PN-ABU-159

# REVIEW OF MERCURY RECOVERY AND HAZARDOUS WASTE TREATMENT TECHNOLOGY

United States
November 22 - December 4, 1993

Prepared for:

US - ASIA ENVIRONMENTAL PARTNERSHIP

WEC

WORLD ENVIRONMENT CENTER

## DISCLAIMER

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## TABLE OF CONTENTS

I. EXECUTIVE SUMMARY . . . . . 1

II. INTRODUCTION . . . . . 2

III. FACILITY AND MEETING SUMMARIES . . . . . 3

IV. SUMMARY RECOMMENDATIONS AND FOLLOW UP . . . . . 10

## APPENDICES

A. CONTACT LIST
B. PHOTOGRAPHS

# I. EXECUTIVE SUMMARY

From November 22 to December 4, 1993, Mr. Shin-Bom Lee, Executive Director of the Environmental Management Corporation (EMC), Seoul, South Korea, participated in a World Environment Center (WEC) Environmental Business Exchange (EBE) project in the United States. Funding for this project was provided through a cooperative agreement with the United States-Asia Environmental Partnership and additional project funding was made available through the Environmental Management Corporation.

The purpose of this EBE was to provide Mr. Lee with an intensive technology assessment tour of private and public sector organizations implementing state-of-the-art hazardous waste management technology and industrial health and safety practices.

The Environmental Management Corporation is a state-run organization in South Korea which provides technical and financial support to industries throughout the country for treating and disposing hazardous and municipal waste, providing guidelines for environmental education programs, and guidelines for industrial health and safety programs. EMC's projects are under the inspection by the Ministry of Environment, the National Assembly and the National Auditing Office.

Host facilities and organizations visited during this exchange include: South Coast Air Quality Management District, Diamond Bar, CA, International Technology Corporation, Chemical Waste Management, U.S. Environmental Protection Agency, WMX Technologies, Mercury Refining Co. Inc., East Bay Municipal Utility District, and Wheelabrator SOS Inc.

Funding for this project was provided through a Cooperative Agreement between the World Environment Center (WEC) and the United States-Asia Environmental Partnership (US-AEP).

## II. INTRODUCTION

The Environmental Management Corporation (EMC) is a state-run organization in South Korea which provides technical and financial support to industries throughout the country for treating and disposing hazardous and municipal waste, providing guidelines for environmental education programs, and guidelines for industrial health and safety programs.

Mr. Shin-Bom Lee, Executive Director of EMC, participated in an intensive two week technology assessment tour of U.S. facilities implementing state-of-the-art environmental technology and management practices for municipal and hazardous waste, mercury recovery, and wastewater treatment.

A priority focus for this project was given to assessing the transferability of mercury recovery technology, particularly with respect to florescent light bulbs, implemented in the United States.

## III. FACILITY AND MEETING SUMMARIES

**November 22, 1993**

South Coast Air Quality Management District (SCAQMD), Diamond Bar, California

Mr. Lee met with Mohan Balagopalan, Senior Air Quality Engineer, and Mr. David M. Madesen, Public Information Specialist, to discuss air pollution control management strategies and technologies implemented in California to mitigate the problem of urban air pollution.

Information was provided to Mr. Lee regarding the Regional Clean Air Incentives Market (RECLAIM) program of SCAQMD. This program investigated market based incentives for air emissions reduction in the Los Angeles area. Of particular interest to Mr. Lee were procedures governing emissions reporting (self reporting) under the RECLAIM program.

Because the meeting was limited to three hours, Mr. Lee made a verbal commitment to return to SCAQMD to investigate actual technologies implemented to reduce emissions from both stationary and mobile sources. A re-visit was planned for 1995.

**November 23, 1993**

International Technology Corporation (IT), Crosby, TX

Mr. Steven DeCicco, Process Engineering & Services Manager, Pollution Control Engineering Division, met with Mr. Lee in Texas to provide a detailed technology assessment tour of the IT facility.

The IT facility in Crosby, TX treats a Superfund site called Sikes. Sikes is an abandoned hazardous waste disposal site which stored petrochemical wastes in unlined ponds and drum burial trenches from 1960 to 1967. Contamination from the disposal sites has resulted in approximately 220,000 tons of contaminated sand and river bottoms, and approximately 90,000 tons of hydrocarbon sludges and tars.

