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- 802 Gaphouses)
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- 809 ☐ Ceiling Hung Precipitators 810 ☐ Air Quality Instrumentation 811 ☐ Title V Operating Permit Consultant

Type I would like to receive/continue to receive Environmental Protection Type

- 812 ☐ Fans/Blowers 813 ☐ Recorders
- 814 Catalytic Oxidizers
- 2. What is your projected budget for the product(s)/service(s)?
- 815 Q Over \$200,000
- 816 \$100 001-\$200 000

- 817 350,001-\$100,000
- 818 -\$10,001-\$50,000 819 35.000-\$10.000
- 820 Under \$5,000
- 3. How immediate is your need for the selected products/services? (select one)
- 821 3-6 months 822 7-9 months
- 823 10-12 months
- 824 Q Over 12 months

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A. Function	on which	best	descr	ibes	your	activity	į
Pollution	Control	(chec	k only	one):		

- A □ Corporate responsibility for Pollution Control B □ Manage all Pollution Control Operations at
- this location
- C
 Supervise sub-group in Pollution Control Operations

 D
 Provide professional consulting service on
- Pollution Control E Provide staff environmental service on
- Pollution Control

(22) Textile

- B. Type of Business (check only one):
- A Manufacturing. If manufacturing, please check the appropriate SIC (check only one):
 (20) Food (31) Leather
- (21) Tobacco
- ☐ (32) Stone/Clay/Glass☐ (33) Primary Metal☐ (34) Fab. Metal☐ (23) Apparel ☐ (24) Lumber & Wood ☐ (35) Mach., except Elect. (25) Furniture (36) Elect & Electron
- ☐ (26) Paper Mach (27) Print/Publish (37) Trans. Equip. (28) Chemicals (39) Miscellaneous Mfg.
- Type of Govt.: H County K Transportation

B Q Mining

- N 🔾 Labs P 🔾 Real Estate O Training
 Z Misc. Services
- C. Number employed at this location:

D \(\text{Engineering & L \(\text{Consulting} \)
Contracting \(M \(\text{Consulting} \)
E \(\text{Utilities, public, private & cooperative} \)

Govt. including municipal or district sanitary

- D. In your job function do you recommend, speci-fy or purchase? (check all that apply)
- A Pollution Control Equipment B 🗆 Instrumentation

C Agriculture

L Consulting

ater treatment sys. or plants

I State J State J Federal

- D Q Parts & equipment for maintenance
- operation & control

 E

 Services/Consulting
- F \(\text{None of the above} \)
- E. What types of Pollution Control are you responsible for? (check all that apply)
 A \(\text{P} \) Air \(\text{B} \(\text{U} \) Water
- C Q Noise D Solid Waste Disposal
- E D Industrial Hygiene
 F D Toxic & Hazardous Material
- G 🗅 Energy Control/Energy Conservation H \(\text{None of the above} \)
- F. Which of the following publications do you receive personally addressed to you? sed to you? (check all that apply)
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- C D Environmental Solutions D Q Pollution Equipment News
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- F Q Water Environment & Technology G \(\text{None of the above} \)

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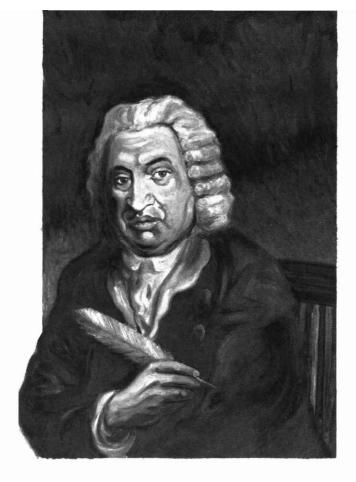
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About the cover:

In recent decades, industrial development and its accompanying pollution have torn into the world's environment and adversely affected natural resources. To reverse this trend, U.S. companies are developing new products and services that promote cleaner air and water and clean up contamination of the land. The 1998 Buyer's Guide, which begins on page 97, provides you with the names of companies throughout the United States that have the technology and expertise you need to solve your environmental problems.

Cover design by Kathleen Logan and Greg Lakloufi

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Beyond Checklists:The New Environmental Audits

n the 1970s and 1980s, companies performed environmental audits for one main reason—to prevent regulators from whacking them with fines and jail time for violations of environmental laws.

The explosion of regulations at the federal, state and local levels during that era continuously ratcheted up industry's anxiety level. To ward off the regulatory bogeyman, companies dispatched audit teams with checklists in hand throughout their facilities to review the plant operations and determine if they conformed with applicable laws. Typically, the audits would cover a wide range of concerns, such as evaluations of monitoring, reporting, recordkeeping, the need for or status of permits and the operation

and condition of pollution control equipment.

Now, audits are taking on an added dimension. Besides dealing with compliance issues, they are evolving into sophisticated tools used in formatting business strategies and management effectiveness. This mirrors the trend of corporate America's opting for green practices—not out of fear of regulators—but rather because they make good economic sense. Sometimes referred to as internal audits, these investigations into management-related activities may include assessment of the success of existing environmental management systems, evaluation of the environmental risks from operational practices and assessment of the company's operations that may require future pollution control expenditures.

In growing recognition of audits' many benefits, numerous states have recently passed legislation to encourage their use by businesses. Yet, ironically at the same time the states are promoting audits, the federal government is taking steps that are causing companies to think twice about doing such self-evaluations. One of our features this month, "Environmental Audit Legislation: *EPA vs. the States*," which starts on page 32, focuses on this clashing between state and federal laws. According to the article's authors, the audit laws of many states, which grant companies immunity from state penalties when they voluntarily disclose lapses in compliance, do not shield these same companies from penalties imposed by the U.S. Environmental Protection Agency.

Along the same lines, the adoption last year of the credible evidence rule (*Federal Register: Feb. 24, 1997*, Vol. 62; pages 8313 to 8328) established that citizens and enforcement officials can use any evidence permitted under state and federal rules of evidence to prove a violation of the Clean Air Act. Once an action is brought in federal court, it will be up to the court to decide the scope of the privilege under state audit laws and balance it against the use of the federal credible evidence rule.

Ideally, audits are intended to help companies avoid litigation by improving their compliance with environmental laws. But, with the current uncertainty created by the discrepancy between state and federal laws, companies are beginning to view audits as potential weapons that can be used against them in lawsuits and fear they may end up defending themselves in federal court against information they voluntarily disclosed

under state laws.

Given that self-assessment can be a valuable tool in promoting environmental excellence in corporate operations, EPA needs to reevaluate its current policy and work with the states to encourage companies' use of audits.

> Angela Neville Angela Neville, JD, REM Editor-in-Chief

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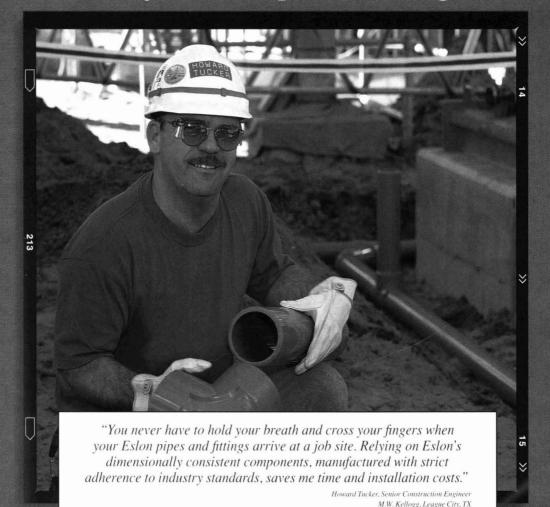
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ep news Wire NEWS AT A GLANCE

Compiled by Kristie Guillotte

Global Warmina Attitudes

TORONTO—The first commercially available survey of global environmental attitudes in 5 years was conducted by Environics International, a Canadian environmental group. Of the 24 countries surveyed, the United States appears the least concerned.

Twenty-seven thousand people were interviewed in person and by telephone between January and April of 1997.

When asked if "we should assume the worst and take major action now to reduce human impacts on climate, even if there are major costs," 46 percent of U.S. respondents said yes. Another 46 percent said that "we should wait until we know more," and 8 percent did not agree with either statement.

More people in other developed countries who participated in the survey want to take strong action now despite the

Bonanza

economic costs. Seventy-four percent in France, 71 percent in Italy, 70 percent in Switzerland, 69 percent in both Japan and Korea, 67 percent in Australia, 64 percent in New Zealand and 61 percent in both Canada and Chile want to see environmental problems addressed.

Environmental problems endangering children were of major concern. Ninetyseven percent in India, 95 percent in both Italy and China, 93 percent of the people in the countries of Peru, Hungary, India, Chile and Canada, 92 percent in Poland, 91 percent in the U.S., Australia and Finland and 90 percent in both Great Britain and Switzerland believe environmental problems affect children either a "great deal" or a "fair amount."

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Battle Over Nuclear Waste

WASHINGTON, D.C.—The U.S. Department of Energy has to accept and dispose of civilian nuclear waste or face paying billions of dollars. A D.C. Circuit court ruled November 14, 1997, in Northern States Power Co. vs. Department of Energy that the agency must adhere to the Nuclear Waste Policy Act (NWPA).

In addition to the NWPA, which imposes upon the DOE an unconditional obligation to take and dispose of civilian nuclear power plants' radioactive waste, the department signed contracts with civilian nuclear utilities promising to dispose of their waste. A fee on consumer electric bills would cover the cost of the disposal.

