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BILL PITTMAN

MIDWEST RECOVERY COMPANY

P.O. Box 431 • ARLINGTON HTS., IL 60006 • 312/655-4077

Manufacturer & Designer
of Air Filtration Products

Representatives for:

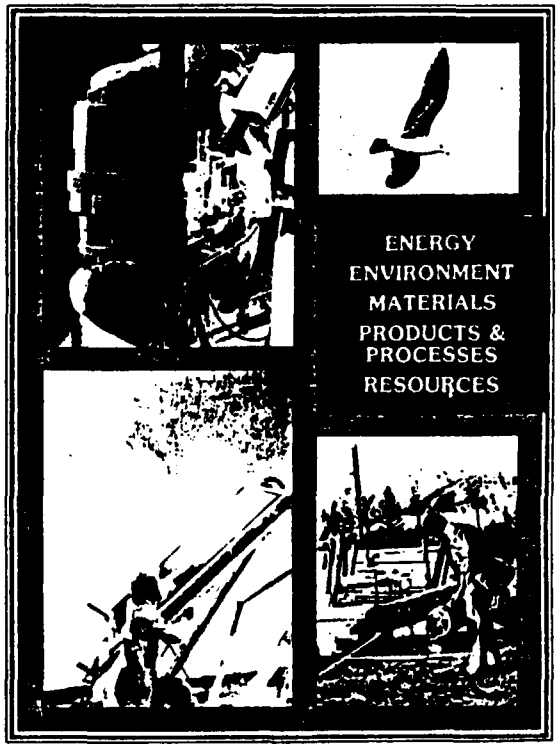
- **Koch Filter Corporation**
  Complete Air Filter Line

- **S.D.I.**
  Air to Air Heat Recovery Systems

- **Morse Boulger, Inc.**
  Waste Heat Incinerators

- **Peerless Metal Industries**
  Complete Metal Fabrication

TECHNOLOGICAL RESOURCES



ONTARIO RESEARCH FOUNDATION

1982

Since its founding in modest quarters on Toronto's Queen's Park Crescent in 1928, the growth of Ontario Research has continuously reflected the expanding and ever changing needs of industries in Ontario and Canada. Today, a staff of more than 400 exercises its scientific, technical and administrative skills in 275,000 square feet of laboratories, shops and offices divided between a main building and pilot plant located in Sheridan Park Research Community, in Mississauga, Ontario.

The business of Ontario Research is providing technological resources on a contract or fee basis. Our areas of inquiry encompass the physical sciences and engineering. Our capabilities range from routine testing to pure invention.

Above all, the backbone of Ontario Research is people · · · scientists, engineers and technologists backed by a solid support staff · · · working hand in hand with industry to solve technological problems, to innovate and to invent. We complement corporate research and development and act as the R & D arm for companies too small to have their own.

Each capability listed in this catalogue includes the name or names of persons to contact regarding assistance in specific areas. Their expertise is just a phone call away.

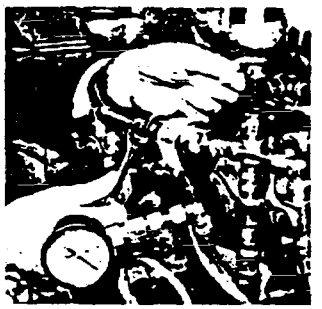
Index

Energy

ENERGY CONSERVATION PROGRAMS AND ANALYSES

Energy audits are done on the heating and cooling systems of buildings and industrial processes, using analytical and experimental methods. Cost benefit analyses are done on new and retrofit building energy systems, applications and testing of heat pumps for both industrial and residential use; assessments are made of internal combustion engine efficiency and fuel conservation measures.

E1 - Contacts:
Vijay Deshpande
Lou Bruno
Peter Edwards
(Buildings & Industrial Processes)
Dr. Alex Lawson
(Internal Combustion Engines)



THERMAL INSULATION DESIGN AND EVALUATION

Thermal performance of materials and building systems is measured routinely. Systems are designed to have specific thermal transmission characteristics. Recommendations are made for upgrading thermal insulation in buildings and industrial processes.

E2 - Contact: **Greg Ovstaas**

WASTE HEAT RECOVERY

Studies include the use of low pressure heat exchangers (air to air type) to preheat incoming air, and the reclamation of waste heat from grey waters and such industrial sources as stacks, process streams and ventilation.

E3 - Contact: **Vijay Deshpande**

BUILDING ENERGY SYSTEMS AND MONITORING

The thermal performance of existing building energy systems, including office buildings, plants and greenhouses, is evaluated and the performance of proposed new systems predicted. Assessments are made of the thermal efficiency of experimental systems, designs and materials.

E4 - Contacts: **Vijay Deshpande**
Greg Ovstaas
Lou Bruno

HEAT STORAGE SYSTEMS AND MATERIALS

Expertise exists on systems and materials for storing low, medium and high temperature heat including both sensible and latent heat technologies. Storage systems can be developed to suit specific energy sources and end uses, and performance evaluations made on existing units.

E5 - Contacts:
Vijay Deshpande
Cyril Gibbons
(Low temperature systems)
Greg Ovstaas
(Calorimetry measurements)
Brian Sellars
(Medium & high temperature systems)

THERMOELECTRIC GENERATION

Capability exists for designing and testing prototype thermoelectric generators based on the isothermal expansion of alkali metal vapour. Facilities include a dry box capable of handling reactive materials such as molten lithium.

E6 - Contact: **Rob Roy**

Energy ...cont.

COMBUSTION TECHNOLOGY
Combustion efficiency is measured routinely, and performance characteristics determined for a variety of fuels and burning devices. Thermal efficiency is optimized by utilizing appropriate design factors.
E7 - Contact: Lou Bruno

BURNER DEVELOPMENT
Subjects of study include premix burners, low excess air burners, internally and externally atomizing burners and low BTU gas burners. Burner design is optimized for emissions, thermal efficiency, minimum excess air, and materials compatibility (burner material vs fuel).
E8 - Contact: Lou Bruno

HEAT TRANSFER ANALYSIS
Studies are made comparing theoretical heat transfer with actual measured values. Building energy audits are done and recommendations made. Industrial process heating requirements and heat transfer mechanisms are determined. Instrumentation includes IR sensors and heat and mass flow sensors.
E9 - Contact: Lou Bruno

SOLAR SYSTEMS MONITORING
Programs are designed to quantify energy flows in such situations as buildings and solar collectors. The monitoring hardware is installed and maintained, and collected data analysed by computer.
E10 - Contact: Michael Dean

NATIONAL SOLAR TEST FACILITY
This facility is operated by Ontario Research for the National Research Council. Services available include standard tests on solar collectors and the use of the 100kW solar simulator for a wide variety of purposes.
E11 - Contact: Vern Nielsen

SOLAR TECHNOLOGY
This activity includes special studies on solar collector design and performance, optical measurements on glazings and coatings and the development of standards.
E12 - Contacts: Dr. Harry Pullan
Dr. Mike Westcott

WIND POWER
Capabilities include surveys of wind power systems, with wind velocity audits, determination of wind machine characteristics and the evaluation of electrical energy storage systems. Cost benefit analyses are made on small individual-location wind machines, and large-scale systems.
E13 - Contacts: Vijay Deshpande
Lou Bruno
Thomas Yu

