TECHNOLOGY TRANSFER

The Bridge Between Research and Use

U.S. ENVIRONMENTAL PROTECTION AGENCY MAY 1975

TECHNICAL CAPSULE REPORT ON FLUE GAS DESULFURIZATION AND SULFURIC ACID PRODUCTION VIA MAGNESIA SCRUBBING

A technical Capsule Report covering the two-year operation of a large prototype sulfur dioxide recovery plant based upon magnesia slurry scrubbing is presently being printed and will be available for distribution at the APCA '75 Exhibition, June 15-19, in Boston, Mass. This prototype program was jointly funded by EPA and Boston Edison Company. The SO_2 absorption plant was installed at Boston Edison's Mystic Station in Everett, Massachusetts, and the regeneration facility at Essex Chemical's Rumford, Rhode Island, sulfuric acid plant.

The Capsule Report describes both process operations at Boston Edison and Essex Chemical; the problems encountered during the test program, as well as the solutions to these problems; the economics of MgO scrubbing, MgO regeneration, and sulfuric acid production; and areas of application for this process.

During the operational period, the system demonstrated its ability to regenerate and reuse magnesium oxide. Over five thousand tons of commercial grade sulfuric acid were produced from magnesium sulfite and the scrubbing system demonstrated a consistent ability to achieve SO_2 removal efficiencies in excess of 90 percent using regenerated magnesium oxide. During the last four month period of the recovery system's operation, the monthly availabilities were 87%, 81%, 57% and 80%. The lowest reported value was due to the lack of MgO for SO_2 removal, caused by problems in the sulfuric acid plant and an intentional emptying of the MgO silos during a controlled test.

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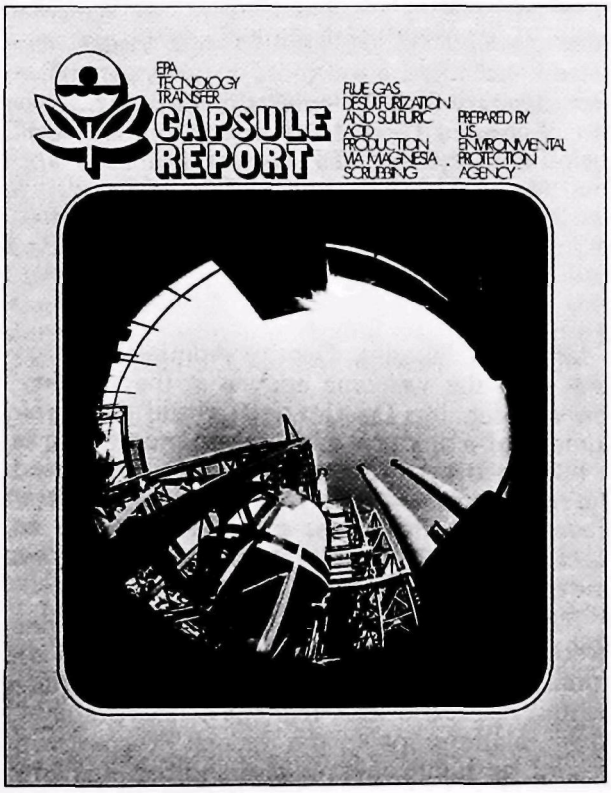


TECHNOLOGY TRANSFER LAND TREATMENT SEMINAR SERIES

Technology Transfer recently completed the first two of a series of design seminars on "Land Treatment of Municipal Wastewater Effluents". The first two seminars were held in **Atlanta, Georgia**—April 23-24, and **San Francisco, California**—May 7-8, 1975. This seminar series is aimed at providing federal, state and municipal engineers and the consulting engineering profession with the latest design information to properly design and evaluate land treatment as a viable treatment alternative.

Russell E. Train, USEPA Administrator, initiated the seminar series and presented the introduction and purpose to the 330 plus attendees at the Atlanta Seminar.

Interest has been extremely high at both seminars due to the timeliness of this subject area. The latest design factors and cost compari-

Refer to inside last page of this publication for complete listing of current Technology Transfer publications.

sons are covered in detail. Case histories are presented on successful projects and the up-to-date status of the Muskegon, Michigan, EPA demonstration project is discussed. Seminars for the other EPA Regions are being planned and detailed information may be obtained from contacting the respective Regional Technology Transfer Chairmen. Following is a general outline of the seminar format:

- **EPA's APPROACH TO LAND TREATMENT AND COST EFFECTIVENESS**
- **DESIGN FACTORS**
  - Introduction & Pretreatment
  - Overland Flow
  - Irrigation (Nutrient/Water Utilization)
  - Infiltration-Percolation
  - Site Selection
  - Storage (Total Water Balance)
  - Land Availability
  - Distribution Techniques
  - Public Health Considerations
  - Monitoring (Need)
  - Land Use
  - Climate, Topography
  - Surface Runoff Control
  - Hydraulic Loading
  - Nutrient Loading
  - Soil
  - Water Rights
  - Crop Selection (Forest Application-Hardwood/Softwood)
  - Heavy Metals
  - Farming Management
  - Underdrain Systems
  - Groundwater Conditions
  - Monitoring (Location)
- **REVIEW OF SIGNIFICANT LAND TREATMENT PROJECTS**
  - Overview & EPA-APWA Report
- **MISC. CASE HISTORIES**
  - Penn State
  - Mich. State
  - Melbourne
  - Phoenix
  - Tallahassee
- **MUSKEGON, MICHIGAN, PROJECT**
- **COST OF LAND APPLICATION SYSTEMS**
- **EXAMPLE COMPARISON OF LAND TREATMENT AND AWT**