Mr. Lee's interest was in viewing a Transportable Hybrid Thermal Treatment System (HTTS) implemented by IT for site remediation. The HTTS system used at the Sikes location implemented a single, high capacity, rotary kiln connected to two parallel HTTS SCCs and gas cleaning systems, identified as the HTTS 4 and HTTS 5 systems. The configuration of the IT waste remediation system allowed for the treatment of 50 tons per hour of contaminated solids.

Of particular interest to Mr. Lee was the transportability of the IT system as well as overall performance; the HTTS system demonstrated full compliance with all regulatory requirements and concentrations of contaminants in the ash were less than one-tenth the allowable concentration.

**November 24, 1993**

Chemical Waste Management, Inc. (CWM), Carlyss, Louisiana

Chemical Waste Management's Carlyss facility, which occupies 160 square acres, treats all solid, semi-solid and liquid hazardous waste excluding confines gases, explosives, radioactive materials, biological warfare agents, infectious wastes, PCB's, concentrated oxidizing or reducing agents and dioxins. The treatment and disposal methods are as follows:

- Fuels Blending
- Chemical Separation and Treatment
- Neutralization
- Chemical Oxidation
- Stabilization
- Organics Separation
- Drum Management
- Secure Landfill of Bulk and Containerized Solids

Mr. Lee was met by Donna Hartnet, Facility Service Representative, and was given an overview and tour of the facility. Particular focus of the site visit was given to the facility's automated drum processing unit and health and safety equipment and management.

The automated drum processing unit allows containerized waste to be tested, sorted and decanted in a single mechanized process. This system reduces the risk to employees and also reduces the risk of chemical spills due to human error.

Mr. Lee was most interested in heath and safety management and equipment implemented at the facility. CWM requires that all new employees attend a one week intensive course; Chemical Waste Management's Corporate and Site Safety Program. The facility employs two full time health, safety, and fire protection professionals and one full time industrial hygienist. Random industrial hygiene air monitoring of employees is conducted and all safety and fire equipment is tested on a weekly basis.

Mr. Lee was provided with CWM's Corporate Safety Procedures, and a list of health and safety equipment vendors.

Mr. Lee would like to send senior EMC managers to the facility for a one month internship regarding hazardous waste technology advancement and health and safety management.

**November 29, 1993**

U.S. Environmental Protection Agency (USEPA)

Mr. Lee met with Mr. Jentai Yang, Office of International Activities, to discuss the USEPA agreement with the Korea Ministry of Environment for capacity building. Mr. Yang will be visiting Korea from December 9-11, 1993 and may call on Mr. Lee to further discuss environmental issues and future cooperation. Mr. Lee reviewed the important issues facing the EMC including: heavy metal contaminated "yellow dust" from China's coal burning activities and industrial wastewater dumping in the Yellow Sea.

Hiroshi Dodohara, Office of Toxic Substances, Chemical Regulation Branch, PCB Disposal Section, presented Mr. Lee with information regarding Federal guidelines for PCBs. Mr. Lee received copies of legislation regarding PCB contaminated site clean-up and companies licensed to treat PCBs.

Matt Strauss, Office of Solid Waste, Waste Management Division, gave an overview of hazardous waste definition in the U.S. and provided Mr. Lee with documents regarding hazardous waste regulations in the U.S. A list of mercury recovery/treatment companies in the U.S. was also provided, as EMC is greatly interested in mercury treatment and recovery.

**November 30, 1993**

WMX Technologies, Washington, D.C.

As a follow up to the Carlyss facility visit, Mr. William Brown, Environmental Planning and Programs, WMX Technologies, Inc., provided Mr. Lee with an overview of WMX operations, with a focus on municipal solid waste collection.

The most recent municipal solid waste collection technology, the "WMS" system, involves a removable container on a regular size collection vehicle which gets exchanged for an empty one at a central location. When three containers are full a larger truck connects the barrels like train cars and hauls them for disposal. WMX also uses rail transport in some locations.

Mr. Lee toured a municipal solid waste landfill in Bowie, Maryland which is near

completion. Mr. Frank Quirus, Senior Environmental Engineer and Mr. William Wainer, General Manager, provided an overview of plans for closure including designs for a park area at the site.

