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19432

Distr.
LIMITED

IO.58(SPEC.)
30 January 1992

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ORIGINAL: ENGLISH

Joint UNIDO/APCTT Workshop on Environmental
Considerations and Waste Recycling in the Chemical,
Metallurgical and Engineering Industries

Manila, the Philippines, 9 to 13 December 1991

REPORT*

* This document has not been edited.

V.92 50752

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INTRODUCTION

The Workshop on Environmental Considerations and Waste Recycling for the Chemical, Metallurgical and Engineering Industries, organized by the United Nations Industrial Development Organization (UNIDO) and the Asia and Pacific Centre for Transfer of Technology (APCTT) and United Nations Development Programme (UNDP) in cooperation with the Environmental Management Bureau, Department of Environment and Natural Resources, the Philippines, was held at Manila, the Philippines, from 9 to 13 December 1991. The Workshop was attended by representatives of Member States of UNIDO as well as non-governmental organizations and industry. A list of participants is attached in Annex 1.

The objectives of the workshop were as follows:

- (a) to promote in the region awareness of the status and potential for future growth of the chemical, metallurgical and engineering industries, with the goal of sustainable development in the region;
- (b) to promote the utilization of and transfer of low and non-waste, energy efficient technologies, waste prevention and minimization of pollution control, waste recycling, including training in these areas, and the encouragement of investment;
- (c) to promote institutional structures, policies, legislation and awareness-building by means of the media, educational institutions and programmes.

RECOMMENDATIONS

1. The Workshop recommended that governments of developing countries in the Asia and Pacific Region should:

- 1.1 Continue to issue regionally coordinated legislation considering real impacts of hazardous and polluting raw materials, processes and products, providing incentives wherever practicable for waste recycling and not put national industries into a disadvantageous market position.
- 1.2 Implement a national waste management policy which actively encourages waste recycling and exchange through incentives and through establishment of national waste treatment and recovery centres.
- 1.3 Support financially R&D efforts of industries, universities and institutes in developing opportunities for waste minimization, materials recovery, waste recycling, clean process identification and safe hazardous waste disposal.
- 1.4 Support training programmes within industry to maximize application of waste minimization, waste recycling programmes, etc.
- 1.5 Seek to locate or relocate "hazardous" industries in appropriate areas or sectors.
- 1.6 Raise environmental awareness of the public and industry through education and media coverage.
- 1.7 Support and contribute to the preparation and implementation of a Code of Practice for industry which inter alia:
 - bans or controls certain hazardous chemicals from international trade;
 - facilitates ease of transfer of low waste technologies with full disclosure of information;
 - promotes action on industrial safety.

2. In relation to industry the Workshop recommended that:

- 2.1 Best practices for waste minimization, materials recovery and recycling, cleaner processing etc. should be implemented as a matter of priority to avoid unnecessary pollution.**
- 2.2 Information on commercially viable low waste technologies and other pollution reduction opportunities should be made available to other industries (national and international).**
- 2.3 Training programmes on environmental awareness and management should be carried out on a regular basis.**
- 2.4 Industry should cooperate with government in the formulation of environmental legislation.**

3. In relation to United Nations organizations and agencies the Workshop recommended that:

- 3.1 Increased financial support is provided to relevant agencies for establishment and development of user friendly information systems on:
 - water conservation, waste minimization and material recovery opportunities both on an industry by industry and inter-sectoral basis;
 - new processes or processing methods (cleaner technology);
 - cost-effective end-of-pipe treatment systems with particular reference to systems developed in Asia and Pacific Region countries;
 - waste exchange information (national and international).**
- 3.2 Increased technical support is provided for training within government and industry on the implementation of low waste technologies and operating procedures.**
- 3.3 Support is given to the preparation of an industry wide guideline document to assist industry implement waste minimization, materials recovery and waste recycling opportunities through procedures for changes in management, waste auditing, etc.**
- 3.4 Support is given to the establishment of an operational network in Asia and Pacific Region countries on environmental protection management to ensure continuous exchange of information, coordination of R&D efforts and advice on legislative measures etc.**
- 3.5 Support is given to the establishment of a list of raw materials, processes or products which should be substituted by cleaner materials and/or technologies as a matter of priority.**
- 3.6 Support is given to governments in the design and formulation and harmonization of legislation.**
- 3.7 Support is given in the implementation of the legislation.**
- 3.8 Support is given to promote the exchange of experience and information through sector specific seminars, workshops, training courses, etc.**
- 3.9 Technical assistance is provided in assessment and selection of appropriate technologies.**
- 3.10 Technical assistance is provided in establishing pilot plant programmes to assess potentially viable environmental technologies for environmental compatibility.**
- 3.11 Support is given to a detailed survey of hazardous industrial raw materials, chemicals by-products and products including classification and potential effects on health, soil, oil, water, etc., as well as their handling, treatment, recovery and disposal.**

