

WATER POLLUTION CONTROL
IN
DEVELOPING COUNTRIES

Proceedings of the
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Held at Bangkok, Thailand
February 21 - 25, 1978

Edited by

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PREFACE

Environmental pollution is a fact of life, but has reached alarming proportions because of rapid population growth, increasing urbanization and industrial development. Urbanization increases as a country develops economically, and environmental pollution will become more severe. Indeed, it is unfortunate to observe that there is a direct conflict between economic development on the one hand, and environmental pollution control on the other hand in many developing countries. While the former provides greater employment leading to a generally higher standard of living, the latter commands a low priority in terms of national investment. The quality of the environment in which we live, work and play affects the quality of life itself and there is an obvious interaction between the two. Fundamental principle to a rational approach in environmental pollution management is the principle of relating environmental quality standards to the demands of legitimate beneficial uses of the environment. Of all natural environmental resources, water is the most severely threatened by pollution. Hence, water pollution control is presently a high priority in many countries and among numerous pollution control agencies.

Organised by AIT's Environmental Engineering Division this International Conference on Water Pollution Control in Developing Countries is to enable the exchange of experiences, ideas and plans for water pollution control in developing countries. It was designed to deal with technical, legislative, social, economic and managerial aspects of water pollution control in developing countries. Two volumes of the Conference Proceedings contain 88 papers and 10 keynote addresses on many aspects of water pollution control and management. These papers were selected from more than 120 contributions encompassing 20 countries, and classified under ten topics. The division into ten sections is, in some cases, rather arbitrary since several papers could deal with more than one subject. It is suggested that the reader refer to the abstracts and keywords section in Volume II.

We gratefully acknowledge the financial assistance of the Canadian International Development Agency, without which this Conference would have not been possible. The cooperation of the International Association of Water Pollution Research (IAWPR), the National Environmental Board (NEB) of Thailand and the International Water Resource Association (IWRA) are highly appreciated.

To ensure a uniformity of typographical presentation, most papers have been edited and retyped. For any mistakes that have been by-passed, we assume full responsibility and wish to extend apologies for such mistakes. Miss Chalerm Sri Liengvichuphun, Mrs. Ladawan Boonykietibotra and Mrs. Ratana Siengsukon did most of the retyping of manuscripts, while the environmental engineering students put a final touch on the drawings. The assistance of Mrs. Pat Lee in editing the manuscripts is gratefully acknowledged. To them we extend our deepest appreciation and gratitude. Finally, we wish to thank Professor Robert B. Banks, AIT President and Professor Hiroyoshi Shi-igai, AIT Vice-President and Provost and all members of the Organizing Committee who are greatly appreciated without whose counsels this Conference would not have been possible.

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REGIONAL AND COUNTRY REPORTS

**INTERNATIONAL CONFERENCE ON
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WATER POLLUTION CONTROL IN THE REPUBLIC OF CHINA

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ABSTRACT

This is a country report of water pollution control in the Republic of China. Owing to population increase, rapid growth of industry and expansion of urbanization, the extent of water pollution ranges from moderate to serious along the downstreams of most rivers in Taiwan. The main sources of pollution are industrial and domestic wastes. This paper reviews the physical features, present status of water pollution, damage caused by pollution, and control measures including legislation, the work of executive agencies and control programs implemented so far.

INTRODUCTION

Taiwan, an island located 150 Km off the coast of China Mainland, covers an area of 35,980 sq km. 32% of the island is mountainous (above 1,000 meters mean sea level), 31% is hilly terrain between 100-1,000 m and the remaining 37% below 100m is alluvial plains where cultivated lands and human settlements are concentrated. In 1976, the total population of Taiwan was about 16.5 million with a density of 458 persons per sq km or 1,795 persons per sq km of cultivated land. The urban population was 65.3% and rural 34.7%. The urban population has grown at a much faster rate than the population as a whole.

In the past two and half decades, the country has concentrated on economic development. Taking 1952 as the base year, the general index of agricultural production rose by nearly 167% and that of industrial production rose nearly 25 times between 1952 to 1976. The country's gross national product in 1952 amounted to only US\$1.3 billion and per capita income was US\$132, while in 1976, the GNP reached US\$17.2 billion and per capita income increased to US\$809.

The climate is subtropical in the north, and tropical in the south. Rainfall is abundant, but its distribution is quite uneven, mostly concentrated in short periods during the rainy season. All rivers are short, steep and non-navigable. The riverflows are sudden and torrential after each storm, but during the dry season from November to April, their flows are very low. The availability of dependable surface water resources for utilization is therefore limited. At present, the largest use of water is irrigation, followed by industrial use and public water supply. The extensive agricultural area on the west part of the island has virtually utilized all dependable riverflows. Storage reservoirs have been constructed to augment dry season flows. Groundwater is being extracted in increasing volume. In 1976, the total water utilization was estimated as 16.6 billion cu m, of which irrigation accounted for 87.4%, and public water supply and industrial use, 13.6%. Future demand in 1995 has been forecasted at 20.2 billion cu m, of which 73.2% will be used for irrigation, and 12.3% and 14.6% for public water supply and industry respectively.

PRESENT STATUS OF WATER POLLUTION

The demand for water in Taiwan has been increasing rapidly every year. Much of the water drawn from surface and underground sources is returned to surface rivers in the form of irrigation returns, industrial and municipal wastes. It was roughly estimated that non-consumptive return flows of all uses amounted to 7.8 billion cu m which represented 47% of the total demand (16.6 billion cu m). At present the degree of water pollution ranges from moderate to serious along downstreams of most rivers in the western plains of the island.

Municipal and Domestic Wastes

As all cities and towns are densely populated, the construction of sewage and sewerage systems is far behind the actual need. In the past, farmers used nightsoil as fertilizer for agriculture. At present chemical fertilizers are used and the nightsoil is mostly disposed into nearby rivers. Everyday, an average of 3,000 metric tons of nightsoil are produced (800 MT from Taipei City and 2,200 MT from Taiwan Province). In 1976, only 30% and 0.7% of the population were served by storm sewers and sanitary sewerage systems respectively. Currently, there are only eight treatment plants with a design capacity of 29,720 CMD serving a population of 108,000 persons. When the secondary treatment plant at Dihua of Taipei City is completed in 1979, the total treatment capacity will be increased to 274,000 CMD serving 1.6 million persons.

Industrial Wastes

In 1976 there were 56,381 units of industry and mining, of which about 3,189 plants discharged industrial wastes. The total wastewater was estimated as 824 million cubic meters with a calculated BOD loading of 326,000 metric tons per year or 1,087 tons per day in 1976. The in-