

U.S. Environmental Protection Agency
Science Advisory Board
Environmental Health Committee
Halogenated Organics Subcommittee
Roster for November 19-20, 1987 Review of the Draft Final
Drinking Water Criteria Document for Polychlorinated Biphenyls

Dr. John Bull, Chairman, Professor of Pharmacology and Toxicology, University of Kansas Medical Center, Kansas City, Kansas 66103 (913) 588-7508 or

Dr. Seymour Abrahamson, Vice-Chairman, Professor of Zoology and Genetics, Department of Zoology, University of Wisconsin, Madison, Wisconsin 53706

Subcommittee Members and Consultants

Dr. George T. Bryan, Department of Human Oncology, K-4, Room 528, 608 Clinical Science Center, 600 Highland Ave., University of Wisconsin, Madison, Wisconsin 53792

Dr. Larry Hansen, College of Veterinary Medicine, University of Illinois, 2001 South Lincoln, Urbana, Illinois 61801

Dr. Ronald D. Hood, Professor and Coordinator, Cell and Developmental Biology Section, Department of Biology, University of Alabama, and Principal Associate, R. D. Hood and Associates, Consulting Toxicologists, P. O. Box 1927, University, Alabama 35486

Dr. Larry Kaminsky, Director Wadsworth Center for Laboratories and Research, New York State Department of Health, Albany, New York 12201

Dr. Curtis Klaassen, Professor of Pharmacology and Toxicology, University of Kansas Medical Center, 39th and Rainbow Blvd., Kansas City, Kansas 66103

Dr. Don E. McMillan, Chairman, Department of Pharmacology, Mail #638, University of Arkansas, Medical Sciences, 4301 West Markham, St. Little Rock, Arkansas 72205

Dr. Martha Radtke, University of Cincinnati Medical Center, Department of Environmental Health 3223 Eden Avenue—W. L. #56, Cincinnati, Ohio 45267

Dr. Thomas Starr, CIIT, P. O. Box 12137, Research Triangle Park, North Carolina 27709

Executive Secretary

Dr. C. Richard Cothran, Executive Secretary, Environmental Health Committee, Science Advisory Board (A-101F), U.S. Environmental Protection Agency 401 M Street, SW, Washington, D.C. 20460

I. Background:

Appreciable levels of PCBs were detected in ground water samples from wells near highly industrialized and landfill areas of New Jersey. Surface water, sediments and fish from a good number of rivers in the U.S. and in the Great Lakes were found to contain PCBs. PCBs were also detected in tap water samples of a few communities which obtain their water from the highly contaminated Hudson River. However, none of the above ground water and municipal tap water surveys identified the specific Aroclor mixture in drinking water samples. There is only one published report which identified Aroclor 1016 mixture, at levels as high as 100 ng/l, in samples from a small upstate New York public water supply system. The two reservoirs of this waterworks, where Aroclor 1016 was also detected, used the Hudson River as their source of water. Higher chlorinated Aroclor mixtures were present in the Hudson River and in one of the reservoirs but not detected in the finished drinking water samples from this community.

Polychlorinated biphenyls pose special problems with respect to establishing meaningful drinking water regulations. There are 209 different PCB isomers and it seems only 100 individual isomers have been identified at significant levels in commercial mixtures. Although toxicological studies have been performed on only a small number of the Aroclor mixtures, it is evident that there are significant differences in toxicity between different isomers and congeners. In particular, toxicity appears to increase with increasing chlorine content, and isomers which are axially substituted (positions 3,4, and 5) are more toxic than species that are substituted in positions 2 and 6. Consequently, the toxicity of PCB mixtures depends on the isomer-specific composition of the mixture, as illustrated by the differing chronic toxicities of various commercial PCB formulations. In addition, different PCB preparations may differ considerably in the content of toxic contaminants, such as polychlorinated dibenzofurans.

For these reasons, toxicity data derived from a particular commercial PCB formulation are not directly applicable to other formulations, and may not even be applicable to different batches of the same formulation. More importantly, toxicity data from studies of commercial PCB formulations may have little relevance to the toxicity of PCBs in drinking water because the composition of environmental mixtures is markedly changed from the parent contaminant as a consequence of differing solubility and stability characteristics of the PCB isomers. Since the toxicity of a mixture could be dominated by a few relatively minor but highly toxic constituent isomers or contaminants, measurement of total concentration is not an adequate index for assessing the toxicity of PCB mixtures.

II. Issue:

Based on the information on the toxicity of PCBs (mixtures, isomers and congeners) and on their solubility and stability in drinking water, is it possible to develop meaningful acceptable concentrations of PCBs in drinking water?

III. Options

Option I

- Consider evaluating the toxicity of individual isomers and derive criteria for drinking water for each isomer, if the data permit. This is a scientifically sound method for addressing the toxicity of PCB mixtures. This approach is not feasible at present, both because isomer-specific toxicity data are not available and because isomer specific analysis of water is not feasible on a routine basis.

Option II

- Assume that all PCB mixtures in the environment are composed entirely of the most highly toxic isomer (3,4,5,3',4',5' hexachlorobiphenyl) and use this to estimate acceptable level of PCBs in drinking water. This will be the most conservative, approach. While this would be certainly protective, this isomer is a minor component of most formulations and has low solubility in water. This option may not be protective of the carcinogenic potential of PCBs because of the lack of data on the carcinogenic potential of this isomer.