3.12 Support is given in the preparation of a Code of Practice for industry on key issues which:

- ban or control certain hazardous chemicals from international trade;
- facilitate ease of transfer and implementation of low waste technologies;
- promote action on industrial safety;
- locate or relocate potentially hazardous operations in appropriate areas or sites;
- facilitate training programmes;
- ensure full cooperation with governments on formulation of standards, implementation of control procedures and monitoring of emissions.

3.13 Support is given to the preparation of regional studies on environmental protection management in accordance with the schedules documented in Annex 2.

3.14 Support is given to the proposed regional projects on environmental protection management detailed in Annex 3.

3.15 A list of sector specific issues discussed is attached in Annex 4.

I. Organization of the Workshop

The workshop was formally opened by J. Ganapin, Jr., Undersecretary, Department of Environment and Natural Resources. Inaugural statements were made by K. Zacharia, Chief, UNDP Regional Bureau for Asia and Pacific; a Senior Industrial Development Officer, Chemical Industries Branch, on behalf of the Director, Industrial Operations Technology Division, UNIDO; O. C. Bugge, Director, APCTT; R. Fuentes, Environmental Management Bureau; V. Ramos, Department of Environment and Natural Resources, who read a paper on behalf of F. Factoran, Secretary, Department of Environment and Natural Resources of the Philippines.

Country and area representatives participated in the workshop as follows: Bangladesh, China, Hong Kong, India, Indonesia, Republic of Korea, Malaysia, Mongolia, Pakistan, Papua New Guinea, the Philippines, Sri Lanka, Thailand and Viet Nam.

The following organs of the United Nations system and United Nations specialized agencies were represented: O.C. Bugge, J. Pelkonen, V. Kotelnikov of APCTT, and S. Zacharia of UNDP.

The provisional agenda was adopted without amendments.

The report of the workshop was adopted at the final plenary session with the understanding that the UNIDO Secretariat was authorized to finalize it in light of the amendments.

A list of papers is available in Annex 5.

II. Summary of Discussions

The session was convened to discuss the problem "Role of low and non-waste and pollution control technologies, designing engineering, training, management and information in chemical industries to improve its negative effects on environment". Papers were presented by C. Appleyard, Environmental Resources Ltd., UK, D. Ganapin, Assistant Secretary, Department of Environment and Natural Resources, R. Lamar, Institute for Microbial and Biochemical Technology, United States of America, D. Reeve, Environmental Protection Agency, Australia.

Two keynote papers were presented by C. Appleyard (UNIDO consultant) covering sources, emissions and effects (paper 1) and management and control (paper 2) of chemical pollution from industry. The principal theme of the presentations was that substantial reduction in pollution load can be achieved through application of source reduction techniques. Such an approach source

management was defined as "the development of a full understanding of the nature of all waste streams (aqueous, gaseous or solid) and the exact circumstances by which they are generated in order to eliminate or minimize pollution before it arises".

The essential components of source management embrace a number of key technical and management activities.

Key technical issues included identification of opportunities for:

- application of "cleaner" processes or processing methods;
- enhanced housekeeping practices;
- water conservation including reuse and recycle;
- waste minimization or avoidance;
- materials recovery and/or reuse.

It was noted that often little or no capital expenditure would be required to produce major financial and environmental benefits.

