DEC 9 1977

DEC 2 1977

Mr. John Reinhardt
Solid Waste Section
Wisconsin Department of Natural Resources
Post Office Box 7921
Madison, Wisconsin 53707

Dear Mr. Reinhardt:

Enclosed is the information concerning contaminated sediments and soils at the Kerr-McGee plant site in Milwaukee that I spoke to you about. I would appreciate you or your staff reviewing this data and evaluating some of the alternatives of disposal we discussed over the telephone on November 28, 1977. If you have any questions or comments do not hesitate to call me at (312) 353-2110.

Yours truly,

William H. Miner

William H. Miner

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement
EPA-330/2-77-022

THE POTENTIAL FOR POLLUTION OF THE LITTLE MENOMONEE RIVER FROM THE KERR-McGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN

(September-October 1977)

November 1977

National Enforcement Investigations Center - Denver
and
Region V - Chicago

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I. INTRODUCTION

Creosote contamination of the Little Menomonee River from the operation of a Kerr-McGee/Moss-American creosote plant near Milwaukee, Wisconsin has been a long-standing problem in the area. Severe contamination occurred in the past as a result of the direct discharge of wastewater and now, even though the plant has ceased operations, continued contamination from residual creosote deposits is of concern.

The National Enforcement Investigations Center (NEIC) of the Environmental Protection Agency (EPA) was requested by EPA's Region V to conduct an investigation of the plant site and recommend measures to eliminate further pollution of the River. This investigation was conducted in September and October of 1977. A review of the history of the site and the resulting pollution is presented in an earlier report by NEIC.*

Due to the highly technical and complex nature of the subject matter concerning creosote contamination of the Little Menomonee River, the Honorable Myron L. Gordon, U.S. District Judge (Eastern District, Wisconsin) appointed David A. Saichek, of Gaines and Saichek, to serve as Special Master in the matter of United States v. Kerr-McGee/Moss-American, Inc.** All drilling, sampling and other field observations conducted by NEIC were done in accordance with requirements specified in a letter from the Special Master dated April 29, 1977 to Mr. Frank J. Daily, Attorney for the defendant, and Mr. Charles H. Bohl, U.S.

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* *National Enforcement Investigations Center, June 1977. Impact of Creosote Deposits in the Little Menomonee River, Wisconsin (April 1977). Denver: Environmental Protection Agency, 330/2-77-016, 47 p.*

** *Case No. 75-C-277.*

Attorney. In addition, on-site field operations including well drilling, sampling, water level measurements, well casing removal, well back-filling and abandonment procedures were observed by the Special Master, the EPA Region V Attorney, and representatives of the defendant.

This report describes the field methods used during the September and October surveys. It also presents the results of the investigation and recommends measures to reduce or eliminate movement of creosote from the plant site into the Little Menomonee River.

II. SUMMARY AND CONCLUSIONS

As requested by EPA, Region V, the National Enforcement Investigations Center conducted an investigation of the abandoned Kerr-McGee/Moss-American plant site near Milwaukee, Wisconsin. The objectives of the investigation were to determine the extent of creosote contamination in soil and groundwater, to evaluate the potential for continued pollution of the Little Menomonee River from this site, and to determine the measures necessary to eliminate the source of pollution.

During a site visit on September 19 and 20, 1977, six wells were drilled, casings were installed, groundwater levels were determined and water samples were collected from four of the wells for analysis [Appendix A]. In addition, core samples were collected at depths over 4.6 m (15 ft) during well drilling. Transects were laid out in relation to the wells and to structures in the area, and more than 100 soil samples were collected at depths up to 90 cm (3 ft) for later analysis.

Another site visit was made on October 19, 1977 to collect a second series of water samples from the wells and to remove the well casings. The wells were backfilled and the property was restored to its pre-survey condition to the satisfaction of Company representatives present on the site.

All soil and water samples were returned to the NEIC under chain-of-custody procedures [Appendix B] and analyzed for methylene chloride extractables [Appendix C]. The moisture content of the soil samples was also determined. The presence of creosote in the extracts was confirmed by gas chromatography on all of the extracts and the individual components of creosote were confirmed by mass spectrometry analyses of selected samples.

Groundwater level at each well was measured during both visits. These measurements plus general observations of the area and a knowledge of geology and hydrology indicate that the groundwater flows toward the Little Menomonee River.

The presence of creosote in water samples from two wells during both site visits and from a third well during the October visit shows that the groundwater is contaminated with creosote.

Analyses of core samples and soil samples taken from the transects show that the entire area is contaminated with creosote, in some cases to a depth of at least 4.6 m (15 ft) below ground level. In one case, the concentration of methylene chloride extractables in the soil was greater than 27% and it was greater than 10% in several more samples.

Such widespread and high concentrations of creosote at the Kerr-McGee/Moss-American plant site make it evident that contamination of the Little Menomonee River will continue unabated for years if no efforts are made to control surface runoff and mobility of the creosote-contaminated groundwater.

The provision of an interceptor ditch, however, would prevent the contaminated runoff, groundwater and soil from entering the River. A granular carbon adsorption column may be necessary if the ditch effluent contains dissolved contaminants.

III. RECOMMENDATIONS

The inflow to the Little Menomonee River of creosote-contaminated surface runoff, groundwater, and soil could be prevented by installing an interceptor ditch along the railroad track north of the site and between the contaminated area and the Little Menomonee River [Figure 1, Section IV].

The ditch should intercept the groundwater and surface runoff from the Kerr-McGee/Moss-American property. A system of skimmers and adsorption media (straw), placed in the ditch, would remove creosote from the interceptor discharge before it enters the Little Menomonee River. At 2.4 m (8 ft) deep, the ditch would collect any creosote floating on the water table and any soil washed off during a storm.