Presentations at the seminars have been given by Bill Whittington, Office of Water Program Operations (OWPO), EPA, Washington, D.C.; Charles Pound, Metcalf & Eddy, Palo Alto, Calif.; Morgan Powell, CH_2M/Hill, Denver, Colo; Belford Seabrook, OWPO, EPA, Washington, D.C.; Frank D'Itri, Michigan State University, Lansing, Michigan; Y. A. Demirjian, Deputy Director of Public Works, Muskegon County, Michigan; and Gordon Culp, Clean Water Consultants, Eldorado Hills, Calif.

95TH AWWA CONFERENCE

Technology Transfer will provide a manned exhibit for the 95th Annual American Water Works Association Conference in **Minneapolis, Minnesota,** June 8-13, 1975. Over five thousand private and municipal water utility personnel are expected to attend the meeting, which is being held at the Minneapolis Convention Hall.

The theme of the exhibit will be a Technical Capsule Report on "Magnesium Carbonate—A Recycled Coagulant for Water Treatment", which will be initially distributed at the Conference.

MONITORING SEMINARS

Technology Transfer held six more Monitoring Industrial Wastewater seminars for industry. Each of these seminars was well attended by plant managers and engineers. Dates and locations of the Monitoring seminars were:

January 9, 1975	**Washington, D.C.**
February 18, 1975	**Kansas City, Missouri**
February 19, 1975	**Denver, Colorado**
March 11, 1975	**Oklahoma City, Oklahoma**
March 13, 1975	**Houston, Texas**
March 20, 1975	**Chicago, Illinois**

Mr. John Quarles, Deputy Administrator of EPA gave the welcome address at the Washington seminar. Mr. Quarles emphasized the development of a practical approach to monitoring as it relates to permit conditions. He also stressed the need for a cooperative effort by the Federal Government, the states, and the discharger to meet their respective monitoring responsibilities under PL 92-500.

The morning session of these seminars covered EPA regulatory policy with regard to the monitoring requirements of PL 92-500. States within respective EPA regional offices presented their relationships to the Federal Program with regard to monitoring policies and requirements.

Mr. John Quarles, EPA Deputy Administrator, at the Washington, D.C. Monitoring Seminar.

The afternoon sessions offered technical guidance for implementing a monitoring program. Gerry Shell of AWARE, Inc. concentrated on an overview of Monitoring Industrial Wastewater. Dr. Phillip Shelley of Hydrospace-Challenger discussed Sampling. The session on Flow Measurement was presented by Vic Jelen of the EPA Cincinnati Field Investigation Center. The session on Analytical Quality Control was prepared by Robert Booth of the EPA Cincinnati Methods Development and Quality Assurance Research Laboratory. The final session on In-Process Monitoring was presented by Walter Zabban of Chester Engineers.

MUNICIPAL DESIGN SEMINARS

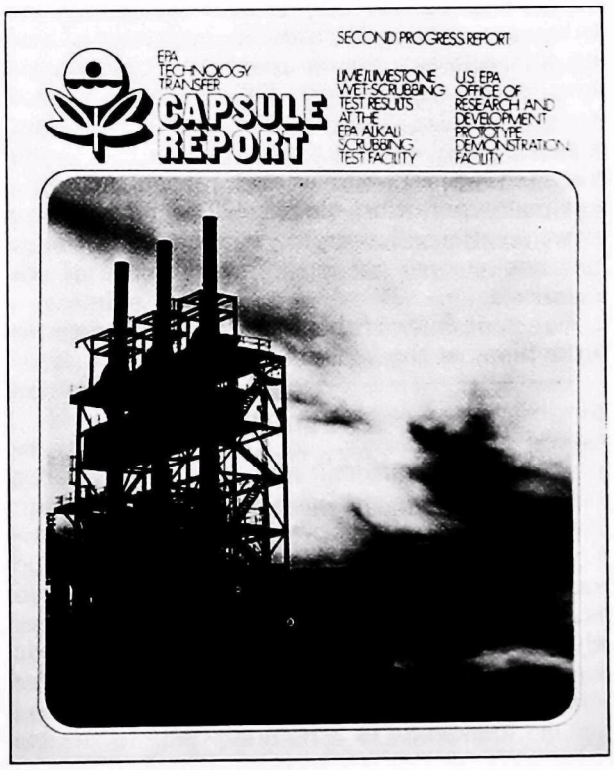
One additional Technology Transfer municipal design seminar has been conducted since the January, 1975, newsletter was published. A special cold climate treatment seminar was held in **Anchorage, Alaska** on April 9-10, 1975.