COAL, LIGNITE AND OIL SANDS PROCESSING
Capabilities exist in coal crushing, cleaning and beneficiation: hydrometallurgical techniques for sulphur and ash removal; and preparation of coal/oil etc., slurries. A study has been done on the conversion of lignite to charcoal, and another on the ultrasonic processing of oil sands tailings.
E14 - Contact: Dr. Hans Brandstatter

ALTERNATE FUEL UTILIZATION
Internal combustion engines are modified to burn such alternate fuels as ethanol, methanol and propane, and current awareness is maintained on fuel options such as hydrogen. Studies are done on alternate fuels for steam generation such as coal/oil, coal/water and coal/methanol.
E15 - Contacts: Dr. Alex Lawson
Vijay Deshpande

BATTERY AND FUEL CELL TECHNOLOGY
Ontario Research specialization is in advanced battery materials including ceramic electrodes, seals for lithium and nickel-cadmium batteries, ionic conductors for high-energy density batteries, testing for power output and conversion efficiency, and studies in the degradation of materials.
E16 - Contacts: Dr. Nora Middlemiss
Lou Bruno
Bob Elliott

PEAT PROCESSING AND UTILIZATION
Peat is an indigenous resource in many parts of Canada. Capabilities and experience exist to examine novel methods of processing peat to fully utilize its energy and material values.
E17 - Contacts: Tom Gallo
John Sheppard
Lou Bruno

FENESTRATION MEASUREMENTS
Thermal performance of window systems is measured, including systems utilizing blinds, drapes and vertical louvres. Measurements can be made of solar/optical properties, shading coefficients and 'U' values.
E18 - Contact: Richard Mortimer

AMBIENT AIR QUALITY ASSESSMENT

Facilities and expertise are available to design and conduct air quality surveys, including the acquisition, handling and interpretation of air quality and meteorological data. We have over 30 years experience in ambient air quality assessments and investigations of site-specific problems.

EV1 - Contacts: Dr. Syd Barton
Dr. Harry McAdie

ENVIRONMENTAL IMPACT ASSESSMENTS

The capability exists for assessing the present or potential environmental impact of any industry or commercial activity. Ontario Research staff can provide specific capabilities to complement those of other specialists such as planning, biology, etc.

EV2 - Contacts: Dr. Syd Barton
Dr. Harry McAdie

LONG-RANGE TRANSPORT OF ATMOSPHERIC POLLUTANTS

The transport and interaction of pollutants in the atmosphere and subsequent deposition to land and water are studied. One study has been concerned with the removal of pollutants (such as acid constituents) from plumes of major sources by washout. Remote sensing techniques are available for plume tracking.

EV3 - Contacts: Dr. Syd Barton
Doug Johnson

PRECIPITATION CHEMISTRY

Recent atmospheric deposition studies have involved the development of improved sampling and analytical methods for the assessment of precipitation samples. In addition to using standard methods, special attention has been given to the collection and determination of labile species such as mercury and dissolved sulphur dioxide.

EV4 - Contacts: Dr. Syd Barton
Doug Johnson

PARTICULATE CHARACTERIZATION STUDIES

Ontario Research staff are experienced in the conduct of comprehensive studies to characterize ambient particulate matter and document the relative importance of various source categories. Micro-inventory, chemical mass balance and dispersion modeling techniques have been used in such studies.

EV5 - Contacts: Dr. Syd Barton
Monica Dobson

EMISSION INVENTORIES

Ontario Research staff are experienced in the preparation of detailed emission inventories. Recent studies have been concerned with the preparation of Canada-wide inventories of fine particulate and primary sulphate emissions from anthropogenic sources.

EV6 - Contacts: Doug Johnson
Dr. Syd Barton

SOURCE SAMPLING

Ontario Research has the ability to measure gaseous or particulate emissions from any type or size of source in accordance with the Ontario Source Testing Code or EPA requirements. Continuous gaseous monitoring and particle size distribution capabilities are also available, together with dispersion modelling.

EV7 - Contacts: Dr. Fred Hopton
Jim Craigmile

ODOUR EMISSION AND CONTROL

Ambient odour problems or specific odour sources are evaluated by a specially trained odour panel. Analytical methods, such as gas chromatography, are used to separate and identify odourants. Pilot-scale equipment is used to determine effective means of odour control from specific sources.

EV8 - Contacts: Dr. Fred Hopton
Michael Rix

ASBESTOS MEASUREMENT AND CONTROL

Samples of asbestos fibre are taken from air, water and bulk materials such as insulation. Fibre measurements are made on samples using optical counting, TEM, SEM, dispersion staining and polarized light microscopy.

EV9 - Contacts: Dr. Eric Chatfield
Mrs. Jane Dillon
Dr. Ivan Joyce
Mrs. Jackie Terry

OCCUPATIONAL HEALTH AND SAFETY STUDIES

Studies are made of work environments to measure and evaluate exposure to chemical and physical stresses, and corrective measures recommended. An industrial physician is consultant to the ORF team. Capabilities in sampling, measurement, analysis, ergonomics (q.v.), literature surveys and safety footwear development and testing are available.

EV10 - Contacts: Dr. Fred Hopton
Bruce Stewart

DIESEL EMISSION CONTROL TECHNOLOGY

Developments include both fuel modifications (fuel emulsions, alternate fuel utilization, etc.) and emission control hardware such as catalysts, filters, exhaust gas recirculation and scrubbers. A complete engine dynamometer and emission measurement capability is available to assess resulting performance.

EV11 - Contact: Dr. Alex Lawson

AIR POLLUTION CONTROL

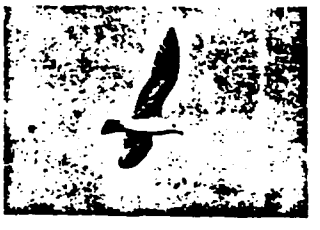
Economic and technical assessments of best available control strategies, plus independent evaluation of new methodology or devices, are available from ORF's scientists and engineers.

EV12 - Contacts: Dr. Fred Hopton
Stephen Thorndyke

PESTICIDE RESIDUES

Analyses for pesticides and industrial contaminants are made on virtually any substrate, e.g., biological tissue, soils, water. Analytical methods are developed for pesticides and other contaminants. Residue analyses are made for chemical firms in support of pesticide registration.

EV13 - Contact: Dr. Lincoln Reynolds



TRACE METAL ANALYSIS
Trace (parts per million) and ultratrace (parts per billion) analyses, multi-element or single metal, are made on a wide range of substrates, including biological tissue and fluids, water, air particulates, plating solutions, slags, ores, fly ash, paints, foodstuffs, drugs and textiles.
EV14 - Contact: Dr. John Christison

TRACE ORGANIC ANALYSIS
With emphasis on biological tissue, virtually any substrate can be analysed for the full range of Canadian and U.S. priority pollutants. Areas of specialisation are: nitrosamines, PCBs, PAHs, monomers, solvents.
EV15 - Contact: Dr. Gord Thomas

MUTAGENIC TESTING
Mutagens and potential carcinogens are detected by means of the *Salmonella / mammalian-microsomal* mutagenicity assay of Dr. Bruce Ames and Associates. The method is both rapid and inexpensive, and is particularly useful for preliminary mutagenic screening of pure compounds and environmental samples.
EV16 - Contact: Art Horton