The ditch would have to be maintained regularly to remove accumulated skimmed material and solids that have settled.

If the water leaving the ditch is contaminated with soluble or emulsified components of creosote, it may be necessary to install a granular activated carbon column to treat the discharge from the ditch.

IV. STUDY METHODS

WELL AND SOIL SAMPLING SITE LOCATIONS

The investigated site consists of approximately 44,500 m^2 (11 acres) located in the NW 1/4, Section 8, T.8N., R.21E. near Brown Deer, Milwaukee County, Wisconsin [Figure 1]. From an aerial photograph of the site and an on-site inspection, the decision was made that six observation wells would be drilled to characterize the degree of contamination of the soil and the groundwater with creosote. One well was drilled near the northeast corner of a green shed close to the former retort area, and where it was assumed that the concentration of creosote would be the highest. Five other wells were drilled in relation to this "green shed" well, as described in Table 1; Figure 1 shows the approximate location of these wells. Because of surface characteristics (water, muck, etc.), it was not practicable to drill all of the wells at what was considered optimum locations.

Once the wells were located, transects were established in relation to the wells and to structures in the area [Table 2]. The transects enabled the location of sites for collection of samples of soil from the surface and down to depths of 90 cm (3 ft) below land surface. The analysis of the samples collected allowed a more complete evaluation of the extent of contamination in the area.

The six observation wells were drilled on the eastern half of the Kerr-McGee/Moss-American plant site on September 19 and 20, 1977 using a truck-mounted continuous flight auger drill rig. In the field, a geologic log was prepared of each hole, including observations made by studying cuttings brought from the wells, noting rig behavior and taking drive samples.

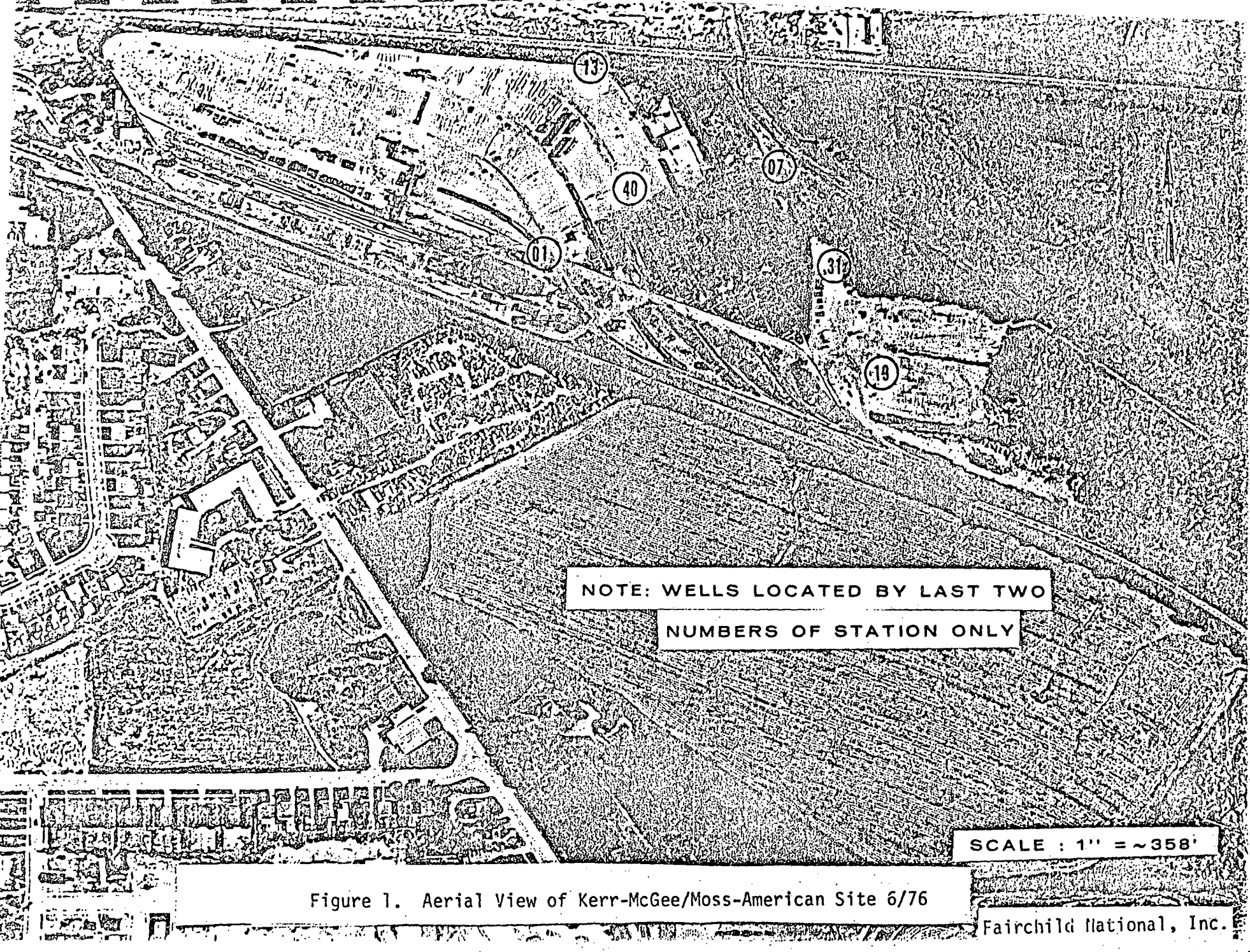

Figure 1. Aerial View of Kerr-McGee/Moss-American Site 6/76

Table 1

LOCATION OF WELLS INSTALLED AT THE KERR-MCGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN September 19-20, 1977