Option III

- Assume that a mixture of PCBs in water retains an average toxicity that is not greatly different from that of the parent formulation. Based on this assumption, acceptable levels could be derived for commercial formulations as if they were individual chemicals. One disadvantage to this approach is that it is usually difficult to identify which specific PCBs formulation(s) is (are) the source of PCBs in drinking water.

IV. Recommendation:

Option III is recommended. The key assumption upon which this option rests (that PCBs in water retain an average toxicity similar to the parent formulation) may not be true. However, it is unlikely to underestimate risk since the more toxic higher chlorinated isomers would have least water transport potential. Changes in the acceptable levels of PCBs in drinking water or in the basic regulatory approach may be possible in the future as additional data and techniques become available.

II. Points of Interest:

1. PCB cancer potency: Comparison with the human evidence (Discussion to be added to document)

The Agency's cancer potency for PCBs (calculated from the Norback and Weltman rat study and reported in the May 1987 Drinking Water Criteria Document to be 7.7 per mg/kg/d continuous lifetime exposure) compares favorably to the number of cancer cases seen following the rice-oil incident in Japan. Although more cancer cases may be reported in the future, a rough calculation can be made from currently available information.

The Drinking Water Criteria Document (page VI-14, attributed to Kuratsune) reports the average amount of PCBs consumed during the riceoil incident to be about 2 grams. Dividing this by 70 kg (the weight of a typical adult) and by 25,600 days (the number of days in a typical 70-year lifespan), the average daily exposure is estimated to be about 0.0011 mg/kg/d. Multiplying this by 7.7 per mg/kg/d (the Agency's cancer potency) shows the risk to be 847 per 100,000. In an exposed population of 1761 (page VI-31, attributed to Kuratsune) approximately 14.9 excess cancer cases are expected. This projection is not inconsistent with the 7.39 excess liver cancer cases reported to date (page VI-31, 9 observed minus 1.61 expected).

Several major sources of uncertainty in this comparison should be noted:

- a. The Agency's potency estimate is a plausible upper bound, which would tend to overestimate the number of cancer cases.
- b. The rice oil was contaminated with polychlorinated dibenzofurans at a level 250 times more concentrated than in the commercial PCB product Kanechlor 500. To the extent that these dibenzofurans are responsible for the observed cancer cases, a projection based on based on the cancer potency of PCBs alone would tend to underestimate the number of cancer cases.
- c. Calculating an average daily exposure prorated over an entire lifetime is very problematical, since the exposure was intense but of short duration. In the absence of evidence to the contrary on PCBs, this approach is consistent with the Agency's cancer guidelines. Nevertheless, it remains a substantial source of uncertainty.

Review of the Draft Drinking Water Criteria Document
for Polychlorinated Biphenyls (PCBs)
by the
Halogenated Organics Subcommittee
Environmental Health Committee
Science Advisory Board

I. General Comments

The regulation of PCBs in drinking water or, in fact, any environmental medium, encounters many problems, including several involving the existing scientific data base. All are described in the criteria document, but virtually none are resolved. These scientific problems include the complexity provided by 209 different congeners and isomers present in commercial PCB mixtures, each with a different toxicity; the presence of highly toxic non-PCB components such as polychlorinated dibenzofurans (PCDFs); the differential rates of removal of PCB congeners from the environment which leads to differences in congener profiles from those of the original pollutant mixtures; and the incomplete knowledge of individual PCB congener toxicity.

The draft criteria document suffers from a failure to clearly identify its scientific objectives. Thus, as reviewers, the Subcommittee members encountered a myriad of facts that were not critically applied, either directly or to support a hypothesis for subsequent regulatory decisions. It must be initially resolved whether the objective is to regulate Aroclors or PCBs in the environment. The Subcommittee believes there is a need to more precisely define what is meant by the term "PCBs", in part because Aroclors may or may not be PCB compounds and because of the varied composition of PCB mixtures.

The Subcommittee recommends that the available data on PCB congeners be developed on a scale of congener toxicity, even if this is only an approximation in which data and professional judgment are combined. Any such scale will be imperfect, however. For example, it is unlikely that the adverse health consequences of thalidomide would be detected.

The draft document has improved considerably from a previous version. There are, however, some sections that require extensive revisions before it represents a scientifically adequate statement of existing knowledge. A major problem with chapters V, VI and VIII is that they are out of date. For example, in chapter V all of the recent structure activity relationships (SAR) for PCBs have been ignored even though they are discussed in detail in chapter VII. The chapter on human health effects almost completely omits a series of papers in Environmental Health Perspectives (volumes 59 and 60) and the American Journal of Ind. Medicine (volume 5) that discuss Yusho/YuCheng poisoning in Japan and Taiwan, and occupational exposures. These omissions severely compromise the quality of this chapter. In addition, it has been shown by two studies that the major etiologic agents in Yusho and YuCheng poisoning are PCDFs.¹ This does not, however, absolve PCBs as toxic agents and as contributors to some of the symptom of Yusho and YuCheng poisoning.