Study of Treatment Technology for PCB's
To Meet The Toxic Pollutant Standards
As Proposed

I. Introduction

On December 27, 1973, the Environmental Protection Agency published the proposed Toxic Pollutant Effluent Standards. Subpart I, which covers Polychlorinated Biphenyls (PCB's) discharge levels for point sources into navigable waters, is summarized below:

a) No discharge into streams of low flow less than or equal to 0.283 cubic meters per second (10 cfs)

b) No discharge into lakes with an area of less than or equal to 202 hectores (500 acres)

c) 280 ug/l (280 ppb) daily average concentration shall not be exceeded when discharged into streams and lakes which have a low flow of greater than 10 times the waste stream flow

d) 0.0294 kg/day (0.0648 pounds/day) total waste loading into streams regardless of receiving water flow. This is a chronic limit of 0.0012 ug/l (0.0012 ppb)

e) 0.0245 kg/day (0.0540 pounds/day) total waste loading into lakes regardless of receiving water flow. This is a chronic limit of 0.0010 ug/l (0.0010 ppb).

Estuaries and coastal water are not discussed here because the proceedings were limited to fresh water (streams and lakes) (pages 3944 to 3949, Monday, May 20, 1974).

The chronic limit for the standards were based upon the Proposed Criteria for Water Quality of October, 1973 of 0.002 ug/l for freshwater. On May 28, 1973, it was proposed to change the chronic level to 0.001 ug/l which in effect will lower the daily loading standard by one half. The discussion will deal with the standard as proposed.

II. Objectors Comments

A. Monsanto Chemical Company

Mr. W.B. Papageorge affidavit stated on page 3

"8. Technology for the attainment of the proposed PCB effluent standard has not been demonstrated and is not available to the industry. Unachievement of the strict standard proposed would have the effect of a ban on the use of PCB's with serious economic and social consequences very thoroughly described in an impact statement submitted to the Agency on January 15, 1974, by the General Electric Company."

He went on further under Economic Considerations

> "At our PCB manufacturing facility, we developed and instituted an aggressive control program which we described before the Effluent Standards and Water Quality Information Advisory Committee, EPA (41). Yet, in spite of all our efforts, we cannot today meet the proposed effluent standard."
>
> "In response (42) to an inquiry from the U.S. Department of Commerce, we emphasized that technology has not been developed to the point that facilities could be designed to meet a reasonable standard. However, analytical techniques suggest a conceptual design using adsorption, settling and filtration of aqueous waste, followed by incineration of the adsorbent, probably carbon. We estimate the captial cost of such a facility, sized to handle our plant waste, at $600,000, not including a dedicated incinerator for the disposal of the adsorbent material. Annual operating cost would approximate $150,000."

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REFERENCES:

41. "Polychlorinated Biphenyls (PCB's)", A Presentation to the Effluent Standards and Water Quality Information Advisory Committee, EPA, by Monsanto Industrial Chemicals Company, November 29, 1973.

42. Correspondence, W.B. Papageorge, Monsanto Industrial Chemicals Company to Dr. Sidney R. Galler, U.S. Department of Commerce, February 21, 1974.

Mr. Papageorge's testimony, pages 2812 through 2827, discussed present treatment that Monsanto uses in their manufacturing and incineration facility which is the William G. Krumudge plant, Sauget, Illinois. He described their plant containment as

> "the 'bathtub' approach, which really involves paving, curbing, isolating the drains from these curved pavements into a separate sewer system, into a sump in which any accidental spills would be trapped before these drainage points enter the rest of the sewer system of the plant which, in turn, goes to the Sauget Village municipal treatment plant."

B. Westinghouse Electric Corporation

Dr. James Wright's affidavit stated on page 3 and 4

> "B. A review of techniques for removal of materials such as PCB's from the water has revealed that no commercial operation is now in effect. Furthermore, there is no proven technology on which such a technique might be based.
>
> Two techniques for removal of PCB's from water have been suggested which after considerable research effort over an extended period of time may be shown to be effective. The first of these is carbon adsorption. While we have no data nor have performed any experiments along this line, a practical system might be developed sometime in the future.
>
> The other technique which would find some usage here would be reverse osmosis. While no experimentation has been performed to date that we are aware of, the reverse osmosis contacts have advised us that there is a possibility of using this technique. However, again capital costs are expected to be extremely high and operating costs probably would exceed that of the activated carbon system.
>
> In addition, in using the R.O. system and the adsorption system, disposal of the concentrate would be a problem.
>
> The EPA explicitly states that "the attached standards are not based upon...the availability of treatment technology". (see page 35389 of F.R., Vol. 38, No. 247 dated December 27, 1973) from which we derived that the EPA also acknowledges that no suitable treatment method exists."