In 1995, the DOE argued that because no repository or interim storage facility was available, it did not have a contractual duty to dispose of the waste. In 1996, a D.C. Circuit court rejected this argument in Indiana Michigan Power Co. vs. Department of Energy. Last June, the DOE went back to court, in the Northern States Power Co. vs. Department of Energy case; arguing that "because of an array of technical and regulatory problems, the delay in disposal was, according to its interpretation of the contracts 'unavoidable' due to acts of Government in its sovereign capacity, and thus the agency was not responsible for any monetary damages either."

According to the Northern States case, DOE may not avoid contractual compliance, or "absolve itself from bearing the costs of its delay if the delay is caused by the government's own act. This cannot be a valid interpretation, as it would allow

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the executive branch to void an unequivocal obligation imposed by Congress.

Fourth Graders Learn Hands-On About Recycling

WASHINGTON, D.C.-More than 15,000 teachers nationwide are getting their students involved in recycling through a new program, "Aluminum

Beverage Cans: The ABCs of Environmental Education." The program was developed by the Can Manufacturers Institute (CMI) and the North American Association for Environmental Education (NAAEE). It brings together different perspectives and diverse skills to produce a balanced, useful set of inclass lessons and experiments.

Aluminum cans are used as a snapshot of the role scientific and environmental concerns play in the development of packaging. By studying the attributes of aluminum cans, students see firsthand the challenges that industry faces in protecting the environment while also providing consumers with safe, enjoyable products.

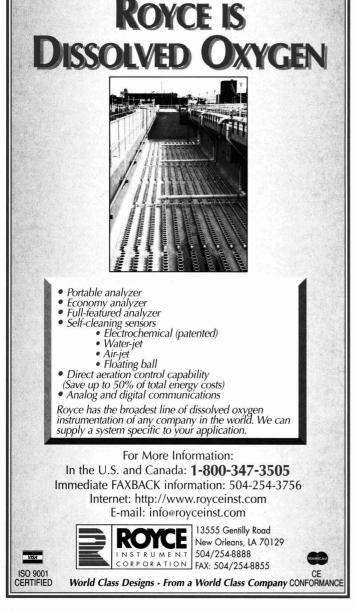
The program comes to an end on April 1, 1998, with the presentation of cash awards for students who collected the most cans per capita and those students with the most innovative ideas on helping their community recycle.

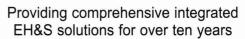
Selective Catalytic Reduction Widespread

WASHINGTON, D.C.—The Institute of Clean Air Companies (ICAC) released a revised version of its white paper, Selective Catalytic Reduction (SCR) Control of NOx Emissions. ICAC's SCR Committee prepared this revision, the first since 1994, to incorporate recent information on the capabilities, limitations, applications and costs of SCR. The paper also provides an updated list of SCR installations in the United States.

In the SCR process, ammonia is injected into exhaust gases containing nitrogen oxides. A catalyst promotes the reaction of ammonia with NO_x to produce harmless nitrogen gas and water vapor. Control levels of greater than 90 percent are achieved in many cases, with unreacted ammonia emissions often below two parts per million. In some cases, systems providing lower levels of control have been installed to meet less stringent permit limits.

Jeffrey C. Smith, ICAC executive director, said, "SCR, invented and patented in the United States almost 40 years ago, is being used to control NO_x emissions from hundreds of units in this country, including boilers, stationary internal combustion engines, gas turbines, process heaters, annealing furnaces and chemical plants." Smith believes that SCR will play an important role in reducing NOx emissions to meet the acid rain rules, the Ozone Transport Region NO_x budget limits and the cap-and-trade program to be set up in response to the EPA state implementation plan.





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Group Flames WTIIncinerator Project

In your October 1997 issue, an article entitled "Voluntary Environmentalism" and written by Alfred Sigg, Daniel Zorbini and Edward J. Sowinski contained many inaccurate and misleading statements.

One of the most glaring inaccuracies was the statement, "Most residents generally favor and support WTI's operation." I challenge the authors of that sentence to support it with verifiable evidence.

I have in my possession signatures of approximately 15,000 citizens opposing the building and operation of the WTI facility. In 16 years of opposition to this facility, I have never seen nor heard of most residents favoring or supporting this facility.

I would like to inform you that Save Our County Inc. (SOC) has never been a member of the Tri Lateral Committee.

When the article stated "All of the participants except SOC signed the statement...," it leads the readers to assume that SOC was a member.

I suggest for your own benefit you demand that the authors of this article provide you with evidence that is verifiable, supporting their assertions.

Alonzo Spencer, President Save Our County, Inc. East Liverpool, Ohio

Edward J. Sowinski, PhD, DABT, CIH, Environmental Health Management and Science, responds: Our article, "Voluntary Environmentalism," summarizes a novel, multifaceted environmental monitoring program associated with a hazardous waste incinerator. The program is noteworthy since it was not required by regulation. Instead, it was designed and implemented voluntarily in addition to the extensive regulatory requirements for waste incinerators. It is especially notable since it was considered at the time of inception to be responsive to the concerns of a small number of local citizens rather than a large majority.

The basis for action involved the premise that any concern pertaining to the environmental impact of an industrial facility, even if expressed by only one person, merits due consideration on behalf of responsible parties. This concept, carried forward by the local board of health and the mayor of

East Liverpool, Ohio, led to voluntary, cooperative and tangible support by FDA, EPA, state agencies, the owners of the incinerator and others in the development of specific environmental monitoring programs aimed at addressing local citizen concerns. This was a novel accomplishment that can serve as a model for similar situations in other communities.

It is regrettable that the local citizens formally organized in opposition to the incinerator were not supportive of the monitoring programs as members of the voluntary organization described in the article. Their opposition contributed to the recent discontinuance of the voluntary activities. Environmental concerns of local citizens cannot be addressed in the most effective manner without factual environmental data being developed as fully as possible.

Chemicals Affect More than Just Humans

I have just finished reading the Editor's Note by Angela Neville, which was entitled "Facing the Future Armed with Facts" and published in your October 1997 issue. As one who has also read and reviewed Theo Colborn's book, Our Stolen Future: Are We Threatening Our Fertility, Intelligence and Survival? A Scientific Detective Story, and as one of the co-authors of the U.S. Environmental Protection Agency Special Report on Endocrine Disruption, I think that you may have overlooked a significant point implicit in both of these documents.

Several organisms in the environment have already been experiencing serious developmental and reproductive effects from chemical exposures resulting from human activities. They have been signaling us for decades, as the environmental sentinels exposed to our chemicals, that there are significant reasons for concern.

It has been our continual narrow focus upon humans, and also upon cancer as "the answer," that has blinded us and resulted in our myopic vision of the impacts of the broad scale environmental contamination that we cause. This narrow focus has, perhaps to our detriment, also limited our vision of and attention to the impacts of chemicals upon organisms in the environment.

One reason that this has happened is because most humans try very hard to

see themselves as separate and "away from" the environment. The reason we need to overcome this handicap is that we are not nearly as separate as we would like to believe. The good news is that this means that we can use what happens in the environment to learn from and, just maybe, prevent problems to us.

The lesson that I get from Colborn's book is that we need to pay significantly closer attention to what the organisms in the environment are telling us now about their exposures. More research on humans is necessary, but not nearly sufficient, to prevent the further "surprises" that are probably already being previewed for us by nature.

I enjoy your publication, but please don't forget that the term "environmental protection" isn't really supposed to be just for and about humans.

> Maurice Zeeman, PhD Department of Pharmacology and Toxicology National Institute of Health Bethesda, MD

Editor's Note: I agree with you that we should not restrict our focus to the impacts of chemicals on humans. Clearly, we must expand our research efforts to determine the effects of industrial chemicals and pesticides on animal populations and the world's diverse ecosystems.

For our readers who are not familiar with Our Stolen Future, your reference to "cancer as the 'answer" refers to Colborn's assertion that cancer has dominated the scientific research programs exploring possible human health effects from chemical contaminants in the environment. She argues that this preoccupation with cancer has blinded us to evidence signaling other dangers and has thwarted investigation of other risks, such as reproductive disorders, that may prove equally important not only to the health of individuals but also to the well-being of society.

WHAT DO YOU THINK?

Letters to the editors should be sent to Environmental Protection, 5151 Beltline Road, Suite 1010, Dallas, Texas 75240, or by e-mail: ablyth@cmpu.net

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the grapevine Compiled by Ingrid Truemper

Cherin Karis has been appointed industrial applications engineer at Smith & Loveless Inc., Lenexa, Kan.

Professional Services Group Inc. (PSG) secured a new contract with the city of Ingleside, Texas, for the operation, maintenance and management of the city's public works department.

SGS International Certification Services Inc. announced its RAB accreditation for AS9000 assessment and registration services.

ECS Underwriting Inc., Exton, Pa., has introduced an insurance program to cover the environmental exposures of privatized water and wastewater treatment facilities.

INFICON® announced the first direct interface GC/MS field-test procedure for on-site analysis of VOC emissions to be included in EPA's list of methods for stationary sources.

Foster Wheeler Environmental Corp. has been selected as the program man-

agement contractor for the \$1.2 billion environmental cleanup of the Rocky Mountain Arsenal, located near Denver, Colo. When completed, the 17,000-acre former chemical munitions and pesticide production site will become one of the nation's largest urban wildlife refuges.

URS Greiner Inc., in joint venture with OHM Remediation Services Corp., has been awarded a \$150 million, 6-year operation and maintenance contract to provide hazardous waste management services at McClellan Air Force Base, Sacramento, Calif., and its satellite locations.