However, the following management initiatives were considered mandatory to ensure success:

- Senior management awareness and commitment
- Better training of technical staff and operators
- A management structure, which positively links production, pollution control and environmental management
- Audits of processes and utilities to identify opportunities
- Disciplined monitoring of performance.

D. Ganpin noted that the rapid growth of industrialization had a tremendous impact on the world's natural resource base through the entire cycle of raw material exploration and extraction, manufacturing, energy consumption, waste generation, and consumer use and disposal of industrial products. While it was true that the industry enhanced the quality of raw materials and extended their use, it had also been the source of process and product pollution as well as depletion and degradation of natural resources.

Industrialization would definitely be the trend as development takes priority in the world's economic and socio-political agenda. Several concerns should be properly tackled in this respect. Firstly, the energy raw material requirements from the natural resource bases would increase as a result of the build-up of industrial infrastructure. Secondly, pollution and waste would also result from industrial activities. Thirdly, industrial facilities were concentrated in urban areas which also magnified the industry's potential environmental implications and lastly, there would be emerging environmental risks as new industrial technologies are introduced.

R. Lamar noted that in the United States, there was an increasing emphasis on the development and use of biotechnologies for both waste minimization and pollution control. Those technologies were generally less energy intensive and were far less polluting than conventional physical-chemical technologies. Lignin-degrading fungi were nature's major degraders of lignocellulosic materials and played a dominant role in the recycling of photosynthetically fixed carbon. Their ability to depolymerise and metabolize lignin, an amorphous, water-insoluble aromatic biopolymer was unique to them, and gave them access to the cellulose and hemicellulose components that were otherwise shielded by lignin in wood.

D. Reeve's paper gave an overview on metal finishing industry, processes included and sources of wastes produced in this sector. It introduced the new approach of clean technology, which aims at zero waste with 100% production, and also gave examples of several cleaner production technologies, which were proven to be economically feasible for small industries. It highlighted the legislative measures implemented by the Environmental Protection Agency of Victoria, Australia, and presented the programmes carried out by the United Nations Environment Programme (UNEP) in the field of clean industrial production.

As a key recommendation, Mr. Reeve stressed the importance of education and cooperation between government and industry. To convince the industry of the profitability of cleaner production, a re-thinking would be required to assess alternative technologies and recast recovery equipment in

light of legislation and disposal costs. He also requested experts from the developing countries to join UNEP working groups on cleaner production and to participate in programmes organized by UNEP.

During the discussions the following problems were raised:

Application of integrated source control was already successful in India. A delegate from Sri Lanka however emphasized the problem of a general lack of knowledge about such techniques particularly within the smaller industries; also cost effective end of pipe treatment. A second delegate from India sought guidance on a preferred policy relating to existing problem industries and raised the question as to whether such industries should be persuaded/forced to change to cleaner technologies. A delegate from China emphasized the need to promote environmental awareness within industry. A major problem in China was stated to be the availability of technologies to achieve materials reused and recycled. A delegate from Indonesia raised the problem of monitoring and control of industrial discharges even when legislation is in place and called for increased environmental awareness and responsibility by industrial management. A delegate from the Philippines confirmed the prospect of cost benefits to industry in achieving integrated source control but went on to address the problem faced by small companies in achieving success because of lack of information and training.

It was also strongly advised that all elements of the technology operation have to be considered in an integrated manner: this includes adequate engineering, proper execution of the construction works, training of the staff and labour, as well as the managerial conviction to protect the environment.

The session was convened to discuss the problem "Socio-economic impacts, constraints, policies and measures on recycling of wastes in developing countries". The papers were presented by:

- T. Jackson, Stockholm Environment Institute at York, United Kingdom;
- E. Ouano, Total Consultancy Services, the Philippines;

In addition, delegates from following countries also presented papers on this issue: China, Republic of Korea, the Philippines, Papua New Guinea.

It had been stressed that the policy measures should consider not only technical and financial constraints of environmental protection but also the socio-economic impacts of the industry development.