Dr. Wright reinterated on page 18, under Summary and recommendations,

> (1) There is no presently available technology or process for removing PCB's from plant effluents; therefore, the proposed limits violate the statement and intent of the Federal Water Pollution Control Act (1972).

Dr. Wright described present treatment methods used by Westinghouse on pages 5 and 6

"Westinghouse took strong measures to further limit the amount of PCB's entering the environment as the result of manufacturing operations (Exhibit III). Drains in manufacturing areas where PCB's were used were sealed. All waste matter was collected in specially marked containers in the factory. This material was subsequently sent to incinerating plants we understood were designed to consume the PCB's at temperatures that would destroy them. When accidental spills occurred in a manufacturing location, the material was absorbed with industrial absorbents and this material was sent to incineration plants. All possible precautions were taken to minimize the flow of PCB's from Westinghouse plants into nearby streams to sewage systems. Despite all of the precautions, there is an irreducible effluent limit below which manufacturing operations cannot be continued."

Dr. Wright on page 11, went on to state under Alternatives,

"a. Existing Plant, Existing Product, Refurbish Manufacturing Process

Economically this is the most attractive alternative for manufacturer, utility and consumer. However, the controls on the manufacturing process and/or new manufacturing techniques are not available to meet the proposed standard. There exists a serious question whether it is technically feasible to develop such controls. This alternative could be economically attractive but proves to be an alternative more technically limited than economically limited."

In Dr. Wright's testimony on page 2637 the questioning on Treatment follows:

Q. Have you tried any techniques for treatment of PCB's?

A. The word "treatment" requires, I believe, some elaboration.

We have done extensive work in every one of our plants in process control to reduce the PCB's that might be escaping into the environment. This is postulating, and I believe the next page -- on this page there are hypothetical postulations on two possible ways to waste water treatment as opposed to process control treatment or process control management.

Q. And those two are simply carbon adsorption and reverse osmosis?

A. Yes.

Q. But on neither of these have you done any tests?

A. That is correct.

Dr. Wright also in his testimony discussed what Westinghouse did to curtail PCB contamination, on page 2641

"So among the things, and there are others who could give the chronology of the actions of the plants better than I, but I think we have most of the net results.

One is, we went in and sealed all of the floor drains in all the PCB areas of the plant so that in no way any drippage could get joined with the process or sewage from the power plants.

Secondly, we modified substantially the spill procedures for PCB's in the plant, that from this point on we were using industrial adsorbance materials collected together and finally incinerated offsite by a contractor.

We have testified, I believe, as to several steps in the process, and I am going to have to look again at where this is in my testimony.

We stopped short of instigating clean-room procedures; they're very expensive, and as far as I'm concerned, not warranted. But we did not go that far, but we did consider it."

Further, on page 2646 he said to the question:

Q. I'd like to know what kind of treatment is used for the process water which is discharged.

A. The process water itself, as far as I know, is not--It's certainly not treated for any PCB removal. Again, we have no knowing point at which PCB's can enter the process or waste waters.

In the questioning of Dr. Wright on treatment technology, on page 2653, and 2654 it went;

Q. Well, let me ask this.

In your qualifications statement you state that you hold numerous patents on pollution abatement processes. Have you ever utilized or studied activated carbon as a treatment process?

A. Sure.

Q. Have you ever utilized it for the control of chlornated hydrocarbons?

A. No.

Further on page 2654 and 2655 the questioning went:

Q. Have you investigated for the control of PCB's, what levels would probably be achievable with activated carbon?

A. No.

I have no way of anticipating the relative adsorption coefficients of PCB's which would doubtless be diluted with mineral oil, which would doubtless be soluble in minute quantities in a water stream that might be used in the process. I have a tough time being able to predict anything about how well activated charcol would do.

Q. When you say PCB's would undoubtedly be diluted with mineral water, do PCB's coexist -- are they used with mineral oil in the transformers?

A. Not at the outset, no.

But there are wastes. For example, all the wastes--a point I didn't make -- all the waste PCB's that are collected in everything from rags to waste to buckets to drums and finally placed in a tank: if it's any good at all it's processed and reused. If it is not good, it's shipped off the site for disposal.

In that process of recollecting what we cann the waste material, it will be contaminated with everything that we have in the plant, including oil and the like, so I'm just extrapolating from that data in saying that any PCB's that happen to be in water would also be contaminated with oil.