Robert L. Henigar has been named president and chief operating officer of **Berryman & Henigar**, one of Florida's largest multi-disciplinary professional services firms.

Naiad Technologies Inc. has received \$3.1 million in second-round funding from a combination of institutional and private investors. The Portland, Ore.-based company develops and commercializes environmentally friendly technologies designed to reduce toxic liquid waste.

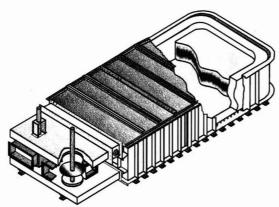
William Pfrang has been appointed Metcalf & Eddy's new vice president for the Philippines. M&E provides environmental engineering and consulting services to industry and government clients worldwide.

James R. Wiegner has been named vice president of the utility, environmental and industrial power division at Babcock & Wilcox Power Generation Group. James S. Kulig has been appointed vice president and general manager, B&W Service. Ronald F. Strunk has rejoined B&W as vice president of purchasing, materials and transportation.

Montgomery Watson Mexico announced the appointment of Dr.
Ernesto Espino de la O to director general of the company, a subsidiary of Boulder, Colo.-based Montgomery Watson Americas.

Mert VanderLind has been appointed group executive vice president at Battelle, with responsibility for governmental business in the areas of transportation, health, human services, EPA, the U.S. Department of Defense and NASA.

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Zurich Services Corp., a risk management services operation of the Zurich Group and Levine-Fricke-Recon Inc., an environmental consulting firm, is offering its services to chemical manufacturers and users in helping them comply with new nationwide air-quality regulations passed by the U.S. EPA.

Hoover Materials Handling Group Inc. hired Howard Weathersby as logistics manager to help coordinate Hoover's new expanded logistics program.

Robert E. Brown Jr., CIH, CSP, CHMM, has been promoted to director of health, safety and environment for Dexter Aerospace Materials, Pittsburg, Calif.

BetzDearborn Inc., Trevose, Pa., and Project Earth Industries, Atlanta, Ga., a privately held research and development company, have signed a worldwide licensing agreement to develop, commercialize and market newly discovered chemical technologies with a wide range of applications in industrial water, wastewater and process treatment.

Lockwood Greene announced that Jerry Riddell has become the new office manager of its Austin, Texas, office. The company's operations in Austin provide consulting, design and construction services to microelectronics clients.

Charles, Craig and Randall Blue, along with their partner Vinod Sikka, are using technology developed and explored at the U.S. Department of Energy's Oak Ridge National Laboratory to build their new business, Infrared Technologies Inc. The company specializes in applying infrared technologies to heat and process metals, plastics and ceramics.

Drew E. Dillingham, PE, has joined Northern Environmental Technologies Inc. as lead engineer in the Mequon, Wis., office. Robert K. Sanborn also joined the same office as project manager. Dean A. Sylla has been appointed lead engineer in the company's Green Bay, Wis., office.

Don Wesenberg has been named vice president of engineering and manufacturing for TerraTherm Environmental Services Inc. The Houston-based company is an affiliate of Shell Technology Ventures Inc.

Grundfos Pumps Corp. has consolidated distributorship of its environmental pumps from 100 distributors to six. Geotech Environmental Equipment Inc. has been named one of the exclusive distributors.

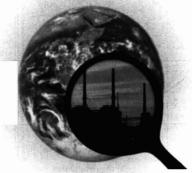
The board of Oxford Molecular Group PLC announced that it has entered into an agreement to invest up to approximately \$8 million in Cambridge Drug Discovery Ltd., a new company that will specialize in providing advanced high-throughput screening services.

Futura Coatings Inc. announced it has entered into a sales and distribution relationship with ICI Devoe Coatings, a protective coatings manufacturer of industrial epoxy, acrylic, zinc and thin film urethane enamels.

The Eastern and Southern African Mineral Resources Development Centre. based in Dar es Salaam, Tanzania, has supplied ER Mapper to the geological surveys of 13 African countries. ER Mapper is an integrated mapping software produced by Earth Resource Mapping.

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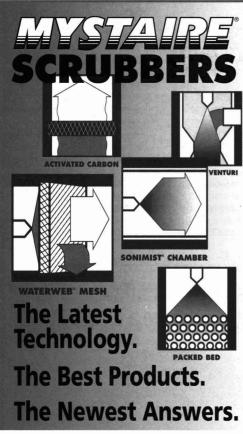
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THE HAZMAT PRO® CATALOG details spill containment pro-



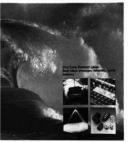
ducts, gas cylinder storage cabinets and drum handling equipment. It provides technical specifications, regulatory requirements and a selection of storage solutions. It covers single drum pallets, multidrum warehouse complexes for the storage of thousands of drums, IBCs and smaller containers. P&D Solutions Corp. Circle 181 on card.

DATATEST'S BROCHURE examines the Model 201 electrostatic dust monitor. The unit has an intrinsically safe 5-inch stainless steel probe for temperatures up to 1,550 degrees Fahrenheit and a NEMA 4 control box. It can be remotely mounted up to 1,000 feet away. Datatest. Circle 182 on card.

PRECISION SPRAY NOZZLES and Accessories Catalog in-

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cludes new products, a complete section for primary metals producers and additional technical reference material. The color catalog emphasizes value, precision, reliability and quick delivery. Lechler Inc. Circle 183 on card.

BRS RESILIENT SEATED Butterfly Valves highlights a line of AWWA-compliant butterfly valves in sizes from 3 inches to 120 inches. All valves included in the 14 page brochure meet or exceed the requirements of AWWA C504. Also included are a variety of manual, electric and pneumatic actuators. DeZurik.

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BIG NEWS IN WASTEWATER Treatment brochure describes the Kaldness® Moving Bed Biofilm Reactor System (MBBR). The brochure explains how the MBBR handles loads of 50 kilogram COD/m³d or more, cuts hydraulic retention time by as much as 80 percent and occupies only 20 percent of the floor space. Purac Engineering Inc.

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A UNIQUE SEALING Solution, a 12-page color catalog, shows how stock or customdesigned strip brush can be used for many industrial applications. It is divided into 10 sections: Why Brush, How Brush is Used, Specialty Brushes, Selecting the Right Brush, Stocked Specialty Brushes, Nylon Stock Brush, Aluminum Holders, Metal Filaments and Channels, Custom Brush and For More Information. Sealeze Corp. Circle 186 on card.

FOR LEAK AND SPILL Control is full of products, tips and solutions for all types of industrial and maintenance spills. Features include the Storm Drain Protector, epoxy putty, Versa Guard, drum handling equipment and secondary containment. Andax Environmental Corp. Circle 187 on card.

HAZ-VAULT™ HAZARDOUS Materials Storage Lockers is a two-page color flyer describing the hazmat locker line. The flyer describes how the lockers are prefabricated weatherproof structures that offer vault-like safety, security, segregation and secondary containment for hazardous materials, chemicals and waste. It also outlines the options for fireproofing and non-combustible construction. Haz-Stor. Circle 188 on card.

ANALYTICAL REFERENCE Materials Catalog provides a complete listing of organic environmental reference materials for CLP and EPA 400, 500, 600 and 800 series methods. Within the 108 pages, ASTM organic and petrochemical stan-

dards, international reference materials, FAMEs, USP test mixures, pharmaceuticals, inorganic calibration standards, TO-14 air monitoring standards and column evaluation mixtures are also highlighted. Restek Corp. Circle 189 on card.

ANALYTICAL REAGENTS brochure features the practices, philosophies and performance of Mallinckrodt AR® analytical regeants. Safe, space-saving packaging are also highlighted in the brochure. Mallinckrodt. Circle 190 on card.

FLOW COMPONENTS AND Controls for Gases and Liguids contains information on Matheson's complete line of flowmeters and includes a "Product Line Overview" for easy access to information on the extensive line of variable area flow control products for both liquids and gases. A description of the Tube Cube®, multi-tube units, mixers and proportioners and the flowmeter kit are included. Matheson Instrument Group. Circle 191 on card.

ORGANIC CHEMICAL Reference Standards Catalog is 250 pages of technical information. It includes over 1,000 analytical standards for the environmental, petrochemical, industrial and research fields. Accu-Standard Inc.

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THE ISO 14001 Implementation Guide: Creating an Integrated Management System, written by Suzan L. Jackson, contains step-bystep instructions for implementing an effective and cohesive EMS that will help cut costs, increase efficiency and focus energies. John Wiley & Sons Inc. Circle 193 on card.

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A WATERSHED GETS A FACELIFT

This unique mitigation project next to an impacted watershed includes custom-designed wetlands and stream enhancements

By Roger Zyma, Gary Von Stetina and Deborah E. Lynch

southeastern Pennsylvania watershed improvement program compensated for the developmental impacts of a landfill expansion by creating wetlands and installing stream enhancements in an adjacent local watershed. The landfill expansion involved the permanent taking of watercourses and wetlands. The expansion permit application demonstrated to

regulators that the wetland and watercourse work could not be avoided or replaced in the same local watershed. Implementing the program in an adjacent watershed is unusual because most mitigation programs occur within the same watershed as the impacted area. Another unique aspect of the program included improvement to rather than replacement of a stream. Successful implementation of the watershed improvement program required early and coordinated regulatory agency involvement and a well-researched technical program to design, permit and construct the wetlands and stream structures.

Regulatory Coordination

Early in the project, contact and rapport were established with the various regulatory agencies responsible for approving and permitting the project. Through this process, special circumstances concerning mitigation of the stream impacts and the wetlands were explained, analyzed and modified as appropriate prior to acceptance.