The Bowie landfill has leachate collection ponds, methane gas collection system and is currently undergoing the permit process for expansion. There are residential areas within one quarter mile of the facility and Waste Management has received complaints of odors. The facility now releases a vanilla scented deodorizing agent to reduce the odor. It is a difficult issue because there are other odor causing industries in the area, but the landfill is usually the first target of criticism.

**December 1, 1993**

Mercury Refining Co. Inc. (MRC), Albany, New York

Alan Wilds, Vice President Marketing and Sales, and David Cohen, President, met met Mr. Lee at the mercury refining facility. MRC currently has a staff of 35, and expect 50 employees by early 1994, with scheduled expansion of capabilities. The company has been in business for 38 years.

Fluorescent lamps include cadmium, lead, etc. The U.S. produces approximately 600 million lamps annually. Currently manufacturers don't have a deposit requirement. Some states are looking at such a system for batteries.

MRC receives mercury waste from Europe by the container load for processing. This option is more cost effective for them because mercury is a finite problem in Europe, making shipment cheaper than the cost of a facility for short term use.

Mr. Lee mentioned the potential for MRC to enter the China market and be an example for the rest of Asia with a demonstration facility. MRC is putting together a new technology to retrieve mercury from tubes currently in prototype stage.

A Korean company called Han Vac has visited MRC to discuss technology exchange. Dr. Park from the Institute of Mining, Metallurgy and Metals was involved in the project and first established the technology exchange between Han Vac and MRC.

**December 2, 1993**

International Technology Corporation, Martinez, California

Gerhard Locke, PhD, Manager, Remedial Engineering Design, and Rich Purdue, P.E. Site Projects Engineering Manager, met with Mr. Lee. IT has assisted with a proposal to care for hazardous waste on Nanji Island in the Han River, Korea.

IT has 20 staff on data management, using an Oracle based system modeling and analysis. 60-70% of IT's business is government projects which generally involve a great deal of data. Risk assessment is essential to IT's business. IT tries to eliminate risk to a comfortable level; they cannot completely remove the waste so there is always some risk.

There are various regulations and options for capping hazardous waste sites; consolidation is the key - property is very valuable and IT tries to minimize the space necessary for a fill.

Mr. Lee requested copies of the numerous training materials developed by IT.

**December 3, 1993**

East Bay Municipal Utility District (EBMUD), Oakland, California

Michael Heaton, Wastewater Shift Supervisor, and Richard Harris, Civil Engineer, Office of Reclamation, met with Mr. Lee at the wastewater treatment facility. Since 1944, Special District Number 1 treats wastewater for approximately 600,000 people in a 83-square-mile area along the east shore of the San Francisco Bay.

Each community in the District's region owns and operates its sewer collection system which discharges into the District's region-wide interception system. The interceptors are 21.6 miles of reinforced concrete pipes ranging from 12 inches to 9 feet in diameter. They collect wastewater from approximately 1,800 miles of community sewers and are fed by 14 pumping stations ranging in capacity from 1.5 to 60 million gallons/day (MGD).

The treatment facility provides secondary treatment for up to 170 MGD and primary treatment can be provided for up to 325 MGD. The average flow is 80 MGD.

Primary treatment removes floating material, oils and greases, sand and silt and organic solids heavy enough to settle from the wastewater. Secondary treatment biologically removes most of the suspended and dissolved organic impurities.

Treatment steps include: pre-chlorination (for odor control), screening (to remove large objects), grit removal, primary sedimentation, secondary treatment using high purity oxygen-activated sludge, final clarification, sludge digestion, dewatering and composting. The treated effluent is finally disinfected, dechlorinated and discharged one mile off the East Bay shore through a deep-water outfall into San Francisco Bay.

This EBMUD operation has won the U.S. Environmental Protection Agency's highest award for pre-treatment twice in the past few years. In addition, EBMUD operators

won a national competition in the fields of safety, laboratory, mechanical, collection system, and process control.