The Anchorage Seminar included technical sessions on cold climate biological treatment and physical-chemical treatment. Ernst Mueller, Commissioner of the Department of Environmental Conservation for the State of Alaska, opened the seminar attended by approximately 135 consultants and regulatory personnel. Technical presentations during the two-day seminar were given by Lee Reid, Borough of Anchorage; Jack Grainge, Environmental Protection Service, Environment Canada; Gene Suhr, CH_2M/Hill; Jack Cleasby, Iowa State University; Gordon Culp, Clean Water Consultants; Joe Rizzo, Calgon Corporation; and Randy Bayliss, State of Alaska. EPA speakers were Jack Coutts and Jim Westrick.

TECHNICAL CAPSULE REPORT ON LIME/LIMESTONE WET-SCRUBBING

A technical Capsule Report covering progress at the EPA alkali test facility at the TVA Shawnee Power Station is presently being printed and will be available for distribution at the APCA '75 Exhibition, June 15-19, in **Boston, Massachusetts.** The Capsule Report is the 2nd in a series on the Shawnee project, with each new capsule report being prepared when significant test data have been developed.

The Shawnee test facility consists of three parallel scrubber systems: (1) a venturi followed by a spray tower; (2) a Turbulent Contact Absorber (TCA); and (3) a Marble-Bed Absorber. Each system is capable of treating approximately 10 Mw equivalent (30,000 acfm



@ 300° F) of flue gas containing 1800-4000 ppm sulfur dioxide and 2 to 5 grains/scf of particulates.

The limestone and lime reliability testing at the Shawnee facility has shown that scrubber internals can be kept relatively free of scale if the sulfate (gypsum) saturation of the scrubber slurry is kept below about 135 percent.

For your copy of this Capsule Report, use the order blank at the back of this newsletter.

TECHNICAL CAPSULE REPORT ON MAGNESIUM CARBONATE– A RECYCLED COAGULANT FOR WATER TREATMENT

A technical Capsule Report describing a new magnesium recycle coagulation system for water treatment is presently being printed, and will be available for distribution at the 95th Annual Conference of the American Water Works Association (AWWA) in **Minneapolis, Minnesota,** June 8-13. The system is based on a combination of water softening and conventional coagulation techniques which can be applied to all types of water.

The process development began in 1957 at the Dayton, Ohio, water treatment plant where a hard, clear, high magnesium water is softened by a lime-soda process. The cities of Melbourne, Florida, and Montgomery, Alabama, have also provided additional support to the development of the magnesium carbonate coagulation system.

Approximately 1 million tons per year of dry solids are produced from an estimated 3,600 water treatment plants practicing coagulation throughout the country. Of these, less than 5 percent receive treatment of any kind before return to the water course. Wastes from water treatment plants are today recognized as a significant pollution problem. The new process offers an alternative approach to chemical sludge handling as well as providing for reuse of the chemicals.

For your copy of this Capsule Report, use the order blank at the back of this newsletter.

PROCESS DESIGN MANUAL FOR SLUDGE TREATMENT & DISPOSAL

The following changes should be made in the Process Design Manual for Sludge Treatment and Disposal:

- Figure 8-4, page 8-9: BTU rating should read—1,000 BTU/CF
- Figure 9-2, page 9-11: Curves were based on a sludge concentration after thickening to 3-1/2% solids.

TECHNOLOGY TRANSFER/AICHE CO-SPONSOR THE 2ND NATIONAL CONFERENCE ON COMPLETE WATER REUSE (WATER'S INTERFACE WITH ENERGY, AIR AND SOLIDS)

Technology Transfer and the American Institute of Chemical Engineers jointly sponsored the 2nd National Conference on Complete Water Reuse, held at the Palmer House, May 4-8, 1975, in **Chicago, Illinois.**

The Conference brought together government, industry, management, and environmental personnel to consider and evaluate the meaning and potential for complete water reuse systems to fulfill the objective of Public Law 92-500 for Zero Discharge of Pollutants, and Water's Interface with Energy, Air and Solids.

Session topics included: Land Disposal of Wastewaters and Sludges; Technology Transfer in Water Reuse; Energy; and Air/Water Interface.

APCA '75 MEETING AND EXHIBITION

Technology Transfer will exhibit recent air-related publications at the 68th Annual Air Pollution Control Association Meeting and Exhibition, to be held June 15-19, 1975, in **Boston, Massachusetts.** Technical sessions will be conducted at the Sheraton Boston, which is directly connected to the John B. Hynes Civic Auditorium exhibit hall.

The Conference will bring together government, industry, management, air pollution equipment manufacturers, and environmental personnel to learn about the latest technical developments in air pollution effects, measurement and control.

Participants at Technology Transfer Textile Seminar held in Boston on January 15-16, 1975. In front row (l-r) Mr. Luis Dichtl Subias of Empresa National Adaro, Spain; Mr. Fernando Troyano Lobaton of Spain's Ministry of Public Works; and Mr. Jaime Ruiz Rodriguez of Spain's Ministry of Industry.