An additional benefit of the coordinated regulatory program was the cooperative effort by agencies with similar functions. Meetings were scheduled with these agencies at the same time to avoid redundancy. For example, the Pennsylvania Department of Environmental Protection and the U. S. Army Corps of Engineers both have responsibilities related to wetland construction. Coordination with interested agencies such as



The bank stabilization process took several steps, beginning with erosion reduction.

Photos courtesy of STV h



Existing exposed soils and bank required crib stabilization.

the Pennsylvania Fish and Boat Commission, U.S. Fish and Wildlife Service, local conservation district offices and township officials resulted in unified acceptance of the project.

Landfill Expansion Setting

The landfill expansion is located within an unnamed tributary watershed that covers approximately 125 acres. The expansion itself covers less than 50 percent of the watershed.

Prior to expansion, the land was primarily deciduous forest. Three ephemeral/intermittent streams and two small wetlands were located in the expansion area. Totaling approximately 3,400 feet in length, the streams did not flow continually and were unable to support fish and other aquatic populations.

The wetlands filled by the landfill expansion consisted of approximately one half acre of palustrine forested (PFO) and palustrine scrub shrub (PSS) habitat that had low water levels and provided low-quality wildlife vegetation. These wetlands provided marginal habitat to wildlife and insufficient habitat to wetland-dependent species.

Adjacent Mitigation Watershed

Studies to determine an appropriate location for the watershed improvement program evaluated slope, soil, ground and surface water, construction activities and potential for future landfill conflicts.



Stabilized stream bank backfilled and seeded.

A location approximately one mile from the expansion was selected.

The chosen site, located in an adjacent local watershed, contains a perennial stream and an existing wetland system situated adjacent to the stream. The

The new wetland provides a degree of flood control for the adjacent stream and a place for sediment to drop, supplying nutrient and groundwater recharge.

total drainage area within the selected watershed is two square miles, or 1,300 acres. Land use within the area consists mostly of farmland and forest land. Hemlock and black walnut are the primary tree species in the upstream portion of the project area, while white ash and sycamore predominate in the downstream portion. White-tailed deer, red fox, raccoons and red-tailed hawks are the dominant wildlife in the watershed. The watershed is underlain by the



Finished cribbing with fish overhang using overhang of bottom log structure.

Brunswick formation, which is a reddish-brown shale, mudstone or siltstone and silt loam.

Existing Stream Conditions

The area selected for the watershed improvement program contained a perennial stream, part of which was bordered by existing wetlands. The stream enhancements were suggested to improve existing aquatic habitat conditions, physical stream characteristics and low-flow conditions. Physical conditions included bank erosion, insufficient stream depth during low-flow conditions and loss of water-holding capacity to sustain fish populations during low-flow conditions.

High-flow periods during storm events caused significant erosion against the silt loam stream banks. The erosion created unstable banks, contributed to bank destruction and affected aquatic habitats. The increased sediment load resulting from bank erosion degraded overall stream quality and impacted macroinvertebrate habitats. It was deposited in a downstream dam and troutstocked receiving stream that local residents used for recreation.

Stream Enhancement Program

The program to correct these conditions included constructing and placing 36 custom-designed structures throughout 8,500 feet of the stream. These structures were primarily built of logs,



Typical condition of stream during low flow.

rock and other natural materials. Ten bank cribbing structures, totaling approximately 1,000 feet, were installed to protect and stabilize the eroded banks. Ten single-wing deflectors were installed to guide and concentrate flow and to create meandering within the stream. To redirect and increase the depth of flow, the construction team built one channel block and two channel constrictors. Seven K-dams were

low-log imitators in the downstream dam to support catfish spawning. Also within the dam, the project team added three tree snags to provide cover for fish. Trees and shrubs were planted adjacent to the stream to block sunlight penetration to the stream, provide shade and lower the water temperature during summer low-flow months. The lower water temperatures improve dissolved oxygen levels.



Single wing deflectors concentrate and direct flow.



Channel constrictor installed to concentrate and direct flow through mechanically created deep pool.

placed to provide pools upstream of the structures, collect organic matter and create a waterfall effect to improve dissolved oxygen levels within the stream. The resulting continuous and deeper flow in the main channel improved the physical characteristics of the stream and the habitats.

To enhance habitat adjacent to the stream, several additional structures were added. The team added three hol-

Following completion of the stream enhancements, bird, bat and waterfowl nesting platforms were placed adjacent to the stream and in the surrounding wetlands to enhance and maintain nearby higher-quality terrestrial wildlife habitats.

Wetland Creation

The studies performed to determine the optimal location for a created replacement wetland indicated that an area in

the same watershed as the stream enhancement program was the best location for a constructed wetland. This site is adjacent to an existing palustrineemergent (PEM) wetland and located between the convergence of two stream branches. Soil and hydrologic studies also suggested that this would be an optimal area. During summer, when the groundwater level was low, free water was still available in the soil. Also, mottling in the upper soil layers indicated a suitable wetland site.

As previously noted, the filled wetlands consisted of approximately one half acre of PFO and PSS wetland habitat. In accordance with state and federal guidelines, the filled wetlands were replaced at a 2-to-1 creation to mitigation ratio with a wetland of similar value and function

The created one-acre wetland consists of PFO, PSS and PEM habitats. The PFO and PSS section incorporates red maple, silky dogwood, buttonbush and arrowwood, which occur in other wetlands in the vicinity. The PEM plants in the created wetland are similar to the vegetation in the adjacent natural PEM wetland, namely soft rush, woolgrass, rice cutgrass and others. The adjacent wetland contributes natural seeding and species diversity to the created wetland. The new wetland pro-



Stream meander was created by installing deflectors and constrictors in series.

vides a degree of flood control for the adjacent stream and a place for sediment to drop, supplying nutrient and groundwater recharge.

Construction Issues

Several construction techniques were implemented to maximize the beneficial results of the project and minimize impact to the environment. For example, all custom-built structures were made

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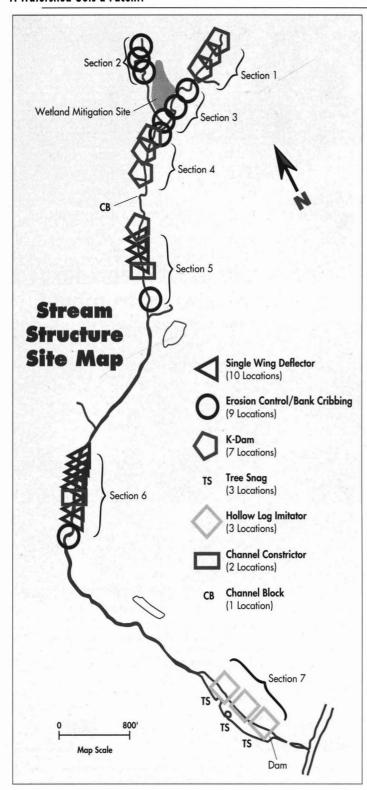
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from natural logs rather than treated lumber. To facilitate the water-holding capacity of ponds, tight seals were achieved using a filter fabric installed behind the structure along with a bentonite mat. The bentonite mat, designed to swell when wet, sealed the structures to minimize water leakage between logs.

To minimize bank disturbance, the project team accessed each construction site via existing trails. Work within the stream was limited and completed as quickly as possible. The bedrock stream channel was used as an access road for parts of the project. Rubber-wheeled vehicles and flat-tracked versus cleat-type equipment reduced the impact to the stream and bank. All of the work was installed starting at the most upstream areas and proceeding downstream to avoid sediment load to the constructed stream enhancements.

The wetland creation was staged with a winter excavation, then a spring and fall planting. The project team ensured hydrology during one of the driest seasons in many years by supplemental watering to support the plants through this period.

Project Evaluation

The stream enhancement structures and wetland mitigation site are inconspicuously placed and appear natural in the landscape. Approximately 1,000 linear feet of erosion control features were installed. Ponded backwaters were created in areas that did not exist previously and 1,000 linear feet of meanders were created from channel constrictors and single-wing deflectors. Planted materials and volunteerism of native wetland species from adjacent areas in the created wetland site have met site and regulatory agency expectations less than one year after construction. Monitoring of the program will continue over the next five years.

The wetland and stream improvement program is part of a master plan to use buffer properties adjacent to landfills to benefit the local community with recreational and outdoor activities.

Roger Zyma is a senior vice president of STV Environmental and STV Inc. Gary von Stetina is a senior environmental engineer with Waste Management Disposal Services of Pennsylvania. Deborah E. Lynch is a wildlife biologist with STV Inc.

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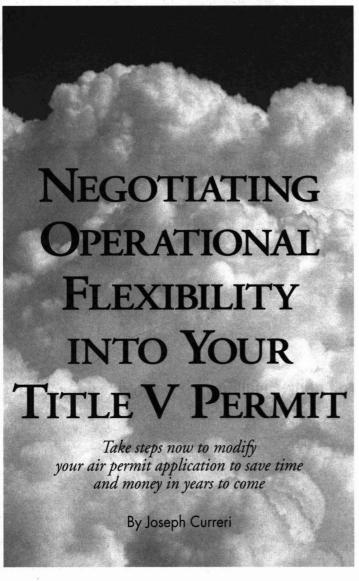
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itle V of the 1990 Clean Air Act Amendments has been a top compliance priority for industry in the 1990s. Many companies have already submitted their Title V permit applications. Unfortunately, in the rush to meet regulatory deadlines and secure "application shields," the all-important longterm goal of preserving operational flexibility may have been overlooked. The result can be overly stringent operating limits that erode profits and hinder growth and development for years to come.

