/kg dry wt.	422 mg/kg dry wt.
		158 mg/kg dry wt.			
		185 mg/kg dry wt.			
PSOL % solid	82.26	77.75	81.46	79.66	84.42
		N/A			

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		N/A			
ZN_S mg/kg	982 mg/kg dry wt.	4390 mg/kg dry wt.	2740 mg/kg dry wt.	7740 mg/kg dry wt.	191 mg/kg dry wt.
		5250 mg/kg dry wt.			
		5810 mg/kg dry wt.			

TEST CODE default units	Sample 06 (entered units)	Sample 07 (entered units)	Sample 08 (entered units)	Sample 09 (entered units)	Sample 10 (entered units)
AS_S mg/kg	27.7 mg/kg dry wt.	1730 mg/kg dry wt.	1930 mg/kg dry wt.	3510 mg/kg dry wt.	3680 mg/kg dry wt.
CR_S mg/kg	14.0 mg/kg dry wt.	1510 mg/kg dry wt.	653 mg/kg dry wt.	3280 mg/kg dry wt.	4010 mg/kg dry wt.
CU_S mg/kg	31.6 mg/kg dry wt.	549 mg/kg dry wt.	292 mg/kg dry wt.	989 mg/kg dry wt.	1110 mg/kg dry wt.
PB_S mg/kg	57.3 mg/kg dry wt.	221 mg/kg dry wt.	162 mg/kg dry wt.	234 mg/kg dry wt.	296 mg/kg dry wt.
PSOL % solid	85.53	71.56	77.61	75.77	71.10
ZN_S mg/kg	38.6 mg/kg dry wt.	2330 mg/kg dry wt.	978 mg/kg dry wt.	4900 mg/kg dry wt.	6900 mg/kg dry wt.

TEST CODE default units	Sample 11 (entered units)	Sample 12 (entered units)	Sample 13 (entered units)	Sample 14 (entered units)	Sample 15 (entered units)
AS_S mg/kg	21.1 mg/kg dry wt.	22.7 mg/kg dry wt.	18.7 mg/kg dry wt.	21.6 mg/kg dry wt.	19.4 mg/kg dry wt.

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CR_S mg/kg	28.1 mg/kg dry wt.	28.8 mg/kg dry wt.	37.8 mg/kg dry wt.	40.0 mg/kg dry wt.	<4.6 mg/kg dry wt.
CU_S mg/kg	<9 mg/kg dry wt.	33.6 mg/kg dry wt.	<9 mg/kg dry wt.	37.2 mg/kg dry wt.	116 mg/kg dry wt.
PB_S mg/kg	176 mg/kg dry wt.	112 mg/kg dry wt.	95.6 mg/kg dry wt.	90.8 mg/kg dry wt.	505 mg/kg dry wt.
PSOL % solid	92.53	92.11	88.60	90.04	87.73
ZN_S mg/kg	175 mg/kg dry wt.	154 mg/kg dry wt.	202 mg/kg dry wt.	251 mg/kg dry wt.	338 mg/kg dry wt.

TEST CODE default units	Sample 16 (entered units)	Sample 17 (entered units)	Sample 18 (entered units)	Sample 19 (entered units)	Sample 20 (entered units)
AS_S mg/kg	22.2 mg/kg dry wt.	17.7 mg/kg dry wt.	16.1 mg/kg dry wt.	15.3 mg/kg dry wt.	20.4 mg/kg dry wt.
CR_S mg/kg	21.0 mg/kg dry wt.	58.8 mg/kg dry wt.	173 mg/kg dry wt.	31.0 mg/kg dry wt.	25.8 mg/kg dry wt.
CU_S mg/kg	63.0 mg/kg dry wt.	<9 mg/kg dry wt.	44.7 mg/kg dry wt.	51.4 mg/kg dry wt.	44.3 mg/kg dry wt.
PB_S mg/kg	222 mg/kg dry wt.	184 mg/kg dry wt.	184 mg/kg dry wt.	129 mg/kg dry wt.	144 mg/kg dry wt.
PSOL % solid	85.66	89.34	89.46	88.57	89.06
ZN_S mg/kg	334 mg/kg dry wt.	427 mg/kg dry wt.	255 mg/kg dry wt.	264 mg/kg dry wt.	294 mg/kg dry wt.

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Received: 1 14/85

Results By [redacted]st

TEST CODE default units	Sample 21 (entered units)	Sample 22 (entered units)
AS_S mg/kg	<4	<4
CR_S mg/kg	<4	<4
CU_S mg/kg	<8	<8
PB_S mg/kg	<1.5	<1.5
PSOL % solid	N/A	N/A
ZN_S mg/kg	<5	<5

002569

[redacted] / [redacted] [redacted] [redacted] [redacted] SPECTRIX [redacted] [redacted] [redacted] REPORT [redacted] [redacted] [redacted] Work Order # 85-11-0[redacted] [redacted]

Received: 1 14/85

Results By [illegible]st

SAMPLE Sample Id	Test: AS S mg/kg	Test: CR S mg/kg	Test: CU S mg/kg	Test: PB S mg/kg	Test: PSOL % solid
01 SCJ-XC-01-01	1140 mg/kg dry wt.	591 mg/kg dry wt.	177 mg/kg dry wt.	110 mg/kg dry wt.	82.26
02 SCK-XC-01-02	1800 mg/kg dry wt.	2100 mg/kg dry wt.	374 mg/kg dry wt.	147 mg/kg dry wt.	77.75
	2840 mg/kg dry wt.	2380 mg/kg dry wt.	347 mg/kg dry wt.	158 mg/kg dry wt.	N/A
	3250 mg/kg dry wt.	2870 mg/kg dry wt.	614 mg/kg dry wt.	185 mg/kg dry wt.	N/A
03 SCK-XC-02-01	2270 mg/kg dry wt.	1400 mg/kg dry wt.	417 mg/kg dry wt.	200 mg/kg dry wt.	81.46
04 SCK-XC-02-02	3870 mg/kg dry wt.	3660 mg/kg dry wt.	1220 mg/kg dry wt.	330 mg/kg dry wt.	79.66
05 SCK-XC-03-01	1160 mg/kg dry wt.	62.3 mg/kg dry wt.	56.3 mg/kg dry wt.	422 mg/kg dry wt.	84.42
06 SCK-XC-03-02	27.7 mg/kg dry wt.	14.0 mg/kg dry wt.	31.6 mg/kg dry wt.	57.3 mg/kg dry wt.	85.53
07 SCK-XC-04-01	1730 mg/kg dry wt.	1510 mg/kg dry wt.	549 mg/kg dry wt.	221 mg/kg dry wt.	71.56
08 SCK-XC-04-02	1930 mg/kg dry wt.	653 mg/kg dry wt.	292 mg/kg dry wt.	162 mg/kg dry wt.	77.61
09 SCK-XC-05-01	3510 mg/kg dry wt.	3280 mg/kg dry wt.	989 mg/kg dry wt.	234 mg/kg dry wt.	75.77
10 SCK-XC-05-02	3680 mg/kg dry wt.	4010 mg/kg dry wt.	1110 mg/kg dry wt.	296 mg/kg dry wt.	71.10
11 SCK-XC-06-01	21.1 mg/kg dry wt.	28.1 mg/kg dry wt.	<9 mg/kg dry wt.	176 mg/kg dry wt.	92.53
12 SCK-XC-06-02	22.7 mg/kg dry wt.	28.8 mg/kg dry wt.	33.6 mg/kg dry wt.	112 mg/kg dry wt.	92.11

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13	18.7	37.8	<9	95.6	88.60
SCK-XC-07-01	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	
14	21.6	40.0	37.2	90.8	90.04
SCK-XC-07-02	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	
15	19.4	<4.6	116	505	87.73
SCK-XC-08-01	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	
16	22.2	21.0	63.0	222	85.66
SCK-XC-08-02	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	
17	17.7	58.8	<9	184	89.34
SCK-XC-09-01	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	
18	16.1	173	44.7	184	89.46
SCK-XC-09-02	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	
19	15.3	31.0	51.4	129	88.57
SCK-XC-10-01	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	
20	20.4	25.8	44.3	144	89.06
SCK-XC-10-02	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	
21	<4	<4	<8	<1.5	N/A
Reagent Blank 1					
22	<4	<4	<8	<1.5	N/A
Reagent Blank 2					

SAMPLE	Test: ZN S
Sample Id	mg/kg
01	982
SCJ-XC-01-01	mg/kg dry wt.
02	4390
SCK-XC-01-02	mg/kg dry wt.
	5250
	mg/kg dry wt.

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		5810
		mg/kg dry wt.
	03	2740
SCK-XC-02-01		mg/kg dry wt.
	04	7740
SCK-XC-02-02		mg/kg dry wt.
	05	191
SCK-XC-03-01		mg/kg dry wt.
	06	38.6
SCK-XC-03-02		mg/kg dry wt.
	07	2330
SCK-XC-04-01		mg/kg dry wt.
	08	978
SCK-XC-04-02		mg/kg dry wt.
	09	4900
SCK-XC-05-01		mg/kg dry wt.
	10	6900
SCK-XC-05-02		mg/kg dry wt.
	11	175
SCK-XC-06-01		mg/kg dry wt.
	12	154
SCK-XC-06-02		mg/kg dry wt.
	13	202
SCK-XC-07-01		mg/kg dry wt.
	14	251
SCK-XC-07-02		mg/kg dry wt.
	15	338
SCK-XC-08-01		mg/kg dry wt.
	16	334
SCK-XC-08-02		mg/kg dry wt.
	17	427
SCK-XC-09-01		mg/kg dry wt.

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Received: 14/85 Results By Test Continued From Above

18 SCK-XC-09-02	255 mg/kg dry wt.
19 SCK-XC-10-01	264 mg/kg dry wt.
20 SCK-XC-10-02	294 mg/kg dry wt.
21 Reagent Blank 1	<5
22 Reagent Blank 2	<5

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Page 11 SPECTRUM CORP. REPORT Work Order # 85-11-032
Received: 1 14/85 Results by Sample

SAMPLE ID SCJ-XC-01-01 SAMPLE # 01 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
1140	591	177	110	82.26	982
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-01-02 SAMPLE # 02 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
1800	2100	374	147	77.75	4390
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-01-02 Duplicate SAMPLE # 02 FRACTIONS: B
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
2840	2380	347	158	N/A	5250
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-01-02 Spike SAMPLE # 02 FRACTIONS: C
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
3250	2870	614	185	N/A	5810
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

002574

Received: 1 14/85 SPECTRIX CORP. REPORT Work Order # 85-11-032

Results by Sample

SAMPLE ID SCK-XC-02-01 SAMPLE # 03 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
2270	1400	417	200	81.46	2740
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-02-02 SAMPLE # 04 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
3870	3660	1220	330	79.66	7740
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-03-01 SAMPLE # 05 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
1160	62.3	56.3	422	84.42	191
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-03-02 SAMPLE # 06 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
27.7	14.0	31.6	57.3	65.53	38.6
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

002575

Received: 14/85 Results by ple

SAMPLE ID SCK-XC-04-01 SAMPLE # 07 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
1730	1510	549	221	71.56	2330
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-04-02 SAMPLE # 08 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
1930	653	292	162	77.61	978
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-05-01 SAMPLE # 09 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
3510	3280	989	234	75.77	4900
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-05-02 SAMPLE # 10 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
3680	4010	1110	296	71.10	6900
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

002576

Received: 14/85 Results by Sample

SAMPLE ID SCK-XC-06-01 SAMPLE # 11 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
21.1	28.1	<9	176	92.53	175
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-06-02 SAMPLE # 12 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
22.7	28.8	33.6	112	92.11	154
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-07-01 SAMPLE # 13 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
18.7	37.8	<9	95.6	88.60	202
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-07-02 SAMPLE # 14 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
21.6	40.0	37.2	90.8	90.04	251
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

002577

Received: 14/85 Results by ple

SAMPLE ID SCK-XC-08-01 SAMPLE # 15 FRACTIONS: A
Date & Time Collected not specified Category

AS S	CR S	CU S	PB S	PSOL	ZN S
19.4	<4.6	116	505	87.73	338
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-08-02 SAMPLE # 16 FRACTIONS: A
Date & Time Collected not specified Category

AS S	CR S	CU S	PB S	PSOL	ZN S
22.2	21.0	63.0	222	85.66	334
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-09-01 SAMPLE # 17 FRACTIONS: A
Date & Time Collected not specified Category

AS S	CR S	CU S	PB S	PSOL	ZN S
17.7	58.8	<9	184	89.34	427
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-09-02 SAMPLE # 18 FRACTIONS: A
Date & Time Collected not specified Category

AS S	CR S	CU S	PB S	PSOL	ZN S
16.1	173	44.7	184	89.46	255
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

002578

Received: [illegible] 14/85 Results by Sample

SAMPLE ID SCK-XC-10-01 SAMPLE # 19 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
15.3	31.0	51.4	129	88.57	264
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID SCK-XC-10-02 SAMPLE # 20 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
20.4	25.8	44.3	144	89.06	294
mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	% solid	mg/kg dry wt.