Well	Location Description†
772401	2.4 m (8 ft) from NE corner of the green shed, bearing 045°
772407	226 m (740 ft) from well 772401, bearing 045°
772419	315 m (1,035 ft) from well 772401, bearing 080°
772413	177 m (582 ft) from well 772401, bearing 335°
772440	About 91 m (298 ft) from well 772401 and 29 m (96 ft) north of transect A
772431	Halfway between wells 772407 and 772419 on transect F

† *All bearings were taken with magnetic compass*

Table 2

TRANSECTS USED IN LOCATING
SOIL SAMPLING AND WELL SITES
KERR-MCGEE/MOSS-AMERICAN PLANT SITE
MILWAUKEE, WISCONSIN
September, 1977

Transect	Description
A	Line connecting wells 772401 and 772407
B	Line connecting wells 772401 and 772413
C	Line connecting wells 772407 and 772413
D	Line east from well 772413 and parallel to railroad tracks
E	Line connecting wells 772401 and 772419
F	Line connecting wells 772407 and 772419
G	Line parallel to and 1 m (3 ft) south of retorts
H	Line parallel to and 0.3 m (1 ft) north of north wall of retort building

A drive sample was collected by removing the auger from the well and replacing it with a "split-spoon sampler" on the bottom end of the drill rod. The split spoon was driven into the undisturbed earth at the bottom of the well by dropping a 59 kg (130 lb) weight. The number of blows required to drive split-spoon sampler 46 cm (18 in) deep was recorded at the time of sampling. These data are recorded in the drill logs.

After the split-spoon sampler was removed, the auger was re-installed in the hole, and drilling continued until the desired depth was reached. Upon reaching this depth, the auger was removed from the hole and a section of 5-cm (2-in) diameter PVC* pipe, capped on the end and perforated with hacksaw slots, was installed in the hole. Backfill around the casing was obtained from cuttings which had been withdrawn from the hole.

During the drilling of the green-shed well (772401), it was noted that cores obtained from 3.0 to 3.5 m (10 to 11.5 ft) and from 4.6 to 5.0 m (15 to 16.5 ft) had layers of creosote** filling fractures and partings. As drilling progressed to about 6 m (20 ft), the auger began to lift water to the surface. This water had globules of creosote floating on the surface. As the auger was withdrawn, it was noted that the bottom 4.6 m (15 ft) was not coated with clay as had been the experience in other holes on the site, but instead was coated with creosote. This apparently was the result of drilling through a layer of creosote which coated the auger and prevented any clay from adhering to the auger.

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* *Polyvinyl Chloride*

** *Identified on the basis of odor and appearance*

SAMPLING AND ANALYTICAL PROCEDURES

Well Samples

Upon completing the six observation wells, the depth to groundwater was determined, and water sampling proceeded. Depth to water, obtained with a Powers' electric well sounder, was recorded as depth below the undisturbed land surface [Table 3].

After the depth was recorded, a 4.6 m (15 ft) long, 2.5 cm (1 in) diameter suction hose was installed in the casing and well was pumped until dry or until suction was broken. This was done twice at each well, then water samples were collected in glass containers prerinsed with water from each well using a Homelight gasoline-powered water pump. Water could not be obtained from two of the wells (772407 and 772419) due to the tight clay which comprises the bulk of the formation.

During each pumping of the green-shed well (772401), the water was noticed to contain globules of creosote, and as the pump broke suction a creosote froth was produced.

The soil samples from the wells were taken by opening the split-spoon sampler and placing the lower portions of the core in chemically clean glass jars capped with Teflon-lined lids. The upper portion of the core, which included material that fell into the hole as the auger was being removed, was not saved as a part of the sample.

All samples, soil and water, were taken to the NEIC Laboratory for analysis. Chain-of-custody procedures were followed throughout.

On October 19, the site was again visited by NEIC to re-sample the wells and return the site to pre-survey conditions. Several of

Table 3

WATER LEVEL MEASUREMENTS IN WELLS DRILLED AT THE KERR-MCGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN September 19 - 20, 1977

Well	Date (Sept.)	Depth to water below land surface (cm)	(ft)
772401	20	142	4.7
772407	19	27	0.9
772419	20	143	4.7
772413	20	33.5	1.1
772440	20	42.7	1.4
772431	20	79.2	2.6

the wells, all of which had been capped with a plastic cover, had been vandalized and the well casing was broken off at or just above the ground surface. As before, the depth to water level at each of the wells was measured, this time using a steel tape [Table 4]. Then the wells were purged to a depth of 4.6 m (15 ft) and left to recover before sampling.

Also as noted during the previous visit, the well nearest the green shed produced a black, greasy liquid during purging. Well 772407, which produced no water during the earlier attempt at sampling, produced a very muddy, thick liquid during purging.

During the October visit, samples were obtained by use of a hand-powered diaphragm pump which was rinsed with acetone between sampling at each well. Well 772407 was difficult to sample, probably because of mud and clay blocking the slots in the casing. To get enough sample for analysis, it was finally necessary to use a hand-operated bailer. The sample contained about 1,000 ml of water and 900 g of clayey sediment.

The sample from the well nearest the green shed was brownish with an iridescent sheen on the surface. The sample was not as dark or greasy as the material removed when the well had been purged earler in the day.