However, it is not too late to negotiate

operational flexibility into your permit, whether or not you have submitted your Title V application. Permit conditions do not become final until they have undergone federal and public scrutiny. Most applications are either under review by state agencies or awaiting review. In addition, states have three years to issue final permits once the U.S. Environmental Protection Agency has approved their Title V programs. That still leaves most companies time to submit strategic supplements or addenda.

The Title V application can be used to

achieve advanced New Source Review (NSR). The Title V application can also be used to modify existing permits, streamline overlapping requirements and reduce or eliminate monitoring, recordkeeping and reporting requirements. The bottom line is substantial cost savings and increased operational flexibility. However, the key to achieving these objectives is strategic and aggressive use of two EPA guidance documents that have been greatly underutilized by state agencies and the regulated community. These documents can be powerful tools for obtaining a permit you can live with.

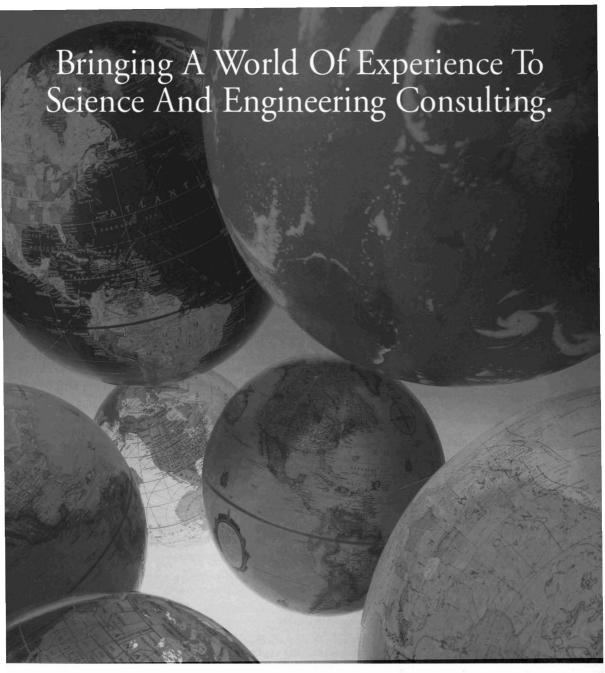
Regulatory Background

The Title V permitting program combines all of the Clean Air Act requirements for a facility into a single document. Because of its vast scope and complexity, many managers become ensnared in the details of the permit application process and overlook important long-term goals. Since Title V became law, EPA has published two White Papers that can be used to help agency personnel and the regulated community simplify the permitting process. By seizing opportunities brought to light in these documents, industry has a second chance to build critical, long-term goals into Title V permits, and managers can focus on reducing operating restrictions, monitoring and recordkeeping costs and reporting requirements.

The "Streamlined Development of Part 70 Permit Applications" (White Paper 1, 1995) simplifies the permitting process under 40 Code of Federal Regulations (CFR) Part 70 by eliminating many technical requirements and many of the details originally associated with the permit application. "Improved Implementation of the Part 70 Operating Permits Program" (White Paper 2, 1996) is also good for industry, primarily because it allows companies to streamline multiple or overlapping air quality requirements.

By reviewing your Title V application with an eye toward incorporating elements of EPA's guidance, your company can still greatly reduce its compliance obligations. Even if your permit application has already been submitted to the state, you may submit revisions as addenda to the original document.

State agencies and applicants alike, in the haste to meet program details and deadlines, have for the most part overlooked EPA's guidance. It is important to remember that the burden is clearly on the regu-





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Negotiating Operational Flexibility into Your Title V Permit

lated community, not agency personnel, to take advantage of these guidance documents. It is also important to work with state regulators to ensure that they understand and accept guidance-related modifications to your Title V permit application.

Enhanced Operational Flexibility

If properly prepared, your permit application can help substantially increase the operational flexibility of your facility. It can be used to revise the terms of your existing air quality permits, avoid future NSR by securing regulatory approval today for new construction or anticipate other "alternative scenarios" planned for tomorrow.

Revising Existing Permit Conditions

The Title V permit review and approval process fulfills the most stringent levels of state, federal and public review necessary for permit revisions. That means that you can use your Title V application to propose changes to any air quality requirements, existing or new, that govern your operations. By incorporating your proposed permit changes into your Title V application now, you may eliminate redundant NSR and other costly permitting efforts in the future.

White Paper 1 allows Title V permit applicants to propose changes to terms or conditions of existing permits. You

ready submitted an application to the state, you can still submit an addendum to remove or clarify any references to non-federal requirements before your application reaches EPA for review.

Avoiding NSR and Approval Process

Building a new facility or modifying an existing one requires a costly permitting effort. To secure a permit-to-construct, new emission sources must undergo a rigorous NSR or Prevention of Significant Deterioration (PSD) review and approval process. The stringent state and federal agency review, public notification and comment period can be excessively time-consuming, leading to construction delays and lost business and revenue opportunities.

Because the Title V review process is at least as stringent, applicants may leverage their Title V permit application to apply for an advanced NSR of planned future modifications. New construction can be incorporated into the permit as an "alternative operating scenario." Once the permit to construct is approved simultaneously under Title V, construction can begin at some future date without any additional review. The applicant need only notify the state once the new facility is up and running.

According to commencement-and-continuation-of-construction requirements, work on a new facility must begin within

Money-Saving "Title V White Paper Strategies" for Industry

- Propose changes to the terms and conditions of existing permits, including elimination of environmentally insignificant requirements.
- Streamline overlapping requirements (e.g., BACT, NSPS, SIP) by subsuming the less stringent requirements into the most stringent, or proposing a "hybrid" requirement.
- Apply for simultaneous "advance" NSR of planned future modifications, thus avoiding a lengthy peer review and approval process prior to construction.

can also mitigate monitoring, recordkeeping and reporting requirements, as well as eliminate obsolete or extraneous permit restrictions. In the permit application crunch, you may not have clearly differentiated federal applicable requirements from other, state-only, requirements. As a result, once the permit is issued, you may have inadvertently imposed new federally enforceable requirements on your facility.

If you did not make the proper distinctions in your original application, now is the time to do so. If you have al18 months of permit issuance. However, applicants may apply for a 12-month extension. Typically, the permit holder will have from 18 to 30 months after the permit is final to begin construction.

Streamlining Air Quality Requirements

Companies can also save time and money by taking advantage of *White Paper 2* to streamline multiple or overlapping air quality requirements in either of two ways:

 Identical emission units with identical applicable requirements at a facility can be grouped together for listing emissions, applicable requirements and monitoring, recordkeeping and reporting requirements.

• A unit subject to overlapping requirements need only comply with the most stringent of these, or with a "hybrid" requirement.

The first type of streamlining allows companies to propose a single recordkeeping, reporting and monitoring requirement for multiple emission units.

Since Title V became law, EPA has published two White Papers that can be used to help agency personnel and the regulated community simplify the permitting process.

Consider, for example, boilers at the same facility that are subject to the same applicable requirements. The guidance states that applicants do not need to submit a separate record for each boiler, or test and develop separate emissions factors. All units can be grouped under one requirement and identified as a single monitoring parameter to save time, money and effort on reporting, record-keeping and monitoring.

Companies may also dramatically reduce compliance costs for any unit subject to overlapping requirements. For example, installation of a new boiler is typically subject to PSD review, Best Available Control Technology (BACT), New Source Performance Standards (NSPS) and State Implementation Plan (SIP) requirements governing sulfur dioxide content and particulate emissions. Any boiler meeting BACT, the most stringent of the requirements, would automatically be in compliance with the other mandates.

In addition, EPA guidance further indicates that a facility can meet compliance obligations by subsuming the less stringent requirements into the most stringent requirement. Where different applicable requirements overlap and it is difficult to determine which is the most

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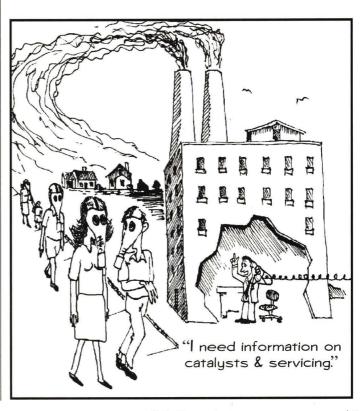
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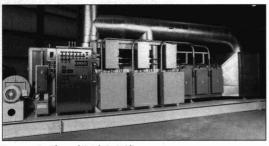
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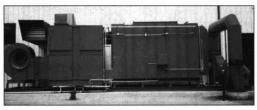


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Glossary of Terms

New Source Review: The federal rules under 40 CFR Parts 51 and 52, which require new major sources or modifications to secure preconstruction permits ensuring compliance with pertinent Clean Air Act provisions

PSD: Prevention of significant deterioration provisions encompassing New Source Review requirements for sources located in areas that are in compliance with the National Ambient Air Quality Standards (NAAQS)

NSR: The term typically refers to provisions encompassing New Source Review requirements for sources located in areas that are not in compliance with the NAAQS.

NSPS: New Source Performance Standards are technology-based standards under 40 CFR Part 60 applicable to emissions from specific categories of sources.

SIP: The State Implementation Plan encompasses all of a state's regulations implementing the EPA regulations issued under the Clean Air Act.

BACT: Best Available Control Technology is required by PSD regulations and is determined on a case by case basis with the requirement that it must be at least as stringent as an applicable NSPS.

stringent, applicants may synthesize the requirements into a single hybrid requirement for compliance.