SAMPLE ID Reagent Blank 1 SAMPLE # 21 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
<4	<4	<8	<1.5	N/A	<5
mg/kg	mg/kg	mg/kg	mg/kg	% solid	mg/kg

SAMPLE ID Reagent Blank 2 SAMPLE # 22 FRACTIONS: A
Date & Time Collected not specified Category

AS_S	CR_S	CU_S	PB_S	PSOL	ZN_S
<4	<4	<8	<1.5	N/A	<5
mg/kg	mg/kg	mg/kg	mg/kg	% solid	mg/kg

002579

Q. C. REPORT

DUPLICATES

SPECTRIX CORPORATION
Date 11-21-85

Client Koppers
Client Sample No. SKC-XC-01-02
Lab Sample ID No. 85-11-032-028
Units mg/kg dry wt.

Matrix Soil

Compound	Sample(S)	Duplicate(D)	RPD[1]
Arsenic	1800	2840	44.8*
Chromium	2100	2380	12.5
Copper	374	347	7.49
Lead	147	158	7.21
Zinc	4390	5250	17.8

* Out of Control

[1] RPD = $[|S - D|/((S + D)/2)] \times 100$

NC - Non calculable RPD due to value(s) less than CRDL

002580

Q. C. REPORT

DUPLICATES

SPECTRIX CORPORATION
Date 11-21-85

Client Koppers
Client Sample No. SKC-XC-01-01
Lab Sample ID No. 85-11-032-01A
Units % Solid

Matrix Soil

Compound	Sample(S)	Duplicate(D)	RPD[1]
Percent Solid	82.96	81.56	1.70

002581

* Out of Control

[1] RPD = [|S - D|/((S + D)/2)] x 100

NC = Non calculable RPD due to value(s) less than CRDL

Q. C. REPORT

SPIKE SAMPLE RECOVERY

SPECTRIX CORPORATION
Date 11-2-85

Client Koppers
Client Sample No. SKC-XC-01-02
Lab Sample ID No. 85-11-032-02C
Units mg/kg dry wt.

Matrix Soil

Compound	Control Limit %R	Spiked Sample Result (SSR)	Sample Result (SR)	Spiked Added (SA)	%R
Arsenic	75-125	3250	1800	20.0	7200
Chromium	75-125	2870	2100	100	770
Copper	75-125	614	374	125	192
Lead	75-125	185	747	25	152
Zinc	75-125	5810	4390	250	568

[1] %R = [(SSR - SR)/SA] x 100

"R" - out of control

Comments: _____

002582

APPENDIX C

CALIBRATION NO. 2 LABORATORY
DATA

002583

002583

SPECTRIX

CORPORATION

DEC 16 1985

December 13, 1985

Mr. Bill Tobin
Koppers Company, Inc.
c/o McBride-Ratcliff & Associates
P.O. Box 40850
Houston, Texas 77040

Re: Spectrix Work Order # 85-12-027

Dear Bill:

Enclosed please find a data results package for the ten (10) soil samples that you recently sent to us for analysis for five (5) metals.

Here again, the EPA-CLP protocol was followed verbatum for these analyses.

Please feel free to call me if you should have any questions.

Sincerely yours,

Ken U. Erondu
Co-Project Officer

KUE/sn
Enclosures

002584

3911 Fondren, Suite 100 Houston, Texas 77063-5821 (713) 266-6800

eceived: 12[redacted]9/85 12/13/85 11:[redacted].14

REPORT TO
Koppers Company, Inc.
c/o McBride-Ratcliff & Assoc.
P.O. Box 40850
Houston, Texas 77040
ATTEN Bill Tobin

PREPARED BY
Spectrix Corporation
3911 Fondren
Suite 100
Houston, Texas 77063-5821
ATTEN Sample Control
PHONE (713) 266-6800

Ken U- [illegible]
CERTIFIED BY

CONTACT FOSTER

CLIENT KOPPERS SAMPLES 14
COMPANY Koppers Company, Inc.
FACILITY McBride-Ratcliff & Assoc.

Please call the above number if you have any questions.
NOTE: ALL SAMPLES WILL BE RETAINED FOR 90 DAYS AND THEN DISCARDED. IF YOU WISH YOUR SAMPLES RETURNED TO YOUR FACILITY CALL SAMPLE CONTROL AT THE ABOVE NUMBER.

WORK ID Soil
TAKEN Client
TRANS Client
TYPE Soil
P.O. # 14-5-50106
INVOICE under separate cover

SAMPLE IDENTIFICATION

01 SCK-XC-01-01A-1
02 SCK-XC-02-01A-3
03 SCK-XC-03-01A-5
04 SCK-XC-04-01A-7
05 SCK-XC-05-01A-9
06 SCK-XC-06-01A-11
07 SCK-XC-07-01A-13
08 SCK-08-01A-15
09 SCK-09-01A-17
10 SCK-10-01A-19
11 SCK-10-01A-19 DUPLICATE
12 SCK-09-01A-17 SPIKE
13 Reagent Blank 1
14 Reagent Blank 2

TEST CODES and NAMES used on this report

AS S	Arsenic - Soil
CR S	Chromium (Soil)
CU S	Copper - Soil
PB S	Lead - Soil
ZN S	Zinc - Soil

002585

eceived: 1[redacted]9/85

Results By Test

TEST CODE default units	Sample 01 (entered units)	Sample 02 (entered units)	Sample 03 (entered units)	Sample 04 (entered units)	Sample 05 (entered units)
AS_S mg/kg dry wt.	858	4430	184	1950	4480
CR_S mg/kg dry wt.	642	3810	144	1460	3670
CU_S mg/kg dry wt.	143	1030	150	496	1120
PB_S mg/kg dry wt.	105	316	294	216	291
ZN_S mg/kg dry wt.	1180	6510	320	2580	4370

TEST CODE default units	Sample 06 (entered units)	Sample 07 (entered units)	Sample 08 (entered units)	Sample 09 (entered units)	Sample 10 (entered units)
AS_S mg/kg dry wt.	24.3	20.3	16.9	17.8	19.0
CR_S mg/kg dry wt.	27.5	31.5	36.0	63.5	30.0
CU_S mg/kg dry wt.	40.5	24.5	59.5	56.0	52.5
PB_S mg/kg dry wt.	164	98.2	212	243	128
ZN_S mg/kg dry wt.	200	232	329	415	341

002586

Received: 12-09/85

Results By Test

TEST CODE default units	Sample 11 (entered units)	Sample 12 (entered units)	Sample 13 (entered units)	Sample 14 (entterred units)
AS_S mg/kg dry wt.	15.5	55.2	<4	<4
CR_S mg/kg dry wt.	34.0	276	<4	<4
CU_S mg/kg dry wt.	63.5	320	<8	<8
PB_S mg/kg dry wt.	130	732	<1.5	<1.5
ZN_S mg/kg dry wt.	344	998	<5	<5

002587

Q. C. REPORT

SPIKE SAMPLE RECOVERY

SPECTRIX CORPORATION
Date 12-13-85

Client Koppers
Client Sample No. SCK-09-01A-17
Lab Sample ID No. 85-12-027-12A
Units mg/kg dry wt.

Matrix Soil

Compound	Control Limit %R	Spiked Sample Result (SSR)	Sample Result (SR)	Spiked Added (SA)	%R
Arsenic	75-125	55.2	17.8	40.0	93.5
Chromium	75-125	276	63.5	200	106
Copper	75-125	320	56.0	250	106
Lead	75-125	732	243	500	97.8
Zinc	75-125	998	415	500	117

[1] %R = [(SSR - SR)/SA] x 100

"R" - out of control

Comments:

002588

Q. C. REPORT

DUPLICATES

SPECTRIX CORPORATION
Date 12-13-85

Client Koppers
Client Sample No. SCK-10-01A-19
Lab Sample ID No. 85-12-027-19
Units mg/kg dry wt.

Matrix Soil

Compound	Sample(S)	Duplicate(D)	RPD[1]
Arsenic	15.5	19.0	20.3*
Chromium	34.0	30.0	12.5
Copper	63.5	52.5	19.0
Lead	130	128	1.55
Zinc	344	341	0.88

* Out of Control

[1] RPD = $[|S - D|/((S + D)/2)] \times 100$

NC - Non calculable RPD due to value(s) less than CRDL

002589

eceived: 12 3/85 12/19/85 14:[redacted]20

REPORT TO
Koppers Company, Inc.
c/o McBride-Ratcliff & Assoc.
P.O. Box 40850
Houston, Texas 77040
ATTEN Bill Tobin

PREPARED BY
Spectrix Corporation
3911 Fondren
Suite 100
Houston, Texas 77063-5821
ATTEN Sample Control
PHONE (713) 266-6800

CDF
CERTIFIED BY

CONTACT FOSTER

CLIENT KOPPERS SAMPLES 5
COMPANY Koppers Company, Inc.
FACILITY McBride-Ratcliff & Assoc.

Please call the above number if you have any questions.
NOTE: ALL SAMPLES WILL BE RETAINED FOR 90 DAYS AND THEN DISCARDED. IF YOU WISH YOUR SAMPLES RETURNED TO YOUR FACILITY CALL SAMPLE CONTROL AT THE ABOVE NUMBER.

WORK ID Soil
TAKEN Client
TRANS Client
TYPE Soil
P.O. # 14-5-50106
INVOICE under separate cover

SAMPLE IDENTIFICATION

01	SCK-XC-08-01-1-21
02	SCK-XC-08-01-02-22 DUP.
02	SCK-XC-08-01-2-22
03	SCK-XC-08-01-3-23
03	SCK-XC-08-01-3-23 SPIKE
04	REAGENT BLANK 1
05	REAGENT BLANK 2

TEST CODES and NAMES used on this report

AS S	Arsenic - Soil
CR S	Chromium (Soil)
CU S	Copper - Soil
PB S	Lead - Soil
ZN S	Zinc - Soil

002590

Received: 12/ /85 Results By T

TEST CODE default units	Sample 01 (entered units)	Sample 02 (entered units)	Sample 03 (entered units)
AS_S mg/kg dry wt.	8.35	9.45	6.55
CR_S mg/kg dry wt.	27.5	32	50.5
CU_S mg/kg dry wt.	73	67	68.5
PB_S mg/kg dry wt.	1160	780	1730
ZN_S mg/kg dry wt.	324	316	336

002591

Q. C. REPORT

DUPLICATES

SPECTRIX CORPORATION
Date 12-19-85

Client Koppers
Client Sample No. SCK-XC-08-01-2-22
Lab Sample ID No. 8512045-02B
Units mg/kg dry wt.

Matrix Soil

Compound	Sample(S)	Duplicate(D)	RPD[1]
Arsenic	9.45	8.35	12.4
Chromium	32	39	19.7
Copper	67	70	4.38
Lead	780	815	4.39
Zinc	316	330	4.33

* Out of Control

[1] RPD = $[|S - D|/((S + D)/2)] \times 100$

NC - Non calculable RPD due to value(s) less than CRDL

002592

Q. C. REPORT

SPIKE SAMPLE RECOVERY

SPECTRIX CORPORATION
Date 12-19-85

Client Koppers
Client Sample No. SCK-XC-08-01-3-23
Lab Sample ID No. 8512045-03B
Units mg/kg dry wt.

Matrix Soil

Compound	Control Limit %R	Spiked Sample Result (SSR)	Sample Result (SR)	Spiked Added (SA)	%R
Arsenic	75 - 125%	19.8	6.55	20	66.2R
Chromium	75 - 125%	122	50.5	100	71.5R
Copper	75 - 125%	188	68.5	125	95.6
Lead	75 - 125%	1800	1730	250	30.0
Zinc	75 - 125%	500	336	250	65.6R

[1] %R = [(SSR - SR)/SA] x 100

"R" - out of control

Comments: Pb is not flagged because the sample result (SR) is greater than 5X spike added (SA).

002593

NOTES REFERRING TO 840 CALIBRATION

— We left your previous calibration intact in Model 1. That is if you measure the sample you will still get ppm readout in Model 1. The only thing changed is the calibration table which now belongs to Model 2.

— Our calibration is stored in Model 2. After we developed this calibration all samples were measured several times using both models (i.e. measurement is made in one model and after it is over you transfer "yourself" to another model and press the RECALC key to obtain the results with that another model).

— As you can see, the instrument is very stable, regardless of the model used. Also nonhomogeneity is not very large. It was determined by measuring ten different aliquots of the same sample and calculating std. dev. of the series corrected for statistical counting error. Example:

For As:

$$\sigma^2_{NONHOM.} = \sigma^2_{TOT} - \sigma^2_{STAT.}$$

$$\Rightarrow \quad = (53)^2 - (39)^2 = 35^2$$

This means, that you ~~shd~~ should be ~~easily~~ able to copy our results with ease!

As far as check-up samples are concerned I suggest No. 4 and 12.

Also I do not see the difference between ours and yours material.