Q. The materials that are shipped offsite for disposal, are they incinerated, did you say?

A. Yes. At high temperature, and, as we understand it, in conformance with regulations that insure their total combustion and destruction.

Later, on page 2656, the questioning was:

Q. Have you made any estimate of what it would cost you to put in activated carbon at the Sharon plant?

A. No, because we would not know how big to make them and whether or not they would do -- you know, what size unit it would take to effect any improvement at all. We would not know what size would be required to make any improvement in the input-output PCB content.

I'd like to add that the activated charcoal and reverse osmosis are simply among the first thing that an engineer would think of as a method for trying to remove small trace quantities from an effluent stream."

C. General Electric Company

Mr. George B. Farnsworth's affidavit stated on page 2,

"Instead, we were confronted on December 27, 1973, with a proposed standard which, if promulgated, would not be "attainable" and would therefore require shutdown of operations involved with these important products. To illustrate, our engineers tell me that the application of the proposed standard to one of our plants would mean that they would be allowed to discharge into the river one-half of one drop of PCB per day."

There wasn't any other discussion on treatment technology in General Electric Company's affidavit other than use of incineration by Dr. Edward Simons.

In the testimony, Dr. Simons stated on page 2689

"We have approached the problem of present operations with the same philosophy that Dr. Wright mentioned: that, because these operations in the manufacture of transformers do not require process water, that Pyranol, which is the G-E trade name for its use of PCB's, these operations do not involve water, the Pyranol is used in an anhydrous state.

Therefore, we have taken all of the steps that we thought were warranted and necessary to keep loses from that operation from getting into drainage systems that would ultimately be discharged to the river."

In a letter by Dr. Simons to Mr. Maurice Eastin, Special Consultant to the Administrator, EPA, May 31, 1974, he stated on page

"1. Control of PCB's from current production is basically a containment process. Water is not an essential component of the manufacturing process, so the problem is not one of removing a contaminant (PCB) from an aqueous process stream but of preventing the adventitious loss of PCB's from the production line to a waste water line."

On page 4, he went further and stated;

"3. At our manufacturing facilities that use PCB's we have installed or are planning to install control measures designed to prevent the adventitious loss of PCB's from current operations to waste water streams - but there is no way that anyone can ensure that installation of such controls in existing plants would enable them to meet the virtually unmeasurable levels that are required by the application of EPA's universal formula for effluent limitations."

D. General Discussion

The affidavits, testimony and papers presented by the objectors cover these basic areas;

A) They are not aware of any presently existing treatment technology to meet the daily loading levels.

B) There have not been any laboratory studies to develop methods to reach the concentration needed to meet the proposed standard.

C) Present treatment is to isolate manufacturing facilities such as the "bathtub" approach.

D) At the pipe outfall, how can present production be identified from background contamination?

III. Other Outside Interests

I have reviewed the written comments from the interested parties listed in Table I, and I did not find any statements on treatment technology.

Table I

Environmental Defence Fund
Natural Resources Defense Council, Inc.
New Jersey Public Interest Research Group
Ford Motor Company
Uniroyal Chemical (NACA)
E.I. duPont de Nemours & Company
Aerowax Industries, Inc.
Cornell-Dubilier Electronics
Sprague Electric Company
Fedders Corporation
Universal Manufacturing Corporation
Electric Utilities Company
Air Conditioning and Refrigeration Institute
Certified Battast Manufacturers Association
National Electrical Manufacturers Association
Envirotech Corporation
Electronic Industries Association
Southeastern Pennsylvania Transportation Authority
Penn Central Transportation Company
National Railroad Passenger Corporation
Louis T. Klauder and Associates

IV. Other Government Interests

I have reviewed the written comments from the interested parties listed in Table II. The only comment on treatment was from the U.S. Department of Commerce which is quoted below.

> "Monsanto has stated that the proposed standards for PCB's, set forth in Subpart I, Section 129.09, cannot be met by that company by use of known current technology. Studies have shown that PCB's can be removed from water by absorption or adsorption by particulate matter such as clays and soils. However, further studies are needed to determine the best method of disposing of the residual contaminated waste.
>
> Even assuming that this technology proves effective, Monsanto estimates that it may require 2 to 2-1/2 years for the design, procurement, installation, and demonstration of the facilities. The situation as it relates to Monsanto's PCB plant is further complicated because of the yet-unknown requirements to be imposed by local and regional waste treatment jurisdictions.
>
> It is apparent, therefore, that Monsanto cannot meet the low proposed effluent standards by July 1975 and we doubt that a new producer with less experience could do so. This could lead to forced termination of PCB manufacture.
>
> The reference to PCB's in EPA's "Economic Impact of Toxic Standards," states that "In summary, the economic impact is expected to be minor." This conclusion is contradictory to information furnished recently by Monsanto and PCB users..."