Operational flexibility will be the ultimate determining factor in the costs associated with your Title V permit. You need not wait until your draft permit is issued to begin negotiating for this flexibility. Making the most of opportunities presented in EPA guidance, along with a thoughtful examination of your Title V application, supports development of revisions or addenda that will help you achieve the most operational flexibility at the least cost.

Joseph Curreri is vice president for Air Quality Studies at ENSR, in Acton, Mass. He has 23 years of experience in industrial air permitting under the Clean Air Act and state air toxics programs.

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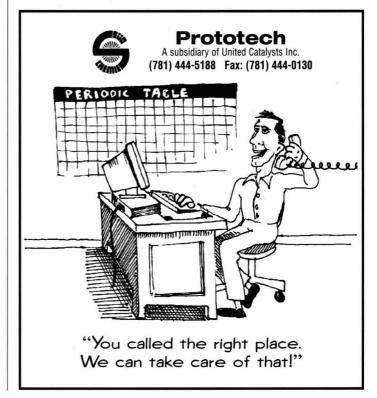
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ENVIRONMENTAL **AUDIT LEGISLATION:** EPA VS. THE STATES

The disparity between EPA's audit policy and many state audit laws leaves companies without complete protection when conducting an environmental audit

By Donald J. Parthum, Jr., JD, and John M. Brown, JD

ederal and state environmental audit laws allow companies to conduct self-audits to measure their compliance with environmental laws and regulations, improve their own environmental management system or evaluate risks associated with their activities. The U.S. Environmental Protection Agency has expressed concern with state audit laws that create evidentiary privileges that prevent the audit from being used as evidence against the company and grant broad immunity from civil and criminal fines and penalties. Michigan's audit law is one example.

EPA's Final Policy

In December 1995, EPA issued its final policy on environmental audits. The stated purpose of EPA's audit policy is to promote voluntary self-policing by companies and encourage voluntary compliance with federal environmental laws and regulations.

EPA's audit policy provides that if violations are voluntarily discovered and reported to EPA, the company may qualify for a reduction in the penalty that might otherwise be imposed. EPA's audit policy contains several important definitions. Environmental audit is defined as a systematic, documented, periodic and objective review of practices related to meeting environmental requirements. Due diligence is defined as a company's efforts to prevent, detect and correct environmental violations. Gravity-based penalty is the penalty levied above and

beyond recoupment of monetary benefits the company has gained by the violation. To qualify for a reduction in gravity-based penalties, a company must meet the following conditions:

- · Discover the violation through an audit or due diligence;
 - · Voluntarily detect the violation;
 - · Promptly disclose the violation to EPA;
- · Discover and disclose the violation independent of government or thirdparty action;
 - · Promptly and comprehensively cor-

EPA strongly opposes the audit privilege because EPA believes it invites secrecy and poses difficulties to prosecutors and litigants.

rect and remediate the violation (corrective action must be initiated and completed within 60 days, otherwise written notice must be provided to EPA);

- Prevent recurring violations (steps taken must be in writing);
- · No repeat violations within the past three years at the facility;
- · Not seriously harm or endanger the public health or environment; and
 - Cooperate with EPA.

EPA will not seek gravity-based penalties or refer the matter for federal criminal enforcement if all of the above conditions are satisfied. If all of the conditions are met except discovery of violations by audit or due diligence, the company is eligible for a 75-percent reduction in gravity-based penalties. EPA's audit policy does not grant immunity from penalties, only a reduction in the amount of the penalty, and does not recognize the concept of "audit privilege," meaning the audit report and its contents are protected from disclosure to the government and others.

State Audit Laws

To date the states have gone in three directions in implementing environmental audit policies. The following states have enacted their own audit laws: Alaska, Arkansas, Colorado, Idaho, Illinois, Indiana, Kansas, Kentucky, Michigan, Minnesota, Mississippi, Montana, New Hampshire, Ohio, Oregon, South Carolina, South Dakota, Texas, Utah, Virginia and Wyoming. Roughly threequarters of these states grant some type of civil immunity-elimination of administrative or civil penalties and fines. Onethird grant some type of criminal immunity-elimination of criminal penalties and fines-and a few reduce criminal penalties not qualifying for immunity. The following states have opted for administrative policies similar to EPA's audit policy rather than adopting broader audit laws: California, Florida, North

Carolina, Oklahoma, Pennsylvania, Tennessee, Vermont and Washington. The following states are believed to be considering administrative policies similar to EPA's audit policy: Delaware, Maryland, New Mexico and West Virginia.

Michigan's Environmental Audit Privilege and Immunity Law, Part 148 of the Michigan Natural Resources and Environmental Protection Act, provides that audit reports are privileged from disclosure of information to the government and to privironmental management system. The audit must be labeled "Environmental Audit Report: Privileged Document," and the privilege also applies to all field notes, records, findings and other supporting information generated during the audit process.

The report is privileged unless:

- · The information is required by law to be reported to a regulatory agency or other person;
 - · The information is obtained by the

The privilege applies if the information contained in the audit is not shared with third parties. However, the privilege is not waived if the information contained in the audit is disclosed by the company to an employee, an agent retained to address an issue or issues raised in the audit, the person's legal representative, or if the information is disclosed under the terms of a confidentiality agreement.

Before its recent amendment, Michi-

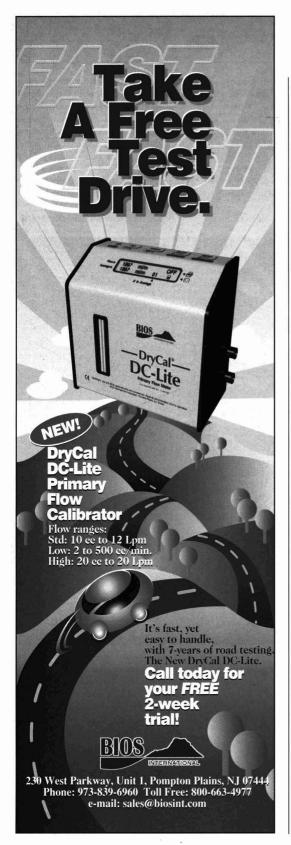


vate parties in any civil or administrative proceeding. Alternatively, if a company elects to waive the privilege and voluntarily discloses evidence of violations, it is rewarded with immunity by the state from most administrative, civil and criminal fines and penalties for those violations.

Michigan's audit law defines an environmental audit as a voluntary and internal evaluation designed to identify historical or current noncompliance and prevent noncompliance or improve compliance, to identify adverse environmental conditions or to improve an enagency's own observation, sampling or monitoring;

- · The information is legally obtained independently of the audit;
- · The information consists of machinery and equipment records;
- · The privilege is asserted for a fraudulent purpose; or
- · The information shows evidence of a noncompliance with environmental requirements and the company for whom the report was prepared failed to take corrective action within a reasonable time, not exceeding three years.

gan's audit law provided that if the audit was voluntarily disclosed to the appropriate state or local agency, the company was granted complete immunity from civil or administrative penalties and criminal prosecutions for disclosed violations. However, the immunity did not apply to criminal penalties or fines for gross negligence or willful criminal acts, continuous or repeated violations, or violations of federal law. The immunity did not relieve a company's responsibilities to correct the violation, conduct necessary remediation or pay damages.



Environmental Audit Legislation: EPA vs. The States

EPA's Reaction to Michigan's Audit Law

EPA's audit policy differs from Michigan's audit law in that EPA's audit policy does not recognize that the audit is privileged or grant immunity from fines and penalties. EPA strongly opposes the audit privilege because EPA believes it invites secrecy and poses difficulties to prosecutors and litigants. On the other hand, industry believes that the lack of privilege allows third-party litigants to use audit data for toxic tort and other lawsuits against the company. EPA also is concerned that statutory immunity language may deprive the state of adequate authority to enforce federal environmental programs. In fact, EPA has in some instances threatened to withdraw the power to enforce federal environmental programs from states with audit privilege and immunity provisions.

For example, EPA has granted Michigan only interim approval for issuing air pollution permits to stationary sources pursuant to the federal Clean Air Act. The primary reason cited by EPA for withholding final approval from Michigan is the privilege and immunity provisions in Michigan's audit law. Michigan's interim approval runs through February 1999. Texas and Idaho also only received interim approval for their air permit programs because EPA was similarly displeased with the Texas and Idaho audit laws. EPA currently is reviewing the audit laws of Colorado, Kansas and Oregon and re-evaluating its grant of full approval to these states in light of its grant of interim approval to Michigan, Texas and Idaho.

In response to EPA's concerns, the Michigan Department of Environmental Quality (MDEQ), the Michigan Attorney General and EPA agreed on amendments to Michigan's audit law to resolve EPA's concerns and federal environmental program delegation issues.

The amendments to Michigan's audit law include the following provisions:

- Require the audit to be completed within six months;
- Require that advance notice of the audit be given to the MDEQ in order to receive immunity;
- Do not recognize a privilege with respect to criminal investigations or proceedings (the audit report can be used as evidence in criminal cases);
- Do not grant immunity if the company gained a substantial economic benefit from the violation, the violation was of an administrative or judicial order or resulted in serious harm or was an imminent threat to human health or the environment; and
- Do not grant immunity from criminal penalties and fines for environmental violations related to wetlands, floodplains, stream beds and stream channels.

