



OCT 1983

SCIENCE BULLETIN

National Science Council

2 Canton Street

Taipei, Taiwan, Republic of China

A Long-range Research Program for Upgrading The Environmental Quality of Taiwan

The natural environment in Taiwan is under severe stress and strain of the recent industrialization and increase of population. The rapid strides in industrial development have elevated personal income of the general public. At the same time the population has been steadily increasing, surging and concentrating onto the cities and industrialized areas. Such events in the course of an industrial evolution lead to prosperity and wealth just as inevitably as intensified the generation of wastes and spread of pollutants, resulting in propagation of diseases, ruin of natural resources and general deterioration of environmental quality. In the evolution there is often a time to pause and to contemplate what should be done to check the threatening pollution in such a way that the industrialization can continue, while the public health and welfare can be assured of sound protection and appropriate conservation.

For integrating the research efforts and conducting the academic depth of environmental engineering here the National Science Council (NSC) conceived a long-range research program. Because of the limited manpower and funds available for this task, the NSC chose a team approach to the program so that unnecessary repetition and overlap can be avoided, but on the other hand, complementary and co-operative effort can be devoted to the solution of complicated cases. A selective group of engineers and scientists from several representative sectors was tapped to serve as a task force for planning a primary research program. After three months of consultation and discussion the following major topics grouped under four divisions — water supply, wastewater treatment, air pollution control and solid waste handling — were agreed upon to be undertaken in the next 10 years, subject to changes and modifications during the course of implementation:

I. Water Supply:

1. The removal of trace organics and toxic substances from drinking water.

tion.

3. The studies of water with special qualities.
4. The environmental impact assessment for water supplies.
5. The protection of raw-water sources.

II. Wastewater Treatment:

1. Wastewater treatment technology with high efficiency.
2. Sludge treatment and disposal.
3. Wastewater reuse and resource recovery.
4. Pollution source control.
5. Marine disposal of wastewater.

III. Air Pollution Control:

1. Air quality analysis and purification.
2. The effect of air pollutants on living things.
3. The improvement of automobile exhaust.

IV. Solid Waste Handling:

1. Solid waste disposal technology.
2. Solid waste storage, collection and transportation system.
3. Nightsoil treatment and disposal.
4. Soil pollution control.

For the first three years, that is, the years of 1983, 1984 and 1985, 31 special research projects in five categories — water quality, anaerobic technology of wastewater treatment, sludge treatment, air pollution control and solid waste handling — have been approved for funding, which are presented in brief descriptions as follows:

A. Water Quality

(1) Survey and Treatment of Hazardous Matters Present in the Public Water Sources of Taipei Area (Szu-Kung Tseng, Yue-Hwa Yu, A.O. Lau and Pen-Chi Chiang, Environmental Engineering, National Taiwan University). In the first year a number of pollutants which either render the water unsafe for drinking or interfere with water purification processes, will be investigated in regard to the extent of their presence in the sources. The pollutants to be investigated include nitrogen, phosphorus, oil and grease, pesticides, synthetic detergents, heavy metals, trihalomethanes, total organics, phenolic and cyanide compounds. The

tion plan for analysis of trace pollutants present in water and studies of feasible processes for their removal prior to the conventional water filtration systems.

(2) Characterization and Removal of Harmful Substances from Water Supplies in the Taichung Area (Chiu-Yang Chen and Wen K. Shieh, Environmental Engineering, National Chung Hsing University). It is proposed to investigate the water quality of Tai-Chia River, a major source of water supply for the Taichung area, and to evaluate ways to improve the performance of an existing water treatment plant, in the first year. Further studies will be conducted in the second and third years to develop effective processes for the removal of the harmful substances found present in the water source.

(3) Effect of Ozonation on Organics Removal by Coagulation (Hsuan-Hsien Yeh, Environmental Engineering, National Cheng Kung University). To remove trace organics from water is a major concern in water treatment technology nowadays. This project is to investigate the use of ozonation to change the surface characteristics or polarity of dissolved and colloidal organics for enhancing the removal of organics by chemical coagulation.

(4) Investigation and Treatment of Hazardous Materials in Public Water Supply of the Tao Yuan Area (Wenta Liao, Civil Engineering, National Central University). It is proposed to investigate whether hazardous materials, such as pesticides, chlorinated organics and heavy metals, prevail in the public water supply of Tao Yuan area, to evaluate the efficacy of the current water treatment method in removing such materials and to study modifications or additions to the existing facilities for improvement of removal.