NOTE: Monsanto is not covered under Section 307(a) because they discharge to the Sauget, Illinois Treatment works.

Table II

Federal Government

Department of Commerce
Department of the Interior

State Governments

State of Connecticut
The Commonwealth of Massachusetts
State of Michigan
Commonwealth of Pennsylvania
State of Washington

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V. Environmental Protection Agency

I have reviewed the affidavits and testimony of the four EPA witnesses and did not find any statements on treatment technology.

I have also reviewed the comments from Region VI, Central Regional Laboratory, Region VIII and OEGC and found no comments on treatment technology.

The most interesting comment other than treatment technology was in the letter of January 18, 1974 to the Chief Enforcement Officer - Water, from the Director, NFIC - Denver, which was an enclosure to the OEGC comments of January 21, 1974. In the letter was a Table II which showed the minimum detectable limit (MDL). For PCB's, the MDL for EPA labs is 0.3 ppb, practical MDL is 3 ppb, and the Toxic Substances Task Force MDL is 1.0 ppb.

VI. Dr. Kenneth S. Price Affadavit

Dr. Price's comments can be broken down into two areas, 1) housekeeping control measures and 2) treatment systems.

Under housekeeping control measures, his comment at the end of page 4 covers this whole subject well. He said

> "The basic philosophies followed in such control measures include minimizing the potential for accidental spills and leaks, containment of unavoidable spills and leaks, and exclusion of water from those areas in which spills, leaks, etc., are unavoidable."

In other words, keep the PCB's out of the water system. Dr. Price goes on to say under PCB's manufacturing facilities on page 11:

> "Even with these control measures, Monsanto indicates that their current effluent discharge would not meet the proposed PCB discharge limitations. Therefore, terminal wastewater treatment facilities for the removal of PCB's would be required."

And under Capacitor and Transformer Manufacturing on page 13:

> "If the recommended control measures are found to be too restrictive for normal production operations, terminal treatment systems could be employed as required to permit compliance with the proposed discharge limitations."

On page 15, Dr. Price discusses Ultimate Disposal and he says

Monsanto in its numerous presentations, the NEMA report, and others have justifiably indicated that the best means of ultimate disposal of liquid PCB's and organic concentrates containing PCB's is through high temperature incineration.

Dr. Price then covers land filling procedures which he says

Since the various landfilling procedures, subsurface injection, etc., really only represent control techniques rather than destruction of PCB's, these means of disposal of PCB's should be avoided if at all possible. However, it should be noted that landfill disposal of small capacitors may be the only satisfactory means of disposal currently available.

Under Potential Treatment, he summarizes on page 20 and 21

Summary. It would appear that the most promising treatment sequence for removing PCB's from water would include gravity separation, possibly followed by filtration, and final removal of PCB's via activated carbon adsorption."

"It should be noted that although the basic technology for the systems cited above are available, laboratory and pilot tests would be required for each specific installation in order to develop exact design parameters."

NOTE: Dr. Price only discussed the daily average concentration part of the standard, not the daily weight waste loading.

VII. Discussion

On July 6, 1973, EPA published a list of nine chemicals to be controlled under Section 307(a) of the Federal Water Pollution Control Act. On September 7, 1973, the criteria and rationale employed for the selection of these chemicals was published. Based upon the criteria, PCB's are on the list because of their toxicity to aquatic organisms and of their bioaccumulation potential. The criteria for a material to be classified as "highly toxic" to man is much below the oral LD50 or dermal LD50 then that shown for PCB's.

On December 27, 1973, EPA published the proposed toxic pollutant effluent standards. The following Table III shows the relationships between the nine chemicals using the Water Quality Criteria as proposed in October, 1973. PCB's has the highest acute toxicity level which is 280 ug/l and the lowest chronic toxicity level which is 0.002 ug/l. The new proposed water quality criteria levels, as stated in the May 28 memorandum, is lowering the chronic level to 0.001 ppb. This makes PCB's the most hazardous material on the 307a toxic Pollutant list.

The following discussion is based upon the levels as stated in the December 27, 1973 proposed standard.

