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UNITED NATIONS DEVELOPMENT PROGRAM

Report on

WATER QUALITY

An Overview of The Present Status and

Future Opportunities

For The

GOVERNMENT OF INDONESIA

State Ministry For Population And Environment

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Executive Summary

This report is directed toward providing some answers to the question--

What should the Government of Indonesia (GOI) do to prevent water pollution from getting worse?

The search for answers began with an overview type inventory of the water quality issues present today. Three issues were identified: domestic sewage and solid waste, industrial waste water and regional water quality management.

Domestic sewage accounts for the dominant source of water pollution in both urban and rural areas in most parts of the nation. No sewage treatment plants exist except in a few minor isolated cases and no major construction program for sanitary sewers and treatment plants is contemplated in the decade ahead. The ongoing projects to provide a sewer interceptor system for approximately one-half of Bandung by 1985 and to provide interceptor sewers and oxidation ponds for a small part of Jakarta are the only known exceptions. Large quantities of domestic solid waste often accumulate in the rivers and canals to reduce the hydraulic capacity of these water channels. The result is aggravated flooding of adjacent land usually occupied in urban areas by low income housing. The flood waters are frequently contaminated with raw sewage creating serious health hazards. The wide range of activities completed and in progress to provide potable water supply and sanitation facilities for the majority of the people during this decade is impressive. The unwritten present policy on domestic sewage and water borne disease is apparently to separate the people and their water supply from the rivers which frequently are similar to open sewers. This policy seems appropriate for now and perhaps for the remainder of the century.

Industrial waste water accounts for a small but important fraction of water pollution present today. Two estimates for greater Jakarta ranged from less than 5% to 30% of the organic pollution present. No estimate has been made for the nation. Industrial waste water probably contains a large fraction of those heavy metals and toxic chemicals that tend to accumulate in the bottom muds of rivers and deltas. They also tend to accumulate in the food chain of aquatic ecosystems and can create dangerous health hazards for humans who eat the fish and other sea food grown in such polluted waters. Examples include mercury, cadmium, PCB and dioxin. Some government regulations on industrial waste water exist, particularly in Jakarta and in Surabaya, but they are not enforced due to inadequate staff and facilities to monitor and enforce. Although there are a few exceptions, the unwritten present policy on industrial waste water is to discharge any volume of any waste into any stream or tributary. This policy does not seem appropriate. It should be changed as soon as possible.

Comments on the requirements for an effective monitoring and enforcement program of industrial pollution abatement are made. The political will to enforce is required. The development and passage of a pollution control regulation without monitoring and enforcement usually guarantees failure of the regulation.

A number of specific recommendations for monitoring and enforcing industrial pollution control are made including suggestions for selection of industry type and location appropriate for initial implementation of the regulation enforcement. Further, comments on the institutional features of a government enforcement organization are made. An industrial discharge permit system is suggested as a process to monitor pollution abatement progress. Cost effectiveness in pollution abatement can be encouraged through several avenues such as ordering a uniform treatment level (secondary or equivalent) for all

industries or by encouraging economy of scale through using one treatment plant which receives waste water from a number of adjacent industries or by developing an incentive system to encourage in plant process changes which reduce the volume and strength of the industrial effluent.

The regional water quality management issue was directed toward those complex land and water use problems that often develop within an intensively used river basin. Upstream land use practices such as deforestation or undercutting terrace walls to create wider valley rice paddies often contribute excessive soil sediment to downstream reservoirs or river deltas. Upstream domestic sewage and industrial waste water often provide polluted water to downstream users. These problems are usually best understood and analyzed for effective solution through a system's approach which includes field monitoring of the biophysical system and computer simulation of alternative corrective actions. There is no policy at present on regional water quality management. A pilot study is suggested to correct this situation. The study could be centered at one of several known river basins containing complex upstream/ downstream problems. It could serve as the focus for training qualified scientists, engineers and support staff to conduct such investigations.

Some elements of the recommendations presented such as the training and education programs seemed appropriate for possible external financial support. They have been highlighted for that purpose (see Section IV. B. 3. page 15. Organizations such as the World Bank, the Asian Development Bank, United Nations or government agencies like the US AID are candidates.

The report concludes with suggestions for addressing longer term water quality issues such as ground water overpumping in coastal areas and extended training needs for both industrial and government technical staff members. Several appendices contain details of subjects discussed briefly elsewhere.

I. INTRODUCTION

The purpose of this report is to provide an independent overview of programs and activities related to water quality in effect at present as well as to suggest future activvities for maintaining and improving management of the environment. Put in another way, this report is intended to provide some answers to the following question:

What should the Government of Indonesia do to prevent water pollution from getting worse?

The attempt to obtain answers was based on a five-week visit to Indonesia with most of the time spent in Jakarta working out of the State Ministry for the Population and Environment Office. Side trips of two to four days duration to Bandung and Surabaya on Java and to Denpasar and surroundings on Bali also occurred. Many meetings with government and industrial officials were held along with a number of field trips through industrial estates, rural areas, villages and kampungs in large urban areas.

This report has been organized to include initially a discussion of the primary water quality issues identified. Next comments on requirements for water pollution abatement are provided. Recommendations follow. The report concludes with some thoughts for the longer term and appendices containing details not presented elsewhere.

II. PRIMARY WATER QUALITY ISSUES

A. Domestic sewage and solid waste

The dominant water quality issue in Indonesia is and will probably continue for a generation to be domestic sewage. The rivers in most urban areas are really open sewers partially clogged with solid waste. During the dry season many river reaches are without oxygen. The coliform counts are very high indicating a major threat to human health. Water borne diseases account for the primary cause of death at all ages. During the wet season, low land flooding is more frequent due to the reduced hydraulic capacity of the rivers and drainage canals. Low income families next to the rivers and canals are flooded with diluted raw sewage providing increased threat of water borne disease.

The existing plans and activities designed to alleviate this water quality problem seem to be well conceived and the implementation schedule, although slow and with some trouble spots, is adequate. The Kampung Improvement Projects (KIP) are effectively isolating many low income urban families from polluted water supplies. The drainage and walkway improvements coupled with potable water supply and the public toilet, washing and water standpipe, Mandi-Cuci-Kakus (MCK), are quite successful. More attention is needed to the maintenance and replacement of the existing potable water distribution system in most urban areas. This problem, along with the related need to reduce water theft is well documented and some corrective actions have already occurred. Expansion of the urban water supply is underway in Jakarta, Bandung and Surbaya. Plans for increased raw water supply from upstream surface storage are also in place and some new reservoirs, e.g. Saguling on the Citarum, are near

completion. The urban solid waste problem has not been solved yet but it is receiving special attention and some progress has been made. The experience gained in Bandung as part of the Urban Development Project should be valuable in this regard.

Domestic sewage and related health problems are also very significant in rural areas where unprotected water supplies are often polluted by human sewage. The rivers are frequently full and flowing with water for irrigation so the existence of gross open sewers is less frequent. Water supply improvements and community health programs are either planned or in progress throughout large segments of the rural area.

It has been sobering to learn that all of these water supply and sanitation projects and programs are not expected to result in a rapid reduction of water borne disease and death. Today most small children contact many diseases early in their life when a natural immunity develops quickly. Such immunity is less effective in older people so children protected while very young are more likely to have fatal attacks after childhood. It may be a decade or more before cholera, typhoid and malaria are significantly reduced.