EPA's OFFICE OF ENERGY RESEARCH

The Office of Energy Research (OER) of EPA's Office of Research and Development is a new office operating within a highly dynamic environment. Not only is the OER responsible for the design, planning and strategic management of a $130-million FY 75 research and development program, but it is doing so within an interagency context which is quite unique.

Dr. Stephen J. Gage, Acting Director of OER and formerly of CEQ, and his staff of eight professionals have designed a R&D program based upon two major interagency working group reports. These reports—**Health and Ecological Effects of Energy Use** and **Environmental Control Technology for Energy Systems**—embody the recommendations of more than a dozen federal agencies, offices and laboratories. In developing these recommendations into a balanced energy/environment R&D program, the OER has had to work in close coordination with the EPA research centers and laboratories for the portion of the work to be performed by EPA, and with other federal agencies for those projects which they will be implementing.

In order to assure the success of this massive and complex planning exercise, the OER evolved an entirely new and highly simplified planning system. The guiding philosophy behind this new planning system is that the proper role for OER in headquarters is one of strategic planning, information integration and transfer, and program and resource balancing. This more limited role requires the delegation of the responsibility for detailed program implementation and management to the field and to those management individuals closest to the research efforts. Implementation of this philosophy required a new set of operating procedures.

The first step in the implementation of the energy/environment R&D program involved the identification of key outputs necessary for an effective program. These outputs range from "initiate demonstration of regenerable sulfur-producing flue-gas desulfurization system" to "produce users manual on cold climate shoreline protection and restoration". They all have two things in common, however. First, they are discrete, identifiable, tangible units, and second, they are all essential parts of a balanced energy/environment R&D program.

Once these necessary outputs have been identified, short descriptions are sent to the appropriate EPA operation or other agency. This other organization reviews the output description and, within the time and resources allotted, provides OER with an accomplishment plan designed to provide the necessary outputs. This process yields several benefits. First, it assures that both OER and field research manager understand what is required. Second, it involves a high level of interaction among all parties involved in a particular research area, thus establishing linkages for future research coordination and information transfer. Third, it reduces to an absolute minimum the amount of paperwork involved.

The program itself is being planned on a five year basis with approximately $130 million programmed for expenditures in FY 75. The purpose of the program is the development of a sound scientific and technical basis for ensuring (1) adequate protection of human health, welfare, ecosystem and social goals; (2) environmental protection necessary to facilitate the use of energy supplies, with particular emphasis on domestic fuels; (3) implementation of energy system initiatives without delays caused by inadequate and insufficient environmental impact data; (4) development of appropriate cost-effective control technologies for emerging energy systems; and (5) assessment of environmental implications of energy conservation measures in order to maximize the energy savings and minimize the associated impacts.

The EPA energy-related environmental research and development program is divided functionally into three activities: (1) the Processes and Effects program to determine the environmental effects (and hence the control requirements) associated with energy extraction, transmission, conversion and use, (2) the Environmental Control Technology Program to identify, develop and demonstrate necessary control techniques based on the source effluent and ambient pollutant control requirements specified in (1), and (3) the Policy Implementation Research Program to evaluate the environmental, economic and social consequences of alternative control strategies for energy systems as input to EPA policy formulation. Each of these three programs is addressed in more detail below.

The energy-related processes and effects research program is composed of three general subactivities: pollutant identification, measurement and monitoring; health effects; and freshwater, marine and atmospheric/terrestrial ecological processes and effects. The program is designed to determine the environmental effects associated with energy extraction, transmission, conversion and use so that measures can be taken in a timely manner to protect human health, the ecosystem and social goals. Identification of the pollutants released by energy-related industrial operations and determination

of their impact on the human and natural environment will define the environmental control requirements for the pollution operations.

The environmental control technology program is divided into four general subactivities: extraction and beneficiation, fossil fuel combustion, synthetic fuels, and advanced systems and conservation. The program is designed to identify, develop and demonstrate cost-effective control techniques for energy extraction, transmission, conversion and use. The program necessarily involves assessment of the pollution potential of source effluent streams and the technological processes producing those pollutants as well as research and development on control devices and process modifications to reduce the impacts of the pollutants on ambient conditions. The thrust of the program is to provide adequate environmental protection as the Nation moves toward expanding use of domestic fuels.

The policy and implementation research program objective is to provide the information necessary to develop comprehensive environmental protection standards for energy production activities while attempting to balance the environmental and economic costs. The comprehensive evaluation of environmental, economic and social consequences of energy alternatives is intended for use as a basis for EPA policy formulation.

EPA's CONTROL SYSTEMS LABORATORY

As a part of EPA's Office of Research and Development, the Control Systems Laboratory (CSL), based in Research Triangle Park, North Carolina, has unique, wide-ranging responsibility in stationary source air pollution control and energy-related programs. CSL, under its director, Dr. John K. Burchard, is currently funding approximately 300 projects encompassing a broad range of research, development and demonstration programs interrelated by a common objective. The work of CSL is geared to answer the challenge of Section 101.(b)(2) of the Clean Air Act "to initiate and accelerate a national research and development program to achieve the prevention and control of air pollution." Over the last decade, CSL has established a comprehensive program to determine air pollution sources, assess the environmental impact of identified pollutants, and accelerate the development and commercial application of air pollution control processes.