T. Jackson (APCTT Consultant) examined the social-economic implications of hazardous waste management in his paper. From the viewpoint of the linear economic model of most industrialized countries, he looked at the sources of waste in the industrial system, and the technical and economic factors which influence waste generation. The paper detailed attempts to modify this structure by introducing recycling, re-use and re-conditioning of goods and materials. However, there were limitations to attempts of improving the material efficiency of the economy. Those were in part physical limitations (relating to thermodynamic laws) and in part economic. The consequences for developing countries were also discussed. In view of prospective dramatic increases in hazardous waste generation the paper called for measures which go beyond purely technical measures aimed at improving efficiency and included, in addition, substitution measures: substitution of less hazardous materials, products and activities for more hazardous ones. The paper set out recommendations for the development of a policy framework to encourage both efficiency improvements (recycling) and substitutions. Finally the paper developed the concept of clean services: the provision for the needs of members of the society without jeopardizing environmental health. It was argued that if development were to be ecologically sustainable, that concept may be more relevant than the production-consumption paradigm which prevailed in most industrial economies. Some indications were provided about how to develop such a concept in practice.

E. Ouano briefly reviewed the different uses of waste materials, the energy, water, and other resources required to treat and reuse wastes in comparison to those using virgin raw materials. He stated that resource recovery and recycling have lower waste load to the environment in comparison with producing similar products using virgin materials. Nevertheless, resource recovery and recycling was not extensively carried out owing to the higher cost of the product using recovered and recycled materials. Various social and financial factors which were deeply entrenched in modern society favoured the use of virgin materials and unnecessarily inflated the cost of recovered and recycled

resources. Cost of virgin materials had not considered the cost of collection, treatment, disposal and replacement of resources. Production of virgin materials and their extraction from nature enjoyed various subsidies, incentives and social appreciation which had not extended to resource recovery and recycling. The environmental damage owing to the production of virgin materials was understated. Social preference often considered those products made of recovered and recycled materials to be inferior.

In addition, recycling and resource recovery shouldered the waste disposal cost of virgin material and indirectly absorbed the cost of financial incentives and subsidies given to the production of virgin materials. Regional and international cooperation was important since competitors could displace local industry, even if the country had the political will to institute drastic changes in resource valuation so to reflect the real value of recovered and recycled materials with respect to virgin materials.

It was concluded that the governments should more actively promote local recycling schemes and provide for the training of recycling operations in industry and in the public sector. They should also seek to establish fiscal regimes, which would encourage the re-use of goods and should negotiate standards for warranty and design of durable goods. The industry should diversify their economic activities towards reusable products and recycling processes. The public, NGOs and other environmental concerns could strengthen the change through their buying preferences, information campaigns and recycling activities in order to reach the gradual change in social, cultural and economic policies towards waste recycling and resource recovery. Those were considered important components for a sustainable civilization.

The session was convened to give:

- (a) an overview of UNIDO's work in supporting development of the environmental activities in Asia and Pacific Region;
- (b) an overview of the regional network on pesticides for Asia and the Pacific, and its contribution to the development of the pesticide industry of the Region, with focus on environmental considerations of occupational safety;
- (c) an overview of the APCTT's activities on environmentally-friendly technologies;
- (d) a presentation of ESICNET's regional information network.

Presentations were made by:

- Senior Interregional Adviser, UNIDO
- Senior Industrial Development Officer,
Industrial Operations Technology Division (IO/T), UNIDO
- Industrial Development Officer, IO/T, UNIDO
- S. Dhua, Regional Coordinator, RENPAP
- J. Pelkonen, Associate Expert, APCTT
- V. Kotelnikov, Consultant, APCTT
- M. Miyashiro, Asian Institute of Technology, Thailand.

A Senior Interregional Adviser, UNIDO, presented a paper entitled "Overview of the UNIDO's work in Supporting Development of Chemical Industry in Asia/Pacific Region". It stressed that the chemical industry was a very quickly developing subsector of industry in the region with good prospects for the future. Even giving a pessimistic projection of the chemical industry development in the Region, the ratio of its MVA in worldwide MVA should reach 15 % and would require extensive investment in the chemical subsector. Therefore, every Government from the Region could and should undertake necessary policy measures to protect the environment and ensure that appropriate technologies transfer, assistance projects and other activities be provided.