NOISE AND VIBRATION ANALYSIS
Analysis is done on the impact of vibration and noise on individuals and entire communities. Measurements of noise frequency and intensity lead to recommendations for compliance with local noise abatement codes and occupational health standards.
EV17 - Contact: Jim Turner

RADIATION MEASUREMENTS
Capability exists for measuring α, β and γ radiation, and for identifying the isotopes emitting them. Typical would be the measurement of radiation from stack samples or phosphogypsum, or Ra^{226} in mine tailings. Equipment is also available for measuring radon gas.
EV18 - Contact: Dr. Bill Stott

PARTICULATE IDENTIFICATION AND MEASUREMENT
Techniques available for particulate identification include X-ray bulk analysis, optical and electron microscopy, and microprobe and image analyses. Particulate analyses are made on samples from such sources as exhaust stacks, driers, paint ovens, spray booths and particulate control systems.
EV19 - Contacts: Dr. Eric Chatfield
Eric Niskanen
Mrs. Jackie Terry

WATER SURVEYS
Surveys are made of water supplies, rivers, streams and lakes, and samples analysed for microbiological and chemical contamination. The equipment and expertise are available to do microbial counts and analyses for trace quantities of organic and inorganic contaminants.
EV20 - Contact: Duncan Smith

WATER PURIFICATION
Studies are done of water contamination problems and recommendations made for disinfection and purification. Analytical capabilities include microbiological counts and trace organic and inorganic analyses. An area of specialization is point-of-use purification.
EV21 - Contact: Duncan Smith

MUNICIPAL AND INDUSTRIAL WASTE WATER TREATMENT PROCESSES
Studies are made of physical, chemical and biological treatment processes for waste waters, including laboratory and pilot-scale evaluations and complete analyses of the wastes. Recommendations are made on the most practical and economical technology to use for a particular waste stream.
EV22 - Contacts: Duncan Smith
Matthew McKim

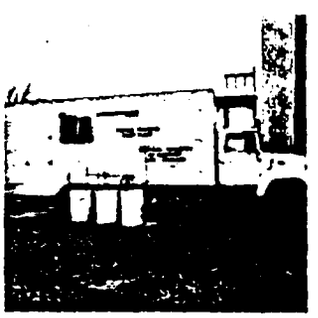
MEMBRANE SEPARATION TECHNIQUES
Pilot plant and laboratory facilities are available for studies in reverse osmosis and ultrafiltration. Applicability of these techniques to industrial and municipal liquid streams is determined, such as the recovery of metals from plating wastes and the concentration of foods and food wastes.
EV23 - Contact: Dr. Bob Laughlin

WET OXIDATION
Wet oxidation can be used to destroy organic wastes and recover inherent inorganic and energy resources to evaluate the applicability of the process to streams containing 1 - 20% organics, and provide the basis for design of commercial scale equipment.
EV24 - Contacts: Dr. Bob Laughlin
Herb Robey

SOLID WASTE TREATMENT AND RECOVERY
The capabilities exist for conducting studies on such solid wastes as plastics, textiles, paper, gypsum and byproducts from metallurgical operations. Ontario Research also operates the Canadian Waste Materials Exchange, through which wastes are channelled to potential processors and users.
EV25 - Contact: Dr. Bob Laughlin

HAZARDOUS WASTE TREATMENT AND DISPOSAL
Expertise is available on the management of hazardous wastes, and in the assessment and analysis of the properties of those wastes. Studies may be undertaken to assess the suitability of treatment or disposal techniques applied to specific wastes.
EV26 - Contacts: Dr. Bob Laughlin
Matthew McKim

ERGONOMICS AND INDUSTRIAL DESIGN
The capabilities are available for evaluation of work environments using human factors analysis. Work systems and environments are designed to improve worker acceptance and productivity.
EV27 - Contact: Stan Barclay



Materials

BUILDING MATERIALS
Product testing and R & D are done on cement and concrete, mortar, brick, glass, aggregate, gypsum, roofing products, wood and wood composites, structural steel, plastic products, protective coatings, adhesives, caulks, insulating materials and asbestos products.
M1 - Contact: Dr. Fred Amos

PLASTICS
Mechanical, physical and chemical characteristics of plastics are evaluated using standard and non-standard test methods, analysis, and performance tests. Problem-solving and failure analysis are done utilizing combinations of techniques, and R & D programs carried out to develop new products and processes.
M2 - Contact: Jacob Leidner

COMPOSITES
Capabilities include the design and development of composite structures, manufacturing processes, and stress analysis of composite materials and structures. Mechanical, thermal, aging, electrical, etc. tests are performed on composite materials and products.
M3 - Contacts: Jacob Leidner
Jim Turner

METALS
Ontario Research is involved in all aspects of process and physical metallurgy, from mineral processing to the finished product. This includes sheet steels, bar products, pipeline steels, powder metallurgy, non-ferrous metals and the recovery of metal values from ores and wastes.
M4 - Contacts:
Malcolm Gibbon
(Physical Metallurgy)
Dr. Hans Brandstatter
(Pyrometallurgy)
Dr. V.I. Lakshmanan
(Hydrometallurgy)

GLASS AND CERAMICS
Activities in glass and glass-ceramics include formulation development, properties evaluation, crystallographic spectrographic characterization and development of biocompatible glass-ceramics. Dynamic fatigue is determined on flat glass up to 5' x 8' in size. Ceramics activities include formulations and process development, properties evaluation, and non-destructive testing.
M5 - Contacts: Dr. Nora Middlemiss
Suktek Johar

WOOD AND WOOD COMPOSITES
Solid wood and wood composites are raw materials for many products. End-use suitability of these materials depends on their availability and their mechanical, physical, chemical and anatomical properties. These attributes are evaluated to provide technical assistance to users.
M6 - Contacts: Adam Sugden
Dr. Geza Matolcsy

BIOMATERIALS
Expertise is available in both metallic and non-metallic biomaterials. The former includes porous metallics for orthopaedic implants and porous metallic coatings for soft tissues. The latter includes glass, ceramics, plastics and adhesives biomaterials. Plastics include hydrophylic polymers and porous polymers for grafts. (See Bioengineering, P9.)
M7 - Contact: Jacob Leidner

ADHESIVES AND PRINTING INKS
Adhesives are selected or formulated for specific applications, and tested to standards such as CGSB, ASTM, PSTC and automotive specifications. Printing inks are analysed for chemical composition and tested to standards such as ASTM and NPIRI. Both products are frequent subjects of failure analysis.
M8 - Contact: Malcolm Rodé

FIBRES, YARNS, FABRICS AND GEOTEXTILES
Quality control testing is done using standard and non-standard procedures. Most common standards are CGSB, ASTM, BSI, and automotive specifications. Apparel, home furnishings, industrial fabrics and geotextiles are subjected to mechanical, physical and endurance tests. Textile waste utilization studies are carried out.
M9 - Contact: Dr. Peter Cashmore

LEATHER
All aspects of leather are evaluated. Typical are strength and finishing tests, grease and chromium contents, and water-proofness. Leather is also evaluated for use in footwear. A study was recently carried out on the amount of leather waste generated in Ontario.
M10 - Contact: Don Popplewell

ORGANIC AND INORGANIC CHEMICALS
Process studies are carried out in which intermediates and products are analysed at various stages of production. Trouble shooting is done on industrial chemical processes, and analysis performed on both organic and inorganic industrial chemicals using various appropriate techniques.
M11 - Contact: Dr. Walter Sowa

SPECIFICATION DEVELOPMENT
As a result of the broad expertise available at Ontario Research, specifications can be prepared on a variety of materials and products. Many staff members are active in such standard-writing bodies as ASTM, CGSB and CSA.
M12 - Contact: Des Hollingbery

QUALITY CONTROL
Analytical and testing capabilities are available at Ontario Research for a variety of raw materials, intermediates and finished products. In addition, there is broad experience in quality control systems and procedures, statistical sampling techniques, field auditing and manual preparation.
M13 - Contacts:
Des Hollingbery
(Analysis and Testing)
Walter Klein
(Quality Control Systems)

MECHANICAL, CHEMICAL AND THERMAL PROPERTIES
Facilities are available for determining the properties of such materials as plastics, glass, ceramics, metals and alloys, textiles, leather, paper, concrete, and composites. Routine tests include tensile properties, fatigue resistance, fracture toughness, tear strength, chemical identification and thermal conductivity.
M14 - Contact: Des Hollingbery

Materials ...cont.