— In the calibration you left in Model 1 we noticed no correlation between ppm Cr and Cr-intensity itself. You correlated ppm Cr with the product of Fe and Zn intensities. Similar thing occured for copper. This is not correct. You always have to have intensity of the element sought correlated with its percentage.

— All calibration data are enclosed. Also enclosed are printouts of spectra taken with your last 10 samples sent to us for qualitative scan. These ten samples have less Ca than the previous set. They appear to be of more sand-type matrix. Anyway I think that you can use the same model to measure them. Actually we did measure the [illegible]

READ BEFORE DOING ANYTHING WITH THE INSTRUMENT

ATTENTION!

HOW TO PREPARE INSTRUMENT TO OPERATION

- PLUG THE PROBE IN. CLOSE THE LID SO THE GAIN CONTROL IS DISABLED.
- TURN ON THE INSTRUMENT AND LEAVE FOR ABOUT 30 ~~[illegible]~~ MIN WITH PROBE LID CLOSED!
- OPEN THE LID AND LEAVE FOR ADDITIONAL 5 MIN.
- TAKE CHECK-UP SAMPLES AND MEASURE EACH FOR 200 SEC. COMPARE THE RESULTS WITH THOSE OBTAINED EARLIER (AT CSI). IF THEY ARE WITHIN ± 2 STANDARD DEV. OF COUNTING STATISTICS → OK. AND YOU CAN START THE WORK.

002595

– Remember, that whenever δ error is larger than the counting statistics (the one read out with STD), you have to use the value of δ when reporting the results.

That is all I can remember now. Call me if you need.

Sta

002596

10 different aliquots of sample #7 (CAL #4)

ASSAYS FORM

Sample type: _____

	Sample	1 As (model 2)	2 Cr	3 Cu	4 Pb	5 Zn	6 As (model 1)	7 Cr	8 Cu	9 Pb	10 Zn
		Assays (Chemical/X-met)									
our	# 4-1	1360±36.8	1720±54.4	466±20.7	196±52.4	2160±26.8	1700±25.7	900±11.5	232±5.04	503±39.7	1960±21.5
	-2	1460±38.0	1610±54.3	463±20.8	134±52.3	2700±27.0	1710±25.8	930±11.6	237±5.23	462±39.6	2010±21.7
	-3	1480±39.0	1610±54.1	431±20.6	75±52.5	2630±26.8	1760	903	223	453	1970
	-4	1390	1620	435	162	2670	1690	909	225	490	1970
	-5	1320	1620	446	211	2660	1660	922	225	538	1950
	-6	1410	1710	436	160	2770	1760	963	233	519	2060
	-7	1360	1740	452	197	2690	1720	912	231	541	1980
	-8	1410	1670	447	150	2790	1770	969	239	468	2080
	-9	1370	1540	429	128	2710	1680	952	226	473	2030
	-10	1470	1590	436	52.1	2790	1810	981	238	411	2100
	Mean	1403	1643	446	146	2707					
	±1SD	±53	±64	±13	±52	±58	1810				
Growth	error due to nonhomog	±35	±33	<±3	<±5	±51					
their	# 4										
	1	1420±39.1	1590±54.0	450±20.6	150±52.5	2640±26.8	1700±25.7	887±11.3	227±5.05	495±39.7	1940±21.5
	2	1430	1620	472	153	2600	1750	880	230	485	1720
	3	1360	1640	468	232	2500	1670	824	218	555	1820
	4	1230±35.4	1680±54.7	473±20.7	303±52.4	2650±26.8	1590	909	228	647	1950
	5	1320	1600	445	171	2670	1660	925	226	510	1990
	6										

002597

TITLE ASSAYS FORM

CIN

ASSAYS FORM Model 1 ([illegible])

Sample type: _____

CAL #

Sample	1 As	2 Ca	3 Cu	4 Cr	5 Fe	6 Pb	7 Rb	8 Zn	9 BS	10
	Assays (Chemical/X-met)									
1	43.4291	5.5291	12.0125	-23.0706	341.8744	4.3046	-72.3577	139.0576	830.7877	
2	237.5867	-128.7147	65.1315	-5.3925	735.7249	117.4402	-339.3613	513.409	844.6149	
3	57.6037	257.9050	14.4551	-30.4925	339.0672	-50.7327	37.6054	21.9186	713.5885	
4	25.1219	-32.9243	119.7663	-26.3333	622.2442	4.1558	-136.9978	177.4210	830.9133	
5	288.7948	-140.5354	100.0997	-13.4332	914.3141	70.7585	-242.2866	312.0750	831.8874	
6	19.1429	19.5447	3.5367	-42.8818	427.8382	-44.1319	26.0970	13.2386	839.3331	
7	22.4487	29.8210	0.6964	-36.0211	401.7653	-46.4986	26.3805	17.8949	830.5568	
8	1.7981	12.6539	3.8619	-52.7101	561.6336	-40.9957	27.8717	11.9254	827.2431	
9	5.3790	12.8305	4.3245	-53.6190	634.3136	-46.9586	25.6795	14.5493	803.4849	
10	6.0731	25.1126	1.4154	-47.4561	532.1079	-42.4203	19.7218	16.7833	804.9561	
11	-48.9486	5.8899	2.4933	-52.2489	544.3114	23.6242	26.3803	-6.2625	820.1287	
12	-22.1499	7.1685	-0.1006	-51.8703	542.4679	-5.9959	32.8731	3.2381	820.2342	
13	-63.9376	1.1167	0.9402	-52.2800	537.3447	46.9919	32.9885	-11.0658	811.9248	

TITLE ASSAYS FORM

002598

CIN Model 2

ASSAYS FORM

Sample type: As Pb? Zn, Pb? Pb Zn As

CAL# 200 SEC. Cu, alone? Cr alone?

Sample	Assays (Chemical/X-met)									
	1 Fe	2 Cu	3 As	4 Zb	5 Ca	6 Cr	7 Zn	8 Pb	9 Bs	10
1	373.8941	143 13.0231	658 37.3358	-61.3421	5.3260	642 6.6188	1180 96.5978	105 27.0980	805.80	
2	810.3892	1030 66.5063	4430 308.6679	-322.5297	-132.2779	3810 59.6323	6510 414.4386	316 135.5580	787.4550	
3	365.4795	150 6.2722	1160 33.9418	42.1108	258.0136	144 -2.8643	320 2.5306	294 -26.5714	684.1650	
4	580.7853	496 32.9583	1130 77.0416	-108.4461	-29.8088	1460 24.6629	2580 153.0333	216 43.7503	790.430	
5	989.5291	1120 80.5635	4480 381.6304	-229.9677	-142.0638	3670 67.1434	4370 253.9956	291 94.0177	778.520	
6	458.3067	40.5 4.4509	24.3 -6.0544	33.2650	23.9560	27.5 -10.777	200 -10.3353	164 -21.9014	803.855	
7	424.2496	24.5 5.4689	20.3 -2.4161	33.0467	31.3357	31.5 -2.5406	232 -4.6957	98.2 -22.1906	793.265	
8	603.6104	59.1 5.7356	16.9 -10.0914	35.9529	16.0353	36 -12.9984	329 -7.5878	212 -25.2225	785.6300	
9	689.1187	56 8.1907	17.8 -17.7911	31.654	12.8118	63.5 -13.7675	415 -9.7516	243 -24.113	766.820	
10	539.3062	52.5 5.1135	19 -15.7668	24.448	28.2981	30 -12.7356	341 -5.6682	128 -19.2306	774.580	
~~11~~	606.3765	73 5.3829	8.33 -41.8148	40.0544	3.9694	22.5 -15.5270	324 -30.3454	1160 31.8281	777.2950	
~~12~~	594.3169	67 5.110	9.45 -28.1343	40.1707	7.3576	32 -13.9620	316 -21.0378	780 9.0582	774.990	
~~13~~	595.0317	68.5 4.6516	9.89 -51.9137	53.7539	1.1814	70.6 -16.8958	512 -38.0699	1853 57.0062	755.080	
11	606.[illegible]	5.7604	[illegible]	42.1918	6.4211	-16.[illegible]	-30.3486	[illegible]	780.420	
12	[illegible]	1.3183	[illegible]	37.8872	7.6515	[illegible]	-20.[illegible]	[illegible]	777.[illegible]	
13	606.[illegible]	4.0[illegible]	[illegible]	48.5914	0.5846	-17.7578	[illegible]	[illegible]	773.8[illegible]	

TITLE ASSAYS FORM

Pb, Zn, As

002599

002599

[redacted] 200 sec. [redacted] Jan 13 [redacted] 1 [redacted]

