

MARINE POLLUTION RESEARCH IN SINGAPORE

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ABSTRACT

The intense usage of Singapore's coastal waters has increased the potential for marine pollution. However, with rigorous monitoring and research programmes and effective legislative enforcement, marine pollution in Singapore is being minimised. This paper lists the various government and quasi-government agencies directly and indirectly involved in marine pollution control. The responsibilities of these agencies are discussed and the type of data collected are identified. The recent conferences and symposia on marine pollution and related topics are also given.

1. Introduction

The increased use of our coastal waters by shipping, industrial (especially petroleum), domestic and agricultural activities has resulted in greater marine pollution problems, especially within our confined territorial sea space. This has necessitated the careful use of the territorial sea space, the careful monitoring of pollutant levels, and legislative measures to keep these levels under control. As pollutants are also brought to the marine environment by inland rivers, canals and streams, efforts to reduce pollution in these inland water bodies will lead to a cleaner marine environment.

Several government and quasi-government organizations are involved in the monitoring of pollutant levels in Singapore waters. Their main concern is to ensure safe levels of pollutants for public health, aquaculture activities and marine life. Their monitoring and research activities provide a basis for the formulation of control measures in the form of anti-pollution acts and other related legislation.

Many published research papers review the general water pollution situation in Singapore (Lye 1971, Chen 1972, Kuttan 1972, Goh 1976, Lee 1978, Lim 1979, Liu 1979). Most of the research in marine pollution pertains to the physical, chemical and biological characteristics of waters around Singapore: levels of heavy metals, hydrocarbons, etc. (Chai 1975, Chai and Wong 1976, Wong and Lee 1976, Rahman and Chia 1976, Chung 1979); thermal effects (Chin 1975, Khoo and Chin 1983); and nutrient and associated plankton abundance (Tham et al. 1968, Khoo 1980). Much

work has also been done on oil pollution (Oakley and Cripps 1972, Preston et al. 1972, Tan 1973). Research carried out in inland water bodies provides information on levels of industrial effluents, agricultural wastes and other potential pollutants from commercial activities (hospitals, hawkers centres, etc.). Water recycling and methods of water and sewage treatment have also been studied (Oakley and Cripps 1972, Lim 1973, Ng 1978).

2. Organizations Involved in marine pollution research

The research and control agencies of water pollution in Singapore are discussed. It should be noted that both inland and coastal water pollution will be considered, since contamination from inland water bodies is a major source of marine pollution.

2.1. Government agencies

2.1.1. Ministry of the Environment (MOE)

The Ministry of the Environment is responsible for the protection and improvement of the environment, of which water pollution is an important facet. Two departments in the ministry are especially active in pollution monitoring and research, namely the Anti-Pollution Unit (APU)¹ and the Sewerage Department. The Ministry is the administrator and enforcer of 2 legislative acts, the Water Pollution Control Act (1975) and the Trade Effluent Regulations (1976)². The Ministry is also involved in clean-up projects of rivers and inland waters. Its recent joint project with the Primary Production Department is the rehabilitation programme of the Singapore River and Kallang Basin. Besides these, the Ministry maintains and develops the sewage system in Singapore. In order to fulfill its responsibilities, the Ministry has an on-going monitoring programme, with regular sampling of water in streams and rivers in non-catchment areas, drains and coastal waters. These include chemical, physical and bacterial characteristics of water at specific locations. Most of these data, however, are unavailable to the public.

2.1.2. Port of Singapore Authority (PSA)

The Port of Singapore Authority is a statutory board under the Ministry of Communications and Information that manages all coastal waters of Singapore. It spearheads all activities related to the prevention, control and co-ordination of

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¹ The Anti-Pollution Unit and the Water Pollution Control Section of the Sewerage Department were merged in August 1986 to form the Pollution Control Department (PCD).

² A third Act, the Poisons (Hazardous Substances) Rules (1986) was gazetted to provide stricter control over storage and transportation of dangerous substances.

counter measures against marine pollution in Singapore coastal waters. There is an overlap of responsibilities with the Ministry of the Environment.

The activities of the PSA include the enforcement and jurisdiction of the Prevention of Pollution of the Sea Act, 1976, and the Civil Liability (Oil Pollution) Act, 1973; daily removal of flotsam and debris; collection of refuse and wastes from ships; and slop and sludge treatment.

Research in marine pollution is mainly concerned with oil pollution and its control. The data recorded by PSA include:

1. Shipping activity - the main source of oil pollution. Daily, weekly, monthly and annual data are available.
2. Total number of oil spills: the location of occurrence and, if possible, the magnitude of oil-spills. This enables PSA to mark out high potential oil-spill areas and implement necessary measures to contain oil spills within these areas.
3. Records of sources and causes of oil pollution.