TEST METHOD DEVELOPMENT
Test methods are developed for such diverse materials and products as building materials, textiles, leather, wood, metals and alloys, glass and ceramics, plastics, asbestos, adhesives and solar collectors. Many staff members serve on standards committees responsible for test method development.

M15 - Contact: Dee Hollingbery

FAILURE ANALYSIS
Failure analysis is routinely carried out on a variety of products: Building materials (concrete, gypsum), Metals (machine parts, steel pipe), Plastic products (automotive parts, outdoor display signs), Protective coatings (paints, clear finishes), Adhesives (construction and packaging adhesives), Textiles (carpeting, upholstery), Footwear (shoes, boots).

M16 - Contact: Dee Hollingbery

FIRE AND FLAMMABILITY
Some thirty standard fire and flammability tests are routinely performed on building products, plastics and textiles. Facilities include a Steiner 25-foot tunnel, corner wall test, radiant panel test, fire endurance test, NBS Smoke Density chamber, oxygen index and toxic gas analysis.

M17 - Contacts: Dr. Hugh Campbell
Eric Semmens

GLASS-METAL SEALS
Among seals developed are those for nuclear applications utilizing high lead glasses, high temperature and pressure glass ceramic seals, lithia-glass seals for lithium batteries, and low thermal expansion seal glasses for semi-conductor packages.

M18 - Contact: Dr. Nora Middlemiss

METAL AND ALLOY POWDERS
Activities include materials and process evaluation, product development and the custom manufacture of metal powders for powder metallurgy applications. Recent programs on metal powders include heart electrodes, prosthetic joints, and the development of products and processes.

M19 - Contacts: Bill Fossen
Malcolm Gibbon

METALLOGRAPHY
Metals and alloys are examined microscopically for microstructures, fractures and inclusions. Petrographic thin sections and polished sections are prepared for microscopic examination. Metallographic examination is a major tool in failure analysis of materials, particularly metals.

M20 - Contact: Tom Wood

MATERIALS CHARACTERIZATION BY OPTICAL AND ELECTRON MICROSCOPY AND X-RAY MICROANALYSIS
Typical applications of these methods are: Identification and size distribution of particulates, examination of bulk materials, mineral identification (optical-microscopy); Identification and measurement of asbestos, failure analysis of metals and plastics (electron microscopy); Quantitative microanalysis of the elements (X-ray microanalysis).

M21 - Contacts: Dr. Eric Chatfield
Jim Baird
Mrs. Jane Dillon

PHOTOVOLTAICS AND IONIC CONDUCTORS
Crystalline and amorphous materials for infrared detection are prepared and characterized as to chemical and electrical properties. Thin films are prepared by spray pyrolysis and vacuum and electron beam deposition. Cationic and anionic conductors are fabricated and formulations developed for maximum conductivity and density.

M22 - Contacts: Dr. Nora Middlemiss
Dr. Harry Shimizu
Dr. Mike Westcott

CORROSION PROPERTIES AND CONTROL
Investigations are made into metal failures caused by corrosion, using X-ray analysis, and SEM and metallographic techniques. Standard ASTM corrosion tests are performed routinely, and corrosion rates measured using a programmed potentiostat. Corrosion studies are made on industrial processes and building systems.

M23 - Contact: Bob Elliott

COATINGS AND SEALANTS
Protective and decorative coatings and sealants are selected or developed for specific purposes, and tested to such standards as CGSB, ASTM and company (e.g., automotive) specifications. Evaluations of products include both performance assessment and analysis. Causes of failure are determined and recommendations made.

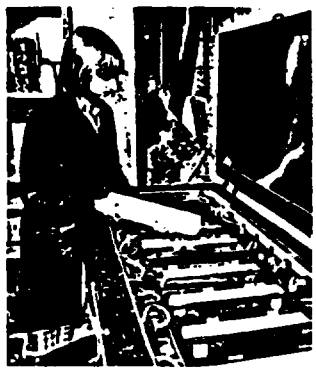
M24 - Contact: Vic Croutch

RUBBER TECHNOLOGY
Capabilities include quality control and product testing to such standards as ASTM, CSA, and automotive specifications. Chemical analysis is done for plasticizers, fillers and other additives. Product and process development and failure analysis are also carried out.

M25 - Contact: Jacob Leidner

X-RAY ANALYSIS
Qualitative and quantitative X-ray diffraction analyses are done on all crystalline materials, such as quartz dust from industrial operations. Qualitative and semi-quantitative X-ray spectrometric analysis are used for all elements above atomic number 9. Typical is the analysis of metal alloys.

M26 - Contact: Eric Niskanen



CEMENT AND CONCRETE
R & D programs and testing services are provided for cement, concrete, mortar, aggregate and admixtures. In addition to the standard mechanical, chemical and performance tests, equipment is available for such specialized tests as pore size determination, resonant frequency, ultrasonic pulse velocity and petrographic analysis.

M27 - Contact: Doug Renton

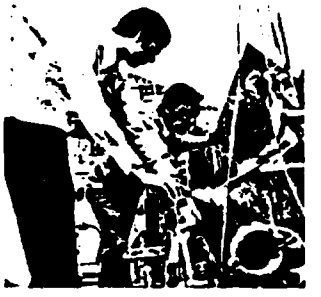
Materials ...cont.