ASSAYS FORM

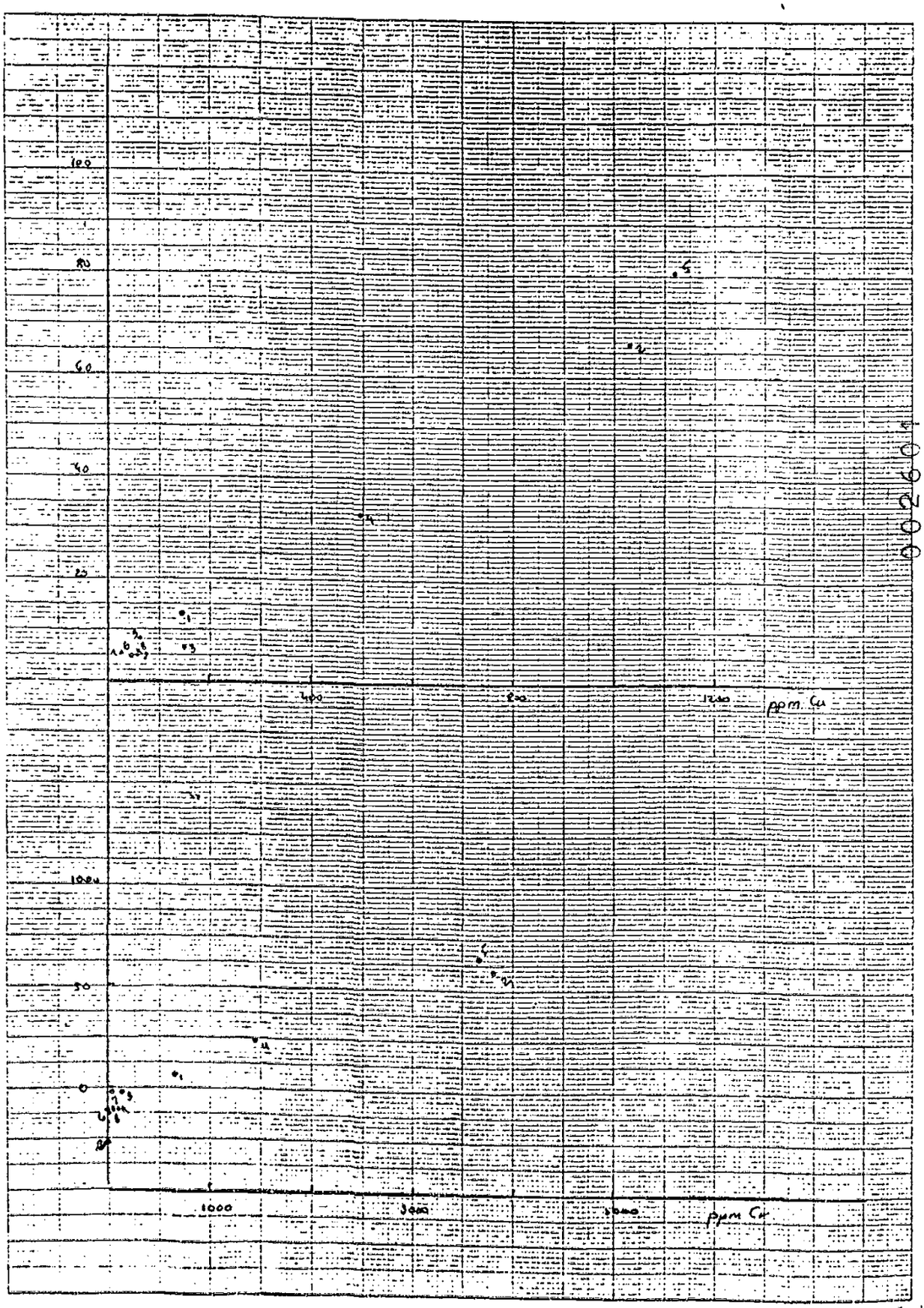
11 your last 10 samples

Sample type: KTX - SB - #

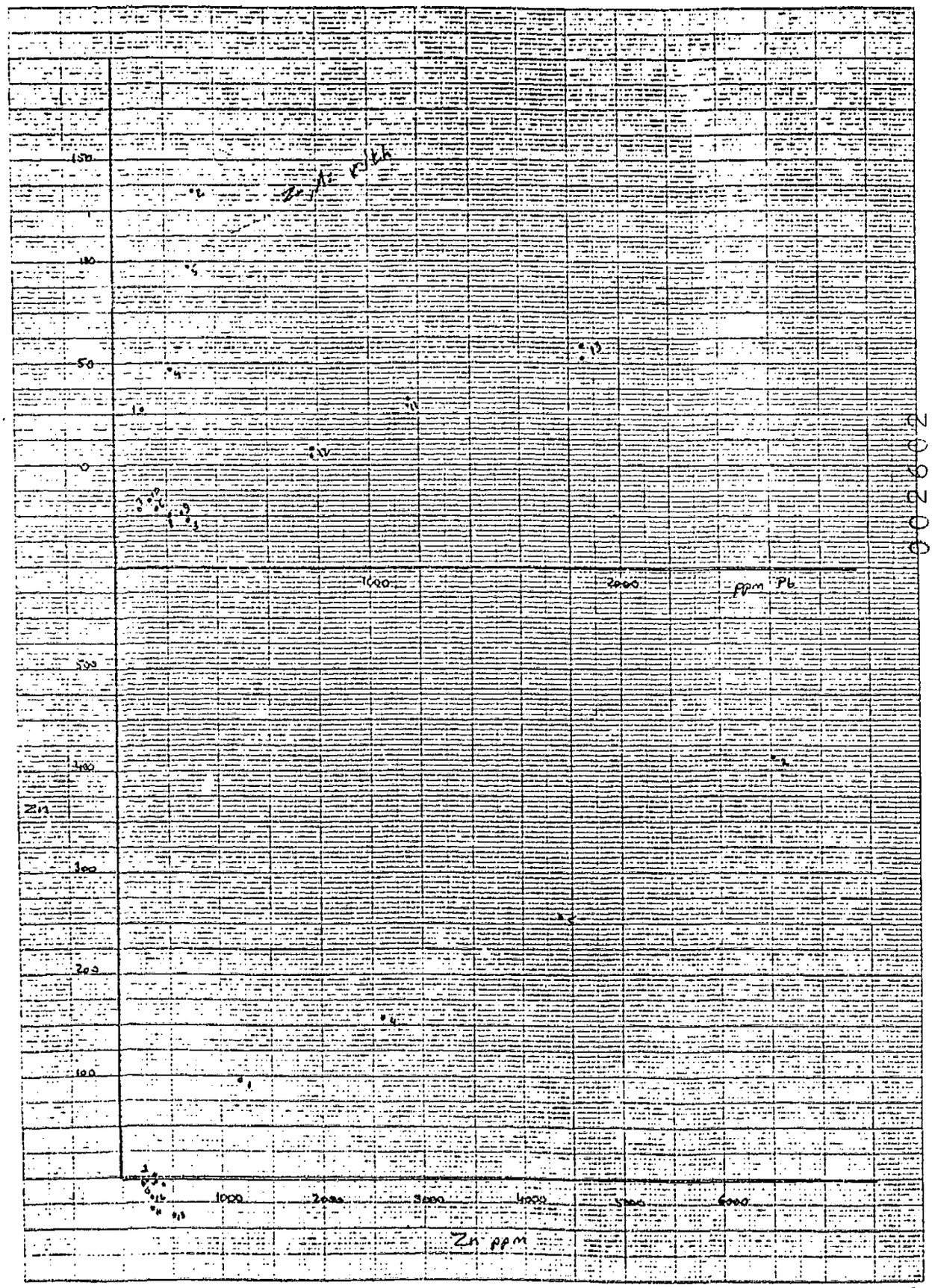
Sample	Model 2					Model 1				
	Assays (Chemical/X-met)									
	1 As	2 Cr	3 Cu	4 Pb	5 Zn	6 As	7 Cr	8 Cu	9 Pb	10 Zn
1	0 ± 65.9	0 ± 39.5	0 ± 14.7	194 ± 52.0	937 ± 18.7	146 ± 21.4	123 ± 2.21	68.5 ± 1.46	572 ± 38.4	153 ± 15.6
5	126 ± 64.0	0 ± 38.9	0 ± 13.1	369 ± 51.5	84.0 ± 15.2	156 ± 21.0	30.8 ± 1.66	65.5 ± .246	594 ± 38.1	0 ± 13.2
10	0 ± 85.7	44.6 ± 46.2	0 ± 17.3	359 ± 54.1	1950 ± 22.9	67.1 ± 23.0	422 ± 6.04	78.6 ± 3.57	719 ± 40.3	1120 ± 18.7
13	0 ± 80.3	0 ± 39.1	0 ± 18.7	248 ± 52.9	3490 ± 26.5	0 ± 22.1	33.2 ± 3.80	138 ± 7.88	781 ± 39.5	2050 ± 21.2
15	219 ± 61.4	0 ± 39.1	6.80 ± 13.2	316 ± 51.3	112 ± 15.4	199 ± 21.0	33.8 ± 1.80	65.4 ± 0.192	562 ± 38.0	0 ± 13.3
20	327 ± 64.3	0 ± 39.1	0 ± 13.1	238 ± 51.4	69.6 ± 15.3	229 ± 21.0	31.7 ± 1.83	65.7 ± .195	481 ± 37.9	0 ± 13.2
25	4.5 ± 57.6	0 ± 42.9	0 ± 13.4	270 ± 51.1	23.1 ± 15.2	26.5 ± 20.9	0 ± 3.75	66.8 ± .477	492 ± 37.8	0 ± 13.2
30	345 ± 65.0	0 ± 37.8	0 ± 12.9	271 ± 51.6	80.2 ± 15.2	253 ± 21.1	37.1 ± 1.32	65.8 ± .145	538 ± 38.1	0 ± 13.1
35	42.2 ± 59.3	0 ± 41.3	0 ± 13.4	379 ± 51.3	117 ± 15.5	88.7 ± 21.1	15.3 ± 2.88	65.8 ± .306	597 ± 38.0	0 ± 13.4
40	0 ± 59.9	0 ± 46.3	58.4 ± 16.9	574 ± 52.6	1630 ± 21.7	0 ± 22.3	393 ± 7.21	83.5 ± 2.37	909 ± 39.5	948 ± 17.8
CAL #			Stability check							
[illegible] 4	1390 ± 36.6	1720 ± 54.7	437 ± 20.8	132 ± 52.4	2790 ± 27.2	1750 ± 25.8	979 ± 11.9	236 ± 5.48	496 ± 39.7	2090 ± 21.8
[illegible] 12	163 ± 27.1	0 ± 48.8	66.1 ± 14.9	783 ± 52.2	363 ± 17.3	13.1 ± 22.4	0 ± 7.81	64.3 ± .696	1130 ± 39.3	109 ± 14.8

TITLE ASSAYS FORM

002600



46 1512
10 X 10 TO THE CENTIMETER
KEUFFEL & ESSER CO.



46 1512
18 X 10 TO THE CENTIMETER
KEUFFEL & ESSER CO. MADE IN U.S.A.

002603

INSTRUMENT CALIBRATION (Operating instructions, sections and)

Date: _____ Measured by: _____

Gain control initialization, (INI)

INI	Probe:	Probe:	Probe:
Gain Channel			

Pure element calibration, CPU ~~(PUR)~~

MODEL: 2 MTIME: _____ s Name: Pb/Waste

PUR				LIM			
Pure sample	Probe number	Peak channel	Fwhm	Lower limit	Upper limit	Norm. c.rate	Norm. factor
1. Fe	3			92	108		
2. Cu				117	130		
3. As				156	176		
4. Rb				211	229		
5. Ca				53	65		
6. Cr				77	92		
7. Zn				131	146		
8. Pb				185	210		
9. BS				255	255		
10.							

002604

TITLE INSTRUMENT CALIBRATION FORM

Model 2

REGRESSION FOR As

Delete 4

R = 1.00 S = 32.0 F(3,9) = 10392.371

NO.	ASSAY	ESTIM	RESID.	ST. RES
1		852.1		
2		4323.0		
3		97.149		
5		4588.3		
6		-3.801		
7		100.2		
8		3.518		
9		-41.595		
10		-10.732		
11		-10.404		
12		43.172		
13		29.378		

INTERC. = 240.6

SL 1 (As) = 85.567802 T = 12.24

SL 2 (Pb) = .0670132 T = 14.14

SL 3 (Pb/As) = -5871.9453 T = -10.84

SL 4 ( ) = T =

002605

002605

REGRESSION FOR Cr on Cr, Fe Model 2

R = 0.991 S = 204 F(2, 11) = 269.993

NO.	ASSAY	ESTIM	RESID.	ST. RES
1		475.0		
2		3382.8		
3		123.2		
4		1614.8		
5		3949.8		
6		-18.135		
7		291.2		
8		100.1		
9		191.8		
10		18.177		
11		-51.333		
12		-62.546		
13		-100.1		

INTERC. = -236.11522

SL. 1 (Cr) = 4.092254 T = 15.36

SL. 2 (Fe) = 1.44189 T = 3.24

SL. 3 (..) = T =

SL. 4 (..) = T =

002606

Model 2

REGRESSION FOR Cu

R = .994 S = 41.9 F(1,11) = 986.548

NO.	ASSAY	ESTIM	RESID.	ST. RES
1		176.9		
2		967.2		
3		77.156		
4		471.5		
5		1175.0		
6		50.244		
7		65.287		
8		69.228		
9		105.5		
10		60.035		
11		69.594		
12		48.283		
13		44.544		

INTERC = -15.527801

SL 1 (Cu) = 14.777069 T = 31.41

SL 2 ( ) = T =

SL 3 ( ) = T =

SL 4 ( ) = T =

002607

Model 2

REGRESSION FOR Pb

R = 0.959 S = 162 F(2,10) = 56.633

NO.	ASSAY	ESTIM	RESID.	ST. RES
1		351.0		
2		124.2		
3		41.956		
4		265.3		
5		469.0		
6		209.2		
7		166.5		
8		132.9		
9		166.7		
10		224.6		
11		1262.5		
12		761.3		
13		1685.1		

INTERC = 522.2

SL 1 (Pb) = 17.40217 T = 10.18

SL 2 (Zn) = -6.66488 T = -10.28

SL 3 (__) = T =

SL 4 (__) = T =

002608

REGRESSION FOR Zn Model 2

Delete 1

R = 1.00 S = 56.3 F(3, 8) = 4903.811

NO.	ASSAY	ESTIM	RESID.	ST. RES
2		646.32		
3		281.9		
4		2641.1		
5		4407.4		
6		214.9		
7		259.1		
8		312.9		
9		352.2		
10		337.3		
11		391.1		
12		348.6		
13		434.5		

INTERC. = 186.44604

SL. 1 (Zn) = 11.92(10) T = 52.41

SL. 2 (Pb) = 6.118395 T = 9.13

SL. 3 (Fe) = 0.6233118 T = 4.03

SL. 4 ( ) = T =

002609

Meas. 200 sec (1)

Tim 139 7/13/85 2 pm

TITLE ASSAYS FORM

ASSAYS FORM

Sample type: _____

CAL # Model 2 Model 1

Sample	Assays (Chemical/X-met)									
	1 As	2 Cr	3 Cu	4 Pb	5 Zn	6 As	7 Cr	8 Cu	9 Pb	10 Zn
1	855±37.1	553±46.8	136±17.5	307±51.3	1780±22.8	1050±23.6	404±6.41	104±2.75	649±38.5	1020±18.6
2	4390±69.0	3210±65.0	941±28.2	96.3±56.3	6560±38.5	5510±33.5	3310±24.2	1030±18.7	425±44.0	5170±30.2
3	87.0±16.7	185±42.9	73.1±13.8	6.39±48.6	285±16.2	153±20.7	52.2±4.41	65.8±0.127	517±35.8	0±13.8
4	1390±36.6	1680±54.4	443±20.7	151±52.4	2740±27.1	1740±25.8	943±11.6	234±5.33	507±39.7	2040±21.7
5	4700±79.1	3820±68.5	1060±26.8	444±56.3	4460±35.0	5840±33.9	2400±24.9	633±10.2	429±44.1	3680±27.7
6	69.7±35.3	0±45.9	68.9±14.2	174±50.6	178±16.2	0±20.9	0±5.66	64.3±0.026	515±37.5	0±13.7
7	98.6±31.3	205±45.7	44.8±14.1	160±50.2	262±16.4	33.3±20.8	21.4±5.30	65.2±.199	512±37.2	0±14.0
8	0±29.9	233±49.1	69.0±14.9	147±50.7	326±17.1	0±21.2	0±7.87	64.8±.324	510±37.6	275±14.6
9	0±23.6	176±51.1	114±15.2	104±50.1	319±17.3	0±21.0	0±9.03	63.7±0.493	434±37.2	388±14.7
10	25.0±24.8	0±47.3	82.1±14.6	160±49.9	310±16.8	0±20.8	6.15±6.84	64.7±0.307	499±37.0	173±14.3
11	39.8±28.2	0±49.3	69.9±15.1	1170±53.4	386±17.5	103±23.3	0±8.11	63.9±0.932	1490±40.5	35±18.0
12	39.0±27.4	0±49.0	69.3±14.9	744±52.2	337±17.2	345±22.4	0±7.75	64.2±0.698	1100±39.3	96.2±14.7
13	39.2±29.0	0±49.3	35.7±15.1	1760±54.9	476±17.9	188±24.4	0±8.21	66.4±1.12	2060±42.1	0±15.3