In 1983, EBMUD began composting digested sludge and marketing it as a soil conditioner under the name "CompGro". Composting serves as an economical and environmentally sound alternative to traditional landfill disposal. Sewage sludge is broken down by bacteria in heated tanks. EBMUD uses the methane gas produced in this process to generate enough electricity to operate the equipment at the plant. The treated sludge is then mixed with wood chips and aerated in piles for a minimum of three days. At this stage, temperatures exceeding 55 degrees celsius kill harmful soil organisms. The sludge/wood chip mix is then spread in rows for drying and curing in the open air before passing through a screen which removes coarse chips. The resulting product, "CompGro" is then ready for use as an amendment for restructuring and improving soils. EBMUD sells the product for $7 per cubic yard for shipments of greater than 1,000 cubic yards.

For the past twenty years, EBMUD has been looking for ways to use reclaimed water as an alternative to potable water in suitable applications. The program began by using reclaimed water internally at the treatment plants and water filter facilities for cleaning and backwashing. The Office of Reclamation was formally established in 1988, and current reclaimed water use is approximately 9 MGD.

Recently the drive to pursue reclamation projects has increased because new water supplies are becoming more difficult and expensive to obtain. In addition, by maximizing the efficient use of current water supply helps support EBMUD's claims to maintaining existing water rights. Other benefits of reclaimed water development include: minimal institutional and environmental barriers to developing a supply, it is a reliable, drought-tolerant supply, and use decreases the wastewater effluent discharged into the San Francisco Bay.

In recent years, the District has prepared a master plan for local non-potable reuse projects and begun implementing projects that are cost effective when compared to the cost of the existing supply. Currently, five golf courses are using between 0.1 and 0.4 MGD of reclaimed water for irrigation. Other projects approved for operation include more irrigation for government land along highways and cooling systems for two oil refineries. These projects, when complete will increase non-potable reuse to 7 MGD.

The cost of extending an additional distribution system from the wastewater facility to the site of use is usually the factor limiting the economic feasibility of reclamation projects. The District has found that projects are generally feasible within a distance of 5 miles (8 km) from the source. Other issues such as user modifications to accommodate the lower quality of water also have an impact on the feasibility of proposed projects.

Projects also run into institutional and regulatory difficulties. Currently EBMUD is working with five wastewater treatment facilities to supply water for their reclamation projects, which could present a problem in supply. EBMUD is also working with local governments to promote ordinances that would require the use of reclaimed water if EBMUD invests funds to build the infrastructure to accommodate the process. In addition, federal, state and local governments have a number of regulatory compliance criteria that each project must meet.

A number of tools are available to EBMUD to finance reclamation projects including state loans, the Water Conservation and Development Fund, as well as reclaimed water and potable water revenues and user finances. Currently the District sets prices on an individual project basis with rates between 60 - 100% of the potable water rate. EBMUD tries to price projects at a level adequate to recover costs over a twenty year period.

**December 4, 1993**

Wheelabrator EOS Inc., United Airlines Facility, San Bruno, California

Al Curly, Plant Manager, United Airlines Wastewater Treatment Facility, provided Mr. Lee with a facility overview and tour. United Airlines operates the only pre-treatment facility at the San Francisco Airport.

The wastewater treatment facility can be monitored and shut down by a remote computer system at the plant managers house. This allows the plant to be manned only during the day and on auto in the evening.

The United facility also has a drum crushing and shredding machine which allows United to reduce the volume of hazardous waste (crushed drums can be deposited in municipal solid waste landfills).

## IV. SUMMARY RECOMMENDATIONS AND FOLLOW UP

### Project Summary

Feedback from Mr. Lee regarding the U.S. technology assessment tour indicated that the project was an overall success. The Environmental Management Corporation, under the guidance of Mr. Lee, will continue to coordinate future assessments of environmental technology and management in the United States.

Beginning in 1994, the Research Institute for Environmental Technology, Seoul, South Korea, will join EMC. Technology assessment and transfer activities are planned once the restructuring is complete and priority projects are identified.

EMC has an immediate interest in the acquisition of health and safety equipment as well as mercury recovery technology. Long term projects include U.S. - South Korea training programs in the area of health and safety management and transfer of hazardous and municipal waste treatment and disposal technology. The following section outlines immediate follow up activities requested by Mr. Lee.

### Project Follow up

- Contact Advanced Environmental Recycling Corp. (ARC); Bob Blanchfield 800-554-2372 for information on regarding mercury recycling capabilities.

- Contact National Electric Manufacturers Association - Doug Bannerman (202) 457-1969. Recommended by Bob Blanchfiled of ARC re: conference for fluorescent bulb producers in early December.