The amendments to Michigan's audit law were patterned after similar changes negotiated and agreed to between EPA and Texas. The state agreed to eliminate immunity and privilege for criminal violations of environmental laws and eliminated immunity where a violation resulted in a serious threat to health or the environment or if the violator gained a substantial economic benefit giving it a competitive advantage. The changes to Texas' audit law became effective September 1, 1997. Similar changes were included in a bill signed by Utah's governor in March 1997. Idaho's governor has stated that he would not support a bill extending Idaho's environmental audit law, which expired on December 31, 1997, unless reauthorized.

Despite the agreements reached with these states, EPA remains deeply opposed to any form of audit privilege. EPA has stressed that state law cannot limit EPA's ability to obtain information or 0 0

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Raising Industry Standards

Environmental Audit Legislation: EPA vs. The States

otherwise exercise its authority under federal law or be used to deny specific rights to private parties under federal environmental laws. However, in a July 1, 1997 letter to the MDEQ, an EPA representative promised not to target Michigan companies that use Michigan's audit law as amended. EPA's commitment should help relieve industry concerns that they may become arbitrary targets of EPA enforcement if they conduct audits under Michigan's audit law and discover violations.

Congressional Involvement

The United States Congress introduced two environmental audit bills (S.886 and H.R.1884) that, if enacted, would provide a company with limited immunity and deem the audit as privileged subject to certain exceptions, provided the company voluntarily conducts the audit and promptly corrects any discovered violations. Congress has also introduced a bill (S.1332) that, if enacted, would prohibit EPA from withholding from states the authority to enforce federal environmental programs simply because those states have enacted audit laws that provide limited protection from discovery of audit information and limited immunity. EPA and environmental groups undoubtedly will play an

Industry believes that the lack of privilege allows third-party litigants to use audit data for toxic tort and other lawsuits against the company.

active role in determining whether this legislation is passed.

It is important that any environmental audit be designed to fall within the protection of well-recognized privileges, such as the attorney-client privilege and the work product doctrine. If certain requirements are met, the attorney-client privilege protects communications between a client and his or her attorney, and the work product doctrine protects materials prepared in anticipation of litigation. These additional protections are important because while state audit laws may benefit a company in state court, the privilege may be lost in federal court. Additionally, companies should recognize that state audit law immunity from penalties for voluntary disclosure does not apply to federal penalties. Given the intricacies involved, it is recommended that a company consult its attorney before beginning any environmental audit to help ensure that it understands the benefits and the risks that may be involved.

Donald J. Parthum, Jr., JD is an environmental attorney who practices law in Detroit, Mich., and John M. Brown, ID, is an attorney with the law firm Kelley, Casey & Clarke, P.C., in Detroit, Mich., where he practices litigation, environmental and insurance law.

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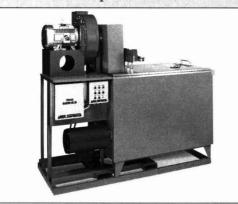
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ENVIRONMENTAL CLEANUP PAVES THE WAY

One brownfield site is redeveloped to become a cost-effective commercial property

By Vern Singh, PE, and Thomas Boyd



The Atlantic City Convention Center site during remediation and development.

he 1990s have seen a surge in government incentives to rehabilitate urban properties for commercial and industrial use. Developers once viewed the redevelopment of "environmentally challenged" urban real estate as too costly in terms of both the expense to remediate a brownfield site and the potential future liability of contaminated land resulting in health risks to the public.

In response to such concerns, the federal Brownfields Economic Redevelopment Initiative (BERI) was created in 1993. Managed by the U.S. Environmental Protection Agency, BERI was designed to reduce some of the cost by lifting regulatory barriers. Unlike suburban real estate, brownfield sites are often centrally located within a city and have an infrastructure already in place.

The Atlantic City Convention Center and Rail Terminal project offers a text-book illustration of the commercial redevelopment of a brownfield site. Located on Kirkman Boulevard, it is half a mile from the Atlantic City boardwalk and adjacent to the Intercoastal Waterway and the Atlantic City Expressway.

The project includes a convention center with more than 500,000 square feet of exhibition space, 46 meeting rooms, 1,500 parking spaces and a rail terminal that connects Atlantic City to major population centers in the northeast, including Philadelphia, Washington, New York and Boston. Planned and constructed by the Atlantic County Improvement Authority (ACIA) in conjunction with the New Jersey Sports and Exposition Authority at a cost of \$268 million, the development is a key component of urban renewal in Atlantic City.

County leaders recognized the value of the brownfield site almost a decade before federal and state programs were enacted. In 1984, ACIA initiated the industrial redevelopment of 36 acres of inactive industrial property. The property consisted of three contiguous sites, including a 29-acre railroad site, a 6-acre coal gas processing facility and a 1-acre bulk fuel oil handling and storage facility. Historic use of the site had led to contamination across much of the project area.

Site Field Investigations

To confirm the information gathered and the preliminary conclusions reached during the search of historical records relating to contamination, URS Greiner conducted site topographic surveys, a ground-penetrating radar survey and aboveground electromagnetic surveys, as well as a cultural resource investigation. URS Greiner completed numerous soil borings, constructed dozens of groundwater monitoring wells and collected and analyzed soil and groundwater samples. Water-level readings were recorded during tidal fluctuations in the adjacent waterway and test pits were used to assess contamination levels.

Once the analytical data was collected

The project includes a convention center with more than 500,000 square feet of exhibition space, 46 meeting rooms, 1,500 parking spaces, and a rail terminal that connects Atlantic City to major population centers in the northeast, including Philadelphia, Washington, New York and Boston.

and validated, "fingerprinting" techniques were used to interpret the data and assess which contaminants resulted from which industrial activities, since cleanup costs were to be divided among several parties.

The most heavily contaminated soils and groundwater were found at the location of the former coal gas manufacturing and fuel oil distribution facilities. The contaminants of major concern in the soil as well as in the groundwater included benzene, toluene, xylene and methylbenzene. The site included abandoned structures that contained coal tartype liquids, abandoned foundations and underground storage tanks.

The railroad site showed a widespread

presence of petroleum-related products with some localized contamination of metals. Total petroleum hydrocarbon (TPH) contamination found across the railroad yard was the result of past activities like repair, cleaning and fueling. The highest concentrations, detected along former track alignments near the engine house and fuel pumps, were at shallow depths and likely the result of surface fuel oil spills.

Polycyclic aromatic hydrocarbons (PAHs), which result after incomplete combustion or pyrolysis of coal, were present near the engine house, in the vicinity of the track alignments and near the ash pits. Phenols, associated with coal use, were detected near the track alignments. Metals found at elevated concentrations included arsenic, chromium, lead, nickel and zinc. Contaminants were not determined to have impacted groundwater.

Remedial Technologies

The project development schedule and ultimate site use were the most significant factors in evaluating remedial technologies. Remedial alternatives were developed and evaluated for technical, public health, environmental, institutional and cost considerations, as well as constructibility, completion schedule and end use.

To minimize the required excavation of contaminated soils and reduce remediation costs, URS Greiner worked with the project design team and the New Jersey Department of Environmental Protection to propose changes in the design of the convention center, such as raising its elevation and constructing a novel slurry wall.

Remedial action design and construction were divided into five operable units. Breaking the work into smaller operable units created a more competitive environment for construction contracts and helped reduce contract costs even further. Time constraints on the project were critical. To comply with the overall project schedule, flexible and innovative design technologies were used and the remedial design and action were carried out simultaneously.

Following detailed discussions and an evaluation of the possible risk to human health and the environment, it was determined that excavation and offsite disposal of contaminated soils coupled with groundwater withdrawal and treatment

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Environmental Cleanup Paves the Way

were the most appropriate remedy for the coal gas and fuel oil sites. However, on the remaining site there was no need to remove the almost 60,000 cubic yards of petroleum hydrocarbon-contaminated soils. These soils were permitted to remain onsite and the convention center floor level was raised to accommodate this soil. The structure and its foundation would be functionally equivalent to a cap, thereby integrating the cleanup plan with the building construction.

Proposed landscaping plans were modified to minimize infiltration through the marginally contaminated soils and to allow the use of an impermeable liner over a portion of the coal gas site. Approximately 2,000 cubic yards of hot-spot soils highly contaminated with TPH were excavated and sent to an offsite recycling facility. The alternative of raising the building rather than removing the contaminated soil resulted in significant savings and made the development more attractive.

During the cleanup of the coal gas and fuel oil sites, abandoned footings, sludge-filled coal gas holder tank bottoms and buried pipes and vaults were uncovered and removed. Groundwater remediation included construction of five subsurface groundwater collection drains and wells, subsurface barrier walls and a pretreatment system.

The original design called for a 2,600-foot-long, 30-foot-deep slurry wall to enclose the site. In addition to sealing off the area from groundwater inflow, the wall had to be compatible with the foundation of the convention center and rail terminal.

A more expedient and cost-effective solution involved a construction method that had been used only once before in the United States. An innovative slurry, comprised of a backfill mix of soil, cement and bentonite, provided a bearing capacity equal to that of the existing soil. To meet the tight rail terminal construction schedule, 600 feet of the wall were constructed using interlocked steel sheetpiles.

Collected groundwater was pumped to a 30-gallons per minute (gpm) pretreatment system that included an oil/water separator, packed tower air stripper and carbon adsorption units. The treatment facility design, which was based on a three-dimensional groundwater model, was customized to fit a 30-foot-wide strip of land acquired by the ACIA across the street from the site. The offsite location allowed construction of the convention center, which opened in May 1997, to proceed without affecting treatment operations. Pretreated groundwater was discharged to the public sewer for final treatment.