An Industrial Development Officer of the Metallurgical Industries Branch, IO/T, UNIDO, introduced the activities of the Branch. In connection with environmental protection, the Branch recently carried out 23 projects of which 12 were implemented in the Asia and Pacific Region. Several workshops/seminars were organized by the Branch and 17 studies were prepared in this field. A short description of those activities with the list of projects, seminars and studies were distributed among

the participants. The environmental protection projects in metallurgy were related to waste (scrap) recycling, waste utilization (red mud, blue dust), recovery of valuable materials from wastes (heavy metals from sludges, effluent and solid wastes), energy saving measures (heat recovery, tube digestion, good housekeeping practices), institution building (mobile environment monitoring units), pollution prevention measures in production plants, reduction of environmental hazards of plants and regions with a high concentration of heavy industry. The Metallurgical Industries Branch provides assistance to the developing countries in plant rehabilitation, maintenance and production management as well, which contributes to maintaining an environmentally-friendly operation.

A Senior Industrial Development Officer of the Engineering Industries Branch, IO/T, UNIDO, explained that the Branch designs, formulates and implements technical cooperation projects in developing countries, covering the following areas: metalworking; machine tools; transport equipment; energy-related equipment; agricultural machinery, packaging machinery; electronic equipment, and computer applications in industry. The Branch's annual implementation is around US\$20 million.

UNIDO's projects, including those of the Engineering Industries Branch, have six main stages: (i) project identification; (ii) formulation; (iii) appraisal; (iv) approval and funding; (v) implementation and monitoring, and (vi) evaluation. The new UNIDO approach introduces environmental screening before and/or after each project stage. This process aims at identifying and assessing the environmental impact of all projects so that measures could be taken to minimize them.

In addition to above-mentioned preventive measures, he pointed out that the Engineering Industries Branch develops and implements projects addressing solely the environmental issues. Examples of such projects were: design, development and manufacture of pollution monitoring and control equipment; exhaust emission control in road transport vehicles; industrial noise control; preparation of guidelines for pollution control in electronics industry, etc.

S. Dhua explained that RENPAP stands for the Regional Network on Pesticides for Asia and the Pacific, a programme funded by the UNDP and executed by UNIDO in association with the Food and Agriculture Organization of the United Nations (FAO), the World Bank, the World Health Organization (WHO) and the Economic and Social Commission for Asia and the Pacific (ESCAP). He said that the multi-sectoral project was based on an innovative concept of supporting a regional, cooperative programme to bring together a group of Asia-Pacific countries with similar agro-climatic conditions and having similar problems in the development, manufacture and application of pesticides for the sole purpose of solving those problems through regional cooperation among member countries. The countries participating in the programme are Afghanistan, Bangladesh, China, India, Indonesia, Iran, Malaysia, Myanmar, the Philippines, Pakistan, Republic of Korea, Sri Lanka and Thailand.

J. Pelkonen gave a short introduction of the Asia and Pacific Centre for Transfer of Technology (APCTT) and summarized its activities on the promotion of environmentally-friendly and clean industrial technologies. She said that the Centre is assisting industry in member countries by providing information on transferable technologies in various forms and by arranging forums for experts from industrialized countries and developing countries to meet and exchange views and experience on the issues of environment and waste recycling. With support from the United Nations and the member countries, APCTT is also looking forward to establish a regional training centre on clean technologies and to creating a regional databank on waste available for exchange and commercial recycling.

V. Kotelnikov highlighted the APCTT programme on cleaner technologies for small and medium scale enterprise through the Asia-Pacific Mechanism for Exchange of Technology Information (METI). That programme would strengthen technology information flow among Asian and Pacific countries. The project would be oriented to small and medium scale industries (SMIS) with the main emphasis put on environmentally-friendly technology.

The METI database designed by APCTT contained information on technology offers, technology requests as well as consultancy organizations and individual consultants specializing in the field of environmental engineering/technology transfer. The information system would be installed at the district level in the METI participating countries to ensure efficient promotion of appropriate environmentally friendly technologies to SMIs from outside and within the region.