At sampling site 772452, about 31 m (100 ft) southwest of well 772440, the discharge from a small spring flowed through a small clump of vegetation and then toward the Little Menomonee River. A small pond had formed which was partially covered by an oily, iridescent sheen. As the water came up out of the ground, a sample was taken.

Table 4

WATER LEVEL MEASUREMENTS IN WELLS AND A SPRING AT THE KERR-MCGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN October 19, 1977

Well	Depth to water below land surface	
	cm	ft
772401	101.60	3.3
772407	36.48	1.0
772419	93.98	3.1
772413	36.83	1.2
772440	34.29	1.1
772431	76.20	2.5
772452	Surface	

After sampling, all casings were pulled from the wells and removed from the site. The holes were backfilled with a mixture of sand and bentonite clay, and the survey stakes placed during the earlier site visit were removed.

Soil Samples

Soil samples were collected from sites on the transects described in Table 2. At each of the sites except the wells, a small coring device was used to collect a surface sample. An auger was then used to excavate a hole to an intermediate depth of 30 to 50 cm (1 to 1.6 ft) where another core sample was collected. The holes were then deepened with the auger to final depths varying between about 55 and 90 cm (1.8 to 3.0 ft) and again a small core sample was collected from the bottom of each hole.

Analytical Procedures

The soil and water samples were analyzed for methylene chloride extractables. In addition, the moisture content of the soils was determined. The methylene chloride extracts were also analyzed for the presence of creosote compounds by gas chromatography.

Individual components of creosote were also confirmed in selected samples by mass spectrometry. In all cases, unless otherwise indicated, most of the methylene chloride extractable material was creosote.

V. GEOLOGIC OBSERVATIONS AND ANALYTICAL RESULTS

The entire Kerr-McGee/Moss-American plant site is underlain by a thick section [at least 17 m (55 ft)] of plastic, clayey glacial till with a greater percentage of gravel material in the till section along the eastern side of the plant site near the Little Menomonee River. The till is locally overlain by a man-made fill and/or by a section of organic peat. In the Kerr-McGee/Moss-American plant site, the till showed evidence of horizontal openings filled with creosote to a depth of at least 4.6 m (15 ft) in the undisturbed core samples. Groundwater occurs in the till section throughout the entire area of the Kerr-McGee/Moss-American plant site investigated. In humid areas such as in the Milwaukee vicinity, the groundwater table configuration is characteristically a subdued replica of the land surface which, at the subject site, slopes north and east across the Kerr-McGee/Moss-American site toward the Little Menomonee River. Groundwater and soil samples obtained from the plant site indicated evidence of severe creosote contamination, especially in the area of the former retort building. As the groundwater and soil are known to contain creosote and the water table slopes toward the Little Menomonee River, any movement will be in this direction.

As reported in Table 5, the water samples collected from the observation well (772401) near the retort contained 4,910 mg/l of methylene chloride extractables in the September sample and 99 mg/l during the October sampling. Even higher concentrations of creosote were noted in the water standing in the well. The suction line from the well to the pump was coated with creosote adhering to the inside of the pipe. Cores obtained from the surface 0.5 m (0 to 1.5 ft) and from depths within the hole -- 3.0 to 3.5 m and 4.6 to 5.0 m (10 to 11.5 ft

Table 5

ANALYTICAL RESULTS - WELL WATER SAMPLES COLLECTED AT THE KERR-MCGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN

Well	Location Description	Methylene Chloride Extractables Sept. 20, 1977 mg/l	Methylene Chloride Extractables Oct. 19, 1977 mg/l
772401	NE corner of green shed	4,190	99
772407	NE corner of area near RR	NS†	600††
772413	Northside center	ND†††	<2†††
772419	SE corner of area	NS†	<2†††
772431	Eastside center	ND†††	<2†††
772440	Center of area	20	9
772452	Spring sample, ∿100 ft southwest of 772440	-	<2†††

† *No sample obtained due to slow water level recovery after well development and purging.*

†† *Value rounded off to nearest 100 mg/l. This sample contained a considerable amount of very finely divided clay-like mud. An 1,800 ml slurry of this material was extracted. The slurry consisted of about 1,100 ml of water and 900 g of mud. The moisture content of the mud was 45%. A small amount of the methylene chloride extractables in this sample was creosote. The majority of the extractable material resembled a highly weathered heavy fuel oil.*

††† *None detected above the detection limit of methylene chloride extractables or no identification as creosote by gas chromatography.*

and 15 to 16.5 ft) -- contained large amounts (2,400 to 7,900 mg/kg) of methylene chloride extractables [Table 6].

It appears that there is a creosote layer, probably several inches thick, at shallow depth in the retort area. In addition, heavier fractions of creosote are apparently sinking through the groundwater to greater depths.

Much of the creosote may be temporarily sorbed on the soil material but a finite portion does move toward the Little Menomonee River. A sample of groundwater obtained from well 772440, near the center of the storage area, was found to contain 20 mg/l of methylene chloride extractables in the September sample and 9 mg/l during the October sample. A core sample, taken at a depth of 3.0 to 3.5 m (10 to 11.5 ft) from this well showed no detectable level of creosote. Creosote was not detected in water samples from any of the other wells except that during the October sampling, the mud-water mixture from well 772407 contained a high concentration of methylene chloride extractables which resembled highly weathered heavy fuel oil. A fraction of this extract was found to contain creosote components. This may be a result of the strong tendency for creosote to adhere to the well casing and to the pump suction line.