The implicit environmental policy for domestic sewage in effect today is: Use the rivers as open combined sewers and make low cost improvements in the urban and rural infrastructure to isolate the people from the open sewers whenever possible. The policy seems appropriate for now. It may need some alteration in the near future as the urban areas continue to grow and the coastal areas near the river mouth become excessively polluted, particularly during the early stage of the wet season when the rivers are flushed into the ocean.

B. Industrial waste water

A small, but important, contribution to degraded water quality is from industrial waste water. Many manufacturing plants have been erected and are operating in the major urban centers, e.g. Jakarta, Bandung, Semarang, Surabaya and Medan. With rare exception the human sewage and industrial process waste water generated within the plants are released without treatment into open drainage ditches which flow into the rivers and canals already clogged with solid waste and domestic sewage. Estimates vary from less than 5% to more than 30% of the river pollution from industry but no one really knows. These industrial wastes probably contain most of the toxic and non-degradable wastes that enter the rivers and eventually end up in the river deltas and coastal areas where they can accumulate in the aquatic ecosystem food chain and eventually cause serious problems. Examples include heavy metals like mercury and cadmium and complex organics like PCB and dioxin.

Industrial pollution is also present on other islands than Java. Although no visits were made the following comments can be made based on a minimum of discussion and report reading. Kalimantan has problems with the discharge of bark and sawdust from sawmills in the rivers. Sumatera has three separate types of industrial water pollution.

-High biochemical oxygen demand (BOD) discharges and related oxygen depletion in rivers receiving waste water from tapioca manufacturing plants in the Kampur area.

-High BOD discharges from palm oil processing plants.

-Waste oil discharge from petroleum refineries.

This has occurred due to inadequate storage space adjacent to

storage tanks. During the rainy season, rainwater combines with spilled oil and fills the storage behind dikes constructed around the tanks. The oil water mixture eventually overflows into the river and nearby wet lands.

Many regulations in effect apply to industrial water supply and waste water disposal but very few are enforced. The Ministry of Industry provides permits for plant locations and construction but the files are both incomplete and rather inaccessible. The provincial governments of both Jakarta and Surabaya have water quality standards in regulation which include periodic reports from industrial discharges. From the more than 5000 industries in Jakarta reports were received from only ten. The Industrial Estate Rungkut in Surabaya is the only known location of a treatment plant which receives and efficiently treats sewage and industrial waste waters. The Ministry of Health also has water quality regulations but they are not enforced. Enforcement is nearly impossible at present due to inadequate staff with inadequate training and equipment, both field and laboratory. A uniform laboratory analysis procedure, necessary for assuring reliability and reproducability of results, does not exist at present. Some progress has been made to increase monitoring and laboratory analysis skills, particularly through short courses offered by the Water Quality Branch, Institute of Hydraulic Research, Ministry of Public Works in Bandung.

Informal discussions with staff members from industrial estates in both Surabaya and Jakarta indicated an awareness of the pollution problems and a general willingness to work with government to abate them. They all cited the lack of adequate regulations as the primary reason nothing is done. They are generally aware of the potential long-term effects on the environment from many

toxic chemicals and heavy metals. Once ordered by an enforceable and implementable regulation, most larger firms would likely comply.

The implicit environmental policy in effect for industrial waste water is no policy, i.e. employ workers and produce salable products without concern about water pollution. This policy can and should be changed very soon in order for significant compliance to be achieved within five years.

C. Regional water quality management

Regional water quality management issues associated with a river basin are complex and not well understood. Downstream degradation caused by upstream land and water use are difficult to address scientifically, politically and legally. They often cross political jurisdictional boundaries and frequently pit the farmer against the fisherman or city dweller. Cause and effect relationships are often unclear and are separated by large time delays.

Examples include: 1) Upstream soil erosion caused by deforestation and rice paddy terracing which fills downstream reservoirs with sediment rapidly thereby reducing their life or creates shallow deltas at the river mouth which reduces the river hydraulic capacity and increases flooding in downstream urban areas. Deforestation in the upstream reaches of the Citanduy and theCitarum river basins has increased soil erosion, sediment transport and river mouth delta formation. 2) Downstream reservoir construction which reduces the natural river capacity to assimilate upstream organic waste. The Saguling reservoir will affect the Citarum River assimilative capacity downstream of Bandung. 3) Upstream changes in land use from irrigated agriculture to urban

housing which reduces infiltration and water storage during the wet season, result in a reduction of dry season river flow downstream and increases wet season runoff and associated downstream floodings. The Ciliwung has been reported to have had a base flow of equal magnitude during both dry and wet seasons a decade ago when the area was primarily agricultural. Today, the watershed has large urban areas and the dry season base flow is 10% of the wet season base flow.

A basin wide system analysis approach based on topographic, hydrologic, hydraulic and land use field data as well as economic data would assist planners and policy makers in the future to predict the environmental effect of alternatives to change land and water use upstream. Such analyses are not possible today due to inadequatly trained personnel in the universities and in the government as well as inadequate monitoring staff and equipment. Environmental data systems management using appropriate digital computers and computer graphics techniques will be necessary for effective analysis. Some government staff, particularly in the Ministry of Public Works and the State Ministry for Population and the Environment are aware of the value of the basin wide analysis approach. The Ministry of Public Works has organized its water resource planning program to coincide with river basin or water region boundaries. A foundation exists, therefore, for a demonstration project in regional water quality management.

There is no policy at present addressing the environmental consequences of regional water quality management.

III. PREREQUISITES FOR EFFECTIVE WATER POLLUTION ABATEMENT

The abatement of water pollution usually depends upon the existence of implementable and enforceable regulations. Some nations, such as Sweden, have been able to reduce water pollution through voluntary efforts based on public information, university research, government demonstration projects and national pride. Most nations, including most of Europe and North America required government regulations and enforcements to achieve the same goal. It seems apparent that Indonesia is no exception.

The government regulations will probably be effective if the following conditions are met:

- There is public understanding and support of them. This includes both the public at large and the business community in particular.
- There is a political will to enforce them.
- They are based on scientific knowledge and state of the art process design.
- There is equity in the implementation and enforcement process.
- There is an adequate number of well trained government staff who have supplies and equipment to monitor the effluent and receiving waters being regulated.
- There is an adequate number of trained government employees to enforce the regulations when necessary.

Pollution abatement is not likely to occur if any one of these conditions are not met.

IV. RECOMMENDATIONS

A. General Recommendations

Three general recommendations can be made--one directed toward each of the primary issues described in Section II.

1. Continue the broad-based efforts to reduce water related health problems by encouraging the separation of people, particularly the low income rural and urban citizen, from the rivers which frequently contain large quantities of raw sewage.
2. Develop, implement and enforce an industrial pollution control regulation.
3. Organize and conduct several demonstration projects to gain experience and confidence in regional water quality management.

Specific recommendations on the industrial pollution regulation and on the regional water quality management demonstration projects follow.

B. Industrial Pollution Control Regulation Specific Recommendations:

1. Use the existing draft regulation on water pollution control as a statement of policy and general guidelines but do not

expect either implementation or enforcement since the conditions stated in Section III are not all met.