(5) Monitoring and Removal of Pesticide Residues in the Water of Shih-Kang Reservoir (Lien-Tsai Jao, Environmental Science and Technology, Tunghai University). The Tai-Chia river could be heavily polluted by repeated usage of the river water for agricultural and industrial purposes,

pesticides on the cultivated land. As proposed, the Shih-Kang reservoir, an impoundment of the river, serving as a local water source, will be monitored regarding its pesticide residues, and the existing water treatment facilities located near the reservoir will be evaluated for its capacity in removing these chemicals from water.

(6) Survey and Investigation of Treatment Methods for the Water of Tai-Chia River (Paul T. Chien, Environmental Science and Technology, Tunghai University). The Tai-Chia river is the main water-supply source for the Taichung area, and is suspected to be polluted by pesticides, fertilizers, animal wastes and chemical solvents, discharged or leached from the land. A survey of the pollution will be made, and the method of removing those pollutants from water by control at sources and/or water treatment will be investigated.

(7) Survey and Investigation of the Heavy Metal Contents of Tai-Chia River Water (Bih-Fong Liang and Lien-Tsai Jao, Environmental Science and Technology, Tunghai University). Heavy metal contents including Hg, Pb, Cd, Cr, Cu and Zn, of the Tai-Chia river water, before and after the current water treatment will be analysed to determine whether their respective permissible limits are exceeded. If the water is not safe for drinking, a continuation of the project will be proposed to trace the pollution sources and investigate remedial measures.

(8) Treatment and Analysis for Trihalomethanes (THMS) in Drinking Water (Chin-Wang Huang, Chemistry, Chung-Yuan University). The objectives of this project are to develop a procedure for routine monitoring of THMS in drinking water, to measure the extent of their presence, to investigate how the THMS are formed through water treatment, and to analyse for other trace organic compounds.

B. Anaerobic Technology of Wastewater Treatment

(1) Improvement of Anaerobic Digestion Efficiency at Low Digestion Temperatures by Fluidized Bed Technology (Szu-Kung Tseng and A.O. Lau, Environmental Engineering, National Taiwan University). This project is intended to use the fluidized bed technology in compensation for the intrinsic low efficiency of anaerobic processes at low temperatures. For the study, the temperature will be controlled at 35°C, 25°C and 15°C. Under different organic loadings the efficacy of the process will be evaluated against waste stabilization, microbial film growth and production of gas and

sludge.

(2) Investigation of the Role of Photosynthetic Bacteria in Anaerobic Wastewater Treatment (I) (Chi-Mei Lee and Pei-Chung Chen, Environmental Engineering, National Chung Hsing University). The objective of this project is to identify and characterize the photosynthetic bacteria in the natural waters and anaerobic wastewater treatment systems prevailing in Taiwan, and to investigate the feasibility of treating wastes of high organic content by means of these species of bacteria.

(3) A Fundamental Study of the Fluidized Bed Biofilm Reactor by Computer Simulation (Wen K. Shieh and Yishu Chia, Environmental Engineering, National Chung-Hsing University). This project is to develop and verify a mathematical model of fluidized bed biofilm reactor (FBBR) for wastewater treatment. The effort will be focused on studying the kinetics of the process.

(4) A Fundamental Study on the Treatment of Organic Wastes by the Anaerobic Filter Process (Jao-Fuan Kao and Jun-En Chang, Environmental Engineering, National Cheng Kung University). This project is essentially to study the population shift, the metabolism of methanogenic bacteria at known substrate loading rates, and the correlation with the efficiency of energy recovery, in an anaerobic filter process. The results are expected to be applicable to the design and operation of the anaerobic wastewater treatment facilities.

(5) A Fundamental Study on the Treatment of Wastes by the Anaerobic Sludge Blanket Process (Jun-En Chang, Environmental Engineering, National Cheng Kung University). This project is to study the population shift of anaerobic bacteria as related to the mechanism of substrate utilization and energy recovery in an upflow anaerobic sludge blanket process. For the experiments, cellulose will be selected as the substrate. The results are expected to be applicable to the treatment of both municipal and industrial wastes.

(6) A Fundamental Study on the Treatment of Synthetic Wastewater by the Anaerobic Bed Bioreactor Process (Chun-Teh Li, Environmental Engineering, National Cheng Kung University). The investigator will devote the first year to clarify the effects of some operating parameters, such as organic loading on the process, to develop design criteria, and to make cost analysis. For the following two years, the process will be tested for its feasibility in the treatment of tannery wastes and pulp and paper mill wastes.