Analysis of the well core samples [Table 6] showed creosote at depths more than 4.6 m (15 ft) below the surface and concentrations of methylene chloride extractables as high as 23,700 mg/kg (2.37%). As previously discussed, this creosote was visible and detected by appearance and odor as the cores were removed from the split-spoon sampler. The creosote had evidently percolated through the soil and the groundwater surface to fill voids in the soil to at least the 4.6 m (15 ft) depth.

The presence of creosote from soil samples [Table 6] is randomly distributed throughout the area investigated. It reached a high of

Table 6

ANALYTICAL RESULTS - SOIL AND WELL CORE SAMPLES AT THE KERR-MCGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN September 19-20, 1977

Description	Depth	% Moisture	Methylene Chloride Extractable (Dry Weight) - mg/kg
	STATION NO. 772401		
Green shed, well	0-1.5 ft	8.7	2,500
	5-6.5 ft	24.2	ND[†]
	10-11.5 ft	16.5	7,900
	15-16.5 ft	10.6	2,400
	STATION NO. 772402		
Transect A, 105 ft from Station 772401	Surface	11.9	9,800
	62 cm	17.5	15,400
	90 cm	14.9	1,700
	STATION NO. 772403		
Transect A, 228 ft from Station 772401	Surface	13.8	9,200
	35 cm	27.4	2,100
	50 cm	35.5	11,100
	STATION NO. 772404		
Transect A, 351 ft from Station 772401	Surface	27.0	8,500
	32 cm	53.5	4,300
	82 cm	30.0	1,000
	STATION NO. 772405		
Transect A, 474 ft from Station 772401	Surface	39.0	5,900
	35 cm	51.3	13,100
	65 cm	45.5	4,200
	STATION NO. 772406		
Transect A, 597 ft from Station 772401	Surface	40.0	9,000
	Mid-Depth	64.5	31,800
	73 cm	60.4	3,800
	STATION NO. 772407		
NE corner of site, well	0-1.5 ft	20.1	23,700
	5-6.5 ft	22.1	ND[†]
	10-11.5 ft	12.7	ND[†]

Table 6 (Continued)
KERR-MCGEE/MOSS-AMERICAN PLANT SITE

Description	Depth	% Moisture	Methylene Chloride Extractable (Dry Weight) mg/kg
STATION NO. 772408			
Transect B, 145 ft from Station 772401	Surface	7.8	4,500
	50 cm	12.6	4,400
	69 cm	18.7	3,500
STATION NO. 772409			
Transect B, 291 ft from Station 772401	Surface	7.5	800
	40 cm	22.7	4,800
	69 cm	21.6	4,300
STATION NO. 772410			
Transect B, 436.5 ft from Station 772401	Surface	16.0	5,300
	42 cm	29.5	3,100
	68 cm	29.8	1,500
STATION NO. 772413			
North side, well	5-6.5 ft	21.0	1,700
	10-11.5 ft	16.6	ND[†]
STATION NO. 772414			
12 ft north of Transect E, 207 ft from Station 772401	Surface	13.3	71,000
	38 cm	20.5	10,400
	55 cm	18.2	34,300
STATION NO. 772415			
12 ft north of Transect E, 414 ft from Station 772401	Surface	12.2	12,900
	50 cm	24.4	ND[†]
	60 cm	22.6	ND[†]
STATION NO. 772416			
12 ft north of Transect E, 611 ft from Station 772401	Surface	12.0	20,000
	40 cm	15.1	5,300

Table 6 (Continued)
KERR-MCGEE/MOSS-AMERICAN PLANT SITE

Description	Depth	% Moisture	Methylene Chloride Extractable (Dry Weight) mg/kg
STATION NO. 772417			
12 ft north of Transect E, 808 ft from Station 772401	Surface	4.9	1,300
	30 cm	11.5	2,400
	60 cm	13.9	2,200
STATION NO. 772419			
SE corner of site, well	0-1.5 ft	17.7	ND†
	5-6.5 ft	9.8	ND†
	10-11.5 ft	14.6	ND†
STATION NO. 772420			
Transect H, NW corner of retort bldg	Surface	18.3	40,200
	50 cm	22.7	19,300
	75 cm	18.5	13,600
STATION NO. 772421			
Transect H, Midpoint of retort bldg 71 ft from Station 772401	Surface	17.1	10,500
	47 cm	21.3	3,800
	72 cm	24.4	2,200
STATION NO. 772422			
Transect H, NE corner of retort bldg	Surface	8.1	4,900
	33 cm	21.1	6,200
	73 cm	22.9	2,200
STATION NO. 772423			
Transect G, Midpoint between 5th & 6th retorts on south facing side	Surface	13.0	41,900
	40 cm	19.7	2,900
	72 cm	23.5	13,900

Table 6 (Continued)
KERR-MCGEE/MOSS-AMERICAN PLANT SITE

Description	Depth	% Moisture	Methylene Chloride Extractable (Dry Weight) mg/kg
STATION NO. 772424			
Transect G, Midpoint of 4th retort from left on south facing side	Surface	11.9	92,700
	38 cm	25.8	127,000
	63 cm	25.9	36,400
STATION NO. 772425			
Transect G, Midpoint of 2nd retort from left on south facing side	Surface	2.4	104,000
	38 cm	43.2	133,000
	70 cm	38.7	89,900
STATION NO. 772426			
Inside retort room, 40.3 ft from NE corner, 2 ft from north wall	Surface	5.0	72,900
	70 cm	26.0	7,100
STATION NO. 772427			
Inside retort room, 20 ft from NW corner, 4 ft in from north wall	Surface	3.3	279,000
	60 cm	20.2	5,600
STATION NO. 772430			
Transect F, 168 ft from Station 772419	Surface	8.4	2,400
	52 cm	23.9	4,100
	60 cm	22.4	ND[1]
STATION NO. 772431			
Transect F, 336 ft from Station 772419	Surface	9.9	1,900
	30 cm	41.0	2,800
	55 cm	38.5	ND[1]