002610

002610

1/13/95 4pm

Meas 200 sec (2)

ASSAYS FORM

Sample type: _____

CAL # Model 2 Model 1

Sample	Assays (Chemical/X-met)									
	1 As	2 Cr	3 Cu	4 Pb	5 Zn	6 As	7 Cr	8 Cu	9 Pb	10 Zn
1	892±37.2	583±46.8	14.2±17.5	246±51.4	1750±22.8	1070±23.6	400±6.36	105±2.92	614±38.5	1010±18.5
2	4140±70.5	3180±65.0	924±28.2	453±46.3	6570±38.5	4170±33.6	3340±2.44	1020±18.8	386±44.0	5200±30.3
3	77.7±17.0	252±43.1	75.2±13.8	0±48.5	258±16.1	445±20.6	46.2±4.40	65.6±0.143	481±35.6	0±13.7
4	1410±37.9	1560±54.2	460±20.7	128±52.3	2670±26.7	1720±25.7	920±11.6	233±5.14	489±39.5	1990±21.6
5	4760±79.1	3860±68.6	1140±26.9	415±56.0	4440±35.1	5810±33.8	2390±24.9	670±10.2	358±43.7	3670±27.7
6	47.3±33.8	622±46.2	24.9±14.1	214±50.6	263±16.3	0±21.0	0.408±5.73	65.4±0.273	562±37.5	8.18±14.0
7	750±30.8	219±45.7	62.1±14.2	202±50.4	259±16.4	163±20.9	166±5.30	64.9±.261	567±37.4	0±14.0
8	0±29.7	26.7±49.2	82.7±14.9	226±50.7	309±17.0	0±21.2	0±7.87	64.3±.433	572±37.7	244±14.5
9	0±22.3	211±51.1	90.5±15.2	180±50.2	384±17.4	0±21.0	0±9.06	64.5±0.376	516±37.3	416±14.8
10	164±26.6	0±47.3	60.5±14.6	141±49.7	336±16.8	0±20.7	19.3±6.82	65.1±0.204	460±36.9	195±14.3
11	35.5±28.6	0±49.2	84.6±15.1	116±53.5	377±17.6	101±23.4	0±8.09	63.1±0.970	1090±40.6	26.5±15.0
12	935±26.7	0±49.0	60.1±14.8	81.4±52.3	350±17.2	403±22.5	0±7.78	64.5±.709	1160±39.4	90.8±14.7
13	447±27.6	0±49.2	68.9±15.1	1780±54.9	452±17.8	169±24.4	0±8.19	63.9±1.23	2080±42.1	0±15.3

TITLE ASSAYS FORM

002611

Meas. 200 ppc (3)

Grain 137

ASSAYS FORM

Sample type: _____

CAL #	Model 2					Model 1				
	Assays (Chemical/X-met)									
Sample	1 As	2 Cr	3 Cu	4 Pb	5 Zn	6 As	7 Cr	8 Cu	9 Pb	10 Zn
1	958 ± 36.2	672 ± 47.0	198 ± 17.7	164 ± 41.4	1910 ± 22.8	1130 ± 23.6	396 ± 6.34	115 ± 2.86	151 ± 38.5	1000 ± 18.5
2	11400 ± 68.8	3380 ± 65.3	987 ± 28.2	116 ± 16.5	6540 ± 38.5	5490 ± 33.6	3300 ± 24.2	1060 ± 18.6	450 ± 44.1	4150 ± 303
3	103 ± 15.9	186 ± 43.0	78.0 ± 13.8	42.2 ± 48.4	290 ± 16.2	408 ± 20.6	48.2 ± 4.46	45.6 ± 1.41	537 ± 35.8	0 ± 13.8
4	1390 ± 36.9	1620 ± 54.2	448 ± 20.6	147 ± 52.5	2670 ± 26.9	1720 ± 25.9	910 ± 11.5	229 ± 5.12	508 ± 39.7	1980 ± 21.1
5	2430 ± 77.4	3940 ± 68.6	1190 ± 27.0	550 ± 56.2	4440 ± 35.1	5980 ± 33.8	2350 ± 24.9	687 ± 10.1	475 ± 44.1	3630 ± 27.7
6	76.7 ± 34.7	0 ± 45.9	59.5 ± 14.2	203 ± 50.5	194 ± 16.2	97.7 ± 21.0	0 ± 5.60	64.6 ± 0.913	532 ± 39.4	0 ± 13.9
7	16.2 ± 30.9	292 ± 45.8	38.4 ± 14.0	301 ± 50.4	273 ± 16.3	0 ± 20.9	11.4 ± 5.24	65.1 ± .210	641 ± 37.4	0 ± 13.9
8	0 ± 29.9	103 ± 49.3	86.2 ± 14.9	190 ± 50.9	302 ± 17.0	0 ± 21.2	0 ± 7.8	64.3 ± .425	537 ± 37.1	241 ± 14.5
9	0 ± 22.9	315 ± 51.3	115 ± 15.3	169 ± 50.1	352 ± 17.4	0 ± 21.0	0 ± 9.02	63.7 ± .471	485 ± 37.2	372 ± 14.7
10	0 ± 25.4	570 ± 47.5	106 ± 14.7	264 ± 49.8	291 ± 16.7	0 ± 20.7	0 ± 6.99	63.8 ± .448	552 ± 37.0	128 ± 14.2
11	130 ± 28.4	608 ± 49.6	76.1 ± 15.1	1230 ± 53.5	393 ± 17.6	80.1 ± 23.4	0 ± 8.09	63.5 ± .969	1550 ± 40.7	210 ± 15.0
12	31.3 ± 25.9	35.8 ± 49.0	73.4 ± 14.9	785 ± 52.3	370 ± 17.3	23.8 ± 22.5	0 ± 7.74	63.9 ± .667	1150 ± 39.4	106 ± 14.8
13	41.5 ± 28.7	0 ± 49.4	68.2 ± 15.2	1790 ± 54.7	445 ± 17.8	187 ± 24.4	0 ± 8.18	64.0 ± 1.24	2050 ± 42.0	0 ± 15.2

TITLE ASSAYS FORM

002612

APPENDIX D

CSI QUALITATIVE SCAN

TEXARKANA SOIL SAMPLES

002613

COLUMBIA SCIENTIFIC INDUSTRIES CORPORATION

ANALYTICAL REPORT NO. 516

CUSTOMER: Koppers Co., Inc.; c/o McBride-Ratcliff
P.O. Box 40850
Houston, TX 77040 ATTN: Bill Tobin; Paul Wild

CUSTOMER'S PURCHASE ORDER NO. Phone-Verbal DATE 12-22-85

ARD QUOTATION NO. ..... DATE .....

DATE REQUIRED ASAP

SPECIMENS:

QUANTITY 10 DATE RECEIVED 01-10-86

DESCRIPTION:

DEPOSIT ON FILTER	☐	SOLID	☐
LOOSE POWDER	☒	LIQUID	☐
MERCURY VAPOR (CARTRIDGE)	☐	OTHER (SEE REMARKS)	☐

REMARKS .....

ANALYSES: QUALITATIVE SCAN ☒

NO. OF SPECIMENS 10

QUANTITATIVE DETERMINATION ☐

ELEMENTS TO BE DETERMINED All major and minor elements traceable

STANDARDS USED CSI standards

NO. OF SPECIMENS 10

RESULTS: SEE ATTACHED TABLES

JOB COMPLETED 01-14-86

SPECIMENS RETURNED X

SPECIMENS STORED AT CSI .....

SPECIMENS DESTROYED .....

10 samples x $60.00 ea. = $600.00

INTERNAL USE ONLY

W.O. NO. .....

AMOUNT $600.00

SIGNED .....

FOR DIRECTOR, MULTIELEMENT ANALYSIS SERVICES
Stanislaw Piórek, Ph.D.

"Columbia Scientific Industries makes a reasonable effort to supply complete and accurate analytical data but does not assume responsibility for actions (loss or damages) arising from the results of analyses, nor liability for errors or omissions."

Telephone AC 512-258-5191, TWX 910-874-1364, 11950 Jollyville Road, P.O. Box 203190, Austin, Texas 78720

COLUMBIA SCIENTIFIC INDUSTRIES

RESULTS OF QUALITATIVE SCAN

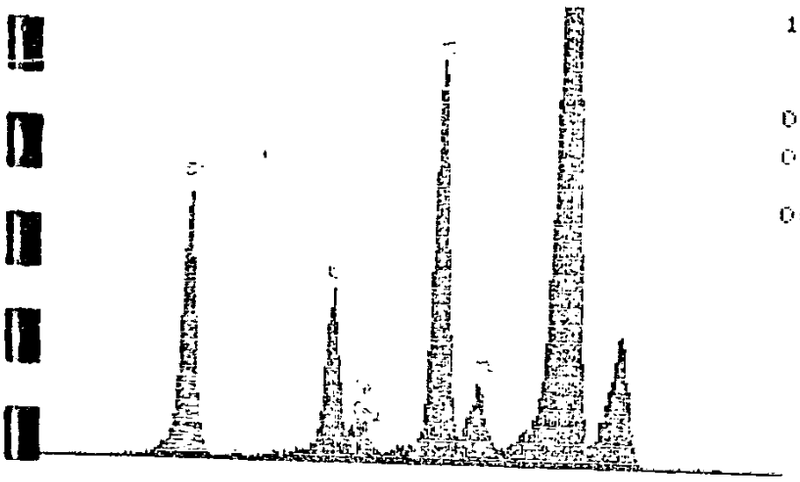
SAMPLE NUMBER	ELEMENTS FOUND		
	MAJOR	MINOR	TRACE
KTX SB 1	Si,K,Ti,Fe,Zn,Zr,Ba,La	Ca,Cu,Sb,Cd	
KTX SB 5	Si,K,Ti,Fe,Zr,Ba,La	Ca,Sb,Cd	
KTX SB 10	Si,Cl,K,Ti,Fe,Zn,Zr,Ba,La	Ca,S,Cu,As,Pb,Sb,Cd	
KTX SB 13	Si,K,Ti,Fe,Zn,Zr,Ba,La	S,Ca,As,Pb,Sb,Cd	
KTX SB 15	Si,K,Ti,Fe,Zr,Ba,La	Ca,Zn,As,Pb,Sb,Cd	
KTX SB 20	Si,K,Ti,Fe,Zr,Ba,La	Ca,Sb,Cd	
KTX SB 25	Si,K,Ti,Fe,Zr,Ba,La	Sb,Cd	
KTX SB 30	Si,K,Ti,Fe,Zr,Ba,La	Sb,Cd	
KTX SB 35	Si,K,Ti,Fe,Zr,Ba,La	Ca,Zn,Sb,Cd	
KTX SB 40	Si,K,Ca,Ti,Fe,Zn,Zr,Ba,La	S,As,Pb,Sb,Cd	

NOTES: See the spectra attached

"Columbia Scientific Industries makes a reasonable effort to supply complete and accurate analytical data but does not assume responsibility for actions (loss or damages) arising from the results of analyses, nor liability for errors or omissions."