Characteristics of the Material

At the present time, there are only 5 types of PCB's manufactured in the United States. The total production in 1973 was 19131.90 metric tons with 3278.09 being exported. The imports were 90.99. One of the types, 1248, is exported and is not used in the U.S. Decachloro biphenyl (71.7% chlorine) is imported and used in the investment casting industry.

Table IV gives some general properties of the PCB's and Table V gives the distribution of the homologs for each aroclar.

Table III

As Published in Federal Register 37, 1972, using Water Quality Criteria of October 1972

| TOXIC SUBSTANCE | LIMIT OF DETECTION METHOD + NUMBER | WATER QUALITY CRITERIA FRESH WATER | WATER QUALITY CRITERIA SALT WATER | WATER TYPE | W.Q.C. STANDARD DEVELOPMENT ACUTE TOXICITY C.L. (PIPE) µg/l | ACUTE TOXICITY Effective Standard µg/l | CHRONIC TOXICITY C.L. Standard 0.01 x C.L. (PIPE) µg/l | CHRONIC TOXICITY Safety Factor Multiplier — | CHRONIC TOXICITY Adjusted C.L. (C.L. x Multiplier) µg/l | MAXIMUM DAILY LOAD FLOW KILOGRAMS 0.283 $m^3/s$ | MAXIMUM DAILY LOAD FLOW KILOGRAMS 283 $m^3/s$ | MAXIMUM DAILY LOAD FLOW POUNDS 10 cfs | MAXIMUM DAILY LOAD FLOW POUNDS 10000 cfs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALDRIN DIELDRIN | 1.0 µg/l GLC EC (1) | 0.005 µg/l (dieldrin) | 0.005 µg/l (dieldrin) | FWS | 0.5 | 0.05 | 0.005 | 0.6 | 0.0030 | 0.0003735 | 0.0735 | 0.0001652 | 0.162 |
| | | | | FWL | 0.5 | 0.05 | 0.005 | 0.5 | 0.0025 | 0.0003113 | 0.0613 | 0.0001377 | 0.135 |
| | | | | SWE | 5.5 | 0.55 | 0.055 | 0.5 | 0.0275 | 0.0003360 | 0.066 | 0.0001487 | 0.147 |
| | | | | COA | 5.5 | 0.55 | 0.055 | 0.6 | 0.033 | 0.0004032 | 0.0792 | 0.0001784 | 0.174 |
| BENZIDINE | 100 µg/l COLORIMETRIC AFTER DIAZOTIZATION (2) | | | FWS | 1.8 | 0.18 | 1.8* | 0.01 | 0.018 | 0.0002244 | 0.44 | 0.0000987 | 0.97 |
| | | | | FWL | 1.8 | 0.18 | 1.8* | 0.01 | 0.018 | 0.0002244 | 0.44 | 0.0000987 | 0.97 |
| | | | | SWE | 1.8 | 0.18 | 1.8* | 0.01 | 0.018 | 0.0002244 | 0.44 | 0.0000987 | 0.97 |
| | | | | COA | 1.8 | 0.18 | 1.8* | 0.01 | 0.018 | 0.00044 | 0.44 | 0.0000987 | 0.97 |
| CADMIUM | 4.0 µg/l ATOMIC ABSORPTION | 0.4 µg/l | 320 µg/l | FWS | 40.0 | 4.0 | 0.4 | 0.6 | 0.24 | 0.0029904 | 5.88 | 0.001306 | 12.96 |
| | | | | FWL | 40.0 | 4.0 | 0.4 | 0.5 | 0.20 | 0.002490 | 4.90 | 0.0010886 | 10.80 |
| | | | | SWE | 320.0 | 32.0 | 3.2 | 0.5 | 1.6 | 0.0199 | 39.2 | 0.00864 | 86.4 |