(7) Bacteriological Studies of Anaerobic Wastewater Treatment (I) (Sy-Ying C. Wang and I-Chen Tseng, Environmental Engineering, National Cheng Kung University). This project is designed to investigate the succession of predominant microbial population in anaerobic oxidation of organic compounds, as well as the nutritional requirements and growth rate of pure culture. It is expected that the results will be useful in design and operation of anaerobic digestors, and add to the knowledge of the kinetics of the anaerobic waste treatment processes.

(8) Effects of Shock Loading on the Anaerobic Sludge Bed Reactors (Jong-Nan Chen, Civil Engineering, National Chiao Tung University). Two upflow anaerobic reactors will be used for the experimentation under controlled PH and temperature. Skim milk will be the substrate. The anaerobic sludge blanket to be cultured in the reactors will be the key component of the system. Two types of shock loading, hydraulic and quantitative respectively, will be applied. It is intended to find the tolerance limits for better design and operation of anaerobic sludge bed reactors. Also the techniques for improving solid-gas separation will be investigated.

(9) A Study on Meat Processing Wastewater Treatment by Anaerobic Digestion with Recycled Sludge (John-Kong Lin, Agricultural Chemistry, National Pingtung Agricultural Institute). This project is to study the application of anaerobic digestion with recycled sludge to the treatment of meat processing wastewater, high in organic contents. The objective is to investigate whether it is feasible to reduce reactor volume, increase gas production and maintain a stable process by recycling sludge. A model will be developed to relate the gas production and the process stabilization.

(10) Phosphorus Removal in the Anaerobic/Aerobic Process of Wastewater Treatment (Ting-Chi Hsu, and Pok-Shing Cheung, Environmental Science, Feng-Chia University). A modified activated sludge wastewater treatment process, using an anaerobic process as the pretreatment was reported to be capable of removing phosphorus five times more than the conventional activated sludge process. This project is to investigate the mechanism and kinetics involved in this innovative phosphorus-removal biological process. For practical applications, the efficiency of phosphorus removal in the treatment of domestic wastewater or night soil by this method will be studied.

C. Sludge Treatment

(1) Disposal and Utilization of

Water Treatment Plant Wastes — Alum Sludge Characteristics and Pollutational Loads (Wan-Fa Yang, Environmental Engineering, National Taiwan University). The discharge of water treatment plant wastes, such as sludges from settling basins, can have serious impact on downstream water quality. This project plans a two-step approach to deal with this source of pollution: gathering information for identification and evaluation of the scope and origin of the problem and conducting studies of implant modifications, closed systems and improvement of alum sludge treatment in order to develop a remedial measure.

(2) The Handling of Metal-bearing Sludges (Kung-Cheh Li, Environmental Engineering, National Taiwan University). Metal-bearing sludges, a source of hazardous wastes generated from the electroplating industry, are widely spread throughout the island of Taiwan. This project will investigate the handling of such sludges in the following aspects: stabilization and utilization of sludges, improvement of the design of sludge-drying beds commonly used by the industries and feasibility of reducing sludge generation in the process of chemical precipitation.

(3) A Study of the Filtration Mechanism of a continuous Rotary Filter Press (Wei-Ming Lu, Chemical Engineering, National Taiwan University). This project will investigate the filtration mechanism of a rotary filter press, including thickening phenomena and rheological characteristics of slurries. For application, studies will be initiated to improve the design of rotary filter presses, regarding the design of impeller, the cake formation under rotary shear force and the number of stages required for the filtering and washing operations of a given slurry.

(4) A Study on the Land Application of Municipal Sludges (Shang-Lien Lo, Environmental Engineering, National Taiwan University). The major constituents of municipal sludges are crop nutrients and organic matters. It is only natural to return such sludges to land as fertilizer and/or soil conditioner. However, some toxic substances, such as heavy metals, PCBs, and pesticides, are often present in the sludges and should be removed before the land application. This project will make a survey of the characteristics of municipal sludges and develop feasible methods of removing the toxic substances from sludges, if present. Also the pathway of such toxic substances in soil, if not removed will be examined. With all the information, an appropriate method of land application will finally be formulated.

