CONTROL POLICIES FOR SPECIFIC WATER POLLUTANTS

PARIS 1982

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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LES POLLUANTS SPÉCIFIQUES DES EAUX

The number of pollutants likely to be found regularly in rivers of industrial countries is growing continually and has now reached several thousand. Though part of the increase may be explained by new analytical techniques which can identify a larger range of substances, industrial development continues to add to the number of pollutants released to the water environment. Many of these pollutants have been shown to be hazardous for man and wildlife: they may be acutely toxic or have long-term chronic effects, even at low concentrations. They include a large number of organic compounds, and a number of inorganic substances - heavy metals, for instance. Contamination of groundwaters, less significant in the past, is now also of concern, since traditionally safe drinking water supplies are also being contaminated and may soon become unsafe. Particular contaminants in this case are nitrates (from agricultural fertilizers) and organic solvents (of industrial origin).

Responding to serious concern in Member countries, the OECD Council recommended in 1974 that intensive efforts be made to control specific water pollutants. With this objective, the Environment Committee launched an integrated programme which was carried out by its Water Management Policy Group and completed in 1981. This report describes the results of the programme, including the identification of pollutants, their origin and pathways, and the possible impacts on human health, in particular through drinking water supplies. Practical control measures are assessed.

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TABLE OF CONTENTS

Part I

SUMMARY

Part II

ASSESSMENT, CATEGORISATION AND HAZARD RATING OF SPECIFIC WATER POLLUTANTS

Part III

ORIGIN, OCCURRENCE AND CONTROL OF SPECIFIC POLLUTANTS IN POTABLE WATER

Part IV

CONTROL OF ORGANOCHLORINATED COMPOUNDS IN DRINKING WATER

(An example of a practical control strategy)

Part I

SUMMARY

I.1. INTRODUCTION

Water pollution by defined chemical substances has a long history; classical examples in the past are phenols and pyridines in effluents from coke oven plants.

Since the mid-1960s, however, people have become aware that some substances - for instance mercury derivatives, DDT and PCBs - can persist in the environment, enter and become enriched in food chains and reach toxic levels in certain organisms. This recognition of toxicity has been a driving force behind the development towards stricter and better environmental management. Furthermore, studies sparked off by the recognition of these effects led to the realisation that contaminants from human activities are ubiquitous in the environment, and that many of these substances are potentially hazardous to man's environment. There is undoubted concern because:

- information on the type and quantity of substances discharged to the environment is incomplete;
- with a few notable exceptions, the information on environmentally significant properties, particularly stability, affinity for living organisms and short- and long-term toxicity is incomplete and scarce;
- a number of these compounds are not adequately removed by present treatment of waste water or potable water, and for other substances there is insufficient information;
- available control instruments - legal, administrative and others, and their implementation - do not always cover all situations where the discharge of specific pollutants should be controlled.

The specific (water) pollutants(*) concept was used to emphasize the difference, on the one hand, between

*) Specific (water) pollutant was defined, for the purpose of this study, as "a substance which is mainly introduced into the environment by human activity and which, under given conditions, lowers the quality and value of a water resource, particularly by toxic and nuisance effects on human beings or aquatic life". Specific pollutants have also been called "trace pollutants", "micropollutants", and "refractory pollutants". Other organisations, such as the EEC, have used different definitions.

identifiable chemical substances, and on the other hand classical aggregate or general parameters such as BOD(*), COD(*) and suspended solids. Some pollutants, for instance mercury and cadmium compounds and phenols, are defined chemical species. Other groups, such as cationic surface active agents, consist of closely related compounds which are sufficiently similar for the whole group to be considered as an entity in water management. A third group consists of a complex mixture of a large number of compounds - such as a textile process effluent - for which a substance-by-substance approach is extremely difficult.

Because of the complexity of the problem, it was not judged possible to carry out a complete assessment on specific pollutants control. For example, not all the characteristics of non-point sources were identified and although methods for analysis of costs of control of some specific pollutants have been improved, a complete analysis could not be made. The main objectives were to review the technologies and strategies for pollutant control, and to propose tools for coherent assessment and priority setting.

Specific pollutants have been found in large numbers in all types of natural waters ranging from obviously polluted industrial rivers to deep groundwaters which were thought to be protected from pollution. Estimates based on the total number of chemicals used in industry (and their probable break-down metabolites or by-products) suggest that the number of pollutants released in the environment is enormous. Most of these specific pollutants present in natural waters have not yet been identified. Industrial development is continuously increasing the number of specific pollutants in the environment. Besides, identification of these pollutants is limited by sensitivity of analytical techniques. Surveys in OECD Member countries have identified several hundred specific pollutants.

Many pollutants have already been shown to be hazardous to man and to aquatic life, and others, which are not acutely toxic, have been shown by laboratory tests or epidemiological studies to have long-term chronic effects. Finally, even nuisance effects may prove very costly, when, for example, supplementary stages are necessary in the preparation of potable water.