However, the information system would need to be easily accessible, and should actively stimulate businessmen to use it. In that connection, a marketing study was undertaken by APCTT within Asia and the Pacific to find out the most effective way of creating awareness among SMIs on competitive and profitable as well as appropriate and environmentally-friendly technologies available with METI.

The paper presented by M. Miyashiro included a comprehensive information about the Environmental Sanitation Information Centre (ENSIC). It stated the objectives of ENSIC, its subject scope, services and publication programme. It described ENSICNET, the regional information network on waters, sanitation and environment that were being developed with the financial support of the Asian Development Bank. Through that regional endeavour data on the national documented production of China, Indonesia, Nepal, Pakistan, the Philippines and Viet Nam, was collected and disseminated. A brief account of the operation of ENSICNET was given, as well as its regional projection and expected results.

During the discussion suggestions emerged that training programmes on environmentally-friendly technologies on a regular basis should be organized for industry in developing countries. There was a demand for a regional databank on waste available for recycling and relating waste treatment technologies.

It was suggested that the United Nations bodies and other development agencies should look into the possibilities of cooperation in their environment and waste recycling related programmes and coordinate the regional activities to avoid duplication and to reach the maximum benefits out of the projects.

The last plenary session was convened to discuss "Case studies on successful recycling of industrial waste".

Papers were presented by M. Dorfman, United States (Consultant), P. Lewis, India (Consultant) as well as papers from the following countries and area: China, Hong Kong, the Philippines, Indonesia, India and Pakistan.

Positive examples of waste recycling were given, showing the technical and economic part of the applied processes and logistic methods.

Mr. Dorfman presented a paper on behalf of Inform Inc., highlighting the enormous economic and environmental potential that exists for preventing the generation of waste at the source. Case studies of low cost, low technology successes from the United States Organic Chemical Industry were described. Specific steps that industry and government leaders could take to promote immediate source reduction achievements were outlined.

Mr. Lewis stated that among the varied wastes generated by industry, several residues are amenable to simple recycling techniques. Unlike those the residues of zinc and copper require a combination of hydrometallurgical, pyrometallurgical and chemical process technologies to achieve maximum utilization. Recycling that waste into high purity, premium value products possess a challenge since the product specifications were established with relatively pure feeds. The paper contained details of processes to recycle zinc ashes and brass ash/dross. The solid residues generated during the processing of these wastes into zinc sulphate were further processed to an micronutrient mixture. The technology for each of these processes was discussed. Economic aspects of conversion of zinc ashes to give zinc metal and zinc sulphate were also covered. A typical plant and machinery list of an integrated plant producing 10 million t/d of zinc sulphate and 5 million t/d of zinc ingot was included. It was established that it is possible to successfully convert industrial waste into valuable compounds.

During the discussion, participants raised questions regarding the feasibility and viability of certain ways of recycling technologies in developing countries. It was also stressed that the local conditions which change from country to country have to be considered, when assessing the appropriateness of different technologies. The general request of developing countries for appropriate waste recovery technology was expressed.

Because of the diversity and the dynamic nature of individual industrial waste generating facilities, it was concluded that regulatory prescriptions dictating particular technological approaches to be employed or even levels of source reduction to be achieved, would be in some cases inappropriate and counterproductive. Unlike the command and control regulations designed to ensure proper management of waste already produced, the role of government in promoting source reduction might be more appropriately viewed as catalytic, thus ensuring that industries are establishing institutional programmes to identify source reduction opportunities and are reporting their progress to government and the public.

It was agreed that the waste recycling industry was of prime importance to source out wastes at local and global levels, since the recycling of wastes requires a constant supply of feeds. Also new feeds which have not yet been commercially exploited should be identified. Industrial waste recyclers tend to be small manufacturing enterprises and have to adopt state-of-the-art technologies as well as close control of overheads and production costs to ensure the competitiveness in the long run.

Following two and one half days of plenary sessions delegates divided into three groups representing the chemical, metallurgical and engineering industries to discuss specific issues and problems and to formulate conclusions and recommendations on environmental considerations and waste recycling in the three industrial sectors.