GYPSUM
R & D and materials evaluation are done on all aspects of gypsum and gypsum products, such as cement, board products and joint compounds. This includes the utilization of by-product gypsum from the phosphate and fluorochemical industries, and from flue gas desulphurization sludge.
M28 - Contacts: Lydia Luckevich
Dr. Richard A. Kuntze

BODY ARMOUR TESTING
Measurements are made to evaluate the performance of body armour against a range of ammunition types.
M29 - Contact: Alan Athey

FOOTWEAR
Comprehensive facilities are available for the evaluation of all types of footwear under the general headings: Quality of materials; Quality of construction; Fitness for purpose. An independent assessment of customer returns is offered. Research in areas specific to the footwear and related industries is undertaken.
M30 - Contact: Don Popplewell

Products & Processes



PULP AND PAPER PRODUCTS
Assistance is given to industries converting paper and board to finished products. Specifications are worked out and problem solving undertaken. Areas of specialization are packaging, sanitary papers and cellulose fluff.
P1 - Contacts: Dr. Geza Matolcsy
Adam Sugden

CLOTHING, FOOTWEAR AND INDUSTRIAL TEXTILE PRODUCTS
Quality assessments are made of all textile products. Capabilities include failure analysis, fibre and fabric analysis, wear testing, specification writing and the evaluation of products for specific end uses. Footwear and leather are tested routinely, and test methods developed for safety footwear.
P2 - Contacts:
Dr. Peter Cashmore
(Clothing and Textiles)
Don Popplewell
(Footwear)

KNITTING TECHNOLOGY
A laboratory-scale knitting machine is employed to evaluate the performance of yarns in the manufacture of fabrics, to determine the optimum knitting conditions for particular fibres, and the effects of knitting conditions on the properties of finished fabrics.
P3 - Contact: Dr. Peter Cashmore

THIN AND THICK FILM SYSTEMS
Thin film work includes custom production, development and design of multilayer optical coatings and electronic thin films, including photoetch lithography. Deposition techniques are vacuum evaporation, electron beam deposition, chemical vapour deposition and spray pyrolysis. Development, design and small-scale prototype production are done on thick film electrical components.
P4 - Contacts: Sukhek Johar
Dr. Mike Westcott
Dr. Harry Shimizu

ELECTRONIC DEVICES
Ontario Research has the expertise for development and custom production of passive electronic devices such as temperature sensors, capacitors and biomedical electrodes. Circuits are also designed for electronic measuring devices.
P5 - Contact: Michael Dean

MICROCOMPUTER SYSTEMS AND APPLICATIONS
Microcomputer and microprocessor capability includes hardware, software and systems design. Needs are analysed and control or monitoring systems designed to fill the requirements of such applications as production line, quality control and energy systems.
P6 - Contact: Michael Dean

FIBRE OPTICS
Specific areas of interest are fibre optics characterization and fibre optics transducer applications. These include coherence techniques for measuring fibre frequency response, refractive index profiles, splice signal-to-noise performance, evaluation of mode scramblers, and investigation of multimode optical fibres as transducers.
P7 - Contact: Dr. Mike Westcott

Products & Processes ...cont.

ELECTRONIC DESIGN
Capabilities in electronic design include equipment for monitoring alternative energy programs, such as those for solar energy or wind power; specialized industrial and scientific instrumentation; and biomedical electronics.
P8 - Contact: Michael Dean

BIOENGINEERING
Expertise is offered in surgical tool design, special purpose test equipment and orthopaedic implants (including whole joints). An ultra-high molecular weight polyethylene moulding technique permits the moulding of shoulder joint cups. Control systems are designed for a variety of medical applications. Also included are lumbar spine studies, knee joint kinetics and development of paramedic support devices. (See Biomaterials, M7.)
P9 - Contact: Jacob Leidner

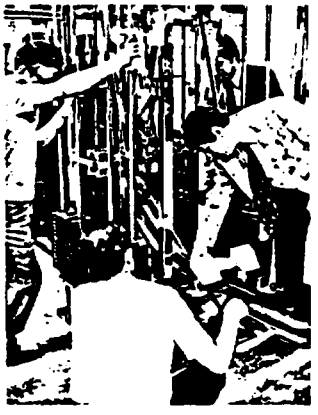
ULTRASONIC AND FLUID SHEAR DEVICES
Developments include methods for removing burnt lubricating oil from the inner surfaces of tubes, transducers for special plastic and glue-line welding, a chemical liquid mixture for ultrasonic sterilization of instruments, and devices for the emulsification of fuel mixtures.
P10 - Contact: Tony Last

MICROWAVE DRYING
Facilities are available for experimental microwave drying of diverse materials. Recent examples are insulating board and dyed thread. Equipment includes a 27 cubic foot 5-kW oven with variable-speed transfer belt, a smaller 700W oven, and wave guides for sheet and fibrous material.
P11 - Contact: Tony Last

TRANSPORTATION AND EQUIPMENT TESTING
Specialties are rapid transit vehicles; buses and trucks; farm, construction, commercial and industrial equipment; shelving and storage systems. Capabilities include design optimization for weight, energy conservation, mechanical reliability and safety, analytical and experimental stress analysis, and modal analysis.
P12 - Contact: Jim Turner

MATHEMATICAL STRESS AND VIBRATION ANALYSIS
A broad capability exists in both static and dynamic operational analysis of structures using advanced testing and analytical techniques. These methods include finite element stress and vibration analysis, as well as experimental modal analysis.
P13 - Contact: Jim Turner

PRODUCT, EQUIPMENT AND MACHINERY DESIGN & DEVELOPMENT
Programs are carried through from concept to pre-production models. Examples are cam, spring, linkages, gear system design and wire rope applications. Capability includes finite element stress analysis, modal analysis, and evaluation and implementation of computer-aided design and manufacturing.
P14 - Contact: Stan Barclay



FUEL EMULSIFICATION
Methods are developed for preparing such alternative fuel emulsions as diesel oil/methanol and gasoline/methanol. Emulsification devices, such as Ontario Research's patented HydroShear, can be designed to emulsify most liquid/liquid fuel combinations.
P15 - Contact: Tony Last

CHEMISTRY OF FOODSTUFFS
Capabilities in ultrafiltration, gas chromatography and high performance liquid chromatography permit the detailed characterization of foods and food additives in relation to process studies, or as required by government regulatory authorities. Food contaminants such as nitrosamines and pesticide residues are also assayed.
P16 - Contact: Mrs. Brigitte Licht

PULP AND PAPER PROCESSES
Wood yard, pulping and paper making operations are reviewed for their efficiency. Full scale plant trials are planned and supervised, and when appropriate, lab scale pulping and paper making studies are carried out.
P17 - Contacts: Adam Sugden
Dr. Geza Matolcsy

CERAMICS PROCESSING
Ceramics compositions are developed to suit such requirements as strength, microstructure, electric properties and density. Processes involved include milling, mixing, calcination and firing, glazing and spray drying to produce flowable powders. Simple, isostatic and hot pressing capabilities are available.
P18 - Contact: Rob Roy

METALLURGICAL PROCESS DEVELOPMENT
Processes are developed to extract metal values from low-grade domestic ores or from wastes. Examples are the extraction of titanium from ilmenite to produce pigment-grade titanium dioxide and the recovery of silver from photographic wastes.
P19 - Contacts:
Dr. Hans Brandstatter
(Pyrometallurgy)
Dr. V.I. Lakshmanan
(Hydrometallurgy)

POWDER METAL TECHNOLOGY
The capability exists to produce ferrous and non-ferrous powders and compact them into full density shapes. The performance of powders for specific applications is evaluated. Facilities include cold isostatic; hydraulic, mechanical and high-energy rate forming presses. Compaction studies are done on metal wastes.
P20 - Contact: Bill Fossen

PACKAGING APPLICATIONS
Capabilities include the structural design, testing and evaluation of distribution packaging such as skids, wirebounds, crates and protective packaging of all types. Instrumentation includes mechanical testers, O_2 permeability apparatus and a slow motion video camera for analysis of high speed production processes.
P21 - Contact: Walter Soroka

TECHNICAL AND ECONOMIC EVALUATIONS
Studies are carried out to determine the technical and economic feasibility of proposed new industrial processes and products, and to improve the efficiency of manufacturing, materials handling, inventory, quality control, distribution and office procedures.
P22 - Contact: Walter Klein