2. Develop a more implementable and enforceable regulation for dissemination by ministerial decree for industrial pollutiion. Suggestions for the regulation follow:

   a. Direct it to larger industry only. For example one criterion might be to have the regulation apply only to industries that have more than 100 employees at any one location. This would exempt all home and other small industry scattered throughout. Of course the right to include any small industry must be retained to prevent problem polluters.

   b. Stage the schedule of implementation to match the growth of government staff to monitor and enforce. For example the industries in selected provinces such as Surabaya, Bandung or Jakarta could be ordered to comply during the first five years with others to follow, or all industrial estates in the selected provinces could be ordered to comply first followed by others.

   c. Organize the government enforcement institutions to use existing government structure and available computer technology for efficiency and effectiveness. See Appendix C for a sample organization chart.

   d. Organize the regulation to obtain industrial participation early at a minimum level and then increase it as more information becomes available. For example, the initial

order could be for industry prepared effluent reports (strength and volume) to be submitted quarterly followed by monthly reports of daily flows one year later.

e. Require technology based treatment of all industrial effluent at the level of secondary treatment or its equivalent. This will be cost effective and simple to enforce. See Appendix D for more comments on cost effectiveness. Retain the right to require higher treatment level in special cases or to grant waivers under certain conditions.

f. Require discharge permits from each industrial plant which identify the level of discharge, both volume and strength, prior to installation of the treatment plant.

g. Encourage economy of scale installations through identification of logical sites along a main highway in the urban area which has many plants adjacent to it. Include offers of assistance in gaining approval from other agencies (local, provincial, central government) who may have jurisdiction on some public land or service needed.

h. Encourage cost effective in plant process changes that reduce the volume and strength of the industrial waste.

i. Retain the right to order disposal of toxic sludge at an environmentally inert location previously identified.

3. Organize and sponsor jointly with appropriate industry organization an information transfer program for all affected industries. For example:

   a. Create an industry advisory committee to assist in developing the regulation.

   b. Co-sponsor workshops and conferences on industrial waste water treatment. Hold some at successful installations such as the Surabaya Industrial Estate Rungkut.

   c. Facilitate the training and availability of local consultants capable of designing appropriate treatment plants. Many plants will probably be "off the shelf" package design readily available through foreign license and local fabrication.

*4. Facilitate the development of various educational and training program for both government and industrial technicians, engineers and scientists. For example:

   a. Short course on laboratory analysis procedures for technicians.

   b. Short course on field monitoring procedures for technicians.

   c. Short course on treatment plant fundamentals and typical operating problems for engineers and scientisits.

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*Candidates for External Agency Funding--See Executive Summary, page 3.

d. Graduate training in relevant subject such as environmental science, environmental law, and environmental engineering for engineers and scientists both in Indonesia and abroad.

Suggestions are presented in Appendix E.

*5. Facilitate the development of a pollution abatement cost incentive demonstration project. There may be some application for encouraging in plant process change to reduce water discharge while increasing production efficiency. A prime candidate for such a project is the Surabaya Industrial Estate Rungkut which already charges industrial dischargers according to effluent volume and strength. A copy of their charge formulation is presented in Appendix F. The Estate management has been very supportive of the overall effort to manage the environment and could be expected to participate enthusiastically in such a demonstration project.

*6. Facilitate the development of a demonstration project for pollution abatement of the tourist industry in Bali. Hotel management at the Bali Hyatt are efficiently operating an extended aeration secondary treatment plant at present. They could be expected to participate enthusiastically in helping other hotels and guest cottage facilities to collect and treat their sewage in a cost effective manner.

*C. Regional Water Quality Management Demonstration Projects

Three different demonstration projects can be identified that will provide experience in different aspects of regional water quality management. Each has downstream losses or benefits associated with upstream land, and water uses. Each depends upon use of applied mathematics and a computer combined with appropriate field monitoring and laboratory analysis of water quality and quantity data previously collected and organized in a data management system. Each is dependent upon a resource economist, an environmental engineer and an applied mathematician working together as a minimum size team to structure the analysis effectively and analyze alternative solutions seeking the most desirable answer based on predetermined criteria such as a minimum allowable flow rate, or dissolved oxygen level or a maximum water elevation.

1. Sunter/Cakung Environmental Management Project (SCEM)

This portion of greater Jakarta includes extensive irrigated agricultural land, urban industrial areas such as the Pulogadung Industrial Estate and a number of kampungs, all of which drain into Jakarta Bay near the harbor. A major multi-institutional sponsored project to monitor the environmental features including water quality during both dry and wet seasons is near completion. The SCEM project area could become the first sector of Jakarta for implementing all elements of the proposed industrial pollution control regulation. The data collected could serve as the base for a broader monitoring effort directed toward a watershed model to predict long-term effects of changing land use and water supply on the downstream reaches of both rivers. For example it may be found that the Sunter River could economically be diverted

into a conventional sewage treatment plant located downstream of the Pulogadung Industrial Estate to provide supplemental potable water during the dry season to the adjacent industrial and residential community.

2. Citarum River Upstream of Jatiluhur Reservoir

This part of the Citarum has a number of important water quality changes already in effect or soon to occur. Upstream deforestation, primarily for urban housing development, has occurred along with significant soil erosion and river sediment load. Within two years approximately one half of Bandung will be served by a sanitary sewer interceptor system which will discharge directly into the river. The Saguling Reservoir will be completed and put into operation in a few years. These changes can be incorporated into a watershed model to help answer important policy questions such as:

- Should a sewage treatment plant be built in Bandung at the junction of the new interceptor and the river?
- What operating policy for the hydroelectric plants at Saguling and Jatiluhur will provide the maximum benefits to the river users? (Power generation, downstream irrigation, water supply and flood control, upstream domestic and industrial organic waste assimilation.)

This river and land area has already been proposed for regional water quality modeling by the Ministry of Public Works and a proposal has been prepared by a UN-WHO consultant.

3. Jakarta Bay and Coastal Area

These tidal waters receive the land based raw sewage, industrial waste water and sediments from Jakarta as well as sediment and solid waste from a large area of West Java. The Bay is already polluted and is stressed particularly during the early weeks of the rainy season when the rivers and canals are flushed into it. A two-dimensional tidal hydrodynamic model coupled with a water quality model could be used to predict the effect of different pollution abatement schemes such as increasing dry season river flow for flushing or diverting dry season river flow to a treatment plant and eventual use as industrial water supply. The model could provide an estimate of the assimilative capacity in the bay and thereby provide informatiomn for planning upstream modifications before an environmental disaster occurs.

V. THOUGHTS FOR THE LONGER TERM

A number of suggestions for the longer term (beyond five years ahead) have been generated during the various discussions, field trips and preliminary preparation of this report. They are listed below to stimulate discussion and trigger early planning for activities like those suggested.

A. Dry season urban water supply

The future demand for potable water by industry and people in the Jakarta area will tax the conventional upstream sources. It may be cost effective and environmentally sound to divert one or more of the rivers

containing large quantities of raw sewage into treatment plants and obtain clean water for use in industrial plnts located nearby or to provide clean water for recharge into the aquifer to abate salt water intrusion or to recycle the cleaner water back into the water intake of the municipal potable water treatment plant. Such ideas may seem exotic now but they may not in a decade.

B. Groundwater overpumping and salt water intrusion

The present state of groundwater use in Jakarta and other coastal urban areas is not well regulated and continued overpumping of the aquifers can be expected unless the situation is investigated more fully and appropriate action initiated. Evidently the requirement to obtain a permit prior to drilling a well is not enforced and there is no record of the present pumping rate. Some coordinated investigations between the public agencies with authority would be desirable before more serious problems develop.

C. The industrial pollution control regulations should be expanded to other provinces as soon as staff, facilities and experience permits.