Industry specific keynote papers and selected country papers also were presented and discussed in the group sessions.

Discussion at the workshop took note of the Conference on Ecologically Sustainable Industrial Development (ESID) organized by UNIDO at Copenhagen in October 1991; also of the United Nations Conference on Environment and Development to be held in Rio de Janeiro, Brazil, in June 1992.

Issues raised and problems discussed in the plenary and individual group meetings included:

- (i) Immediate benefits to be obtained by industry through application of appropriate low waste technologies and enhanced managerial practices to reduce waste at source and the need to provide better information to industry on such opportunities.
- (ii) Benefits to be obtained by industry through application of materials recovery and waste recycling opportunities and the need to provide better information to industry on such opportunities.
- (iii) The need for governments to positively promote waste recycling in general.
- (iv) The need to promote raw material or product changes or process substitution, as appropriate in order to eliminate or minimize hazardous processes (through application of cleaner technology) or products.
- (v) The need to carry out environmental impact assessment as part of new project development.
- (vi) The need for governments to encourage policies on selection of location for certain hazardous industries.
- (vii) The need for monitored waste exchange schemes for viable recycling or industrial reuse to be established on a national and regional basis.
- (viii) The need for waste treatment and/or safe disposal centres to be created and operated on a national and regional basis.
- (ix) The need to ensure that legislation in every country accurately reflects environmental requirements without adversely affecting the competitiveness of industry.
- (x) The need for better training at all levels in industry (management, technical and operational) to ensure effective application of appropriate low waste technologies including good housekeeping practices.

The Workshop recognized that environmental problems within the engineering industries were mostly of a chemical or metallurgical nature.

Finally, participants agreed that environmental issues discussed have both short and long term implications. Furthermore, since environmental problems are common to both developed and developing countries and since the latter have limited resources, participants stressed that developed countries should support environmental management in developing countries on both a technical and financial basis.

CLOSURE OF THE WORKSHOP

The participants were given a certificate on their attendance at the workshop.

The participants expressed their gratitude to UNIDO for arranging the Workshop and providing an excellent training programme and the possibility to discuss various aspects of cooperation between UNIDO and countries of the Asia and Pacific region. They also expressed their appreciation to the Government of the Republic of the Philippines for its hospitality and cooperation in facilitating the activities of the Workshop. The contribution of UNDP was noted with appreciation as having made possible the convening of the Workshop.

Statements of appreciation were made by representatives of China, the Republic of Korea, Pakistan and Viet Nam.

The meeting closed on 13 December 1991.

Annex 1 - List of Participants

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ANNEX 2

Proposed Regional Studies on Environmental Protection Management

CHEMICAL

- Industrial Estate of Chemical Manufacturing Plants and Environmental Protection Measures;
- Plastic/Fibre/Rubber Materials Recycling, Constraints and Options;
- Hazardous Chemicals, Options for Substitution in Asia and Pacific Region countries;
- Toward Efficient Production and Use of Fertilizers.

METALLURGICAL

- Preparation of an Ecologically Sustainable Development Strategy and Establishment of Environmental Monitoring Unit for the Mineral Processing and Metallurgical Industries;
- Collection, Preparation and Recycling of Metal Scrap;
- Environmental Protection Measures in the Electro-Plating Industry;
- Clean Technologies in the Iron and Steel Industry.

ANNEX 3

Proposed Regional Projects on Environmental Protection Management

- (a) Demonstration project for selective ecological alliance between plantations and industrial waste.
- (b) Pilot plant assessment of utilization of spent sulphite liquor from pulp processing in cement slurry manufacture.
- (c) Demonstration project for utilization of scale generated by steel rolling mills.
- (d) Demonstration project on use of phosphate gypsum as a soil conditioner.
- (e) Demonstration projects on metal recovery from spent metal finishing electroplating solutions and effluent treatment sludges.
- (f) Demonstration project on recovery and/or safe disposal of lubricants and oils.
- (g) Demonstration project on utilization of zinc and other heavy metals from flue dusts, sludges and pickling liquors.
- (h) Establishment of a specialist Regional Waste Treatment Institute to strengthen applied research in the field of hazardous waste management.