INDUSTRIAL ENGINEERING APPLICATIONS
There is a broad range of experience in product development, value engineering, plant layout, facility planning, production, inventory, quality control, methods analysis, work simplification, materials handling, work flow, standards and productivity auditing. Consulting services are available to help establish productivity improvement programs.
P23 - Contact: Walter Klein

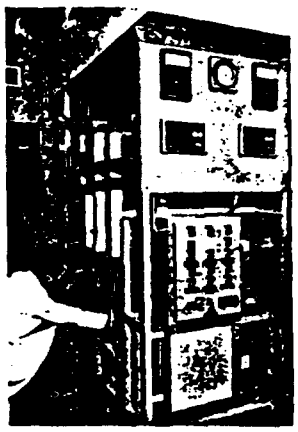
PROCESS CONTROL
Two major types of process control systems are designed, one to meet specific process parameters such as temperature, pressure, flow, yield, and quality, as in integrated solar collectors and heat pumps, and the other to conserve energy, such as feed-back control systems on boilers
P24 - Contact: Vijay Deshpande

ENZYME ANALYSIS
Analyses are done on enzymes in industrial products, such as detergents and pharmaceuticals. Long term studies include the replacement of energy-consuming processes with enzyme-catalyzed processes, the immobilization of enzymes on solid supports for retrieval, and enzyme purification techniques.
P25 - Contact: Dr. John Christison

CRYOGENICS
Capability exists in cryogenic design and engineering, superconductivity, and superconductor tunnelling devices for use in computer memories. The facilities are available for measurement of the properties of materials at low temperatures.
P26 - Contact: Dr. Mike Westcott

ELECTRICAL TESTING
Capabilities are in motor efficiency testing (torque, speed, horsepower, etc.) and electrical properties of materials, such as dielectric properties, dissipation factor, breakdown voltage, volume conductivity and surface resistivity.

RADIOACTIVE DECONTAMINATION
Studies are carried out to develop and/or determine the effectiveness of chemical agents for decontaminating both boiling and pressurized water reactors. Decontaminating agents are evaluated for their effectiveness and for their corrosive effect toward the base metals.
P28 - Contact: Troy Lassau



INDUSTRIAL MICROBIOLOGY
Investigations are carried out on microbial biodeterioration and its prevention in, for example, beverages, textiles, thermal insulating materials and petroleum products.
P29 - Contact: Duncan Smith

BIOTECHNOLOGY
Studies include methane production from agricultural and municipal wastes; butanol, ethanol and single cell protein production from agricultural residues and spent sulphite liquor; microbial leaching of ores and desulphurization of coal; preparation and evaluation of ceramic supports for immobilized cell fermentation.

Resources

MINERAL PROCESSING
Physical separation methods are available to both ferrous and non-ferrous industries on bench and pilot plant scales. These include grinding, magnetic and gravity separation, flotation and pelletizing for ferrous ores; bond work index; autogenous and semi-autogenous milling, and flotation for non-ferrous ores.
R1 - Contact: Gregg Cleland

HYDRO AND PYROMETALLURGICAL PROCESSING OF FERROUS AND NON-FERROUS ORES
Hydrometallurgical capabilities include selective extraction by leaching of non-ferrous metal values, solvent extraction, ion exchange and electrowinning. Pyrometallurgical activities include melting and refining studies on ferrous and non-ferrous metals, rotary-kiln calcining, solid-state reduction and carburization, and extraction of precious metals from sludges and solid wastes.
R2 - Contacts:
Dr. Hans Brandstatter
(Pyrometallurgy)
Dr. V.I. Lakshmanan
(Hydrometallurgy)

COAL EVALUATION AND PROCESSING
Coals are analysed by proximate analysis and BTU values determined with a Paar adiabatic bomb calorimeter. Facilities are available for cleaning and beneficiation of coal, for sulphur and ash removal, and for the binding of coal powders and aggregates.
R3 - Contacts:
Dr. Bejoy Das
(BTU Values)
Dr. Hans Brandstatter
(Cleaning and Beneficiation)

ASBESTOS PROCESSING AND APPLICATIONS
Yield is determined on drill cores and small bulk samples, and the separated fibre evaluated for use in asbestos cement and textiles. Samples for biological tests are prepared in an air jet mill. A 500 lb/hr centrisonic device is available for fibre separations.
R4 - Contacts: Dr. Richard A. Kuntze
Dr. Ivan Joyce

URANIUM PROCESSING
Process flow sheets are developed utilizing acid or carbonate technology. Studies carried out on bench and pilot plant scales include grinding, leaching, solvent extraction, ion exchange, yellow cake precipitation, and treatment of tailings and effluents. Radionuclide analytical capabilities aid in filing environmental statements.
R5 - Contact: Dr. V.I. Lakshmanan

FOREST UTILIZATION
Tree species in forested areas are reviewed for specific end uses. Laboratory scale pulping and other studies are carried out as required, and recommendations made on the best combination of products from each area.
R6 - Contact: Adam Sugden

UTILIZATION OF FOREST AND AGRICULTURAL WASTES
Forest and agricultural wastes are evaluated as sources of fibre, energy and chemicals. Value may be recovered by pulping, combustion, pyrolysis, hydrolysis or microbiological processes.
R7 - Contact: Adam Sugden

UTILIZATION OF INDUSTRIAL, MINING AND DOMESTIC WASTES
Utilization studies are made of wastes from a variety of sources. Typical are plastics for remoulding, textiles for composites reinforcement, blast furnace slags for cement, and flue gas desulphurization wastes for gypsum. Ontario Research also operates the Canadian Waste Materials Exchange.
R8 - Contacts: Dr. Bob Laughlin

ENERGY AND CHEMICALS FROM BIOMASS
Expertise is available to assess the potential of biomass for energy and chemicals using pyrolysis, hydrolysis, fermentation, distillation and purification procedures. One example is the pyrolysis of organics to produce CO and H_2, which can be converted to methanol for fuel.
R9 - Contacts: Dr. Bob Laughlin
Duncan Smith
Lou Bruno

NON-METALLIC MINERALS/ INDUSTRIAL MINERALS
Programs on non-metallic minerals include processing, product development and evaluation for specific end uses. New uses are developed, especially for waste products. Gypsum, mica, clays, sulphur, asbestos and aggregate materials are common subjects of R & D and testing programs.
R10 - Contacts: Dr. Ivan Joyce

IN-PLANT WASTE REDUCTION
The capability exists to assess industrial activities to determine opportunities for the reduction of generated waste. Studies may also examine the opportunity for in-plant upgrading of wastes, through separate collection or simple treatment, to make those wastes reusable.
R11 - Contacts: Herb Robey
Dr. Bob Laughlin

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ONTARIO RESEARCH FOUNDATION

Sheridan Park Research Community
Mississauga, Ontario, Canada L5K 1B3
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—D. Wightman—

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P.O. Box 431, Arlington Heights, Illinois 60006 (312) [redacted] 655-4077
1311 W. Hawthorne Ave ?

April 6, 1983

CH2M HILL
2020 S.W. Fourth Avenue
2nd Floor
Portland, OR. 97201

Attention: Mr. Stewart Davis

Dear Stu,

Midwest Recovery Company is in the process of assembling an appropriate team to bid on the Waukegan Harbour PCB disposal using environmentally sound technology.

