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TITLE: $Al_2(SO_4)_3$ Sedimentation of Polychlorinated Biphenyl (PCB) contaminated water.

PERSONNEL:

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PROBLEM:

Determine suitability of $Al_2(SO_4)_3$ sedimentation as an isolation step in the analysis of PCB's in surface waters.

JUSTIFICATION:

Provide a high-sensitivity analytical method capable of reaching PCB levels compatible with EPA guideline.

SUMMARY:

In the concentration range of 0.5 - 1.0 ppb, better than 75% of Aroclor 1254 was removed from the water phase by $Al_2(SO_4)_3$ sedimentation. Aroclor 1242 removal was somewhat less.

A dependency for removal on concentration and Aroclor type precludes the use of sedimentation in an analytical method.

Consideration should be given to the apparent good effect of sedimentation as a preliminary cleaning procedure in plant or department holding ponds and tanks.

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Details

Introduction

During recent months we have been evaluating various procedures to improve sensitivity with respect to determining PCB's in surface-water samples. Our intention has been to provide a method with a detection limit compatible with the Environmental Protection Agency (EPA) guideline of 0.01 parts-per-billion (ppb). At the present time our sensitivity depends mostly on the volume of water analyzed. Therefore any method which allows us to efficiently process a large volume of water will improve analytical sensitivity.

One procedure under study was aluminum sulfate sedimentation. The basis of this approach is the fact that aluminum sulfate when added to an approximately neutral water solution, precipitates as the hydroxide according to the equation:

$$Al_2(SO_4)_3 + 6H_2O \longleftrightarrow 2\,Al(OH)_3 + 3\,H_2SO_4$$

(Solubility Product Constant of $Al(OH)_3 = 1.9 \times 10^{-33}$)

Trace contaminants in the water, such as PCB's, are adsorbed on the white, gelatinous precipitate during sedimentation. The precipitate (plus other particulate) can then be readily isolated and analyzed. The procedure can be applied to volumes up to 5 gallons before becoming too cumbersome.

A trial examination on actual river water samples was made and reported (Ref. No. 1). At that time it was pointed out that recovery and capacity data for the procedure was incomplete and the results should be viewed in that light. This report completes this study, and presents an evaluation on applicability of sedimentation.

Experimental

The recovery and capacity data were obtained by adding known combinations of Aroclors 1242 and 1254 to one-gallon samples of tap water to give levels of 2 and 5 total micrograms (ug). One-half gram of attapulgus earth was also added to simulate natural particulate matter.

An addition of 1.2 gram of $Al_2(SO_4)_3 \cdot 18\ H_2O$ per gallon was made and sedimentation allowed to proceed overnight. The precipitate (plus particulate matter) was recovered by filtration for subsequent PCB analysis. With several test samples, aliquots of the clarified water phases were recovered for analysis. A control or blank was also prepared and carried through the complete procedure.

Results and Discussion

Figure I (attached) illustrates the removal of PCB's from the water phase by sedimentation with $Al_2(SO_4)_3$. It can be seen that removal is dependent, not only on concentration but also on the type of Aroclor; being most effective on the higher chlorinated 1254. In the concentration range of 0.5 to 1.0 ppb, greater than 75% of the latter was recovered in the precipitate-sediment. The following table shows the distribution of PCB's found between the solid and water phases for several test samples analyzed.

	Sample Composition Aroclor	ppb Added	Percent of Amount Added In: Precip.-Sediment	Water Phase
A.	1242	0.55	66%	47%
	1254	0.80	76%	Not detected
B.	1242	0.80	62%	38%
	1254	0.55	85%	Not detected

The dependency for removal on concentration and Aroclor type precludes the use of the present approach as an analytical method, since both factors are beyond the analyst's control. Additional work, to study the effects of varying levels of the precipitating agent, or different agents is not justified as other possible high-sensitivity methods are under evaluation.

Consideration should be given to the apparent good effect of $Al_2(SO_4)_3$ sedimentation as a preliminary cleaning procedure, in plant or department holding ponds and tanks. Results of this work show better than 50% removal efficiency (61-85%) for PCB's at levels of 1 ppb (or less), using the equivalent of 2.2 lbs. of salt per 1000 gallons. Increased $Al_2(SO_4)_3$ addition might very well extend its application to very much higher concentration levels.

References

1. AR&D Report No. 2274, 1/17/73.

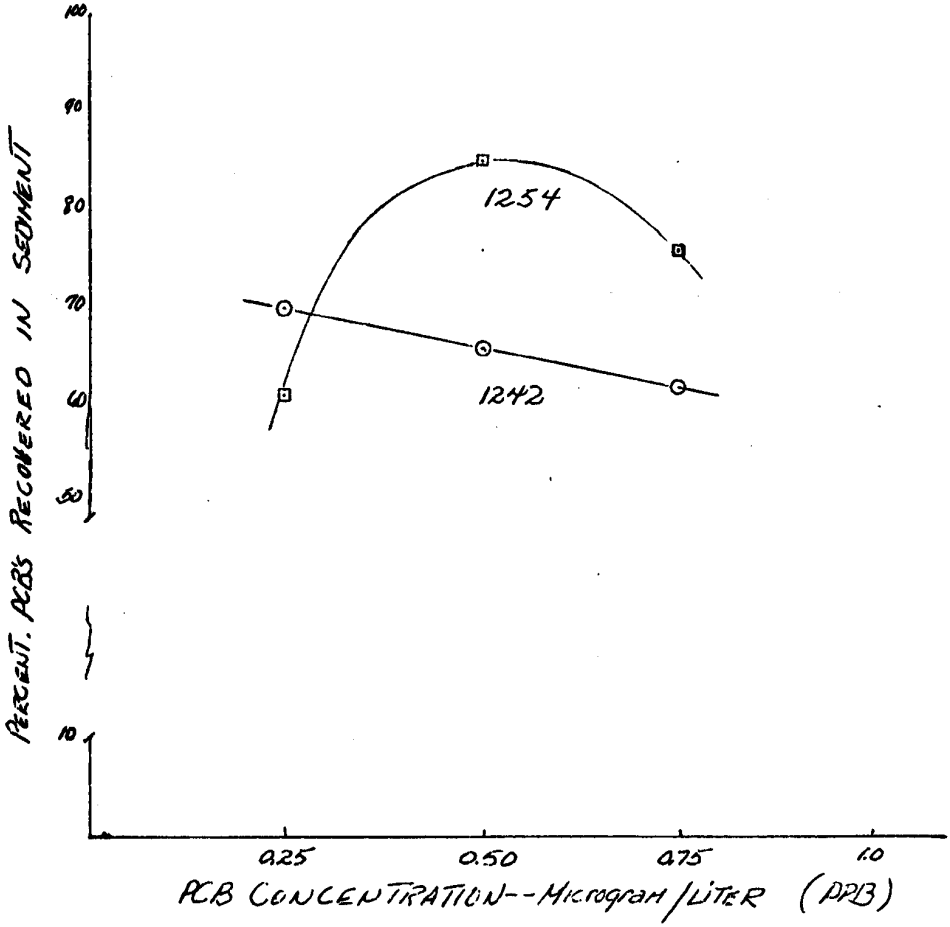
2. Laboratory Notebook, 16001-16100, 16066.

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5.I PCB SEDIMENTATION WITH $Al_2(SO_4)_3$

Tap-water "spiked" with Aroclor



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