D. The proposed training and educational program for all personnel associated with water quality management should continue at appropriate educational institutions in Indonesia and abroad.

E. Other river basins, coastal areas and estuaries prone to environmental degradation should be monitored and modelled to predict the consequences of proposed alternatives such as upstream timber harvesting or downstream industrial estate and harbour construction.

VI. ACKNOWLEDGMENTS

This report has been prepared as part of the environmental sector review for the Government of Indonesia (GOI), State Ministry for Population and the Environment. This review has been scheduled for use by the GOI in the development of their fourth five-year national plan, (Repelita IV). Organization for the review and recruitment of foreign consultants as well as on-site coordination and logistics support has been provided by the United Nations Development Program (UNDP). Financial support for this part of the review has been provided by the International Institute for the Environment and Development (IIED) and the U.S. Agency for International Development (AID).

Many staff members of the State Ministry for Population and the Environment and other GOI agencies have been very helpful. In addition, a number of industrial and municipal officials contributed. Most names are included in Appendix B. Dr Naya Djajadiningarat served as staff coordinator for arranging most meetings. Dr. Robert Repetto, UNDP Consultant, was particularly helpful throughout the investigation period. The writer is grateful to all who gave freely of their time and ideas.

VII. REFERENCES

Government of Indonesia

Ministry of Public Works

- Greater Jakarta Water Supply Development Plan,
  JABOTABEK Metropolitan Development Plan.

Technical Report No. T/23, November 1980.

- Water Resource Availability and Use in Indonesia--a General Perspective, Directorate General of Water Resources Development, July 1983.
- Proposal for the Water Quality Management of the Citarum River Basin, Direktorat Penyelidikan Masalah Air, February 1981.
- The Water Resources of Indonesia--An Overview Directorate General of Water Resources Development, August 1982.

Ministry of Health

- Evaluasi Standar Kualitas Air Baadan Air - 1981/1982.
- Survai Kesenatan Rumah Tangga 1980.

State Ministry for Population and the Environment

- A Review of Information Systems for Land, Water and Forest Resources, September 1980.

- Kualitas Air Sunter Cakung, Draft Laporan, Proyek Sunter Cakung Environment Management, 1983.

Regulations and Laws

- Act of the Republic of Indonesia No. 4 of 1982 concerning Basic Provisions for the Management of the Living Environment.
- The Law of Republic of Indonesia No. 11 of 1974 on Water Resources Development.
- Kebijaksanaan Nasional Tentang Pengendalian Pencemaran untuk Periode Tanun 1984 sampai 1989 (English translation also available).
- Kententuan-ketentuan Mengenai Standar Kwalitas Air Buangan Industri Dan Petunjuk Pelaksanaannya, Gubernur Kepala Daerah Tingkat I, Jawa Timur, 1978.

United Nations

World Health Organization

- Water Quality Management for Citarum River Basin, Proposal prepared by Mr. K. Poppingnaus, WHO consultant on Water Pollution Control and Water Quality Management, 1981.
- Rapid Assessment of Water and Air Pollution Sources in Jakarta, Indonesia, report prepared by W. Martin and A. Economopoulos, 1980.

- Drinking Water and Sanitation Decade, 1981-1990, Decade Plan for Republic of Indonesia, UN official summary.

United Nations Development Program

- Guidelines for Water Quality Monitoring and Surveillance in Indonesia, Report prepared by Harvey F. Ludwig, UNDP, OTC/SF Project: INS-70/527, April 1978.
- Preliminary Assistance for Composting of Municipal Solid Wastes, Report prepared by Robert F. Gillet, May 1981.

Other Organizations

World Bank

- Jakarta Sewerage and Sanitation Project, Staff Appraisal Report No. 4158-IND, November 1982.
- East Java Water Supply Project, Staff Appraisal Report No. 4282-IND, February 1983.

Bogor Agricultural University

- Indonesia's Environmental Progress in Economic Development, Report prepared by R. Goodland,

Office of Environmental Affairs, World Bank, Washington, D.C., 1981.

Jakarta Industrial Estate Pulogadung

- Laporan Evaluasi Program-Program Pengelolaan Lingkungan Di Kawasan Industri Pulogadung, 1980.
- Annual Report, 1981.

Surabaya Industrial Estate Rungkut

- beberapa Informasi Tentang Cara Pembebanan Beaya Pemelinaraan Dan Operasi Sistem Pengolahan Air Bekas, 1983.

Publications

- Kneese, A. V. and Power, B. T., Managing Water Quality: Economics, Technology, Institutions, Johns Hopkins Press, Baltimore, Md., 1971.
- Anonymous, "Brazilian Stabilisation - Pond Research Suggests Low Cost Urban Applications," World Water, Vol. 6, No. 7, July 1983, pg. 20-24, London.

VIII. APPENDICES

A. Terms of Reference
B. Schedule of Activities
C. Model for Monitoring and Enforcement Agency
D. Comments on Cost Effectiveness
E. Education and Training Program Suggestions
G. Sewage Billing Practice
Surabaya Industrial Estate Rungkut

Appendix A.

Terms of Reference

Stated in cable from American Embassy, Jakarta to Agency For International Development, U.S. Department of State, Washington, D.C., June 1983.

A. Review current GOI plans for the development of a water quality management system, including objectives, assignment of responsibilities, underlying legislation and regulation, and mechanisms for enforcement.

B. Advise the GOI on its water quality management planning, taking into special consideration information regarding: current water quality in densely populated areas, programs for supplying drinking water and improving sanitation, current water-related environmental health problems, sources of water pollution, and administrative capabilities and availability.

C. Assist the Ministry in designing one or more pilot programs for the use of pollution penalty charges or other economic disincentives and incentives for control of water quality.

D. Advise the Ministry on needs for longer-term technical assistance in the development of the water quality management system.

E. Recommend improvements in the system for planning water supply and the regulation of water qualities in the context of overall basin planning.

Appendix B.

Schedule of Activities

June 26 to 30 Travel from Green Bay to Jakarta

July 1 to 3 Meet Robert Repetto, Acclimate to Jakarta

4 Jakarta - Briefing by staff of the State Ministry for the Population and the Environment

Mr. Rachmat Wiradisuria

Dr. R. E. Soeriatmadja

Dr. Naya Djajadiningrat

Dr. Repetto

Ir. Nurhadi

5 Jakarta - Ministry Office

Travel to Bandung with Soeriatmadja

6 Bandung - Meeting with Ir. Badruddin Mahbub

Institute of Hydraulic Engineering

Directorate General of Water Resources Development, Ministry of Public Works

Also present:

Dr. Soeriatmadja

Ir. Nornadi

7 Travel from Bandung to Jakarta with Mr. Nurhadi

8 Jakarta - Ministry Office

- Ministry of Health, meeting with

Ir. N. H. Sri Soewasti Soesanto and staff

Dr. Repetto

9, 10 Jakarta

Report Reading

Relaxation

11 Jakarta - Meeting with Dr. J. J. Bosken, Agency for International Development, U.S. Embassy

12, 13 Jakarta - Idul Fitri

Report Reading

Informal discussion with Dr. Repetto

14 Jakarta - Ministry Office

Dr. Naya Djajadiningrat

Dr. Repetto

Meeting with Dr. J. J. Bosken, AID US Embassy

Dr. David Calder, AID US Embassy

Mr. Michael Hauben, AID US Embassy

Mr. van Haderlie, AID US Embassy

15 Jakarta - Ministry Office

Meeting with staff of the United Nations

WHO - Mr. Damrong

Dr. Wilfredo Reyes

UNDP- Mr. Cgleslby

16 Jakarta - City Tour - Field Trip of Water Quality

Old Harbor

China Town

Kampungs

17 Jakarta - Relaxation

18 Jakarta - Ministry Office

Meeting with Minister Emil Salim

Mr. Kismadi

Dr. naya Djajadiningrat

Dr. Repetto

Meeting with Representative of Relevant agencies

Ministry of Population aand Environment

Dr. Sutaminardja

Ir. Nurnadi

Ir. Sri

Dr. Naya Djajadiningrat

Dr. Repetto

Ministry of Health

Ir. Sri soewasti Soesanto

Ministry of Public Works

Ir. Dermawan

Ministry of Industry

Ir. Santoso

PSLH - ITB

Ir. Wibowo Suryo

P4L - DKI

Ir. Yunani

Meeting with

IR. H. A. Razak Manan, Jakarta

Water Supply Utility (PAM)

Dr. J. J. Bosken, AID US Embassy

Dr. Naya Djajadiningrat

19 Jakarta - Ministry Office

Meeting withDr. Sutamihardja

Sunter Cakung Environmental Management

(SCEM)

Ir. Sri Oeripto

Travel to Bandung in UNDP Car with Dr. Repetto

20 Bandung

Meeting with staff of the Bandung Urban Development Project, including a field trip through a Kampung

Dr. Naya Djajadiningrat

Mr. John Macklin

Mr. Martyn Pells

Mr. Tom Carter

Ir. Sutikni Utoro

Dr. Robert Repetto

Ir. P. Sidabutar

Meeting with Director and Staff of the Environmental Study Center, Institute of Technology Bandung

Dr. Naya Djajadiningrat

Dr. Repetto

Meeting with staff of the International Water Supply Consultants

Dr. Naya Djajadiningrat

Dr. Repetto

Ir. A. F. J. Doppenberg

Field Trip to Citarum River

21 Bandung

Meeting with staff of the Institute

of Hydraulic Research, Ministry of Public Works

Ir. Badruddin Mahbub

Ir. Nurhadi

Dr. Sutaminardja

Travel to Jakarta and Denpasar

Meeting with

Mr. Rachmat Wiradisuria

Dr. R. E. Soeriatmadja

22 Denpasar

Meeting with Provincial Staff

Ministry of Public Works

Ir. A. R. Tambing

Ir. Made Subagia

Ir. Byoman Suharya

Ir. Heru Marsudi

Arch. Kertiyasa

Ir. Henri Dharmawan

Field Trip to Bali Hyatt Hotel

Ir. Wayan Mataram

Arch. Kertiyasa

Field Trip to Denpasar Water Supply Utility

Field Trip to Villages of Mas and Ubud

23 Denpasar/Sanur Beach

Meeting with Regional Planning Consultants

Dr. Ivan Landuyt

Ir. Ruchyat Deni Dj.

Field Trip to Lake Bratan and Lake Buyan

with many stops to observe irrigation projects

Ir. Made Subagia

Ir. Nyoman Suharya

Ir. Heru Marsudi

24 Denpasar/Sanur Beach

Relaxation, Report Reading

Travel to Surabaya

25 Surabaya

Meeting with

Prof. Narsetio Deonosepoetro, M.D.

Rector, Airlangga University

Meeting with staff of the Surabaya Industrial

Estate Rungkut

Ir. Bambang Pikukuh Notoamidjojo

Mr. Bambang Prijo Santoso

Field Trip to the Industrial Estate Sewage

Treatment Plant

26 Surabaya

Meeting and Field Trip with staff of

Provincial Office, Ministry of Public Works

Ir. Rochyat, D.S.

Ir. Marhadi

Meeting with staff of Surabaya Water Supply

Utility & Tour of Water Treatment Plant

Ir. Marhadi

Mr. Sukindro

Visit to Urban II, III Development Project for Kampung Improvement

Ir. Marhadi

Ir. Eddy Indrayana

Dr. John Silas, Institute of Technology, Surabaya

Ir. Mario J. Guy Arrieta, World Bank Consutlant

Field Trip to Kampung in Sidoarjo, 20 KM from Surabaya

Ir. Marhadi

27 Travel - Surabaya, Denpasar, Jakarta

28 Jakarta - Ministry Office

Mr. Kismadi

Dr. Sutaminardja

Ir. Sri Oeripto

Ir. Nurhadi

Ir. Susi

Mr. Harris

Mr. Bayliss

Dr. Repetto

Field Trip and meeting with staff of the Pulogadung Industrial Estate

Mr. Zen Umar Purba

Mr. Harris

Mr. Bayliss

Meeting with staff of the Ministry of Public Works, Directorate of Water Resources Development

Mr. Harris

Ir. Putra Juarsa

Mr. Bayliss

29 Jakarta - Ministry Office

Field Trip of Sunter/Cakung

Environmental Management Area

Ir. Sri Oeripto

Dr. Repetto

Mr. Bayliss

30, 31 Jakarta - Report Preparation

August 1 Jakarta - Ministry Office

Report Preparation

Meeting with

Mr. Rachmat Wiradisuria

Dr. Naya Djajadiningrat

Ir. Nurhadi

Ir. Nelly

Meeting at World Bank

Dr. Andrew Steer

Mr. Bayliss

2 Jakarta - Ministry Office

Report Preparation

Meeting with

Dr. Naya Djajadiningrat

Dr. Will Knowland, Aid US Embassy

3 Jakarta - Ministry Office

Report Editing

Meeting with Minister Emil Salim and staff

from relevant agencies

4 Jakarta - Ministry Office

Report Editing

14 Travel from Jakarta to Green Bay

This institutional model for a monitoring and enforcement agency is based on ideas presented during discussions with GOI employees. Effective monitoring and enforcement probably depends upon a strong administrative unit at the provincial level of government. The existing government structure, with pollution abatement responsibilities distributed among several ministries, presents difficulties in providing that strength. Perhaps some success can be achieved through careful planning and consensus decision making by the affected ministries at the central government level.

Appendix D.

Comments on Cost Effectiveness

Cost effectiveness in achieving industrial waste water treatment is both complex and difficult. Many opportunities, institutional and technical, have been identified and used elsewhere. The literature contains a large number of case studies reporting on such actions. Several books, including an important monograph by Kneese and Bower, have been written on the subject. Suggestions for seeking cost effectiveness with the initial effort to abate industrial pollution in Indonesia were made in the body of the report (page). They included:

1) The common requirement that all industry provide secondary treatment or equivalent of the domestic and industrial sewage generated within plants with 100 or more employees.

2) Economy of scale should be encouraged wherever possible by combining the domestic sewage and industrial waste from adjacent industries to build one larger treatment plant for all of the factories rather than have one small treatment plant at each factory.

3) Seek opportunities to provide cost incentives to individual factories for identifying and installing in plant process changes which will reduce the volume and/or strength of waste water generated per manufactured unit while often reducing energy or raw material costs.

Additional discussion of each suggestion may be helpful.

Common Secondary Treatment Level

Domestic and industrial waste water treatment is achieved by using selected physical, chemical and biological processes which occur naturally in rivers, lakes and oceans. These processes have been isolated and studied to obtain design parameters for efficient design and construction of treatment plants. The usual measure of treatment level is the percentage removal of oxygen demanded by bacteria which act upon the organic waste and eventually reduce it to harmless carbon dioxide and water. The term used is biochemical oxygen demand (BOD). Since the demand changes with time and temperature, the numerical values are often stated for five days after release when the water temperature is 20°C (BOD_5 @ 20°C).

