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Evaluation of Three Sorbents for Retention of PCBs in a Natural Gas Stream

Merrill D. Jackson, David W. Hodgson, Kathryn E. MacLeod, and Robert G. Lewis

Environmental Toxicology Division, Health Effects Research Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711

Polychlorinated biphenyls (PCBs) have been found in some pipeline condensates by the natural gas pipeline companies (ANON 1981). A sampling procedure for PCBs in natural gas streams was needed by U.S. Environmental Protection Agency (US EPA) to determine if the PCBs were moving with the gas.

Polyurethane foam (JACKSON & LEWIS 1980), Florisil (HAILE & BALADI 1977), and Amberlite XAD-2 (LENTZEN et al. 1978) have been used by US EPA to determine PCBs in air and stack gases. However, it was not known whether natural gas, which contains several impurities including hexane, the solvent normally used to extract the media prior to analysis, would elute the trapped PCBs from the collection media. To resolve this question, retention efficiency studies were conducted for each trapping medium using natural gas in place of air.

MATERIALS AND METHODS

Sorbents. Polyurethane foam (PUF), open cell polyether type, density of 0.021 g/cm^3, in 7.6 cm thick sheets was cut to fit the sampling cartridges under slight compression. The PUF was prepared by the procedure outlined by LEWIS et al. (1977).

Florisil-PR, 60/80 mesh, was used as received.

Amberlite XAD-2 was prepared for use as described by LENTZEN et al. (1978).

All solvents were pesticide quality.

All standards were obtained from the Pesticide and Industrial Chemicals Repository, US EPA, Research Triangle Park, NC.

Gas Chromatography. A Perkin Elmer* Sigma 1 equipped with a Ni-63 electron capture detector, an AS-100 autosampler, and an integrator output was used. The operating parameters were:

*Mention of trade names is for identification only and does not constitute endorsement by the U.S. Environmental Protection Agency.

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column 182 x 0.6 cm glass with 4 mm bore, packing, 1.5% OV 17/ 1.95% OV 210 on Gas Chrom Q (100/120) at 200°C; and detector at 300°C. The PCBs were quantified by comparing the total area of the eleven main peaks against an analytically pure standard. If no peak was present, a zero peak area was assumed.

Method. In order to obtain the detection sensitivity needed, flows of 1 to 4 L/min of the gas for a period of 4-8 hrs were necessary. The flow available from different gas pet cocks in the laboratory varied from 0.9 to 1.8 L/min; the flow from individual pet cocks was constant during the collection periods studied.

The gas was passed through a 1.5 x 4.0 cm glass sampling cartridge packed with one of the three sorbents. PUF was cut to fit under slight compression and the other sorbents were placed between small plugs of PUF to hold them in place. Florisil and XAD-2 were weighed (2.5 gr/sample) into the sampling cartridge. The PCB (1.6 µg of Aroclor 1242 in 0.5 ml of hexane) was pipetted onto the sorbent which was allowed to air dry. A second sampling cartridge containing only clean PUF was placed downstream from the spiked cartridge, a dry gas meter was attached, followed by a Bunsen burner to burn off the gas.

Each sorbent was tested in triplicate. Testing times were ca. 8 or 15 hrs each. However, the sorbents were only evaluated three times each with the times randomly assigned. The backup PUF trap was used to determine whether any of the PCB was eluted from the primary trap. One control sample for each sorbent was run to determine if the natural gas supply contained any PCBs.

After sampling, each sorbent was Soxhlet extracted with 5% diethyl ether in n-hexane for 16 hrs. The solvent volume was reduced to ca. 1 mL on a rotatory evaporator followed by evaporation under a gentle stream of dry nitrogen. The sample was subjected to a deactivated alumina column cleanup (LEWIS et al. 1977) and a final volume of 4 mL for each spiked sample and 1 mL for each unspiked sample was obtained for GC analysis. One sample from each of the sorbents was extracted and analyzed to determine background levels associated with the reagents only.

RESULTS AND DISCUSSION

The results of this study are given in Tables 1 and 2. The values for the reagent blanks were calculated for each sampling size and results were corrected. From Table 1, it can be seen that there is little differences between PUF and Florisil for retention of PCBs. Even though the retention efficiencies of XAD-2 were poorer, all retention efficiencies were considered to be within the acceptable range. The choice of sorbent could then be made on availability at time of need. As can be seen in Table 2, no appreciable quantities of PCBs were found in the natural gas as delivered to our laboratories. These values were in the same range as those found by extraction and analysis of the reagents. (PUF, 32 ng; Florisil, 48 ng; and XAD-2, 40 ng per sample).

TABLE 1
Retention of Aroclor 1242 on Three Sorbents
Operated in a Natural Gas Stream
(1.6 g/Sample)

Sorbent	Total vol. (L)	Time (min)	L/min		Retention (%)	Backup PUF (%)
PUF	575	440	1.3		90	3
	1210	915	1.3		91	2
	594	336	1.8		98	2
				Avg.	93 ± 4	
Florisil	477	330	1.4		84	4
	544	335	1.6		97	2
	825	910	0.9		102	2
				Avg.	94 ± 9	
XAD-2	1349	910	1.5		76	3
	1528	922	1.7		88	1
	784	480	1.6		79	23*
				Avg.	81 ± 6	

*Probably contaminated somewhere in the process.

TABLE 2
Analysis of Natural Gas Stream in Research Triangle Park,
North Carolina, for PCB (Based on Aroclor 1242)

Sorbent	Vol. (L)	Time (min)	L/min	Collected (μg)	$\mu g/m^3$
PUF	809	921	0.9	0.064	0.079[a]
	690	432	1.6	0.025	0.036
Florisil	900	919	1.0	0.192	0.213
XAD-2	1439	908	1.6	0.288	0.317
	800	438	1.8	0.031	0.039

[a]Not corrected for reagent blanks.

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