- EMC will provide quantitative data regarding the South Korean mercury situation and expected volume to companies in the United States. EMC will begin accepting proposals for implementing mercury recovery technology immediately upon Mr. Lee's return to Seoul.

- The Mercury Refining Company will to provide a detailed flow diagram and prose description of the mercury refining process for EMC engineers to review. A follow up visit by EMC engineers is expected to take place in early 1994.

- Copies of worker health and safety training material from International Technology Corporation and Waste Management, Inc., including OSHA regulations, have been shipped to EMC. Mr. Lee received vendor information regarding suppliers of health and safety equipment and plans to sponsor a demonstration of state-of-the-art safety equipment in South Korea.

# APPENDIX A

# CONTACT LIST

## CONTACT LIST

**November 22, 1993**

South Coast Air Quality Management District (SCAQMD)
21865 East Copley Drive
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Contacts:
Mohan Balagopalan, Senior Air Quality Engineer

Mr. David M. Madesen, Public Information Specialist

**November 23, 1993**

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Contact:
Mr. Steven DeCicco, Process Engineering & Services Manager

**November 24, 1993**

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Contact:
Donna Hartnet, Facility Service Representative

U.S. Environmental Protection Agency
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Contact:
Mr. Jentai Yang, Office of International Activities

**November 30, 1993**

WMX Technologies
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Contact:
Mr. William Brown, Environmental Planning and Program

**December 1, 1993**

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Alan Wilds, Vice President Marketing and Sales

David Cohen, President

**November 29, 1993**

**December 2, 1993**

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**December 3, 1993**

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Contact:
Michael Heaton, Wastewater Shift Supervisor

Richard Harris, Civil Engineer, Office of Reclamation

**December 4, 1993**

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Contact:
Al Curly, Plant Manager

# APPENDIX B

# PHOTOGRAPHS

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1. Assessment of land fill closure project at International Technology's Panoche, California hazardous waste facility. Gerhard Locke, PhD Manager, Remedial Engineering Design, and Rich Purdue, PE Site Projects Engineering Manager, provide overview.