Most treatment plants are classified using the following terminology:

Primary Treatment

Solids initially suspended in the water settle to the bottom due to the force of gravity. They are removed, dewatered and disposed of. Dissolved solids are unaffected.

% BOD removed 35 to 50%

Secondary Treatment

The effluent from primary treatment containing primarily dissolved solids is subjected to bacterial action. Inorganic dissolved solids are unaffected.

% BOD removal 75 to 95%

Primary and Secondary

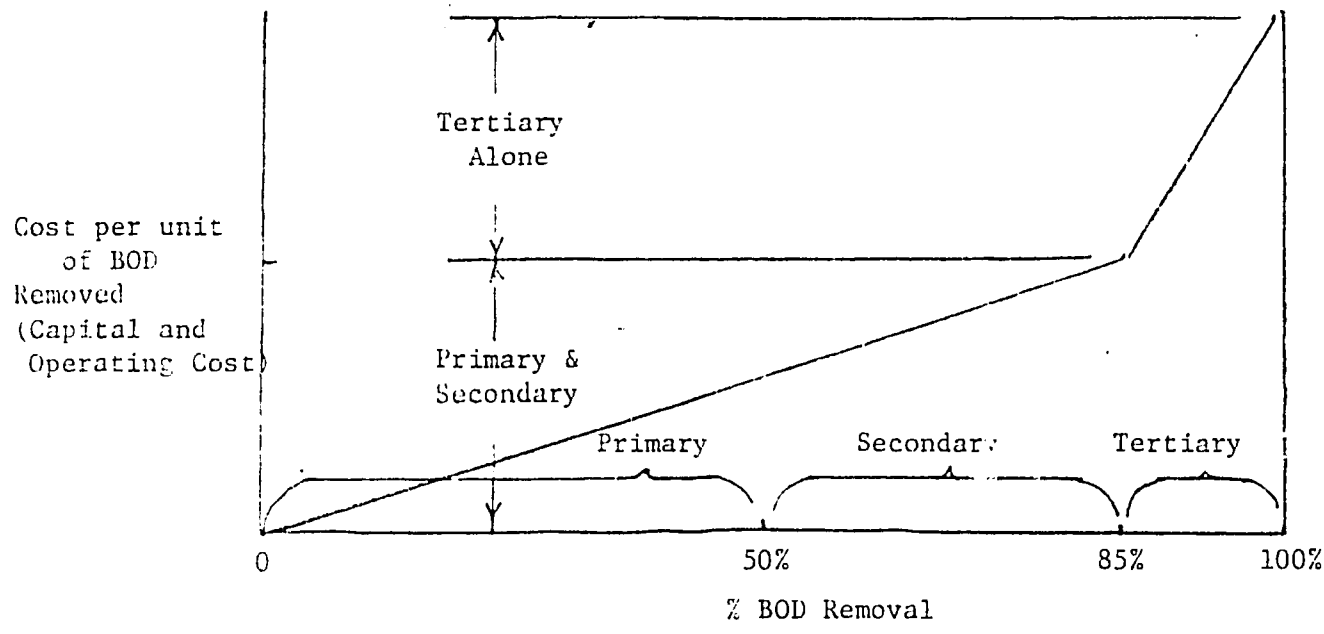
Tertiary and/or Advanced Treatment

The effluent from secondary treatment is subjected to various physical, chemical and biological processes to remove many undesirable water qualities such as taste, odor, color and a portion of the remaining oxygen demanding organic waste.

% BOD removal 99+%

Primary, secondary, and tertiary

The cost of treatment varies according to the BOD removal level as shown in the following figure.



It is not unusual to find the cost for tertiary alone being equal to the cost of primary and secondary combined. Tertiary treatment is seldom considered today for this reason. Primary treatment is soldom considered alone because the increased cost of secondary is not that great.

The design and construction of secondary or equivalent treatment plants (primary included) is well developed in most developed nations. Some success in the use of stabilization ponds (a simplified combination of primary and secondary treatment) in tropical climates has recently been reported. (See World Water in Section VII, references.)

Simplicity of enforcing the construction phase of the proposed regulation, when combined with ease of design and fabrication as well as the low capital and operating cost, suggests that secondary treatment should be the general rule for industrial waste treatment during the initial time period (five years).

Economy of Scale

Experience has shown that substantial economies are possible through the construction of a sewer intercepting waste waters from a number of sources in a given area and transporting them to a single larger treatment plant. The Surabaya Industrial Estate Rungkut is a local example where a single plant receives and treats waste water from approximately 100 factories. The practice there is so effective that consideration is being given to using the effluent as a new source of industrial water supply.

One industrial estate in Indonesia reported that 6% of the capital cost for land and buildings in the estate had been invested in a secondary level treatment plant. It has been suggested that most industries seldom have more than 20% of their total capital investment in land and buildings. Accordingly, the capital cost for a treatment plant should be approxiamtely 1% of the total industrial investment.

Cost Incentives

A wide variety of incentives and disincentives can be developed to encourage industrial pollution abatement. The simplest incentive is to charge each factory for both the capital and operating costs associated with the collection and treatment of their waste water. Of course, that cost would naturally be borne if the factory owned and operated its own treatment plant. More complex incentive systems such as a non uniform payment schedule could be developed at facilities receiving waste waters from a number of factories. Plants discharging large quantities of waste water could have a surcharge added to the regular rate for volumes and strengths in excess of a pre-determined level. Plants discharging less than normal could be rewarded with a lower than regular unit rate.

Appendix E.

Education & Training Program Suggestions

I. Introduction

- Purpose - To train adequate staff within government and industry for the implementation and enforcement of industrial water quality regulations.
- Types of Education & Training

  In Indonesia

  - University Sponsored Courses, Conferences & Worksnops
  - Government/Industry Cosponsored Conferences & Workshops
  - Government Laboratory Training Sessions

  Abroad

  - Graduate Study at Universities
  - Snort Term (1 to 3 months) Training Programs at Central Government and State (Provincial) Regulatory Agencies and at Professional Technical Organizations as well as Universities

The following three possible courses nave been organized in outline form to serve as examples of what might be eventually offered. Substantial additional development for each would be required prior to any actual class activity.