| | | | | COA | 320.0 | 32.0 | 3.2 | 0.6 | 1.9 | 0.0465 | 46.5 | 0.1026 | 102.6 |
| CYANIDE | 10 µg/l SPECIFIC ION 10 µg/l COLORIMETRIC > 100 µg/l TITRIMETRIC (5) | 1.0 µg/l | 1.0 µg/l | FWS | 100.0 | 10.0 | NA | | | | | | |
| | | | | FWL | 100.0 | 10.0 | NA | | | | | | |
| | | | | SWE | 100.0 | 10.0 | NA | | | | | | |
| | | | | COA | 100.0 | 10.0 | NA | | | | | | |
| DDT DDE DDD | 1.0 µg/l GLC EC (1) | 0.002 µg/l | 0.006 µg/l | FWS | 0.2 | 0.02 | 0.002 | 0.6 | 0.0012 | 0.0000294 | 0.0294 | 0.0000642 | 0.0648 |
| | | | | FWL | 0.2 | 0.02 | 0.002 | 0.5 | 0.0010 | 0.0000245 | 0.0245 | 0.0000534 | 0.054 |
| | | | | SWE | 0.6 | 0.06 | 0.006 | 0.5 | 0.0030 | 0.0000734 | 0.0734 | 0.0001602 | 0.162 |
| | | | | COA | 0.6 | 0.06 | 0.006 | 0.6 | 0.0036 | 0.0000881 | 0.088 | 0.0001924 | 0.194 |
| ENDRIN | 0.1 µg/l GLC EC (1 sample) (1) | 0.002 µg/l | 0.006 µg/l | FWS | 0.2 | 0.02 | 0.002 | 0.6 | 0.0012 | 0.0000294 | 0.0294 | 0.0000642 | 0.0648 |
| | | | | FWL | 0.2 | 0.02 | 0.002 | 0.5 | 0.0010 | 0.0000245 | 0.0245 | 0.0000534 | 0.054 |
| | | | | SWE | 0.6 | 0.06 | 0.006 | 0.5 | 0.0030 | 0.0000734 | 0.0734 | 0.0001602 | 0.162 |
| | | | | COA | 0.6 | 0.06 | 0.006 | 0.6 | 0.0036 | 0.0000881 | 0.088 | 0.0001924 | 0.194 |
| MERCURY | 0.2 µg/l (100 ml sample) COLD VAPOR (5) | 0.2 µg/l | 0.1 µg/l | FWS | 20.0 | 2.0 | 0.05† | 0.6 | 0.030 | 0.0007350 | 0.735 | 0.00162 | 1.62 |
| | | | | FWL | 20.0 | 2.0 | 0.05† | 0.5 | 0.025 | 0.0006125 | 0.612 | 0.00135 | 1.35 |
| | | | | SWE | 100.0 | 10.0 | 0.1** | 0.5 | 0.05 | 0.001225 | 1.22 | 0.0027 | 2.70 |
| | | | | COA | 100.0 | 10.0 | 0.1** | 0.6 | 0.06 | 0.00147 | 1.47 | 0.00324 | 3.24 |
| PCB's | 1.0 µg/l EXTENSION OF GLC EC (6) | 0.002 µg/l | 0.002 µg/l | FWS | 280.0 | 28.0 | 0.002† | 0.6 | 0.0012 | 0.0000294 | 0.0294 | 0.0000642 | 0.0648 |
| | | | | FWL | 280.0 | 28.0 | 0.002† | 0.5 | 0.0010 | 0.0000245 | 0.0245 | 0.0000534 | 0.054 |
| | | | | SWE | 10.0 | 1.0 | 0.017† | 0.5 | 0.0085 | 0.0002083 | 0.208 | 0.0004539 | 0.459 |
| | | | | COA | 10.0 | 1.0 | 0.017† | 0.6 | 0.0102 | 0.0002500 | 0.250 | 0.0005447 | 0.551 |
| TOXAPHENE | 1.0 µg/l GLC EC (1) | 0.01 µg/l | 0.01 µg/l | FWS | 1.0 | 0.1 | 0.01 | 0.6 | 0.006 | 0.0001470 | 0.147 | 0.0003204 | 0.324 |
| | | | | FWL | 1.0 | 0.1 | 0.01 | 0.5 | 0.005 | 0.0001225 | 0.122 | 0.0002670 | 0.270 |
| | | | | SWE | 1.0 | 0.1 | 0.01 | 0.5 | 0.005 | 0.0001225 | 0.122 | 0.0002670 | 0.270 |
| | | | | COA | 1.0 | 0.1 | 0.01 | 0.6 | 0.006 | 0.0001470 | 0.147 | 0.0003204 | 0.324 |