We have assembled the information you supplied and also information from the BNA Environmental Reporter regarding Slip #3.

In order to evaluate the various information we received, a starting point had to be arrived at. Our approach addresses Slip #3 and the following results can be assumed.

WAUKEGAN HARBOUR ON SITE PCB DESTRUCTION

1.0 Among the alternatives to be studied under contract is a plan to screen off Slip No. 3, where the highest concentration of contamination is located (500 ppm), and to dredge out an estimated 15,000 cubic yards of sediment and 35,000 cubic yards of water.

2.0 The approach recommended is to pump this slurry into a mixing/holding tank and then to the Wetcom Engineering Ltd. Wet Oxidation Reactor for processing on site. Post treatment includes neutralization, testing, and return of the decontaminated slurry to the harbour. For purpose of budgetary analysis it was assumed that the average concentration after mixing in the holding tank was 500 ppm of PCB's. It was further assumed that the PCB concentration will be reduced 99% (to 5 ppm).

3.0 After completing the study it is estimated that it will take one (1) year to construct and install two 16,000 gallon per day reactors at the site. The recommended

Joseph M. Koch
Filtration Products

MRC Reps
P.O. Box 431, Arlington Heights, Illinois 60006 (312) [redacted] 655-4077

CH2M HILL
Portland, OR. 97201

3.0 (continued)

reactor size is the same as the Wetcom Reactor now operating at the Uniroyal Plant in Elmira, Ontario, and processing 43 different hazardous wastes, 75% (12,000 gal day -1 of which is drawn from holding lagoons.

It is also estimated that after installation it will require one year to process the contaminated slurry. If the processed slurry (PBC concentration 5 ppm) can be returned to the Waukegan Harbour the predicted budgetary cost is 60 to 85 cents per gallon. Of course, the cost prediction is subject to test and detail engineering and operating projections.

This budgetary estimate includes all fixed capital equipment, engineering, installation, debt service, and operating cost. The operating costs include operating and maintenance labor, supervision, overtime, G & A, fringe benefits, operating and maintenance supplies, aux fuel, land rental, electricity, utilities, chemicals, final disposal, management fee, taxes & insurance.

I will contact you the week of April 11th so that further discussions can be arranged.

Thank you for your interest and assistance in developing cost effective pollution free technology for PCB destruction at Waukegan Harbour.

Sincerely,

MIDWEST RECOVERY COMPANY

W. C. Pittman

WCP:jf

Joseph M. Koch
Filtration Products

WET OXIDATION

WASTE DISPOSAL

A major breakthrough for industry and government faced with increasing public pressures in disposing of toxic industrial wastes has been unveiled at Uniroyal Chemical's Elmira, Ontario, plant, where forty-one various toxic chemicals are being simultaneously destructed. Of major interest will be the fact that this new process, under development for many years, renders toxic chemical wastes, including Dioxin and PCB's, both liquid and solid sludge, harmless enough to be handled by most conventional waste and sewage treatment centers. In excess of 150 various toxic chemicals have been successfully destructed, most in excess of 99.9 %.

World rights to this new and exciting Wetox wet oxidation system have been acquired by the Scarborough, Ontario firm, WetCom Engineering Ltd.

Wetox, the result of a nine-year, million-dollar development at the Ontario Research Foundation and the Michigan Technological University, is a process where liquid organic wastes are rendered harmless with a minimum environmental impact.

WetCom's Wetox is a process involving the destructive oxidation of most organic materials under water by forcing air or oxygen into the materials at elevated temperatures and pressures.

The organic materials oxidize readily on contact with the oxygen, being

converted mainly to carbon dioxide and, releasing energy in the form of high pressure steam. This steam can then be recovered by the plant for its manufacturing processes with up to 80 per cent efficiency.

WetCom Engineering acquired an exclusive worldwide license for the Wetox technology from the Michigan Technological University in Houghton, Michigan. Extensive developmental work has been done by Ontario Research Foundation, of Mississauga Ontario, since 1971 adopting the Wetox process to suit many liquid industrial wastes and other challenging problems.

WetCom Engineering Ltd. of Scarborough Ontario, previously formed to become involved in waste and energy processes, acquired several years ago all international rights for marketing, manufacturing and sub-licensing the Wetox process system.

Wet air oxidation as a process is not really all that new! The application of wet air oxidation to waste treatment began with R. W. Strehlenert who, in 1912, patented a process for the treatment of spent pulping liquors with oxygen at elevated temperatures and pressures.

Development of the process proceeded simultaneously in several fields and in many countries, including Sweden, Germany and United States. It is the application of the process that is both exciting and innovative.

Specifically focussing on the Wetox system, one can see how really simple the process is.

A waste to be oxidized is pumped via a high pressure pump through a heat exchanger to first heat the waste and then into a high pressure reactor where it is vigorously mixed with compressed air. The oxygen in the air reacts with the organic matter in the slurry at these high temperatures to break apart the complicated chemical wastes and to produce mainly carbon dioxide, acetic acid and water. Due to the exothermic nature of the reaction, heat is generated further raising the temperature of the reactor contents. The effluent from the wet oxidation reactor is heat exchanged with the incoming waste to preheat it. Indeed, so much heat is often generated that steam can be recovered and reused in the plant. Almost any combustible material which remains in the liquid phase can be oxidized by this process. Destruction of the organic contaminants is achieved as well in water at elevated temperature and pressure as by concentrating the material and incinerating the dry residue. In either case the products are the same: carbon dioxide, water and ash.

The products from wet oxidation are automatically and thoroughly scrubbed since the entire reaction is carried out "under water", hence the problems of air and odor pollution are minimized.

Wet oxidation provides an efficient means for recovering valuable energy from even relatively dilute waste streams. The energy in the form of steam is, therefore, recovered with the highest efficiency. Since it is created directly as a product of the combustion process, specifically focussing on Uniroyal Chemical's Wetox installation, one sees immediate-

ly that the problem is somewhat more complex than a simple single waste stream.

Uniroyal's diverse organic chemical product mix generates a rather wide range of difficult-to-eliminate, and often toxic, wastes, including chlorinated hydrocarbons and dioxins. Relative proportion and intensity of these wastes varies from month to month at the Elmira plant depending on the variations in this mix product.

WetCom's task, then, has been to balance Uniroyal Chemical's flow through surge capacity design, and treat a mixture of as many as 40 different wastes varying in chemical oxygen demand (COD) from as low as 3% to as high as 25%. Initial capacity at Elmira is 8,000 gallons per day, growing in the coming months to 16,000 gallons per day.

There are a number of competing advantages of the Wetox system over the competitive systems, because the Wetox system is based on a horizontal, agitated, multi-compartmented, cascading reactor--compared to the vertical, non-agitated, single-compartment reactor, the Wetox system is able to achieve comparable reaction rates, but at much lower temperatures.

This is because the reaction rate of wet oxidation is faster at lower temperatures when oxygen is forced into the waste through vigorous agitation, rather being contacted with the waste by percolation as with other systems.

In the Wetox cascading compartments, the liquor is increasingly "concentrated" in successive chambers as the products of combustion and steam are withdrawn in each chamber. The more concentrated liquor results in a higher relative COD level and hence, improved reaction rates.

This lower temperature offers very important benefits when it comes to building a system. At the temperatures involved in these reactions, steam is generated at fairly high pressure, and it is a phenomenon of steam production that the pressure of steam generated at those temperatures increases exponentially with temperatures at these upper ranges.