II. Three-Month Training Program (Abroad) for University Graduates in Science or Engineering (Size: 20-30 people)

Month 1 -

Location - University Campus

Week 1 - Acclimation & Introduction to Water Quality Management

- Tour to State Regulatory Agency Office
- Tour to State Water Monitoring Lab
- Introductory Lectures

Systems Approach

Institutional Issues

Technical Issues

Weeks 2, 3, 4 - Course On Waste Water Treatment Fundamentals

Morning - Lectures

Afternoon - Tutorials & Laboratory

Examination

Month 2

Location - University Campus

Weeks 5, 6, 7, 8

Morning - Course on Computer Science and Programming including Computer Graphics

Afternoon - Course on Resource Management Strategy (Resource Economics, Overview of Natural Resources, Political Science & Law)

Examination

Month 3

Locations - Selected State Regulatory Offices, Municipal & Industrial Treatment Plants, Regional Planning Agencies, Central Government Agencies and Laboratories

III. One Month Training Program for Monitoring Technicians (Indonesia)

(Size: 20-30 people)

Location: Bandung, Surabaya or elsewhere

Instructors: University Faculty & Staff

Surabaya Industrial Estate Rungkut

Min. Public Works - Water Quality Monitoring Branch

Other Ministry Laboratory Professionals

Foreign Lecturers

Weeks 1, 2 - Introduction to Water & Waste Water Treatment

Morning - Lectures & Demonstrations

Afternoon - Tutorial & Laboratory

Weeks 3, 4 - Field Experience in Water Quality Monitoring

Laboratory Experience in Chemical, Physical & Biological Analysis

Use Citarum or Brantas River and Tributaries in both urban and rural (upstream and downstream of Bandung or Surabaya) areas

IV. One Month Training Program for Computer Science Technicians

Location: Jakarta, Bogor, Yogjakarta, Surabaya, Bandung or elsewhere

Instructors: Faculty & Staff of Local Universities

Ministry Professionals

Industry Professionals

Weeks 1, 2, 3, 4

Mornings - Lectures & Demonstrations on

- Fundamentals of Computer Science

- Fundamentals of Computer Programming
- Introduction to Computer Operations
  - Card Punching
  - Tape deck preparation
  - Main Frame Operation
  - Data Storage & Retrieval
  - Printout
- Introduction to Computer Graphics
  - Digital map read out
  - Spatial Analysis & Display

Afternoons - Laboratory Exercises Using the Computer & Associated Equipment

Appendix F.

Sewage Billing Practice

Surabaya Industrial Estate Rungkut

COURTESY OF

IR. BAMBANG PIKUKU NOTOAMIDJOJO

OPERATIONS DIRECTOR

SURABAYA INDUSTRIAL ESTATE RUNGKUT

Mailing Address:

P. O. Box 4 Surabaya

Telephones:

(031) 813087

(031) 817617

PT SURABAYA INDUSTRIAL ESTATE RUNGKUT

(P E R S E R O)

BEBERAPA INFORMASI TENTANG CARA PEMBEBANAN BEAYA PEMELIHARAAN DAN OPERASI SISTEM PENGOLAHAN AIR BEKAS .

1. Pembebanan Beaya Pemeliharaan dan Operasi dari sistem pengolahan air bekas disingkat BPO, akan dikenakan kepada semua pabrik yang berada dalam kawasan SIER yang telah memanfaatkan/menggunakan fasilitas Unit Pengolahan Air Bekas PT SIER sebagai realisasi dari apa yang tersebut dalam Pasal 11 Surat Perjanjian Penggunaan Tanah Industri, yang telah ditanda tangani oleh pabrik yang bersangkutan disatu pihak dan PT SIER dilain pihak .

2. Tarip Beaya Pemeliharaan dan Operasi (BPO) dari sistem pengolahan air bekas berlaku untuk satu tahun dimulai sejak 1 September 1983 .
   Besarnya BPO akan ditinjau kembali untuk tahun-tahun mendatang sekali setahun .

3. Besarnya BPO ditentukan berdasarkan :

   3.1. Besarnya beban pollusi dari air bekas yang dibuang kedalam sistem saluran air bekas PT SIER, berdasarkan atas hasil analisa kimia dari contoh air bekas yang diambil bersama antara PT SIER dan pabrik yang bersangkutan sekali setahun, pada bak kontrol yang dibangun oleh PT SIER yang berada didalam kapling pabrik, serta dianalisa pada Laboratorium yang ditunjuk oleh Gubernur Kepala Daeran Tingkat I Jawa Timur khusus untuk air bekas, yaitu ;

   Balai Penelitian Dan Pengembangan Industri
   Departemen Perindustrian
   Jalan Jagir Wonokromo 360
   Surabaya .

   atau Laboratorium lain yang ditunjuk kemudian, serta beaya yang timbul untuk menganalisa air bekas tersebut akan menjadi beban dari pabrik yang bersangkutan .

   Perhitungan besarnya beban pollusi adalah penjumlahan hasil perkalian antara komponen-komponen/parameter-parameter dalam air bekas tersebut dalam unit satuan (mgr/lt, ^{o} C dsbnya) dengan nilai pollusi untuk masing masing komponen yang telah ditentukan seperti apa yang tersebut dalam butir 7 .

3.2. Besarnya .....

3.2. Besarnya volume air bekas yang dibuang kedalam sistem saluran air bekas PT SIER, dalam satu bulan dan ditentukan berdasarkan atas pengamatan/ survey bersama antara PT SIER dan pabrik yang bersangkutan sekali setahun.

Apabila dikehendaki pihak pabrik yang bersangkutan dapat memasang flow meter dengan beaya sendiri agar dapat ditentukan besarnya volume air bekas secara tepat .

3.3. Pengamatan, survey bersama antara PT SIER dan pabrik yang bersangkutan dalam hal penentuan besarnya beban pollusi dan volume air bekas yang dibuang dalam satu bulan, adalah merupakan dasar perhitungan untuk pengenaan BPO dalam satu tahun mendatang .

3.4. Pengamatan/survey bersama bagi pabrik-2 yang telah dikenakan BPO sejak September 1983, selanjutnya akan dilaksanakan pada bulan-bulan sebelum berlakunya BPO untuk tahun-tahun berikutnya .

3.5. Pengamatan/survey bersama bagi pabrik-2 yang baru akan dilaksanakan pada saat PT SIER menganggap bahwa pengamatan sudah memenuhi syarat untuk dilakukan .

3.6. Mengingat bahwa pengamatan/survey air bekas hanya dilakukan sekali setahun, maka diharapkan agar kwalitas air bekas dari pabrik yang bersangkutan dalam tahun yang berjalan, tetap berkisar pada kwalitas air bekas pada saat dilakukan pengamatan .

4. Guna menunjang kelangsungan proses pengolahan air bekas dari seluruh kawasan pada Unit Pengolahan Air Bekas PT SIER, maka kepada semua pabrik yang telah memanfaatkan/menggunakan fasilitas tersebut diharapkan dapat memberikan response positif, misalnya memenuhi kewajiban membayar BPO pada waktunya serta memenuhi kewajiban-2/peraturan-2 yang telah berlaku .

5. Apabila pada suatu saat air bekas dari salah satu pabrik tidak memenuhi standard yang berlaku, maka pihak pabrik mempunyai tanggung jawab moral demi kepentingan bersama untuk memberhentikan pembuangannya, sehingga tidak akan merusak proses pengolahan .

Sedangkan apabila hal tersebut tidak dilakukan pihak pabrik, maka setelah didahului peringatan-2 PT SIER berhak untuk melaksanakan penutupan pembuangan air bekasnya .

6. Mengingat akan kepentingan bersama, apabila pabrik tidak melaksanakan kewajiban untuk membayar BPO, maka PT SIER berhak untuk memberikan sangsi-2 .

