Environmental Health Criteria 2

POLYCHLORINATED BIPHENYLS AND TERPHENYLS

World Health Organization

INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY

ENVIRONMENTAL HEALTH CRITERIA 2

POLYCHLORINATED BIPHENYLS AND TERPHENYLS

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Published under the joint sponsorship of
the United Nations Environment Programme
and the World Health Organization

World Health Organization
Geneva, 1976

ISBN 92 4 154062 1

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While every effort has been made to present information in criteria documents as accurately as possible without unduly delaying publication, mistakes might have occurred and are likely to occur in the future. In the interest of all users of the environmental health criteria documents, readers are kindly requested to communicate any errors found to the Division of Environmental Health, World Health Organization, Geneva, Switzerland, in order that they may be included in corrigenda which will appear in subsequent volumes.

In addition, experts in any particular field dealt with in the criteria documents are kindly requested to make available to the WHO Secretariat any important published information that may have inadvertently been omitted and which may change the evaluation of health risks from exposure to the environmental agent under examination, so that information may be considered in the event of updating and re-evaluating the conclusions contained in the criteria documents.

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Copenhagen, 20-24 October 1975

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ENVIRONMENTAL HEALTH CRITERIA FOR POLYCHLORINATED BIPHENYLS AND TERPHENYLS

A WHO Task Group on Environmental Health Criteria for Polychlorinated Biphenyls (PCBs) and Terphenyls (PCTs) met in Copenhagen from 20-24 October 1975. Dr F. A. Bauhofer, Director of Health Services of the WHO Regional Office for Europe opened the meeting on behalf of the Director-General and the Director of the Regional Office for Europe. The Task Group reviewed and amended the second draft criteria document and made an evaluation of the health risks from exposure to these compounds.

The preparation of the first draft criteria document was based on national reviews of health effects research on polychlorinated biphenyls, received from the national focal points collaborating in the WHO Environmental Health Criteria Programme in Canada, the Federal Republic of Germany, Finland, France, Japan, the Netherlands, New Zealand, Sweden, the United Kingdom, and the USA. Dr J. C. Gage, London, England, prepared the first draft as well as the second draft criteria document which took into account the comments received from the national focal points in Canada, Czechoslovakia, the Federal Republic of Germany, France, Japan, New Zealand, Sweden, the United Kingdom, the USA, and the USSR; from the United Nations Industrial Development Organization (UNIDO), Vienna, the Food and Agriculture

Organization of the United Nations (FAO) Rome, and from the United Nations Educational, Scientific and Cultural Organization (UNESCO) Paris; the Organization for Economic Co-operation and Development, Paris, and the Health Protection Directorate of the Commission of the European Communities, Luxembourg.

Comments were also received at the request of the Secretariat, from Dr K. Kojima, Japan, Dr D. S. May, United Kingdom, and Dr V. Zitko, Canada.

The collaboration of these national institutions, international organizations and individual experts is gratefully acknowledged. Without their assistance the document could not have been completed.

This document is based primarily on original publications listed in the reference section. In addition, some recent publications reviewing the environmental and health aspects of polychlorinated biphenyls were also used. These include reviews by the Commission of the European Communities (1974), the US Department of Health, Education and Welfare (1972), the International Agency for Research on Cancer (1974), the International Council for the Exploration of the Sea (1974), Jensen (1974), Kimbrough (1974), the National Swedish Environment Protection Board (1973), the Panel on Hazardous Trace Substances (1972), the USDA/USDC/EPA/FDA/USDA (1972), and a WHO working group (1973).

Details about the WHO Environmental Health Criteria Programme including the definition of some terms frequently used in the document may be found in the general introduction to the Environmental Health Criteria Programme published together with the Environmental Health Criteria Document on mercury (Environmental Health Criteria 1, Geneva World Health Organization, 1976).

1. SUMMARY AND RECOMMENDATIONS FOR FURTHER RESEARCH

1.1 Introductory Note

The commercial production of the polychlorinated biphenyls (PCBs) began in 1930, and during the 1930s cases of poisoning were reported among men engaged in their manufacture. The nature of this occupational disease was characterized by a skin affliction with acneiform eruptions; occasionally the liver was involved, in some cases with fatal consequences. Subsequent safety precautions appear largely to have prevented further outbreaks of this disease in connection with the manufacture of PCBs, but from 1953 onwards, cases have been reported in Japanese factories manufacturing condensers.

The distribution of PCBs in the environment was not recognized until Jensen started an investigation in 1964 to ascertain the origins of unknown peaks observed during the gas-liquid chromatographic separation of organochlorine pesticides from wild-life samples. In 1966, he and his colleagues succeeded in attributing these to the presence of PCBs. Since that time, investigations in many parts of the world have revealed the widespread distribution of PCBs in environmental samples.

The serious outbreaks of poisoning in man and in domestic animals from the ingestion of food accidentally contaminated with PCBs have stimulated investigations into the toxic effects of PCBs on animals and on nutritional food chains. This has resulted in limitation of the commercial exploitation of PCBs and polychlorinated terphenyls (PCTs), and in regulations to limit the residues in human and animal food.

The environmental impact of the PCBs and PCTs has been the subject

of several reviews, and has been discussed at a number of regional and international meetings. The relevant publications are mentioned in the previous section.

1.2 Summary

1.2.1 Composition and analytical problems

The commercial production of PCBs and PCTs by the direct chlorination of biphenyl and terphenyl leads to a mixture of components with a range of chlorine contents, the mean percentage chlorine in the product being controlled to give the required technical properties. Most of these components have been separated by gas-liquid chromatography, and the PCBs in the mixtures have been characterized after synthesis of the components by unequivocal routes. Techniques are available to analyse environmental samples for PCBs and PCTs, and experience has that interlaboratory collaborative studies are necessary to competence to determine residues below the 1 mg/kg level.

The commercial PCB mixtures contain various quantities of impurities among which chlorinated dibenzofurans and chlorinated naphthalenes have been identified.

1.2.2 Sources and pathways in the environment

The estimated cumulative world production of PCBs since 1930 is of the order of 1 million tonnes. Of this, more than one-half has entered dumps and landfills, where it is likely to be stable and released only very slowly. Much of the remainder has entered the environment by the disposal of industrial fluids into rivers and coastal waters, by leakage from nonenclosed systems, or by volatilization into the atmosphere from incineration of PCB-containing material at dumps. The ultimate reservoirs of PCBs and PCTs that enter the environment are mainly sediments of rivers and coastal waters. PCBs and PCTs are stable in the environment, but a small proportion is transformed by biological action and possibly by photolysis.

1.2.3 Concentration in the environment

Measured concentrations of PCBs in air range from 50 ng/m^3 to less than 1 ng/m^3. Nonpolluted fresh waters should contain less than 0.5 ng of PCBs per litre compared with 50 ng per litre in moderately polluted rivers and estuaries, and 500 ng per litre in highly polluted rivers. The concentration in living organisms depends upon the extent of local pollution, the amount of fat in the tissues, and the trophic stage of the organism in food chains. Highest tissue levels were found