The data are presented in the PSA Annual Reports.

2.1.3. Primary Production Department (PPD)

The Marine Aquaculture Section of the Primary Production Department (Ministry of National Development) is also involved in the regular monitoring of coastal waters designated as aquaculture areas. A series of surveys yielded detailed reports of water conditions in the East and West Johore Straits (Lim 1984a, 1984b). The PPD is also involved with the Ministry of the Environment in the monitoring of water conditions in the Singapore River.

2.1.4. Public Utilities Board (PUB)

The Public Utilities Board is a statutory board responsible for the production, treatment and distribution of potable water. It is also responsible for the monitoring of water quality in rivers, streams, reservoirs and lakes in catchment areas.

PUB conducts daily water sampling of some 160 points along the water supply system. It also monitors water quality in catchment and potential catchment areas. Weekly sampling of water in Jurong Lake and Western and Bedok catchments is conducted. Water from the reservoirs is sampled once a month. Other data recorded are: the water stock in reservoirs and low rates of catchment streams. Some of these data are available in the annual PUB reports.

2.1.5. Singapore Institute of Standards and Industrial Research (SISIR)

SISIR is a national standards body and a research and development organisation which assists local industries. In the area of pollution research, it conducts surveys to monitor the level of trade effluents.

2.1.6. Department of Scientific Services

The Department of Scientific Services is a support agency for the Ministry of Health and has environment control as one of its concerns. The department conducts water analysis of inland waters.

2.2. Tertiary Institutions

The main tertiary institution involved in marine pollution research is the National University of Singapore. Extensive work in the form of published papers as well as unpublished reports, papers of academic exercises and others has been done by the departments of Chemistry, Geography, Civil Engineering and Zoology.

The Department of Chemistry has done some research on the uptake of certain metal pollutants in plants (Wong et al. 1984).

The research of the Department of Geography includes work on coastal management and pollution control (Chia 1981, 1982, 1985); inland water bodies, e.g., Seletar Reservoir (Paklam et al. 1974); and general environmental pollution, including water pollution and possible measures of environmental conservation (Chia 1978, Paklam and Manson 1978).

The Department of Civil Engineering has dealt with water pollution with respect to the impact of wastewater discharge on the marine environment and its control (Aziz 1981a, 1984, Aziz and Jalal 1984, Aziz and Ramaswamy 1978, Koe and Tang 1985). Some work has also been done on the engineering aspect of water treatment e.g., sewage and sludge (Aziz 1981b, Chin and Ng 1984).

Research by the Department of Zoology involves the biological aspect of water pollution. Hydrological studies have been combined with extensive studies of marine life: plankton, fish, shellfish and other organisms (Chua 1970a, 1970b, 1970c, Tham et al. 1968, Johnson 1973a, 1973b, Khoo 1973, Tham 1973, Tan 1973). Some work has also been done on the uptake of certain pollutants by organisms (Sin et al. 1982, Tan and Lim 1984).

These reports and theses are available at the Central Library, NUS and libraries of the departments in which they were written.

3. Conferences and symposia on marine pollution

Conferences and symposia on marine pollution are very important in the dissemination of results of experiments and surveys. Some of these are held on a regular basis by the Science Council of Singapore, Singapore Manufacturers'

Association, and tertiary institutions (including the former Nanyang University - Institute of Natural Science, and the University of Singapore). They include:

- * Regional Workshop on Water Resources, Environment and National Development (1972: by Science Council of Singapore and National Academy of Science of the USA).

- * Our Environment (1976: 1st Symposium by Institute of Natural Sciences, Nanyang University; 1979: 2nd Symposium, Institute of Natural Sciences, Nanyang University; 1984: 3rd Symposium by Faculty of Science, NUS).

- * Pollution Prevention and Environment Conservation in Singapore (1978: by Science Council of Singapore and Singapore Manufacturers' Association).

- * Seminar on Water and Food Industry (1979: by Science Council of Singapore and Singapore Institute of Food Science and Technology).

- * Workshop on Coastal Resources Management in Singapore (1986: by Science Council of Singapore, ASEAN-US Cooperative Programme on Marine Science).

4. Conclusion

Marine pollution levels in Singapore coastal waters have been reported to be acceptable despite the large population of people and the intensity of usage. This is due largely to good management, strict legislative acts enforced and the efficient flushing effect of the tidal currents off the southern coast of the mainland. It has also been reported, however, that the waters of the Johore Straits may potentially face problems of pollution since the natural flow of currents is interrupted by the causeway linking Singapore to Johore (West Malaysia). This problem may be aggravated by the concentration of urban, industrial, agriculture and port activities on both sides of the Straits (Chia et al. 1988).

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