Telephone AC 512-258-5191, 11950 Jollyville Road, P.O. Box 9908, Austin, Texas 78766

KTX SB 1 FE 010986



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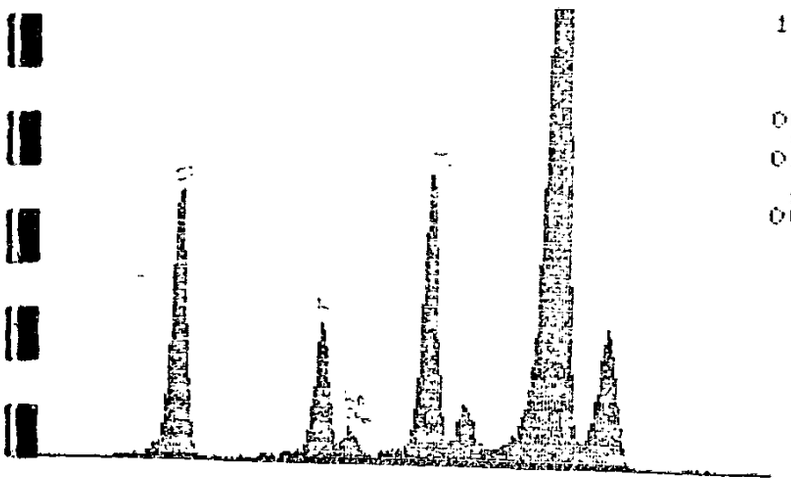

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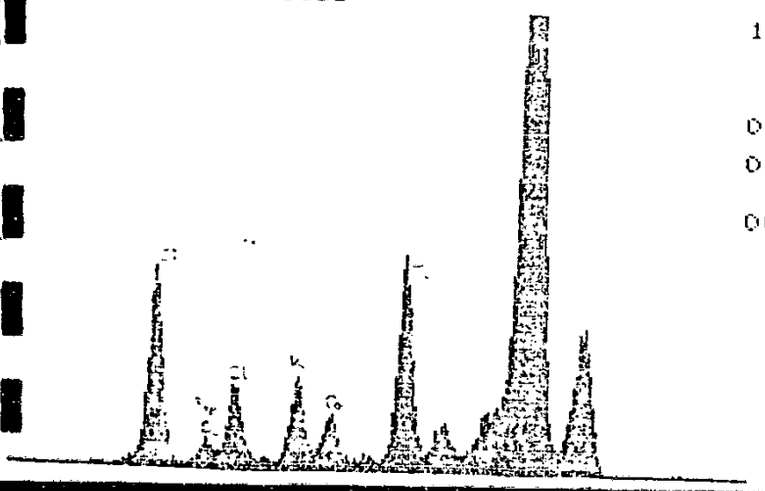

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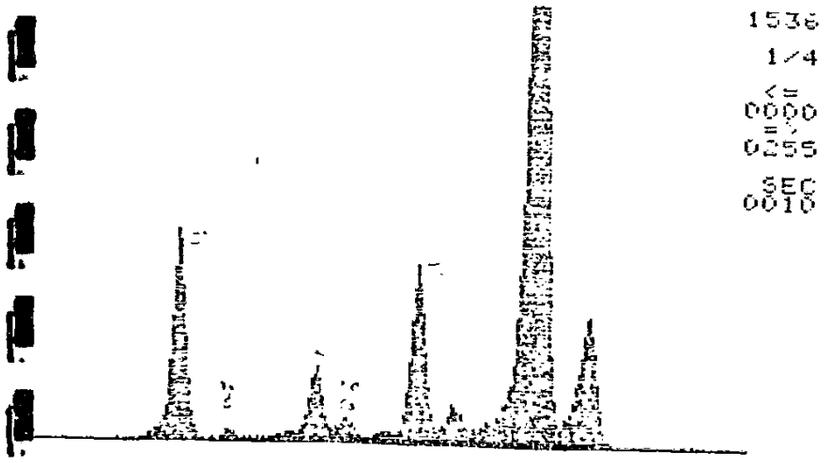

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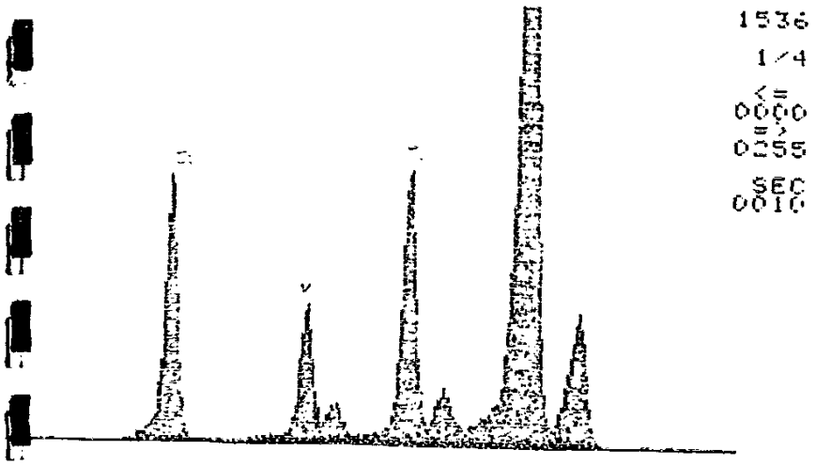

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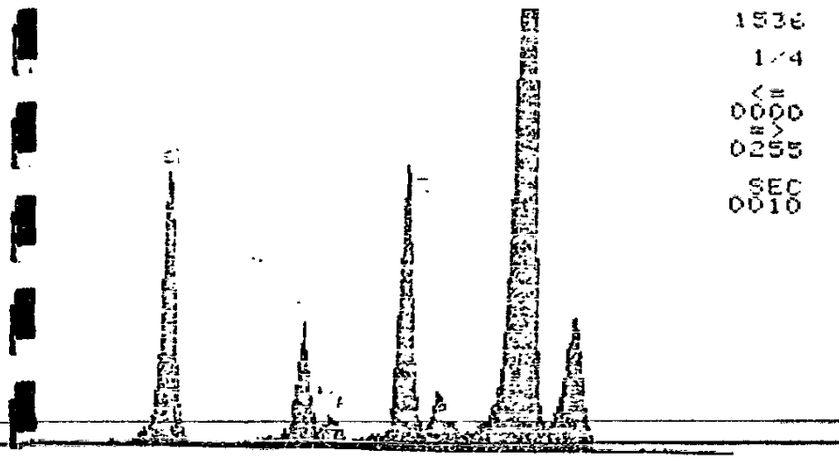

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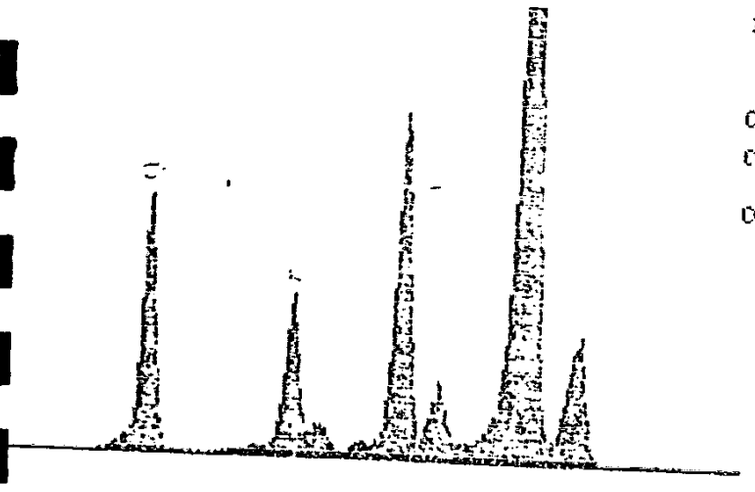

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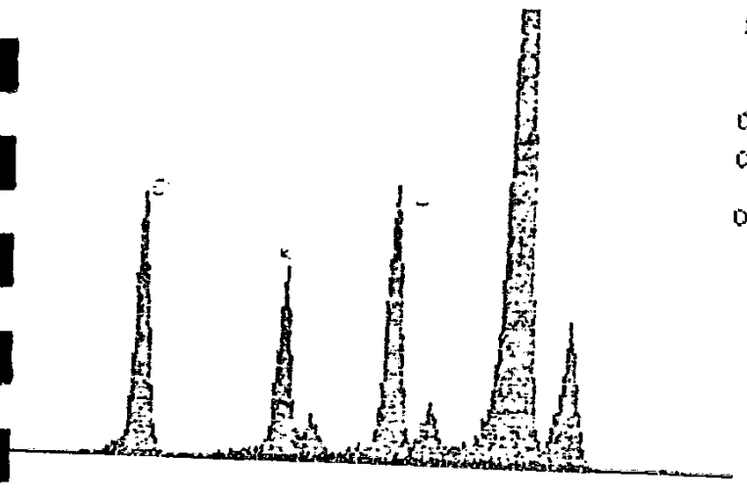

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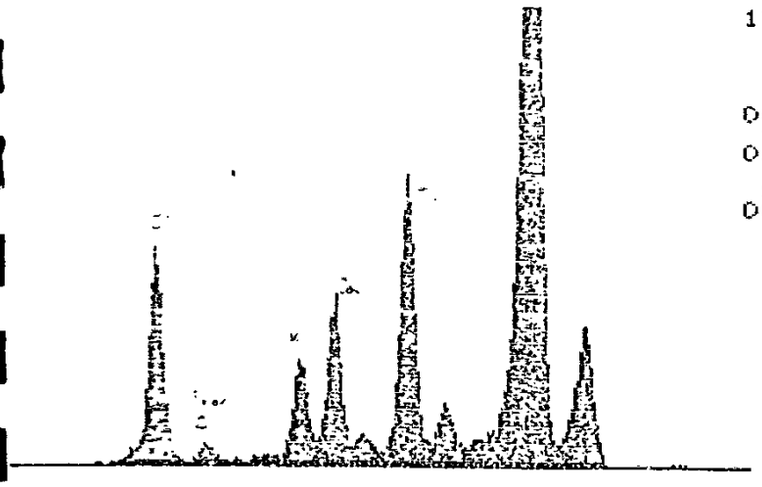

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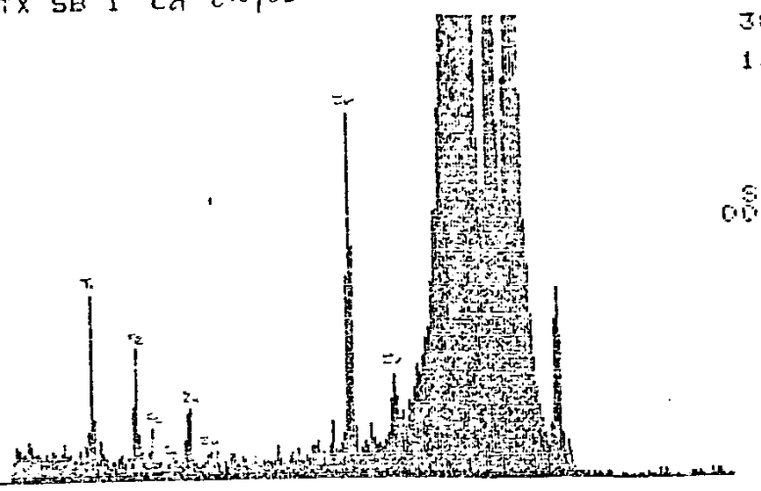

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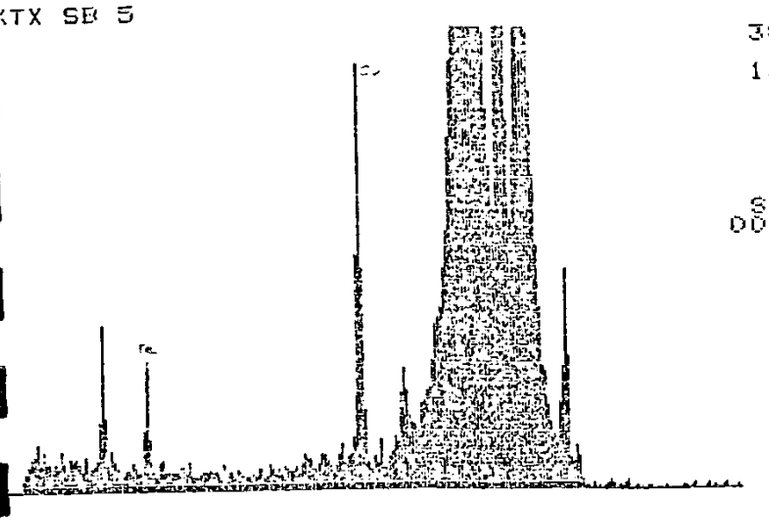

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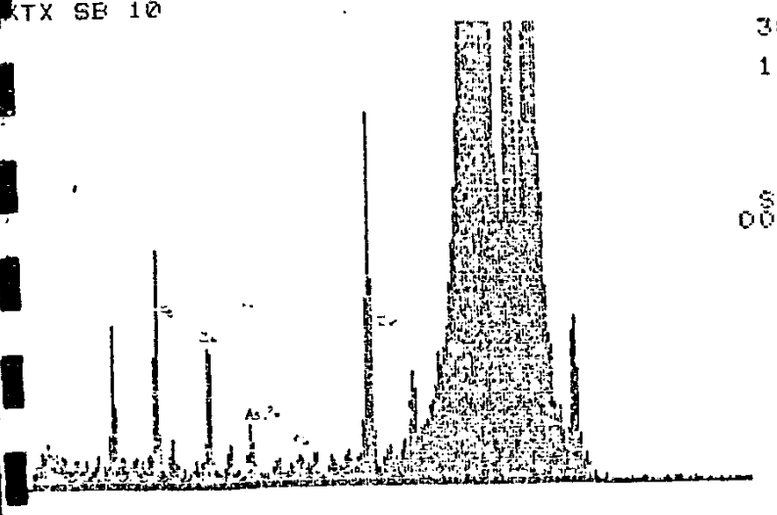

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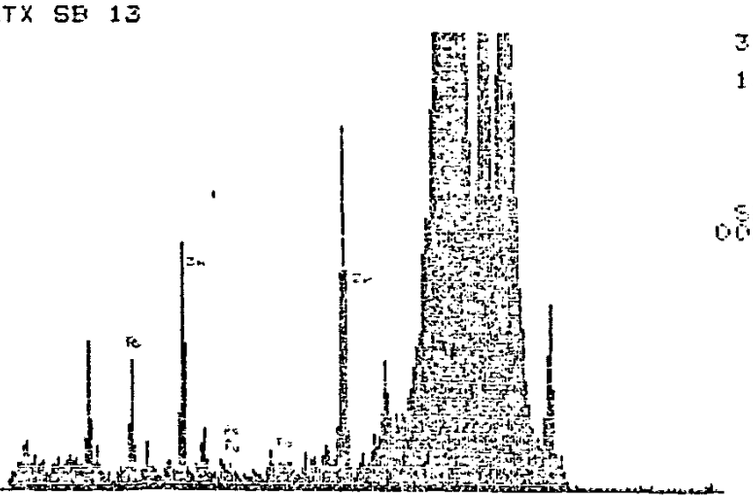