7. Komponen-komponen .....

7. Komponen-komponen air bekas yang dipergunakan untuk menentukan tingkat pollusi, dengan unit satuan dan nilai pollusi adalah sbb :

	Komponen air bekas	Unit satuan	Nilai pollusi
1.	Jumlah zat terlarut	mgr/lt.	2
2.	Jumlah zat yang melayang	"	20
3.	Temperatur (untuk setiap derajat diatas 35°)	^{o}C	50
4.	Allumunium (Al)	mgr/lt	50
5.	Arsen .(As)	"	150
6.	Barium (Ba)	"	100
7.	Besi (Fe)	"	150
8.	Chroom (Cr)	"	150
9.	Kadmium (Cd)	"	150
10.	Nikel (Ni)	"	150
11.	Perak (Ag)	"	150
12.	Air Raksa (Hg)	"	150
13.	Seng (Zn)	"	150
14.	Tembaga (Cu)	"	150
15.	Timbal (Pb)	"	150
16.	Ammonium (NH_3)	"	20
17.	Chlor (Cl_2)	"	150
18.	Fluorida (F)	"	100
19.	Nitrit (NO_2)	"	20
20.	Phosphat (PO_4)	"	20
21.	Sulfida (S)	"	150
22.	pH (diluar batas 6,5 - 9,5 per o,2)	"	150
23.	BOD/COD diambil angka yang paling tinggi	"	50
24.	Angka $KMnO_4$	"	10
25.	Minyak/Lemak	"	50
26.	Phenol	"	150
27.	Komponen-komponen lain	"	100
		"	..

8. Contoh .....

8. CONTOH CARA MENGHITUNG BEBAN POLLUSI PADA MASING-2 PABRIK :

	KOMPONEN AIR BEKAS	Analisa Air Bekas dari Pabrik A mg/l	Pabrik B mg/l	Pabrik C mg/l	Nilai Pollusi	BEBAN POLLUSI DARI PABRIK A	B	C
1.	Jumlah zat-2 yang terlarut .	50	600	200	2	100	1.200	400
2.	Jumlah zat-2 yang melayang .	10	400	160	20	200	8.000	3.200
3.	Temperatur .	30° C	35° C	40° C	50	–	–	250
4.	Allumunium .	0,15	0,06	0,06	50	50	50	50
5.	Arsen .	–	–	–	150	–	–	–
6.	Barium .	–	–	–	100	–	–	–
7.	Besi .	0,40	0,34	0,11	150	150	150	150
8.	Chroom .	0,08	–	0,01	150	150	150	150
9.	Kadmium .	–	–	–	100	–	–	–
10.	Nikel .	–	–	–	150	–	–	–
11.	Perak .	–	–	–	150	–	–	–
12.	Air Raksa .	–	–	–	150	–	–	–
13.	Seng .	0,16	1,33	0,02	150	150	199,5	150
14.	Tembaga .	0,27	0,88	0,41	150	150	150	150
15.	Timbal .	–	–	–	150	–	–	–
16.	Ammonium .	0,03	1,9	29,4	20	20	58,2	788

17. Chloor .....

17.	Chloor .	–	–	–	150	–	–	–
18.	Fluorida .	–	–	–	100	–	–	–
19.	Nitrit .	0,09	0,05	0,02	20	20	20	20
20.	Phosphat .	1,93	1,86	1,34	20	38,6	37,2	26,8
21.	Sulfida .	–	1,18	0,72	150	–	177	150
22.	pH .	9,9	7,5	7,8	100	200	–	–
23.	BOD	100	200	144	50	9.500	35.400	24.200
	COD	190	708	484				
24.	Angka KMnO4 .	8,70	55,5	106	10	87	555	1.060
25.	Minyak / Lemak .	–	4,50	13,25	50	–	225	662,5
26.	Phenol .	0,06	0,28	0,17	150	150	150	150
27.	Komponen-2 lin .	–	–	–	100	–	–	–

BEBAN POLLUSI 10.965,6 46.521,9 31.557.3

9. Tarip yang .....

9. Tarip yang berlaku untuk bulan September 1983 s/d Agustus 1984 :

Beban Pollusi \ Volume m^3	Dibawah 50	51 500	501 2.500	2.501 10.000	10.001 25.000	Diatas 25.000
Dibawah 25.000	Rp 13.500,-	Rp 27.000,-	Rp 47.250,-	Rp 74.250,-	Rp 101.250,-	Rp 135.000,-
25.001 - 50.000	Rp 54.000,-	Rp 81.000,-	Rp 121.500,-	Rp 162.000,-	Rp 202.500,-	Rp 243.000,-
50.001 -100.000	Rp 94.500,-	Rp 121.500,-	Rp 162.000,-	Rp 202.500,-	Rp 243.000,-	Rp 283.500,-
100.001 -500.000	Rp 148.500,-	Rp 175.500,-	Rp 216.000,-	Rp 256.500,-	Rp 297.000,-	Rp 337.500,-
500.001 -1.000.000	Rp 202.500,-	Rp 229.500,-	Rp 270.000,-	Rp 310.500,-	Rp 351.000,-	Rp 391.500,-
Diatas 1.000.000	Rp 270.000,-	Rp 297.000,-	Rp 337.500,-	Rp 378.000,-	Rp 418.500,-	Rp 459.000,-

10. Dalam rangka memberikan kesempatan kepada pabrik-pabrik dalam kawasan SIER untuk memasukkan beaya-beaya tersebut dalam anggaran perusahaan begitu pula pengaruhnya terhadap harga produksi, serta mengajak pabrik-pabrik untuk berpartisipasi terhadap program Pemerintah guna melestarikan sumber air yang ada pada khususnya dan lingkungan hidup pada umumnya, maka PT SIER memandang perlu untuk memberikan subsidi terhadap Beaya Pemeliharaan dan Operasi dari sistem pengolahan air bekas untuk beberapa tahun mendatang, dimana pemberian subsidi tersebut secara bertahap akan dihapuskan

Adapun pemberian subsidi diatur sbb :

Waktu berlakunya tarip BPO	Proses BPO yang dibayar oleh Perusahaan	Prosentase BPO yang disubsidi di PT SIER.
Agustus '81 - Agustus '83	0 %	100 %
September'83 - Agustus '84	30 %	70 %
September'84 - Agustus '85	50 %	50 %
September'85 - Agustus '86	70 %	30 %
September'86 - Agustus '87	90 %	10 %
September'87 dan seterusnya	100 %	0 %

11. Contoh cara .....

Contoh cara pengenaan BPO terhadap tarip tahun 1983/1984 :

Pabrik A . :

- Beban pollusi : 10.965,6
- Volume air bekas : 4[illegible] m^3/bulan

Maka termasuk kolom :

- Beban pollusi : dibawah 25.000
- Volume air bekas : dibawah 50 m^3

Tarip .... Rp. 13.500,-

Subsidi PT SIER : 0,7 X Rp. 13.500,- ..... Rp. 9.450,-

BPO yang harus dibayar pabrik A tiap bulan ..... Rp. 4.050,-

Pabrik B . :

- Beban pollusi : 46.521,9
- Volume air bekas : 45 m^3/bulan

Maka termasuk kolom :

- Beban pollusi : 25.000 - 50.000
- Volume air bekas : dibawah 50 m^3

Tarip .... Rp. 54.000,-

Subsidi PT SIER : 0,7 X Rp. 54.000,- ..... Rp. 37.800,-

BPO yang harus dibayar pabrik B tiap bulan ..... Rp. 16.200,-

Pabrik C . :

- Beban pollusi : 31.557,3
- Volume air bekas : 525 m^3/bulan

Maka termasuk kolom :

- Beban pollusi : 25.000 - 50.000
- Volume air bekas : 501 - 2.500 m^3

Tarip Rp.121.500,-

Subsidi PT SIER : 0,7 X Rp. 121.500,- ..... Rp. 85.050,-

BPO yang harus dibayar pabrik C tiap bulan ..... Rp. 36.450,-

PT. SIER (PERSERO)