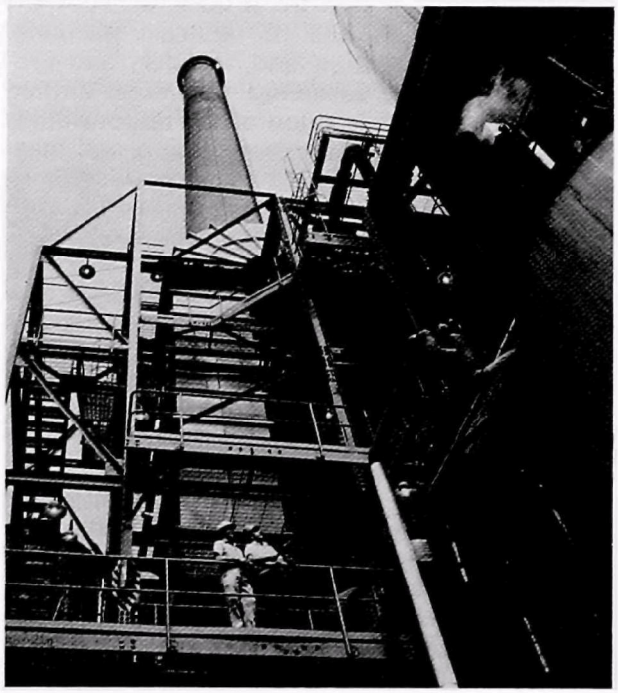
Many of the technologies which show promise as solutions to environment/energy problems originated in CSL. In such diverse areas as flue gas cleaning, clean fuels, combustion modification, pollution control for metallurgical and chemical processes, and particle cleanup, Control Systems Laboratory has taken the developmental initiative through co-sponsorship of major research, development, and demonstration (RD&D) projects, contractual studies, and in-house efforts.

Subdivided programmatically, CSL consists of four Branches: Gas Cleaning and Metallurgical Processes, Clean Fuels and Energy, Particulate and Chemical Processes, and Engineering Analysis. The Engineering Analysis Branch provides the staff function of program monitoring and evaluation support, including project evaluations, program reviews, and industrial processes catalog development.

The three line branches are engaged in a wide spectrum of control systems development work, ranging from small-scale experimental research to full-scale prototype demonstration and evaluation.

The Gas Cleaning and Metallurgical Processes Branch is developing and demonstrating flue gas cleaning for fossil fuel-fired electric utility power plants and industrial boilers, and pollution control systems for metallurgical processes such as in the iron and steel, and smelting industries.

Environmental assessment, pollution control for fuel conversion systems, development of



Research Project—Magnesia Slurry Scrubbing System for SO_2 Removal at Boston Edison.

combustion modification techniques for nitrogen oxides control, and physical and chemical fuel cleaning are the responsibilities of the Clean Fuels and Energy Branch.

The Particulate and Chemical Processes Branch is concerned with control of pollutants from chemical processes, development and demonstration of fine particulate control, improvement of conventional particulate control equipment, and evaluation and development of measurement, sampling, and analysis techniques and equipment.

• FLUE GAS DESULFURIZATION

To date, about 80 percent of CSL's total expenditures have been related to control of sulfur oxides (SO_x) emissions from fuel combustion and have been concentrated in flue gas desulfurization (FGD). The efforts of CSL have accelerated the development of FGD so that it is now in the process of commercialization in this country. Over 100 flue gas desulfurization systems are currently in operation, under construction, or planned.

CSL has been deeply involved in development/demonstration of the following flue gas desulfurization processes. (See table at bottom of this page.)

An advanced FGD process producing elemental sulfur as the major system by-product and a double alkali FGD system are new full-scale development/demonstration projects currently being planned.

In addition CSL has projects underway to improve FGD performance and reliability, and to evaluate and broaden the scope of FGD applications. These projects include determining chemical and physical properties of throwaway sludge, development/demonstration of environmentally acceptable disposal technology, the evaluation of technologies and markets for sludge utilization, purge reduction/elimination studies, evaluation of reductant gas technologies for by-product sulfur production, studies in overall FGD economics and applicability of FGD to non-utility combustion sources, and studies on the marketability of abatement sulfur and sulfuric acid from utility power plants.

• CLEAN FUELS

A second alternative to control SO_x emissions is to remove the sulfur from fuel prior to combustion. CSL has developed and improved methods to physically clean coal of sulfur and ash, thus reducing the fuel's potential to pollute. This program is continuing, with emphasis placed on improving available means of coal cleaning, and evaluating and sponsoring novel techniques of physical pollutant removal. The 2-stage froth-flotation technique for separating pyrite from very fine coal will be demonstrated. A coal cleaning manual is being prepared which will aid in implementation of this technology. Methods are also being developed with CSL's assistance to chemically clean sulfur from coal. This project has been demonstrated successfully at the laboratory scale and a pilot scale operation is currently under negotiation. Other methods of pre-combustion cleaning of fuels are being investigated to determine their potential for control of sulfur, nitrogen, hazardous elements and compounds, and particulates. One of these methods removes vanadium and nickel from high metals, high sulfur residual oils, yielding a low polluting fuel oil.