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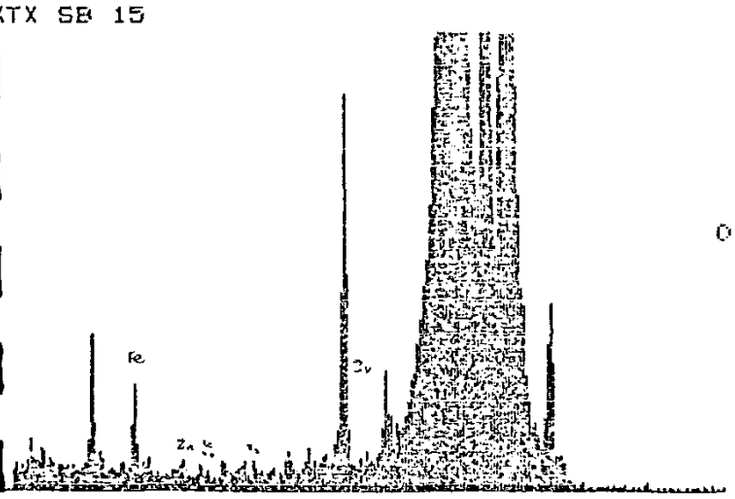

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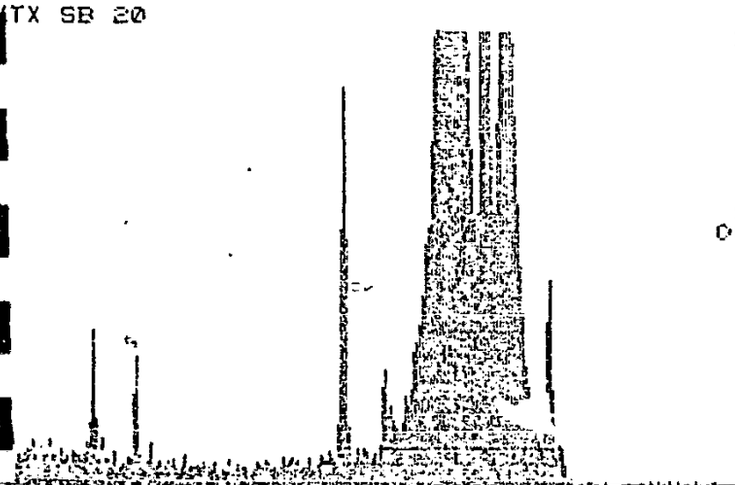

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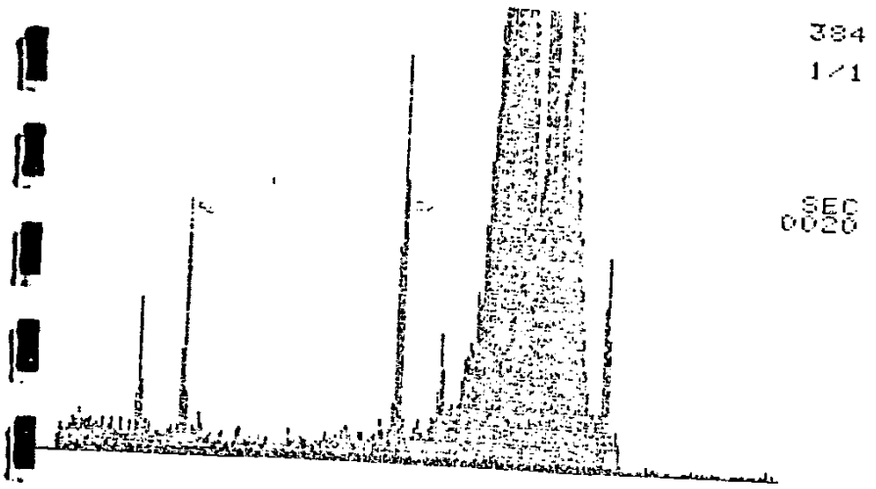

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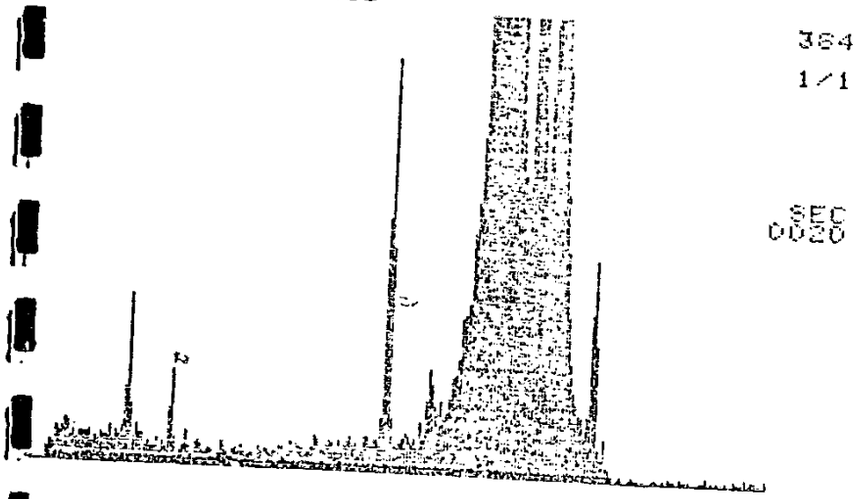

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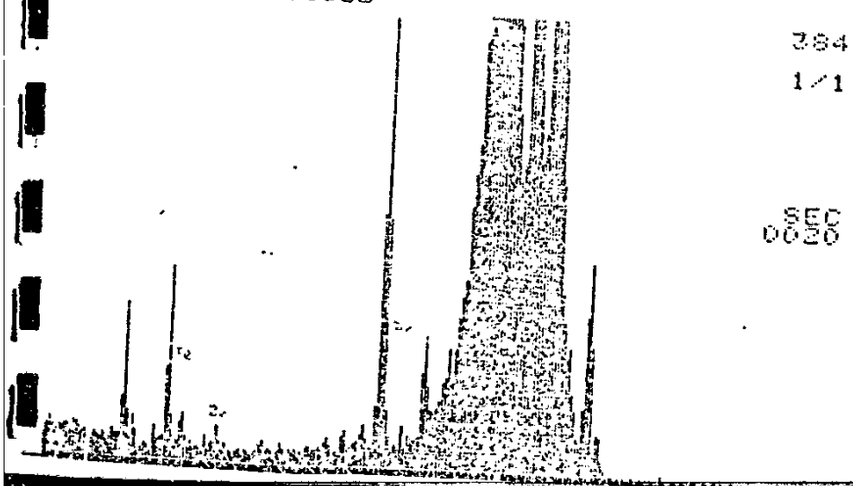

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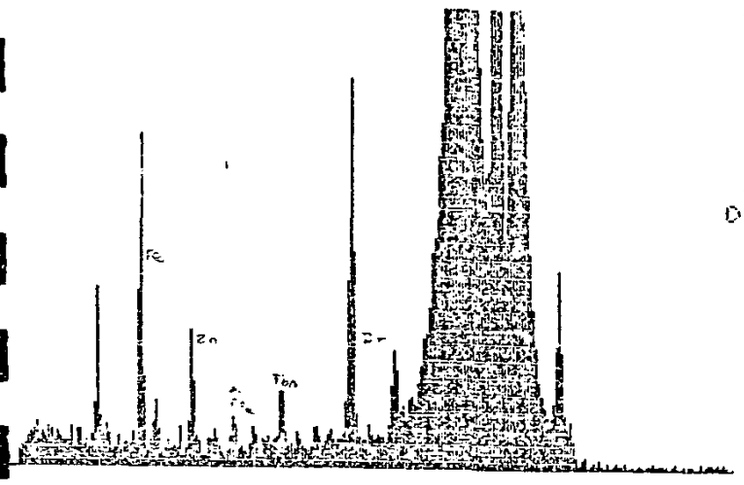

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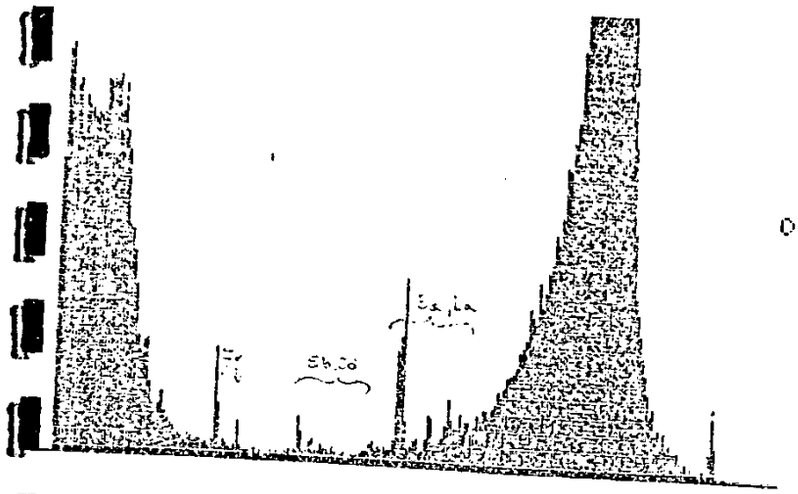

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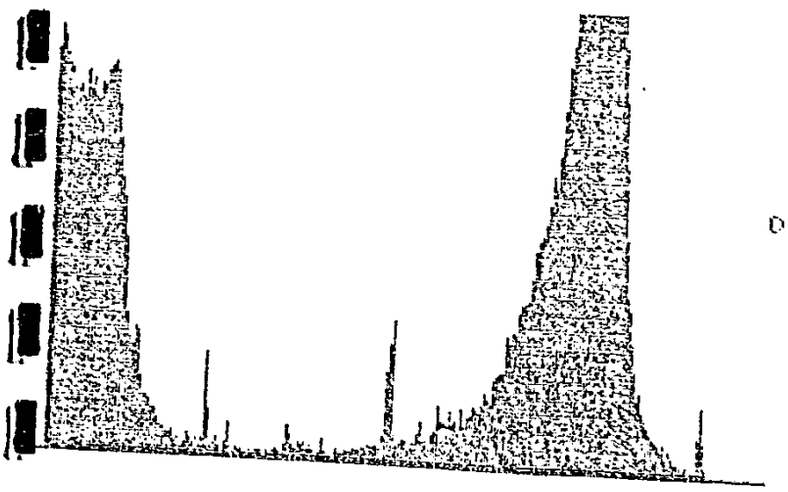

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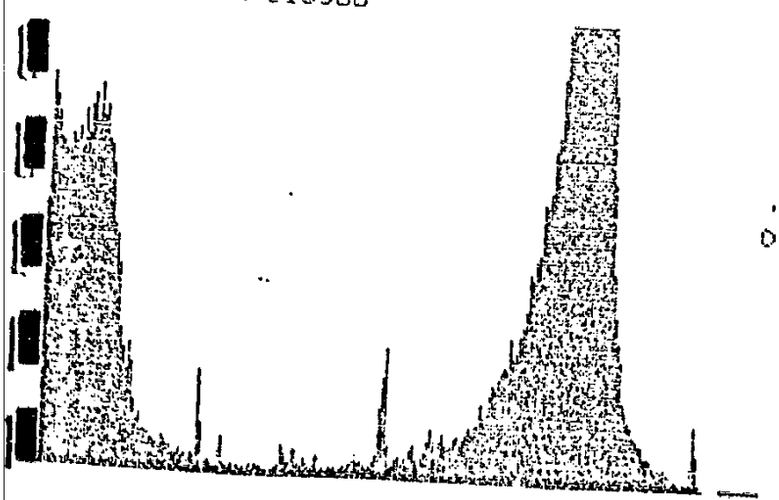

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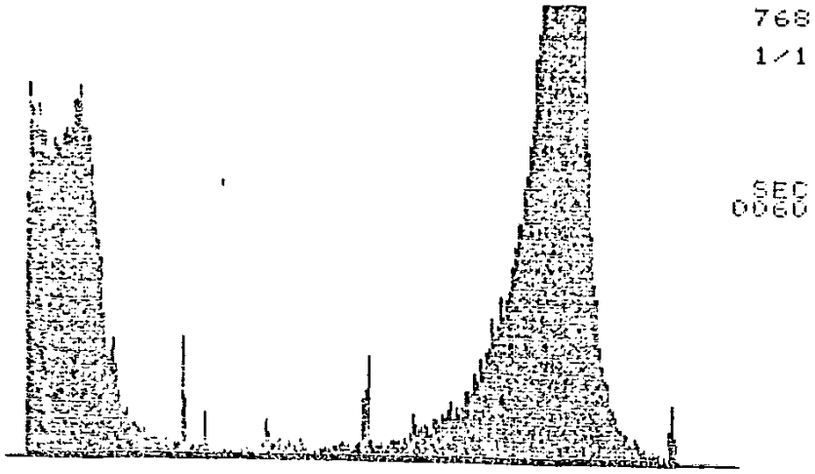