Table 6 (Continued)
KERR-MCGEE/MOSS-AMERICAN PLANT SITE

Description	Depth	% Moisture	Methylene Chloride Extractable (Dry Weight) mg/kg
STATION NO. 772431			
Eastside center, well	5-6.5 ft	18.2	ND
	10-11.5 ft	19.4	ND
STATION NO. 772432			
Transect F, 504 ft from Station 772419	Surface	27.0	11,200
	36 cm	50.8	35,800
	58 cm	47.2	ND
STATION NO. 772433			
Transect D, 75 ft from Station 772413	Surface	24.2	8,800
	40 cm	31.8	ND
	-	41.8	ND
STATION NO. 772434			
Transect D, 168 ft from Station 772413	Surface	23.3	9,100
	40 cm	32.2	1,700
	70 cm	50.0	3,700
STATION NO. 772435			
Transect D, 261 ft from Station 772413	Surface	33.3	19,700
	40 cm	50.8	1,000
	70 cm	55.3	1,000
STATION NO. 772436			
Transect D, 354 ft from Station 772413	Surface	30.2	10,200
	50 cm	51.0	1,100
	80 cm	58.5	15,600
STATION NO. 772437			
Transect C, 152 ft from Station 772407	Surface	26.0	8,600
	32 cm	74.5	11,000
	65 cm	73.6	2,800
STATION NO. 772438			
Transect C, 304 ft from Station 772407	Surface	25.0	1,900
	52 cm	59.9	3,900
	70 cm	58.5	3,100

Table 6 (Continued)
KERR-MCGEE/MOSS-AMERICAN PLANT SITE

Description	Depth	% Moisture	Methylene Chloride Extractable (Dry Weight) mg/kg
STATION NO. 772439			
Transect C, 456 ft from Station 772407	Surface	14.9	900
	38 cm	38.9	25,300
	70 cm	60.4	21,100
STATION NO. 772440			
Center of site, well	10-11.5 ft	13.5	ND†
STATION NO. 772441			
50 ft at 280° magnetic from a point in the RR ditch 23 ft downstream of the confluence with the dock ditch	Surface	21.9	1,600
	37 cm	24.2	1,100
	72 cm	34.6	1,400

† *ND - None detected above the detection limit of 500 mg/kg or no identification as creosote by gas chromatography.*

279,000 mg/kg (27.9%) in a sample taken inside the retort room and was greater than 100,000 mg/kg (10%) at depths up to 38 cm (15 in) below the ground surface at sites outside the buildings.

The absence of creosote in some of the water samples collected and the relatively low concentrations found in wells other than the one nearest the green shed may be an indication of the low solubility of creosote or the strong tendency for creosote to adhere to the well casing and to the pump suction line. It may also be an indication that the wells were placed at the edge of a plane of higher concentration of contaminants. This latter possibility is thought most likely because the wells could not be drilled in optimum locations due to poor surface conditions which precluded ready access.

The high concentrations of creosote found in the groundwater and in the soil at all levels, particularly at the surface, indicate that the pollution of the Little Menomonee River will continue if corrective measures are not taken. It seems likely that a ditch dug along the north and east boundaries of the study area would intercept both groundwater and surface runoff. The creosote thus intercepted could be removed by skimming and sediment removal prior to release of the water to the River. If soluble materials in the water orove to be a problem, it may be necessary to treat the water with activated carbon prior to discharge.

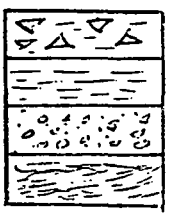
APPENDIX A

WELL LOGS, CASING AND PERFORATION RECORD
AND FIELD NOTES
9/19-20/77

APPENDIX A

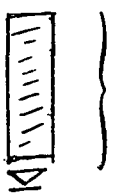
WELL LOGS, CASING AND PERFORATION RECORD AND FIELD NOTES, 9/19-20/77

KEY TO WELL LOGS



Fill, Cinders, gravel, clay and silt
Till, gray, clayey silt, peat, vari-colored clay
Gravel and sand, dense, sandy
Peat, dark gray

TD = Total Depth



Record of casing depth and perforations.

Record of surface of water level. Other notes on field logs are self-explanatory.

A-2 EPA Na Sha Enforcement

Drill Log

Project Number:
Hole Number: 772407
Drill Method: CF Auger

Project: K-M Moss Amer
Location: Approx 12' east of eastern rr tra
Drill Crew: Soil Testing Service Geologist: Rouse
Date: 9/19/1977

Depth Ft	Log	Water	Description
Sample 1 1.5'	A = AV A -V-		Fill; Cinders, clay, dark gray 31/18"
Sample 2			Peat; dark gray, wet
10			Till; Gray, clayey, silty, gravelly with gravel, round to subrnd in stringers Sampled 24/18" inc. tills plat
Sample 3	0 0 0 0		Dense drilling
20			
	0 0 0 0		
30			
			Dense, rocky
40			
50			
	TP 55'		
60			Note: Hole caved, wouldn't
			Csg. Moved 3' south fo hole for csg. Drilled 25', ag Moved 3' further south, drill Set 8' Csg. Water @ 0.9' Returned in p.m North, drilled 2
70			

Note: Slots in Csg are mostly plugged with soil. Water is very slow to recover. Water is very near ground surface, use caution in reading