This means that while Wetox can operate at about 230°C and an operating pressure around 600 p.s.i.g., the competing technologies have to operate at approximately 260°C to 290°, and thus at an operating pressure of 1500-to-3000 p.s.i.g.

In the wet oxidation systems for the conditioning or destruction of sewage sludge or the conditioning of pulp and paper, it is not necessary to manufacture these systems out of any material more exotic than stainless steel.

Wet oxidation for the destruction of liquid industrial wastes where the reactions involve wastes that contain chlorinated hydrocarbons means construction materials change from stainless steel to titanium, hastelloy, zirconium or nickel.

The rate of transfer of oxygen into the solution at a given operating

temperature is controlled by:

1. The solubility of oxygen in the waste which is a function of the oxygen partial pressure or over-pressure. Increased process pressures will, therefore, result in increased rates of mass transfer.

2. The degree of mixing of the oxygen and the waste.

Increased process pressures result in increased capital costs for the reactor vessel, heat exchanger, compressor, etc., as well as increased operating costs. Effective mixing is, therefore, most important in economically optimizing the system.

The Wetox process is uniquely suited to the oxidation of waste liquors, slurries and sludges where the organic matter is but a few per cent of the predominantly water stream.

It is the most economical process for wastes which have a concentration of oxidizable material between 2 and 20% by weight with water.

In this range, sufficient material is available to react with the oxygen to generate enough heat to maintain the desired temperature and pressure in the reactor without external energy being supplied. Above about 5% by weight excess heat is generally produced which can be efficiently and economically recovered. Wet oxidation can be applied to non-biodegradable materials as well as dangerous, toxic or obnoxious wastes.

Valuable inorganic materials can be efficiently recovered from the liquid phase effluent. This is especially important for materials

which after incineration would not be recoverable or in a reusable form. Because the oxidation takes place under water, air and odor pollution is minimized. Potentially obnoxious materials such as sulphur dioxide or nitrogen oxides remain in solution and exit the reactor in the liquid phase as salts or acids.

Examples of some of the waste streams, which have been effectively treated by wet oxidation include:

Industry	Waste
Refinery & Petrochemical	Refinery Cyanide Waste
	Refinery Spent Sour Water
	Chlorinated Hydrocarbon Sludge
	Refinery API Separator Sludge
	Re-Refinery Acid Sludge
	Petrochemical Ammonium Chloride Waste
	Petrochemical Nitrate Waste
	Petrochemical HCl Wash Stream
	Petrochemical NaOH Wash Stream
	Petrochemical Ammoniated Organic Waste
	Linear Alkyl Benzene Sulfonate Waste
	Refinery Spent Caustic
	Refinery Filter Backwash
	Refinery Biological Sludge
Pulp and Paper	Phenolic Waste Stream
	Paper Mill Fines
	Recycled Newsprint
	Wood Preservative Liquor
	Sodium Base Sulfite Liquor
	Calcium Base Sulfite Liquor
	Ammonium Base Sulfite Liquor
	Sodium Base Semi-Chemical Liquor
	Soda Base Liquor
	Clay Filler Sludge
Electroplating	Copper Stripping Solution
	Copper-Cyanide Plating Solutions
	Cadmium-Cyanide Plating Solutions
	Alkaline-Cyanide Cleaner Waste
Food	Vegetable Hydrolysis Sludge
	Tomato Waste

Food (continued)	
	Bean Sludge and Bean Wastewater
	Cheese Whey
	Cornstarch Waste
	Coffee Grounds
	Fish Processing Waste
Iron and Steel	Thiocyanate Waste
	Cyanide Waste
Automotive	Mixed Paint Waste
	Mixed Waste Slurry
	Automotive Lagoon Waste
	Automotive Plant Sludge
	A P I Tops and Bottoms
Textile	Caprolactam Waste
	Nylon Manufacturing Waste
	Condensate from Polyester Resin Production
	Spinning Oil from Nylon Manufacture
Miscellaneous Wastes	Paint Manufacturing Waste
	Paint Stripping Sludge
	Drum Washing Effluent
	Metals Recovery Sludges
	Tanning Wastes Containing Chromate
	Sewage Sludge
	Gastification of Wood Effluent
	Manure
	Mixed Industrial Organic Waste
	Metal Grinding Sludges
	Palm Oil Mill Effluent

Other Wetox process applications currently under active review include:

1. Conversion of agricultural residues to single cell protein and/or methane via wet oxidation and biological treatment.

2. Desulphurization of high-sulphur coal and coke.

3. Combustion of low-grade fuels such as peat, low-grade coal, waste, paper, etc. as energy sources.

4. Recovery of valuable metals from waste streams such as chrome, silver, tin, etc.

The heart of WetCom's Wetox process is the reactor: a multi-compartmented horizontal unit with agitation and oxygen addition in each compartment.

This design results in substantially increased reaction rates and makes possible efficient operation at relatively modest temperatures and pressures (230°C and 600 psi).

The liquid and steam phases are withdrawn separately from the reactor. This feature improves heat exchanger efficiency, increases the effective retention time of the liquid and reduces the volume of liquid effluent for chemical recovery or treatment.

Above 3% COD the process is autothermal and above 4-6% COD the process is a net energy producer.

Simple cost comparisons have indicated that from 3% COD to 40% COD, the capital cost of the Wetox process is the same or less than the comparable biological or incineration system. An examination of operating costs, however, makes the Wetox process even more attractive since it is a net energy producer.

It would be expected, therefore, that the Wetox process would be the most economical system for many wastes with COD concentrations of 3% to 40% (volatile solids from 1.5% to 20%).

Wetcom Engineering's Wetox units can be economically designed from

1,000 gallons per day (2 feet diameter by 8 feet long) to 400,000 gallons per day, (8 feet diameter by 50 feet long). As an example the Wetox Model 4-48 currently being operated at Uniroyal, handles 16,000 gallons per day and is 4' in diameter and 18' long.

On wet oxidation systems currently being reviewed, there are positive pay-back values available to the operator through: reduction in current disposal fees; the energy value of steam generated, and the value of any recovered inorganics in the effluent.

A major appeal of wet oxidation to most industrial processors is through the reduction in uncertainty attached to subcontracted waste disposal costs, and having total waste disposal in-house and under management control. Three new avenues being currently investigated for wet oxidation are:

1. Use as a primer energy utility plant using coal, coke, heavy oil, tar sands, shale or peat as a fuel to generate steam to convert to electricity. High sulphur coal can be used since a high percentage of sulphur is trapped as sulphuric acid.
2. Use of wet oxidation as a reactor to create or alter certain chemical intermediates. For example, rather than consider full oxidation of all COD as the process objective, one can take advantage of the different wet oxidizing temperatures of impurities in components to cleanse those compounds. As an example, the sulphur in coal can be substantially wet oxidized at a low enough temperature

to avoid substantial coal oxidation, thereby "desulphurizing" the coal.

3. Controlled rather than all-out wet oxidation can create a new "reactor" system concept.

The only ultimately politically acceptable waste handling solution is that the waste generator treat and render innocuous all his wastes on his own property. This can be economically accomplished with a continuous or batch WetCom wet oxidation reactor.

For further information contact:

MIDWEST RECOVERY COMPANY

(312) 655-4077