(1) = SEE METHOD DESCRIPTION, APPENDIX C. † = SPECIAL BIOACCUMULATION FACTOR; FWS = FRESH WATER STREAMS FWL = FRESH WATER LAKES SWE = ESTUARIES COA = COASTAL * = CONCENTRATION TO AVOID SLUG CONCENTRATION; ** = PROPOSED ON ADJUSTED LIMITED DATA

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Table IV

General Properties

| Material | Form | Specific gravity 25°/15°C | Solubility - $H_2O$ ug/l |
|---|---|---|---|
| 1221 | Colorless Mobile oil | 1.182-1.192 | 250 |
| 1016 | Colorless Mobile oil | approx. 1.35 | 200 |
| 1242 | almost colorless mobile oil | 1.381-1.392 | 200 |
| 1248 | tinted mobile oil | 1.405-1.415 | |
| 1254 | light yellow viscous oil | 1.495-1.505 | 56 |
| Deca | off-white crystalline powder | approx. 1.95 | <25 |

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Table V

# TYPICAL % COMPOSITION OF POLYCHLORINATED BIPHENYL PRODUCTS *

| HOMOLOG # CHLORINE BIPHENYL | AROCLOR 1221 | AROCLOR 1016 | AROCLOR 1242 | AROCLOR 1254 |
|---|---|---|---|---|
| 0 | 11 | <0.1 | <0.1 | <0.1 |
| 1 | 51 | 1 | 1 | <0.1 |
| 2 | 32 | 20 | 16 | <0.5 |
| 3 | 4 | 57 | 49 | 1 |
| 4 | 2 | 21 | 25 | 21 |
| 5 | <0.5 | 1 | 8 | 48 |
| 6 | ND | <0.1 | 1 | 23 |
| 7 | ND | ND | <0.1 | 6 |
| 8 | ND | ND | ND | ND |

*PER CENT (W/W) BY GC/MASS USING AREA CORRECTION FACTORS BY HOMOLOG RESPONSE

NONE DETECTED, <0.01% = ND



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Characteristics of Waste Stream Flow

Table VI shows the calculations based on the objector's affidavits and testimony. These are the only point sources which are known since there has not been any information gathered from the permit program.

This data shows that the allowable levels which effluent treatment is to achieve are extremely low in terms of daily loading and average concentration.

Table VI Point Sources To Be Controlled Under Section 307(a)

| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| Company Location | Stream Flow | Effluent Concentration | PCB used discharged | Department Effluent | Allowable Total Daily Discharge Pounds (Grams) | Average Plant Effluent based on "C" and "F" | Average Dept. Effluent based on "E" and "F" |
| Westinghouse Sharon, Pa. (Transformer) | Shenago River Controlled 700 - 1000 cfs | 5-600 gpm 0-2 ppb/27 ppb | 1242 40-50 grams | "Y" Build. 87 gpm "A&B" Build. 263 gpm | 0.00452# (2.94 grams) | .6 ppb | 1.08 ppb |
| G.E. Pittsfield, Mass (Transformer) | N/A | 1.86 mm gpd | 1254 | | - | - | |
| G.E. Roma, Ga. (Transformer) | Coosa River 1300 cfs | N/A | 1254 1 pound | | 0.00842# (3.84 grams) | - | |
| | Oostanawa 495 cfs | N/A | | | 0.00321# (1.46 grams) | - | |
| G.E. Hudson Fall, NY (Capacitor) | Hudson River 1600 cfs | 2.1 mm gpd 350 ppb | 1016 10 pounds | | 0.0104# (4.72 grams) | 0.6 ppb | |
| G.E. Fort Edwards, NY (Capacitor) | Hudson River 1600 cfs | 0.5 mm gpd 4,000 ppb | 1016 20 pounds | | 0.0104# (4.72 grams) | 2.5 ppb | |

N/A - Not available



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Effectiveness of Present Treatment

The only treatment used is to isolate the PCB area from the rest of the facility and to try and separate the PCB's from the water in a gravity separation basin. The summary below shows the effectiveness which has been achieved.

| Facility | Concentration | Loading |
|---|---|---|
| Transformer | 2 ppb | 0.01 pounds |
| Transformer | 65 ppb | 1 pound |
| Transformer | - | 1 pound |
| Capacitor | 350 ppb | 10 pounds |
| Capacitor | 4,000 ppb | 20 pounds |
| Manufacturing (this is not a point source under 307(a)) | 960 ppb | 2 pounds |

The transformer plants meet the daily average concentration of 280 ppb, but do not meet the standard on total daily weight. These transformer facilities can effectively isolate the PCB's handling area and to keep water away from the PCB's.

The capacitor manufacturers' facilities using present treatment are not effective at all. The concentration of the effluent is higher than the solubility of the 1016. The reason that the PCB's will carry over in the water is that the capacitors are washed in a detergent-solvent and water and then rinsed with water. The PCB's are very soluble in solvents and detergents which are carried by the water. These PCB's will not settle out in gravity separation.