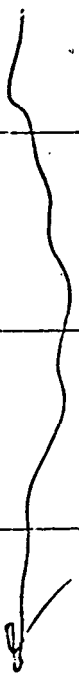
EPA National Enforcement Investigations Center
Drill Log

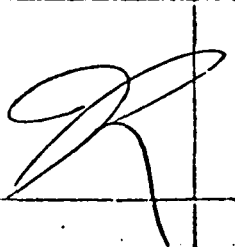
A-3

t Number:
umber: 7724 19
Method: C F Auger

Project: SCA Kerr McGee Moss Amer
Location: SE Cor, line w/ east r.r, & south rd. (Airphoto)
Drill Crew: STS, Inc
Geologist: Rouse
Date: 9/19/1977

Ft	Log	Water	Description
			Fill, gravel, clay
			Till, tan, clayey, silty, gravelly, dense with occas/ dense gravel lenses
		10'	
			Water was 4.7' below l.s on 9/20/77 @ 1000





EPA National Enforcement Investigation Center
Drill Log

A-5

ect Number:
Number: 772413
Method: CFA Auger
Project: Kerr McGee
Location: N. of northern rr track
Drill Crew: STS, Inc
Geologist: Rouse
Date: 9/19/1977

n, Ft.	Log	Water	Description
			Fill, railroad grade
			Peat, dark gray, soft, with roots
5			Clay, gray, plastic
			becomes
			Till, clayey, silty, slight gravel, plastic
10			tan to gray
15			
20			
25			(Break in scale)
35			
45			Gravel layer, dense, sandy
TD = 50'		50'	Water is 1.10' below l.s. on 0930 9/20/77
55			

A-4

EPA National Enforcement Investigation Center
Drill Log

Project Number:
Hole Number: 772401
Drill Method: CF Auger
Project: Kerr-McGee
Location: 8' Not NE Cor, green shed
Drill Crew: STS, Inc
Geologist: Rous
Date: 9/19/1977

Depth, Ft	Log	Water	Description
Sample 1 4 Blows			Fill, gravel, clay
			Till, gray to green, clayey, slightly gravelly, plastic
5 Sample 2			
0			
10 Sample 3 26 Blows			Creosote in
15 Sample 4 50 Blows			Creosote in spoo
20			Auger brings up water w/ creosote globules
			Bottom 15' of auger cleaned of during retreat of auger, creosote coating.
25		25	
			Water 4.65' below L.S. on 9/20/77 @ 0920
			Collected 2 gal sample from well @ on 9/20/77

A-6

EPA National Enforcement Investigation Center
Drill Log

Project Number:
Hole Number: 772440
Drill Method: CF Auger
Project: Kerr McGee
Location: Approx 75' N of 772404
Drill Crew: STS, Inc
Geologist: Rous
Date: 9/19/77

Depth, Ft	Log	Water	Description
			Fill, gravel, clay, soft
			Till, clayey, silty, plastic, gray
5			
10			
Sample 32 Blows			
15			
			Gravel, clayey, dense
20			
	TP20	20	Water was 1.4' below l.s. on 9/20/77 @ 0925
			Collected less than ½ gal @ 140 on 9/20/77

EPA National Enforcement Investigation Center
Drill Log

A-7

ect Number:
Number: 772431
Method: CF Auger

Project: Kerr-McGee Moss Lake
Location: East side, center (Airphoto)
Drill Crew: SITS, Inc. Geologist: Rouse
Date: 9/20/1977

n, Ft	Log	Water	Description
			Fill gravel, clayey
			Peat, dark gray
5			Till, gray, clayey, silty, plastic
			with rust gravel layers, as shown
10			
15			
20			
25			Dense drilling in gravel
30			
TD 30		30	Water was 2.6' below l.s. on 9/20 @ 0950
			Collected water sample (2 gal) @ 1320 on 9/20/77

APPENDIX C

SOIL AND WATER SAMPLE ANALYSES

CONFIRMATION OF CREOSOTE IN WATER AND SOIL SAMPLES FROM THE KERR-MCGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyses of the water extract and soil extract from Kerr-McGee confirming creosote were completed. The samples were screened initially on the flame ionization gas chromatograph, then analyzed utilizing combined gas chromatography/mass spectrometry (GC/MS). The gas chromatograms readily confirmed the presence of creosote when the chromatogram of the standard was compared to the water sample extract and the soil extract. The major sample components in samples and standard all occurred in the same ratio. The mass spectra of the individual compounds in the standard creosote mix and standard spectra of individual compounds run using the same instrumental conditions as the samples were perfect matches and all were confirmed by mass spectrometry and matching gas chromatography retention times. Table I gives the results for the samples and the standard mix.

TABLE I

	GC/MS Identification		
Compound	Commercial Creosote Local	Sample 2311 Soil	Sample 2240 Water
Napthalene	CF(1)	CF	CF
2-methylnaphthalene	CF	CF	CF
1-methylnaphthalene	CF	CF	CF
Biphenyl	CF	CF	CF
1,3-dimethylnaphthalene	CF	CF	CF
Acenaphthene	CF	CF	CF
Dibenzofuran	CF	CF	CF
Fluorene	CF	CF	CF
Anthracene (Phenanthrene)	CF(2)	CF	CF
Carbazole	CF	CF	CF
2-methylphenanthrene	Good (3)	Good	Good
Fluoranthene	CF	CF	CF
Pyrene	CF	CF	CF

Note: CF - confirmed

(1) These compounds confirmed by GC/MS identification, GC/MS of standards, and coincidence of retention times with those of standards.