Process	Waste/By-Product	Application	SO_2 Removal Efficiency
Wet Lime/Limestone Scrubbing	Throwaway Sludge	30 Mw (prototype) coal-fired utility	75-90%
Wet Lime Scrubbing	Throwaway Sludge	40 Mw (full-scale) oil-fired utility	60-80%
Magnesium Oxide Scrubbing	98% Sulfuric Acid	155 Mw (full-scale) oil-fired utility	85-90%
Magnesium Oxide Scrubbing	98% Sulfuric Acid	100 Mw (full-scale) coal-fired utility	85-90%
Catalytic Oxidation	98% Sulfuric Acid	100 Mw (full-scale) coal-fired utility	85-90%
Wellman-Lord/Allied	>99% Elemental Sulfur	115 Mw (full-scale) coal-fired utility	90-95%
Double Alkali	Throwaway Sludge	30 Mw (full-scale) coal-fired industrial	85-95%

Pollutant levels in dirty fuels (coal and oil) can be decreased by fuel conversion processes such as gasification or liquefaction. These processes remove potential pollutants from the raw fuel to provide clean synthetic fuels. In order to ensure that these systems do not simply transfer the environmental problems from the fuel usage to fuel processing, a significant effort is underway to environmentally assess the entire systems. The assessment is resulting in the identification of more environmentally sound and economic systems and is supplying input to environmental control technology development. The converted fuels could be utilized in many ways. One promising method uses the fuel in combined cycle power generation. CSL has performed studies in the past and is currently performing studies on the best integrated combined cycle approach for achieving both environmentally sound and economic total systems. In conjunction with this study, CSL is co-sponsoring the development of a high temperature fuel gas desulfurization system which could be utilized as one step of the total system.

There is a potential for developing nonpolluting fuels from wastes. A full-scale system which utilizes municipal waste as a fuel source is being demonstrated under CSL leadership. As with other fuel usage systems, an important aspect is to ensure that the system is environmentally sound.

• COMBUSTION MODIFICATION

Absorption of sulfur during combustion is another approach being studied by CSL to reduce sulfur oxides emissions. Since 1967, this Laboratory has been actively developing fluidized-bed combustion for coal, and fluidized-bed gasification/desulfurization of residual oil as a means of economical pollution control in steam and power generation. Study of the environmental control potential of the fluidized-bed coal combustion process has advanced to the stage where a 630 kW (equivalent) pilot plant, capable of being operated at up to 10 atm pressure, has been built. Bench scale testing of the fluidized-bed coal combustion process has demonstrated 90-95 percent SO_2 removal at low sorbent addition rates, and up to 80 percent reduction of NO_x emissions. Cost estimates indicate a potential power cost savings for new fluidized-bed boiler plants of 10-15 percent compared to new conventional pulverized-coal boilers with flue gas desulfurization. The environmental potential of the Chemically Active Fluid Bed process for gasifying and desulfurizing heavy fuel oil has been demonstrated in a CSL co-sponsored pilot-scale program. The pilot testing of the process has accomplished impressive reduction of sulfur, vanadium, nickel, sodium, and nitrogen oxides emissions. Economic studies indicate that the process appears to have viable commercial potential. The design of a larger, demonstration scale project is now underway.

Combustion modification techniques are being developed as control methods for nitrogen oxides and other pollutants from existing and new conventional stationary combustion sources, and recent studies indicate that this technological approach is the primary near-term method of controlling NO_x emissions from the combustion of fossil fuels. CSL supported and directed efforts have shown that promising combustion modification techniques include combustion with low excess air, staged combustion, recirculation of flue gas in the fuel/air mixture, and burner/combustor systems redesign. The major emphasis to date has been on combustion control for the electric utility industry since this industry ranks first among the stationary sources as a contributor of NO_x emissions and a major user of fossil fuels. Industrial, commercial and residential combustion sources have also been subjects for significant R&D because of their fuel usage and the potential impact of area source emissions.

Field testing of state-of-the-art combustion modification for residential and commercial heating systems, industrial boilers, and utility boilers is well advanced, and the results are the basis for design and user manuals to inform and guide manufacturers and operators in the application of the technology. Pilot demonstrations of staged combustion and other techniques for coal-fired utility boilers (firing both Eastern and Western coals) at field sites are underway. Reports of these investigations will provide practical operating information on the effects of the control techniques on NO_x and other emissions and on unit performance. Similar studies are planned and are being initiated for other major combustion source categories in an effort to provide maximum stationary source technology for NO_x control.