The manufacturing facility, which is not covered by the proposed regulation, can not meet the standard. The manufacturing facility is open over a diked, concrete pad which has all drains going to a central separation basin. The function of this separation basin is to allow the PCB's to settle out by gravity to the bottom and the water overflow to the outlet. Since the entire plant is on the pad, all materials, including oil, grease, dirt, solvents and such go to the drains and the basin. If the material does not settle to the bottom, it goes to the effluent, such as the oils and suspended dirt.

What Can Be Done

There are two problems to be solved in the 307(a) standard, 1) to meet the daily average concentration of 280 ppb and 2) to meet the total daily weight discharged for each facility.

The transformer plants can presently meet the acute concentration, but the two capacitor plants cannot. The high levels of PCB's is most likely due to the material dissolved in the oils, solvents and detergents and on the suspended particales. Laboratory tests have shown that

filtration can remove the suspended PCB's and the addition of an adsorbent material can achieve an effluent in the 100 ppb range. These studies were not designed for the purpose of determining treatment methods.

The part of the standard which is most difficult to achieve is the maximum total daily weight of PCB's which may be discharged. This is the part of the standard which Dr. Price did not cover in his affidavit.

In the objector's affidavits and testimony, they mentioned that to get to this low level of daily discharge, carbon adsorption may be a method. In the Hager and Rizzo paper on granular activated carbon, they showed in static laboratory study using pure, clean samples, that to achieve a 1 ppb concentration, the percent weight pick up of PCB's to the carbon is less than 0.2%. This preliminary data needs to be extended to tests using actual plant effluent, both bench and pilot plant.

Another problem of using carbon adsorption for PCB's is in the reactivation process for the carbon, the design temperature is approximately 400°C hotter than what is normally used. It is estimated that the carbon loss at this higher temperature would be approximately 3 times greater than normal. Also, the installations shown for carbon activation plants are not of the scale needed for these installations and levels of effluent concentrations as low as needed for PCB's.

Dr. Price briefly mentioned four other possible treatment methods;

a) extraction using hexane
b) membrane separation
c) chemical oxidation
d) surface active agents to foam separate

Of these four methods, three of them rely on physical separation and concentration which still has to be disposed or incineration. Only the chemical oxidation method could chemically destroy the PCB's. The use of ozone as a treatment method could be a viable technique. None of these methods have been tested.

The National Electrical Manufacturers Association (NEMA) has prepared an excellent proposed guideline for handling and disposal of capacitor- and transformer-grade askarels containing PCB's. This proposed standard is being reviewed by the American National Standards Institute and will be adopted shortly. The sections on housekeeping, disposal procedures and control of water effluents are excellent and if industry will fully implement their recommendations, the amount of PCB's being lost to the environment will be further reduced.

Cost

Analytical. One of the costs of a facility which would be covered under the proposed standards is the chemical analysis for PCB's. In conversations with both Monsanto and Westinghouse, the cost would be approximately $100.00 per sample. The care which would be needed in the laboratory to properly control and concentrate the sample for the required low level of detection is much greater than for routine analytical analysis. If a daily composite sample is run on the water influent and on the waste effluent, this cost would be $73,000 per year.

Housekeeping and control

The cost to completely separate the PCB's from any contact with the water system will vary for each facility and is undetermined at this time. The cost for spill clean up and other administrative procedures is also undetermined.

Incineration. Incineration is the best method at this time to finally dispose of PCB's since it destroy's them to carbon dioxide, water and hydrogen chloride. The cost of incineration is on a pound basis, not gallons as Dr. Price indicated. Monsanto is going to raise their pricing on incineration at the Sauget facility to $0.06 per pound. Monsanto can only handle liquid waste. If all effluent from a facility is incinerated, the cost would be approximately $500/1000 gallons.

Filtration. This is the most promising method to acheive the daily average concentration part of the standard. Dr. Price showed a price range of $0.10-0.15/1000 gallons for diatomaceous earth filtration (did not include disposal). There needs to be further studies made to determine the best filtration method, loading characteristics, possible regeneration, and final disposal. Final cost could run $1.00 to 5.00 per/1000 gallons.

Carbon Adsorption. Dr. Price has come up with the following total Annual Cost/1000 gallons.

| | |
|---|---|
| on-site regeneration | $2.05-$29.50 |
| off-site regeneration | $1.15-$11.00 |

These figures seem to be within experience shown by the Calgon Corporation.

Other. At this time, it is not possible to predict cost for the four other systems which have been mentioned. Testing has not shown if any of these are viable. Mr. David Garrett, a professional Chemical Engineer, has investigated chemical oxidation using ozone and it looks like the most promising since this is the only method that does not require any incineration and ozone costs are declining as new technology is being made available.