ANNEX 4

SECTOR SPECIFIC ISSUES DISCUSSED

- perceived agricultural benefits from use of phosphor gypsum on high saline soils;
- problems associated with the discharge of molasses liquors;
- microbial breakdown in soil of organo phosphate and chlorinated hydrocarbon type compounds;
- manufacture of cement slurry using spent sulphite liquid from pulp manufacture;
- regeneration of spent hydrated iron oxide (red mud) for application in fuel gas purification and simultaneous production of pure sulphur;
- metal recovery from metal preparation and finishing spent liquor and effluent treatment sludges;
- utilization of scale from steel rolling mills;
- recovery of metals, slags, acids and waste heat from iron and steel plants;
- recovery of spent lubricants and oils;
- recovery of zinc and other heavy metals from flue dusts and other metallurgical processes.

ANNEX 5

LIST OF PAPERS

1. Opening Speeches

D. J. Ganapin, Jr., Undersecretary, Department of Environment and Natural Resources

K. Zacharia, Chief, UNDP Regional Bureau for Asia and Pacific

M. Youssef, on behalf of A. Tcheknavorian, Director, Industrial Operations Technology Division, UNIDO

O. C. Bugge, Asia and Pacific Centre for Transfer of Technology

R. Fuentes, Environmental Management Bureau, the Philippines

V. Ramos, Department of Environment and Natural Resources, the Philippines

2. Plenary sessions and working group reports

Industrial pollution sources, emissions and effects; C. Appleyard

The role of low and non-waste and pollution control technologies, designing, engineering, training, management and information in chemical industries to improve its negative effects on the environment; C. Appleyard

Environmental considerations in the electrical/electronic industries in the countries of Asia and Pacific Region; G. Blagojevic

Environmental considerations in the metal finishing industry of Asia and Pacific Region; J. Vivas Hohl

Potential biotechnological applications of ligninolytic white-rot fungi; R. Lamar and K. Kirk

Low and non-waste production systems; D. Ganapin, Jr.

Environment and metal finishing reduction, recycling and recovery of wastes in metallurgical industry; D. Reeve

Socio-economic impacts, constraints, policies and measures on recycling of wastes in developing countries; T. Jackson

Environmental issues affecting the chemical industry in the Asia and Pacific Region; E. Quano

Regional network on pesticides for Asia and Pacific Region. Its contribution to the development of pesticide industry of the region with focus on environmental considerations and occupational safety; S. P. Dhua

Case studies on successful recycling of industrial wastes; M. Dorfman and P. Lewis

Introduction of ESICNET, regional information network; M. Miyashiro

Overview of UNIDO's work in supporting development of chemical industry in Asia and Pacific Region; J. A. Kopytowksi

UNIDO's technical assistance activities in metallurgy; T. Grof

UNIDO's technical assistance activities in engineering; C. Guerkok

Overview of APCTT's activities on environmentally-friendly technologies; J. Pelkonen and V. Kotelnikov

3. National reports and presentations

Environmental considerations and waste recycling for the metallurgical industries in Malaysia; C. T. Yean and T. G. Hong

Pollution control and waste recycling in Malaysia; H. Malik

Environmental considerations for the metallurgical industries in Malaysia; H. Hutagalung

Environmental consideration for the chemical industry in India; V. K. Majotra

Advances in anodizing production on aluminium alloy and environmental considerations in China; Z. Zufang

Recycling of Industrial Wastes in China; G. Gyangyu

Waste recycling in chemical industries in Pakistan; M. A. Khattak

Environmental considerations for the engineering industries in Indonesia; S. Sudjono

Environmental considerations for the metallurgical industries in Sri Lanka; P. K. D. Somasiri

Environmental considerations for the metallurgical industries in Sri Lanka, K. D. Wijenayaka

Situation of environmental pollution caused by industrial wastewater in Vietnam and some results of a wastewater treatment study; V. T. Tran

Environmental considerations for the metallurgical industries; C. D. Khai

Production and environment in engineering industry of Vietnam; V. D. Phu