• POLLUTION CONTROL FOR METALLURGICAL AND CHEMICAL PROCESSES

Control Systems Laboratory is also developing, evaluating, and improving air pollution control systems for metallurgical industries. Because of the different nature of each industry and different technical and economic constraints confronting it, programs to develop air pollution control technology have been tailored to each industry. The most significant advances to date have been in the control of emissions from coking operations. A full-scale demonstration by CSL in the development of coke oven charging control methods has led to the commercial installation of smokeless coke charging systems

by several coke producers. Other promising demonstration programs in coke pushing and quenching are nearing completion. Novel coke oven door sealing techniques are now being evaluated and will be tested on operating ovens in the next fiscal year.

Another metallurgical process for which CSL is developing control techniques is the charging of basic oxygen furnaces. This development program, being conducted on a 1 ton pilot furnace, is concentrated on process modifications, including development of a prototype emission collection system and a gas cleaning system that will allow emissions to be collected.

Recirculation of sinter plant effluent gases is being studied as a means to control the large quantities of particles, hydrocarbons, and other gaseous emissions which are currently being emitted from these plants. CSL co-sponsorship has assisted in the development of a windbox gas recirculation system which is being installed on a commercial sinter plant. This process appears to be a viable solution to the sinter plant emission problem, with initial results indicating significant reduction of both plant emissions and system energy requirements.

Evaluation and/or developmental control process work is also being conducted for the iron foundry cupola, secondary aluminum smelters, ferro-alloy furnaces, and primary copper, lead, and zinc smelters.

The control of emissions from chemical and petroleum processes is also being studied by CSL. Steam stripping for the control of sulfur oxides from petroleum catalytic cracker regenerators has been tested favorably in a laboratory program. Available alternatives to control sulfur emissions from refineries and determination of the economic impact of various levels of control on the petroleum industry are currently being studied. Efforts to control atmospheric emissions from nitric and sulfuric acid plants are presently concentrated on treatment of tailgases from these industries. Demonstration programs are currently underway to evaluate the efficiency of a promising process for cleanup of these gases. Control of hydrocarbons is being tested for solvent evaporation operations, ethylene dichloride manufacture, and other stationary sources.

• PARTICLE CONTROL

Much progress has been made in recent years to control particulate matter emissions. Systems currently used for particulate removal (i.e., scrubbers, electrostatic precipitators, and fabric filter particle collectors) are receiving continued development and improvement through research conducted by Control Systems Laboratory. This CSL program has led to the development of a new class of scrubber systems. Called the Flux Force/Condensation scrubber, this system is currently being tested at the pilot scale demonstration stage. The control of fine particulate (less than 3 microns) is receiving high priority because these particles persist in the atmosphere, comprise a variety of known toxic substances, and are a major contributor to atmospheric haze and visibility problems. Activities include evaluation of dust conditioning techniques, modification of charging sections and collecting electrodes for electrostatic precipitators, and evaluation of special operating techniques and filter fabrics to extend the capability of baghouses. In addition, novel concepts of particulate collection are being evaluated for performance and cost.

Nearly 70 contractors, grantees and consultants are currently working with CSL to develop particulate control technology as rapidly as possible. A systems study of conventional electrostatic precipitators (ESPs) has been published in an ESP Handbook, and a systems study of wet ESPs is scheduled for completion this year. Other documents which have been prepared in this area under CSL direction include a wet scrubber handbook and a fabric filter handbook. A handbook documenting a systems study of wet scrubber entrainment separators is in preparation.

• AUXILIARY PROGRAMS

CSL has efforts underway to acquire source assessment data relating the characteristics of hazardous, toxic and other pollutant emissions to their probable impact on receptors in order to define control technology development needs. The sources include industrial and utility combustion sources, non-combustion industrial processes, and open-burning sources. A listing of source priorities has been established and sources have been selected for which initial Source Assessment Documents are now being developed. These documents will consider the environmental impact of identified pollutants and present information necessary to allow decisions to be made by CSL personnel as to control development needs for the source types under consideration.

Evaluation and development of sampling and analytical procedures supports assessment of problem areas, evaluation of control technologies and the development of advanced control technologies. CSL is involved in detailing currently available techniques and developing new methods for sampling, measurement and analysis. The overall program area is balanced between process stream measurement and analysis, and specialized air pollution emission measurements. Several handbooks have been completed detailing manual methods for sampling and

analyzing gaseous pollutants, reviewing instrumental methods for measuring gases, and review methods for determination of particulate mass and size. In the area of particle measurement systems, a stack sampler which increases accuracy, minimizes sampling time, and is especially applicable to gas streams with low grain loadings was commercially packaged under contract. Studies are being implemented to develop an even higher volumetric rate sampler in support of the development of very high efficiency control devices.

A significant auxiliary program within the Laboratory is concerned with disseminating the large volume of information generated by its research, development and demonstration projects. For about 7 years, CSL has sponsored symposia, conferences, briefings, etc. in key areas such as flue gas desulfurization, clean fuels, particulate control, and combustion modification techniques for SO_x control and for NO_x control. About 25 such information exchanges have taken place and a number are planned within the near future. CSL personnel publish about 60 papers per year for presentation in EPA sponsored and co-sponsored symposia, technical and industrial association symposia, and institutional symposia. In addition, as indicated throughout this article, CSL RD&D has led to the publication of numerous (nearly 90 in 1974) handbooks, manuals, and technical reports which are available to potential users of the technologies.