(5) Application of Solid-state

Fermentation for Stabilization of Organic Sludges (Hsi-Hua Wang, Agricultural Chemistry, National Taiwan University). To begin with, this project will modify the head-space analysis by gas chromatography, a technique used in the brewing of Kao-liang liquor, for measuring the stability of organic sludges. In the following two years the kinetics of solid-state fermentation of organic sludges under both aerobic and anaerobic conditions will be studied in laboratory-scale experiments, using stability and some other measurements as the parameters. Finally the fermentation rate constants, thus determined, will be applied for scaling up the process in field.

(6) A Study on the Handling of Industrial Sludges (Ching-Ming Ko and Chiu-Yung Chen, Environmental Engineering, National Chung-Hsing University). Inadequate handling of the industrial sludges generated as a result of the treatment of industrial wastewaters, essentially from industrial parks has created a serious source of pollution. This project will conduct a survey of the sludges regarding their amount and characteristics whereby hopefully the scope of the problem can be estimated, and feasible methods of treatment and disposal can be developed.

(7) A Study of the Conversion of Biological Sludges from Municipal Wastewater Treatment Plants (C. F. Ouyang, Civil Engineering, National Central University). This project will study the conversion, in BOD removal, of the biological sludges from various types of secondary municipal wastewater plant, for which the volume, concentration and dewatering properties of the sludge will be used as the parameters. Analysis will also be made of the relationship between BOD removal and energy consumption. It is intended to apply the data for future investigation of feasible methods of stabilizing biological sludges.

D. Air Pollution Control

(1) Cell Dispersion Model of Fixed Air Pollution Source for Photochemical Pollutants. (W. G. Liang and Jin-Ching Wang, Physics, Academia Sinica). This study will apply a cell dispersion model and photochemical reaction equations to simulate the transformation and atmospheric dispersion of photochemical pollutants. For practical purposes, the model will be simplified so that one-dimensional calculations can be used instead of 3-dimensional approaches to estimate the air quality in the vicinity of a fixed air pollution source.

(2) Evaluation of Emission Factors for Air Pollution Sources (Fu-Tien Jenq and Pen-Chi Chiang, Environ-

mental Engineering, National Taiwan University). Emission factors can be conveniently applied to calculate the average rates of emission from distributed sources of a community for air quality management. This project will collect emission data of stationary and moving sources via questionnaires and visitations which will be supplemented by field sampling and analysis. Hopefully the data will provide sufficient information for the evaluation of emission factors.

(3) Investigation of an Inert Gas Dispersion Model (I) (L. W. Chang and R. R. Huang, Environmental Engineering, National Taiwan University). This inert gas dispersion model will simulate the conditions of the area in the vicinity of Kao-hsiung. Information regarding pollution sources and air quality will be collected and supplemented in cooperation with other related projects. The simulation will be based upon the Gaussian dispersion model to modify the dispersion coefficients for adjusting the empirical models being used.

(4) Secondary Pollution Control of Refuse Incineration (Jing T. Kuo, Mechanical Engineering, National Taiwan University). This project will gather information on the pollution control methods for refuse incineration. The data will be analysed and applied to develop a conceptual design of the secondary pollution control system for a one-ton incinerator which is to be built for experimentation.

(5) Monitoring and Control of Airborne Contaminants of the Organic Solvents Used for Industrial Processes in Taiwan (Ada Ma Lin and Simon Hsu, Industrial Engineering, National Tsing Hua University). This project will conduct field survey, assessment and analysis of airborne organic contaminants evolved from the solvents used by some selected manufacturing factories. Control options will be evaluated, using cost-effectiveness as a key factor.

E. Solid Waste Handling

(1) Analysis of Heat and Fluid Flow in the Furnace of an Incinerator (S. T. Lee and Ruey-Hor Yen, Mechanical Engineering, National Taiwan University). A mathematical model will be used for numerical computation to describe the heat transfer and air flow in the furnace of a incinerator, as influenced by the furnace configuration. Also an experiment will be performed to verify the theories and hypotheses upon which the model is developed.