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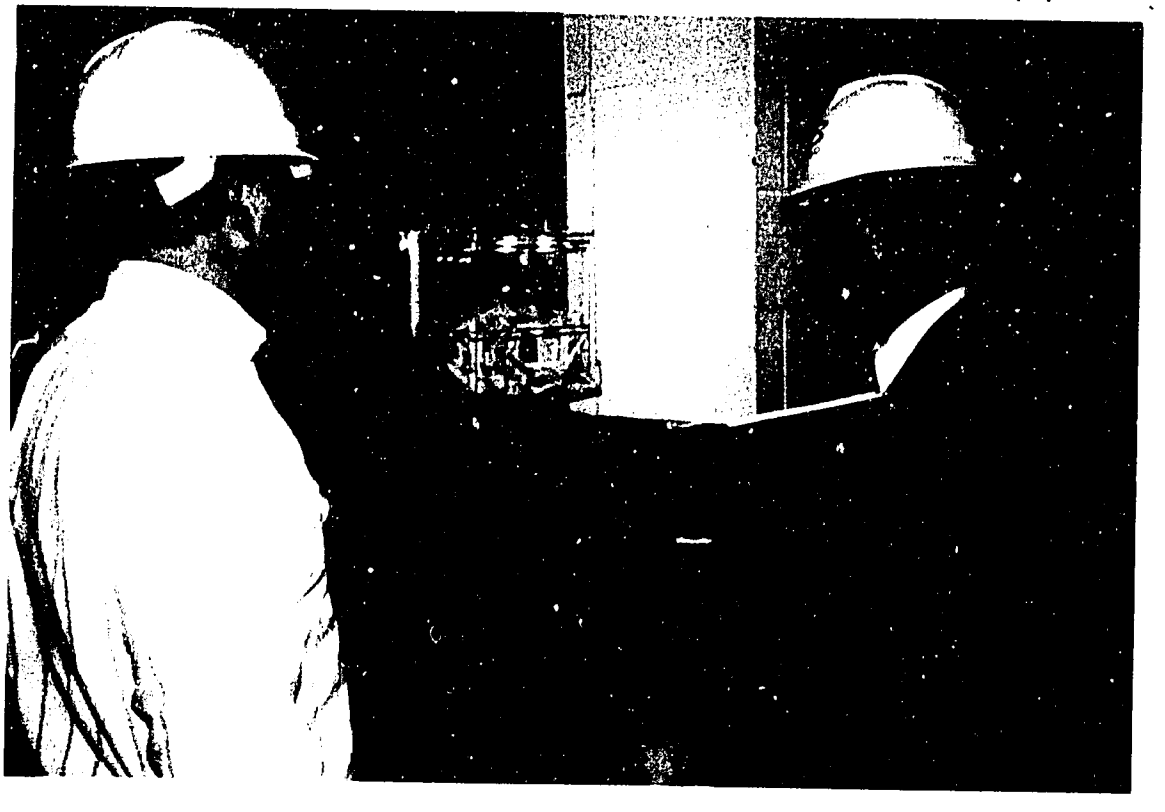
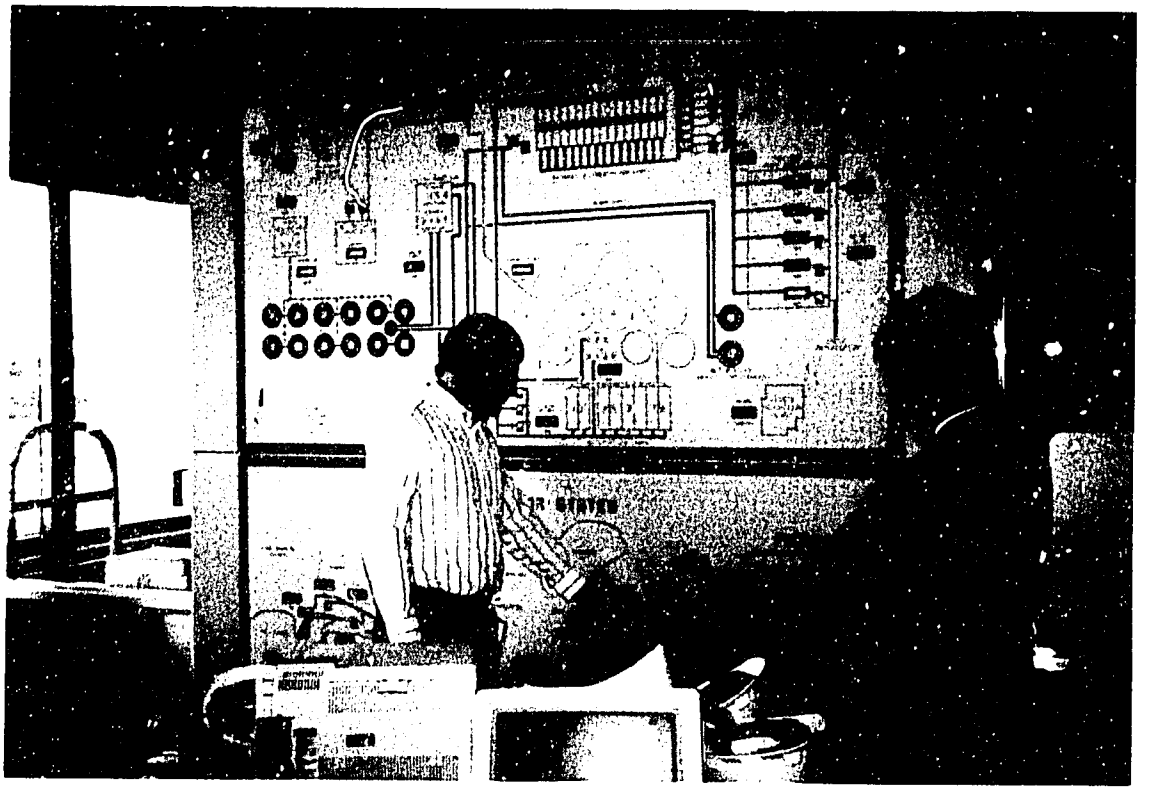
2. Michael Heaton, Wastewater Shift Supervisor, East Bay Municipal Utility District, Oakland California, explains health and safety measures - ear protection equipment.



3. Michael Heaton explains the odor control system, based on the use of sodium hypochloride.



4. Al Curley, Plant Manager, United Airlines Waste Water Treatment Facility, provides technical information regarding the treatment process.

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