A report containing titles, etc. of contract, grant, in-house (including symposia proceedings), and interagency reports covering air pollution RD&D work sponsored by CSL and other EPA organizations is prepared semi-annually and includes instructions for obtaining the documents. Additionally, CSL prepares a monthly report of abstracts representing CSL reports which have been issued but not yet included in the overall EPA report of air pollution technical publications. These documents are made available to interested parties. CSL is currently formulating a program to intensify efforts to disseminate, to industry and regulatory agencies, technical and economic information derived from its RD&D programs in order to accelerate commercial application of control technology.

Where to Get Further Information

In order to get details on items appearing in this publication, or any other aspects of the Technology Transfer Program, contact your EPA Regional Technology Transfer Committee Chairman from the list below:

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I	Lester Sutton	Environmental Protection Agency John F. Kennedy Federal Building Room 2304 Boston, Massachusetts 02203 617 223-2226 (Maine, N.H., Vt., Mass., R.I., Conn.)
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X	John Osborn	Environmental Protection Agency 1200 6th Avenue Seattle, Washington 98101 206 442-1296 (Wash., Ore., Idaho, Alaska)

For the following audio-visual material, please contact your Regional Technology Transfer Chairman. (See above)

MOTION PICTURES (16mm sound)

- Richardson Texas Project—Title: "Somebody around here must be doing something good." (15 min.)
- Phosphorus Removal (5 min.)
- Water Quality Management, Alameda Creek, Calif.—Title: "The Water Plan." (28½ min.)
- The Seattle METRO Story. (28 min.)

VIDEOTAPES

- Carbon Adsorption. (40 min.)
- Upgrading Activated Sludge Treatment Plants. (40 min.)

REQUEST FOR TECHNOLOGY TRANSFER MATERIAL

The publications listed on this form are the only ones available through the Office of Technology Transfer.

Please send me the following publications at no charge. (Check appropriate boxes)

PROCESS DESIGN MANUALS

- ☐ Phosphorus Removal 1001
- ☐ Carbon Adsorption 1002
- ☐ Suspended Solids Removal 1003
- ☐ Upgrading Existing Wastewater Treatment Plants 1004
- ☐ Sulfide Control in Sanitary Sewerage Systems 1005
- ☐ Sludge Treatment and Disposal 1006

TECHNICAL CAPSULE REPORTS

- ☐ Recycling Zinc in Viscose Rayon Plants 2001
- ☐ Color Removal from Kraft Pulping Effluent by Lime Addition 2002
- ☐ Pollution Abatement in a Copper Wire Mill 2003
- ☐ First Interim Report on EPA Alkali SO_2 Scrubbing Test Facility 2004
- ☐ Dry Caustic Peeling of Peaches 2005
- ☐ Pollution Abatement in a Brewing Facility 2006
- *☐ SO_2 Scrubbing and Sulfuric Acid Production Via Magnesia Scrubbing 2007
- *☐ Second Interim Report on EPA Alkali Scrubbing Test Facility 2008
- *☐ Magnesium Carbonate Process for Water Treatment 2009

INDUSTRIAL SEMINAR PUBLICATIONS

- ☐ Upgrading Poultry Processing Facilities to Reduce Pollution (3 Vols.) 3001
- ☐ Upgrading Metal Finishing Facilities to Reduce Pollution (2 Vols.) 3002
- ☐ Upgrading Meat Packing Facilities to Reduce Pollution (3 Vols.) 3003
- ☐ Upgrading Textile Operations to Reduce Pollution (2 Vols.) 3004

MUNICIPAL SEMINAR PUBLICATIONS

- ☐ Upgrading Lagoons 4001
- ☐ Physical-Chemical Treatment 4002
- ☐ Oxygen Activated Sludge 4003
- ☐ Nitrification/Denitrification 4004
- ☐ Upgrading Existing Wastewater Treatment Facilities—Case Histories 4005
- ☐ Flow Equalization 4006
- ☐ Wastewater Filtration 4007
- ☐ Physical-Chemical Nitrogen Removal 4008

BROCHURES

- ☐ Physical-Chemical Treatment 5001
- ☐ Phosphorus Removal 5002
- ☐ Upgrading Existing Wastewater Treatment Plants 5003
- ☐ Carbon Adsorption 5004
- ☐ Oxygen Aeration 5005
- ☐ Nitrogen Control 5006
- ☐ Seattle, Washington METRO 5007
- ☐ Wastewater Purification at Lake Tahoe 5008
- ☐ Indian Creek Reservoir 5009
- ☐ Richardson, Texas 5010

HANDBOOKS

- ☐ Analytical Quality Control in Water and Wastewater Laboratories 6001
- ☐ Monitoring Industrial Wastewater 6002
- ☐ Methods for Chemical Analysis of Water and Wastes 6003

*Publication listed for first time

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