The capability of traditional waste water treatment plants to reduce, to acceptable levels, pollution as measured by classical parameters, is now recognised as insufficient. Furthermore, this study illustrated the limited ability of these plants to remove specific

*) Biological Oxygen Demand; Chemical Oxygen Demand.

pollutants. For example, recent comparisons of BOD, COD and TOC data have shown that treatment plants do not remove certain types of organic compounds. The potential toxic, carcinogenic and nuisance effects of many pollutants are therefore sufficiently serious to encourage more rigorous examination of sources of pollution and measures by water authorities to combat them.

I.2. PRINCIPLES FOR EVALUATING SPECIFIC POLLUTANTS

Recognising that monitoring of specific pollutants and quantification of the problem is difficult, and acknowledging that action is needed to prevent deterioration of water quality, the Water Management Group proposed a framework and guidelines for gathering quantitative and qualitative data on specific pollutants (see Part II for further details).

Lists of hazardous chemicals - "black lists" - based on existing information and experience, although useful, are not exhaustive and cannot possibly relate to all practical conditions. The Group therefore decided to try to develop a general, preventive and predictive approach better to protect potable water supplies and aquatic ecosystems, and which should meet water authorities' requirements for an evaluation system in day-to-day use.

The system takes into account the information required for decisions on control of pollution by widely occurring chemical substances and preparations. Data on, for instance, chemical and physical properties; potential effects on different kinds of organisms; use patterns; and removability from waters should be compiled and analysed before the appropriate level of control can be finally established. It is often necessary to make administrative decisions based on present knowledge before a full analysis of the situation can be made. Part II gives a basis for a hierarchical system for identifying substances which may endanger water quality. The system allows new information to be incorporated quickly. It is primarily intended as a checklist for experts working with regulatory authorities with the ultimate responsibility for evaluating hazards. The rational and consistent information structure is to aid overview and comparison and prevent inadvertent omission of important factors.

It was also recognised that those responsible for implementing water management policies would be helped if the hazard potential of specified water pollutants could be expressed by a simple formula which would assist in their ranking. A number of existing or proposed systems for rating hazards were first examined, but the Group noted that these were mainly intended for particular situations - such as the GESAMP profiles for the seaborne transport of chemicals.

A hazard rating system for general use in water management needs to cover a number of complex, frequently dissimilar situations, in which substances may be intentionally or unintentionally, partially or completely dispersed in waters. A choice had to be made between developing either an elaborate and complex rating designed to cover a maximum number of situations or a simple rating for alerting or early warning. While recognising the possibility of misuse of a simple rating system, the Group proposed an easily read formula which summarises particularly relevant data and alerts the water authority that the production, use or disposal of a particular pollutant may interfere with the quality of the water resources and that special protective measures may be required.

The system is called the THP rating, which stands for Toxic or harmful effects in the aquatic environment (T), Hazard to human health (H), and biochemical Persistence (P). The rating has three numbers related (on a logarithmic scale) to:

i) the lowest concentration at which the pollutant has an adverse effect on aquatic ecology;
ii) the lethal dose for oral intake by man (LD_{50});
iii) the maximum half-life of the specific pollutant in the aquatic environment.

The THP rating is easily understood, since the greater the value of the component numbers the greater is the need to consider regulatory measures. It is stressed that the rating has to be used with discrimination and it should not be used for purposes for which it was not designed. (See Part II for further details of the Hazard rating system.)

Lowest concentration having an adverse effect in the aquatic environment (g/l)	Toxicity T	Quantity giving rise to hazard to human life by direct oral intake LD_{50} (g/kg)	H	Estimated maximum half-life of pollutant in aquatic environment (days)	Persistence P
1	0	1	0	1	0
10^{-1}	1	10^{-1}	1	10	1
10^{-2}	2	10^{-2}	2	100	2
10^{-3}	3	10^{-3}	3	1 000	3
10^{-4}	4	10^{-4}	4		
10^{-5}	5	10^{-5}	5		
10^{-6}	6	10^{-6}	6		
10^{-7}	7	10^{-7}	7		

Suspected or established carcinogens are designated by adding a 'c' after the H value.
If a pollutant tends to be bioaccumulated a '+' is shown.

I.3. SOURCES OF SPECIFIC POLLUTANTS

Sources of pollutants may differ widely in technical and environmental significance as well as in ease of control. The principal types are point sources and non-point (diffuse) sources but there are some overlapping and borderline situations.

A. POINT SOURCES

Until the present, point sources have been the major category. They include:

Industrial sources:

- extraction and primary processing of minerals and fuels;
- industrial production of materials and chemicals;
- utilisation and transformation of materials and chemicals by industry;

Municipal sources:

- domestic, commercial, service and small industries.

a) Industrial sources

i) Extraction and processing of minerals and fuels

Several forms of mineral extraction give rise to effluents or spills which, without preventive measures are likely to impair water quality. Decisive factors are the character and richness of the particular mineral and the local technical, geological and hydrogeographical conditions. Typical pollutants from mineral extraction are toxic metals and sulphuric acid from weathered sulphidic ores, sulphuric acid and certain organic chemicals from pyritic coals and alkaline earths, metal sulphates and chlorides from rocksalt deposits. Mainly for economic reasons, OECD Member countries have tended to close the smaller operations, leaving large-scale and long-term activities. Extraction of a particular mineral is often confined to a few sites.