(2) Phenanthrene and anthracene have identical mass spectra and the gas chromatography retention times are only slightly different, with phenanthrene eluting later. It appears as a definite shoulder on the anthacene peak with the GC conditions used when more dilute solutions are run. Both compounds are obviously present.

(3) This compound was identified by mass spectrometry only. A standard was not available.

ANALYTICAL METHODOLOGY - SOIL, WELL CORE AND GROUNDWATER SAMPLES COLLECTED SEPTEMBER 19-20, 1977 AT THE KERR-MCGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN

On September 23, 1977, 6 water and 113 soil samples were received at the NEIC Laboratory for creosote analysis. All samples were handled according to chain-of-custody procedures. The waters and soils were analyzed for methylene chloride extractables and the soils for moisture content. The methylene chloride extracts were also analyzed for the presence of creosote compounds by gas chromatography. The results are summarized in Tables 5 and 7 in the body of the report.

Methodology:

A. Moisture

About 10 grams of thoroughly mixed sample was accurately weighed in a tared 50 ml beaker and dried overnight in an oven at 105°C. The water loss was determined by reweighing the cooled and desiccated beakers.
Calculations:

$$\frac{\text{Wt. of water loss}}{\text{Wt. of sample wet}} \times 100 = \% \text{ moisture}$$

B. Methylene Chloride Extractables

Soils - 10 grams of thoroughly mixed soil was weighed into a 150 ml beaker. Large stones, twigs, leaves, etc. were avoided. 30 grams of granular anhydrous sodium sulfate was added to the beaker and the soil and sodium sulfate were mixed thoroughly to obtain a coarse granular consistency. The mixture was then transferred to a 33 x 80 mm cellulose extraction thimble and placed in a Soxhlet extractor. 200 ml of methylene chloride was placed in a 500 ml flat-bottomed flask and attached to the extractor. The extractor was allowed to cycle for 2 to 3 hours, with a rate of about 10 cycles per hour. Each flask was then placed on a rotary evaporator and the solution was concentrated to a volume of about 20 ml. The remaining solvent was quantitatively transferred to a tared 50 ml beaker and evaporated to dryness on a warm hot plate under a gentle stream of carbon-filtered air. Each beaker was reweighed and the residue determined. Results were calculated on a dry weight basis using % moisture values.

$$\frac{\text{Wt. of residue in mg}}{\text{Wt. of sediment extracted wet (gm)} \times \text{wt fraction solids}} \times 1000 =$$

mg/kg dry basis

wt fraction solids = 1.00 - wt fraction moisture

Waters - From 100 ml to 3 liters of the water samples were extracted twice with 100 ml of methylene chloride. The extracts were combined and evaporated to dryness in tared beakers on a warm hot plate under a gentle stream of carbon-filtered air. Each beaker was reweighed and the residue determined.

C. Creosote Compounds

Creosote is a complex mixture of compounds, some of which can be detected on a flame ionization gas chromatograph. These compounds give a distinctive pattern of peaks. This pattern was used to identify the presence of creosote.

The methylene chloride extracts were dissolved in 10 ml of acetone and an aliquot was injected on a Hewlett-Packard 5700A gas chromatograph equipped with an automatic sampler. Chromatograms were compared with a "standard" creosote sample that was purchased locally. The standard creosote sample was labelled as containing 60% creosote by weight. The sample was cut with a light refined petroleum-based oil.

Some samples with methylene chloride residues as high as 7,000 mg/kg showed no creosote pattern by gas chromatography. These residues could be caused by either "natural background" material, non-creosote compounds which have been extracted by methylene chloride, or creosote compounds which are not chromatographable. The samples which contained detectable amounts of methylene chloride residue, but which exhibited no creosote pattern, were reported as None Detected.

ANALYTICAL METHODOLOGY
GROUNDWATER SAMPLES COLLECTED OCTOBER 19, 1977 AT THE KERR-MCGEE/MOSS-AMERICAN PLANT SITE MILWAUKEE, WISCONSIN

On October 21, 1977 seven plant site well samples were delivered to the laboratory in accordance with NEIC chain-of-custody procedures. The samples were analyzed for total methylene chloride extractables and the extracts screened by flame ionization detection - gas chromatography (FID-GC) to determine the presence of creosote material.

FID-GC analysis showd that samples from Stations 772413, 772419, 772431, and 772452 did not contain any observable creosote material. All other samples contained observable amounts of creosote. The results of these analyses are presented in Table 5 in the body of the report.

Methodology:

A. Moisture

About 10 grams of thoroughly mixed sample was weighed in a tared 50 ml beaker and dried overnight in an oven at 105°C. The water loss was determined by reweighing the cooled and desiccated beakers. Calculations:

$$\frac{\text{Wt. of water loss} \times 100}{\text{Wt. of sample wet}} = \% \text{ moisture}$$

B. Methylene Chloride Extractables

Waters - From 1,000 ml to 3.5 liters of the water samples were extracted twice with 100 ml of methylene chloride. The extracts were combined and evaporated to dryness in tared beakers on a warm hot plate under a gentle stream of carbon-filtered air. Each beaker was reweighed and the residue determined.

C. Creosote Compounds

Creosote is a complex mixture of compounds, some of which can be detected on a flame ionization gas chromatograph. These compounds give a distinctive pattern of peaks. This pattern was used to identify the presence of creosote.

The methylene chloride extracts were dissolved in 10 ml of acetone and an aliquot was injected on a Hewlett-Packard 5700A gas chromatograph equipped with an automatic sampler. Chromatograms were compared with a "standard" creosote sample that was purchased locally. The standard creosote sample was labelled as containing 60% creosote by weight. The sample was mixed with a light refined petroleum-based oil.