In summary, of the initial thirty one (31) projects, there are eight (8) in

the category of water quality, ten (10) in anaerobic technology of wastewater treatment, seven (7) in sludge treatment, five (5) in air pollution control and one (1) is solid waste handling. All the water-quality projects essentially deal with survey and removal of the trace amounts of toxic substances including pesticides, chlorinated organics and heavy metals, present in the river waters which are used directly or via impoundments as water-supply sources. The projects in wastewater treatment are practically all devoted to the deve-

lopment of anaerobic biological processes, particularly for treating concentrated organic wastes, or serving as a precursor to remove a large portion of the organic contents prior to other treatment units. In the categories of sludge treatment and air pollution control, the subjects of interest are rather diversified. The former one includes reuse of water-treatment sludges, stabilization and dewatering of wastewater-treatment sludges, and land application of municipal sludges. The latter one ranges from atmospheric dis-

persion modelling, evaluation of emission factors, pollution control systems for refuse incineration to an industrial hygiene problem of volatile solvents. The only project of solid waste handling is related to the thermodynamics of refuse incineration.

It is hoped that this initial effort will provide sufficient information, inclusive of scientific and technological findings and experiences in working as a team in research, for pointing to a way how further research of the 10-year program should be directed.

Premier Sun's Report On Science & Technology

The following is excerpted from Premier Sun Yuan-suan's Administrative Report to the Executive Yuan delivered on September 23. -Ed.

"1. The National Science Council has been working together with other agencies concerned in studying procedures to advance technology developments and plans of a number of research projects. Projected research fields include fuels, materials, manufacturing automation, biotechnology, information science, electro-optics, he-

patitis vaccine and food technology. The council has been reorganized into five groups dealing with basic science to augment the studies. In addition, the projected Synchrotron radiation center will contribute to the upgrading of basic science and the advance of national construction.

"2. A new plan to accelerate cultivation and recruitment of technological personnel is being jointly drafted by the National Science Council, Ministry of Education and National Youth Commission. The plan emphasizes the cooperation of domestic and overseas Chinese scholars and experts, and calls for the cooperation of industry, education, defense, the government and the people. The National Development

Seminar in July brought together Chinese scholars from at home and abroad. The theme was science and technology with five groups devoted to computer-based education, electro-optics, biotechnology, epidemics and food technology.

"3. Development of the Hsinchu Science-based Industrial Park has moved into the second phase. As of now, 46 companies have been granted approval to establish plants and products have been exported to 24 countries, including the developed ones. The business volume in 1983 will be about US\$100 million. We plan to simplify procedures and offer better services, thus creating better incentive for more foreign investments."

ROC-RSA Seminar On Materials Science Held

The first Sino-South African seminar on alloy and ceramics technology was held last month with the two countries pledging to strengthen their cooperation in the field.

The seminar opened Sept. 1 at National Tsing Hua University in Hsinchu with more than 100 scholars and experts from the two nations participating. The first two days were devoted to reading and discussing papers presented by the participants. Later the attenders took a four-day fact-finding tour around the island. Then they met again at Tsing Hua for an overall review on their findings and made the following decisions aimed at facilitating cooperation between the two countries:

-To exchange information on the latest developments in materials science;

-South Africa will provide some minerals for the Republic of China for research purposes while the ROC will in turn submit research results to South Africa for further study and development;

-Research staffs of the two countries will exchange visits, during which they will study and teach.

NSC-Supported Research Projects

Chen-Yuan Wen
NSC73-0412-B002-14

An Horseradish Peroxidase Study on the Masticatory Motor and Proprioceptive Neurons in the Rat Motor and Mesencephalic Trigeminal Nuclei

Bor-Shen Hsieh
NSC73-0412-B002-15

The Prostaglandin and Renin-Angiotensin Systems in Renoparenchymal Hypertension

Tsu-Pei Hung
NSC73-0412-B002-16

Study of Acetylcholine Receptor Antibody in Myasthenia Gravis

Lon-Lon H. Liao
NSC73-0412-B002-17

Cytotoxic and Cytokinetic Effects of Isodiospyrin on Cancer Cells

Cheng-Yi Wang
NSC73-0412-B002-18

Studies of Colorectal Cancer in Chinese-I

Teh-Hong Wang
NSC73-0412-B002-19

Early Diagnosis of Pancreatic Cancer

Chien-Ts Chu
NSC73-0416-B002-07

Establishment of a hybridoma center - Study of human monodonal antibodies

Liang, AM; Mak, OT;
Chen, SH; Chen, CC
NSC73-0416-B006-01

Establishment of Hybridoma Research

Ling-Kuo Huang
NSC73-0412-B002-03

Biosynthesis of Territrem B

Jung-Yaw Lin
NSC73-0412-B002-04

Conjugation of Lectin with Trypsin Inhibitor

Jen-Kun Lin
NSC73-0412-B002-05

Pyrolytic Degradation of Foods and Formation of Amines