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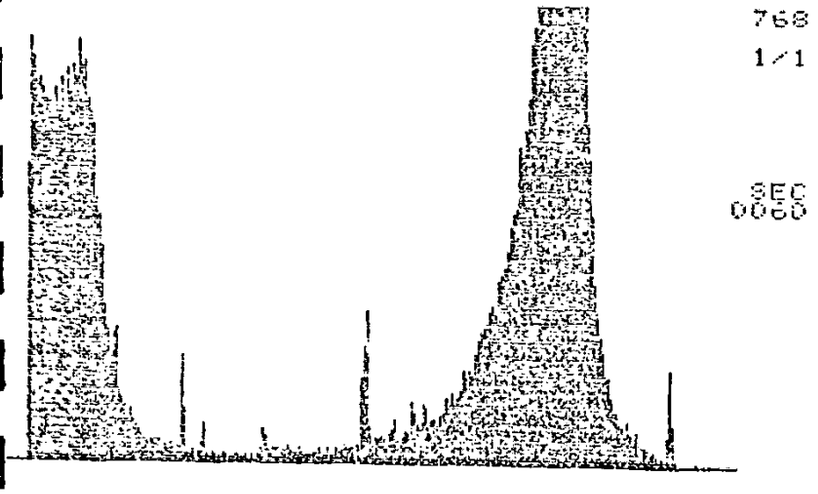

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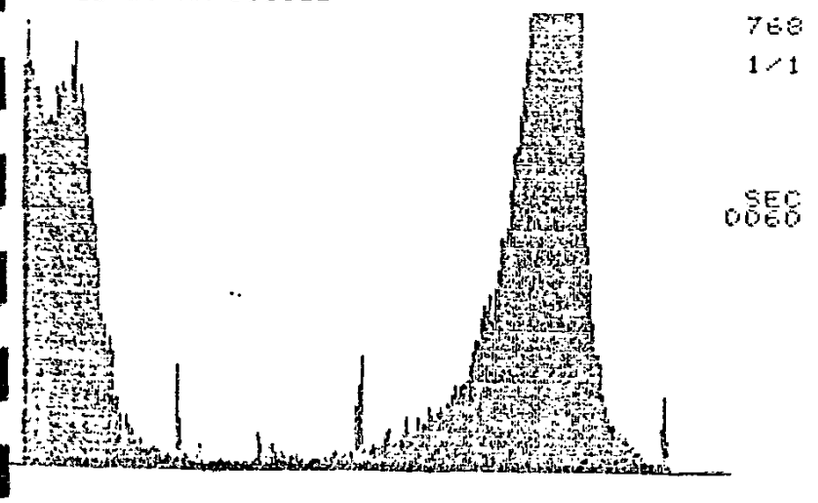

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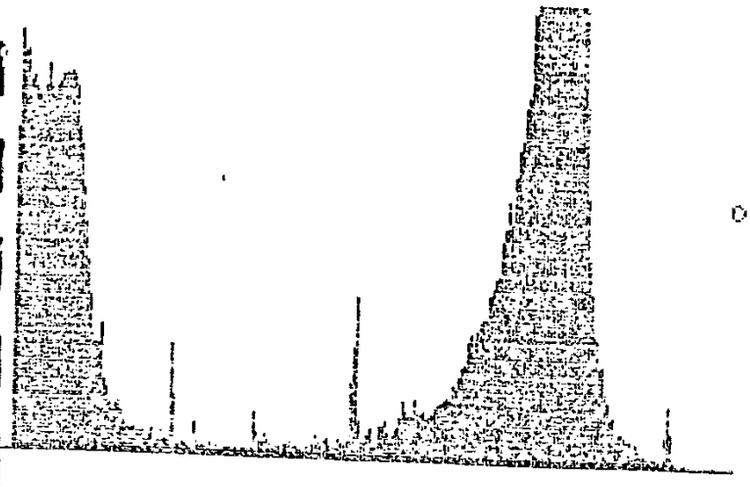

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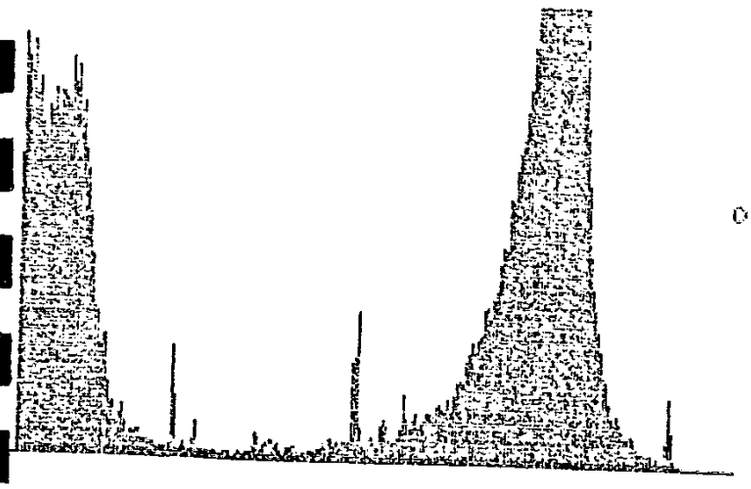

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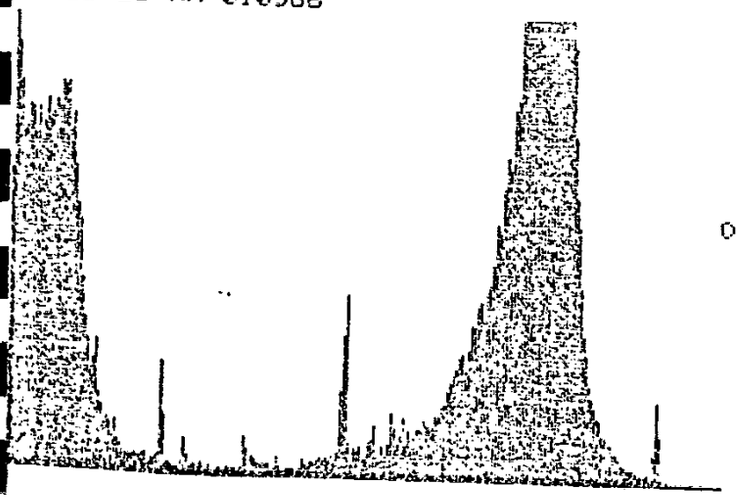

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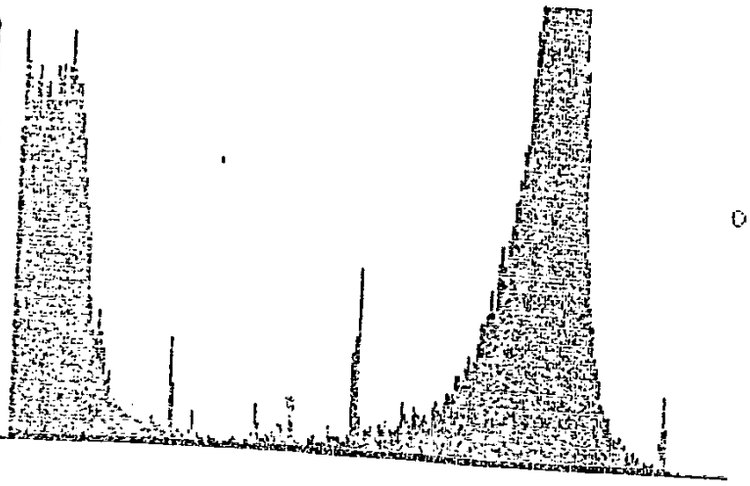

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APPENDIX E

QUALITY CONTROL/QUALITY ASSURANCE
DATA

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002628

DETECTION LIMITS X-RAY ANALYSIS DATA SHEET

PROJECT NO.: 85-317
PROJECT: Texarkana & S. Cavalcade
CLIENT: Koppers

DATE TESTED: 2/4/88 BY: PRW

METALS CONCENTRATION/SAMPLE STANDARD DEVIATION

SAMPLE NO.	DEPTH	SAMPLE DATE	TARE WEIGHT	CAN PLUS WET SOIL	CAN PLUS DRY SOIL	WATER CONTENT	ARSENIC MODEL SD=32 MODEL DL=63	CHROMIUM MODEL SD=204 MODEL DL=66	COPPER MODEL SD=42 MODEL DL=25	LEAD MODEL SD=162 MODEL DL=101	ZINC MODEL SD=66 MODEL DL=30
Std. #11							0 / 45.3	0 / 46.2	50.5 / 16.4	296 / 50.9	179 / 16.3
" #6							196 / 38.6	0 / 43.8	94.5 / 14.1	348 / 50.5	128 / 16.0
" #15							0 / 44.8	0 / 48.9	13.9 / 14.8	243 / 51.1	318 / 17.0
" #13							0 / 41.7	0 / 45.6	48.8 / 14.3	303 / 50.6	257 / 16.5
Ottawa Sand #1							45 / 66.0	0 / 73.9	0 / 12.5	302 / 51.3	116 / 15.0
" " #2							493 / 67.3	0 / 74.1	0 / 12.6	244 / 51.3	45.6 / 15.0

REPLICATE SAMPLE NO.	METAL	STANDARD VALUE / END-OF-DAY VALUE	DEV.	REPLICATE 1 RESULTS					
	As	1678 ± 67		DIFFERENCE					
STANDARD SAMPLE NO.	Cr	1438 ± 200		LESS THAN 2 STANDARD DEVIATIONS ?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
CHECKED BY:	Cu	427 ± 37		REPLICATE 2 RESULTS					
DATE:	Pb	174 ± 63		DIFFERENCE					
STATUS: ☐ DRAFT ☐ FINAL	Zn	2612 ± 56		LESS THAN 2 STANDARD DEVIATIONS ?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO

McBride-Ratcliff and Associates, Inc.

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X - RAY ANALYSIS DATA SHEET

PROJECT NO.: 85-317	PROJECT: Texarkana & S. Cavalcade	CLIENT: Koppers

DATE TESTED: BY:

SAMPLE NO.	DEPTH	SAMPLE DATE	TARE WEIGHT	CAN PLUS WET SOIL	CAN PLUS DRY SOIL	WATER CONTENT	ARSENIC MODEL SD=32 MODEL DL=88	CHROMIUM MODEL SD=204 MODEL DL=88	COPPER MODEL SD=42 MODEL DL=25	LEAD MODEL SD=162 MODEL DL=101	ZINC MODEL SD=58 MODEL DL=30
1/29 8:00 Std. #4							1650 / 49.4	1750 / 54.8	451 / 20.7	145 / 52.4	2600 / 26.8
1/29 16:30 Std. #4							1580 / 48.2	1290 / 53.8	419 / 20.5	166 / 52.5	2570 / 26.6
1/30 8:00 Std. #4							1570 / 48.2	1490 / 54.3	454 / 20.6	204 / 52.5	2550 / 26.6
1/30 16:30 Std. #4							1560 / 49.6	1600 / 54.6	403 / 20.8	190 / 52.5	2670 / 26.9
1/31 8:30 Std. #4							1530 / 47.9	1540 / 54.3	500 / 20.7	231 / 52.6	2510 / 26.6
1/31 19:00 Std. #4							1530 / 49.2	1210 / 53.9	399 / 20.6	195 / 52.6	2650 / 26.8
2/1 8:15 Std. #4							1500 / 48.8	1470 / 54.3	389 / 20.6	210 / 52.7	2690 / 26.9
2/1 16:00 Std. #4							1510 / 48.6	1490 / 54.5	442 / 20.7	253 / 52.3	2610 / 26.7
2/3 8:15 Std. #4							1700 / 49.8	1480 / 54.3	436 / 20.7	46.8 / 52.5	2630 / 26.9
2/3 14:30 Std. #4							1650 / 50.7	1060 / 53.5	375 / 20.6	97.4 / 52.6	2640 / 26.8

REPLICATE SAMPLE NO.	METAL	STANDARD VALUE / END-OF-DAY VALUE	DEV.						
				REPLICATE 1 RESULTS					
STANDARD SAMPLE NO.	As	1578 ± 67		DIFFERENCE					
	Cr	1438 ± 200		LESS THAN 2 STANDARD DEVIATIONS?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
CHECKED BY:	Cu	427 ± 37		REPLICATE 2 RESULTS					
DATE:	Pb	174 ± 63		DIFFERENCE					
STATUS: ☐ DRAFT ☐ FINAL	Zn	2612 ± 56		LESS THAN 2 STANDARD DEVIATIONS?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO

McBride-Ratcliff and Associates, Inc.

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