Throughout the course of the project, the ACIA and its environmental consultant, URS Greiner, held a succession of partnering sessions and discussions with state and local regulatory agencies. These sessions were particularly fruitful during the early stages of the project, allowing the construction of the rail terminal to be completed within schedule, which was necessary to qualify for federal funding.

The key to a successful brownfield project is the dedicated cooperation among all the parties involved. As the Atlantic City example demonstrates, a remedial action approach can be successfully integrated with construction requirements to expedite the process and bring about a cost-effective commercial development.

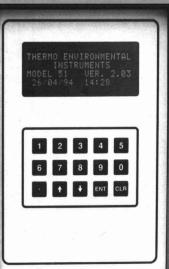
Vern Singh, PE, is senior vice president with URS Greiner Inc., and Thomas Boyd is project director with the Atlantic County Improvement Authority.

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PRODUCT STEWARDSHIP: A NEW MINDSET

Part Two of a two-part series outlines how responsible product management can increase corporate earnings and cut costs

By Gregory G. Bond, PhD

roduct stewardship is an important discipline for any corporation that faces issues relating to the environment, health and safety. And as we noted in our previous article, product stewardship must be a mindset which colors everything we do (see "Product Stewardship: A New Mindset, Part I: Managing EH&S Issues in the February issue of EP). For a product stewardship program to work effectively, however, the company's business groups must take ownership of the environmental, health and safety goals and processes and integrate them into their business strategy.

A number of tools can be used to assist the line managers of each business and encourage them to develop strategies within the EH&S mindset. Chief among these are core issue analysis, life cycle analysis and full cost accounting. These can all be sold to businesses on the basis of the value they contribute.

Tools for Integrating Product Stewardship

Core issue analysis is a process in which a business evaluates the vulnerabilities in its products and processes—what might be called the gaps between public expectation and the actualities of performance. This procedure leads to the identification of the top three to four issues.

Once these issues are identified, a series of scenarios are developed around them: a best case, a worst case and a "base case" or most likely scenario. The financial impact of each scenario is then estimated, as a guide to determining what resources are needed for managing the issues and how they should be deployed. The resulting decisions then become part of the business' strategic thinking. And since members of the business have worked through the process, the business takes ownership of the resulting strategies.

Life cycle analysis (LCA) is a crucial tool for developing continuous improvement. It consists of three components: life cycle inventory, life cycle impact analysis and life cycle improvement analysis.

Life cycle inventory, the first step in the LCA process, is often mistaken for the whole analysis. Although this involves a thorough and time-consuming inventory of all impacts of a product or

Only by recognizing the value of the process can we get away from using product stewardship as a mere reaction to regulatory pressures, and instead integrate it into strategy.

process on the human and natural environment throughout its life cycle, it is only the beginning of the total process.

Life cycle impact analysis, the second component, picks up where the inventory leaves off. It is involved with measuring the product's or process' impact on the environment and public health. The third step, life cycle improvement analysis, then analyzes the changes which must be introduced into the product's or process' sourcing, production, trans-

portation, handling and disposal, as a result of the first two steps of LCA. A business group that has gone through this total process is well on the way to integrating EH&S into its business strategy.

Full-cost accounting holds great promise for the future, but is not yet adequately developed. It includes several mechanisms to measure and incorporate all direct and indirect costs into the cost of a product, including those associated with EH&S considerations. The longterm goal of this discipline is to make sure all costs are traceable in the product price.

Value of Product Stewardship to the Business

If product stewardship is to be sold to a corporation's businesses, it must be on the basis of the value it contributes. Only by recognizing the value of the process can we get away from using product stewardship as a mere reaction to regulatory pressures, and instead integrate it into strategy. It is not always easy to measure the value of product stewardship, but some specific results can be identified.

To begin with, product stewardship adds value to corporate management and marketing by both increasing revenue and decreasing costs. Revenue is increased through:

- · Satisfying the customer's needs for a safe product and for assistance in safe handling, use and disposal. Increased customer satisfaction can lead to increased market share.
- The development of newer products and processes with less harmful impact on human health and the environment, through introducing EH&S considerations at the development stage.
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Product Stewardship: A New Mindset

sary regulatory approvals more quickly, thus allowing sales to occur sooner than they might have otherwise.

Costs are decreased through:

- Reduced cost of compliance through working with regulators to develop more realistic, science-based regulations, and to bring greater recognition of industry's voluntary improvements.
- Ensuring regulatory compliance. Product stewardship helps both the producer and the customer to comply with regulations, thus avoiding civil and criminal penalties.
- Sharing costs of developing product safety data and procedures with competitors through working in trade associations.

- Minimizing costly environmental and health impacts associated with the use of the products. This can also provide the product with a real sales incentive.
- Reducing product liability costs through minimizing potential injuries and illnesses associated with product use.
- Minimizing the cost of defense in liability cases. When liability cases come to trial, we have found that juries are often favorably impressed when they learn that we have a person responsible for the safety of a particular product.
- Promoting trust in industry, including greater confidence in the chemical processing industry and other producer industries on the part of customers and the public.

Product Stewardship and the Customer

The transfer of product stewardship information to the customer is an important element in any EH&S program. Dow's product stewardship program for the chlorinated solvents is a good example.

The chlorinated solvents, methylene chloride, perchloroethylene and trichloroethylene, are used in a variety of industries for both cleaning processes and product formulation. Regulations governing exposure, emissions and disposal are stringent, so users of these products must be fully informed of safety and waste minimization procedures. Dow provides customers with a library of helpful literature. Among the available information is:

- A product stewardship manual detailing safe handling and disposal procedures, as well as physical and chemical data on the products.
- An illustrated safety brochure for operating personnel, "How to Get Along with Solvents," and a safe handling wall poster for the plant. The brochure is available in both English and Spanish, while the poster uses pictograms to aid comprehension across language barriers.
 - · A waste reduction kit containing literature on waste reduction and minimization.
- A vapor degreasing kit containing literature on economical and efficient vapor degreasing methods, as well as procedures for converting surface cleaning lines to chlorinated solvents.
- A chlorinated solvents newsletter for both direct customers and customers of distributors. This contains information on federal and state regulations as well as tutorial articles on safe and responsible use of the solvents.
- The development of a closed-loop system for both delivery of solvent to the customer's
 equipment and the removal of waste solvent for disposal/recycle. A special vapor return capability permits solvent transfer with virtually no emission of vapors to the atmosphere.

In addition, workplace vapor monitoring badges are available to customers, as well as test kits to measure the quality of the inhibitors in the solvents. Dow's Technical Service and Development (TS&D) personnel are also available to advise customers and help them comply with regulations.

For customers using perchloroethylene for dry cleaning, even more specific information is offered. This is particularly useful, since most dry-cleaning facilities are small businesses with no plant safety specialists on staff. Dry-cleaning customers receive a safe handing manual, in both English and Korean versions, a safety wall poster (also available in Korean) and a newsletter containing regulatory information and tips on environmentally responsible procedures. In addition, safe handling videos, produced by Dow, are available through the solvent distributor.

To provide safer and more environmentally responsible delivery of perchloroethylene, Dow, in conjunction with a major equipment manufacturer, has also developed a closed-loop delivery system which uses small volume returnable containers. This system is already being used by a number of Dow's dry-cleaning distributors.

Value Through Global Capabilities

A global product stewardship program adds value on a worldwide scale. This has proved itself in practice at Dow, where businesses have become global and we have aligned product stewardship with this new organization. Many of our major customers have also become or are becoming multinational, and want us to supply them internationally. Through our global EH&S capability, we can help them expand on the world market by sharing our knowledge about EH&S challenges, regulations and legislation in other areas of the world. To obtain value on a global scale:

- We standardized product stewardship practices to avoid a "double standard."
- We are able to identify the specifically global issues and manage them as such, since some EH&S issues are global while others are local.
- · We are able to leverage North American and European resources and technology to benefit developing countries.

· We can coordinate EH&S testing internationally to better manage costs.

· We are developing a multinational system for new chemical inventory registration (i.e., Toxic Substance Control Act, EINECS, CEPA, etc.). This is important for introducing products into new markets, and for obtaining a "license to sell" by getting products on country inventories.

These examples show that product stewardship is not only good for health and the environment-it is also good for business. There is no need for EH&S professionals to apologize for any costs involved in product stewardship; in most cases they are amply repaid. Value, however, results from viewing the world and your business with the product stewardship mindset.

However, it is necessary for managers throughout the entire product value chain to adopt product stewardship quickly as a voluntary program, if they have not already done so. Already, some governments are looking at mandatory "extended producer responsibility." Such mandates are rarely as effective as voluntary industry initiatives, which allow greater innovations and flexibility.

Gregory G. Bond, PhD, is the corporate director of product responsibility at The Dow Chemical Co., Midland, Mich.

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CONTROLLING TETRAETHYL LEAD **EMISSIONS DURING** REMEDIATION

One New Jersey cleanup project cost-effectively eliminated organic lead emissions by using enclosures and air treatment systems

By Brian Ambrose, CHMM, William J. Barnes and Mary L. Glowacki, CHMM

he control of air emissions at remediation sites is a problem that has plagued the industry for years. Traditional engineering controls have had limited degrees of success. Thus, controlling organic lead emissions from the remediation of a 1.5-mile former process waste ditch system (PWDS) in New Jersey posed a real engineering challenge.

Tetraethyl lead (TEL), an organometallic compound, is a colorless, poisonous, oily liquid having a pleasant odor. Its major hazard is the poisonous nature

of its liquid or vapor when ingested, inhaled or absorbed through the skin. Exposure can cause both acute and chronic poisoning, affecting both the central nervous system and reproductive systems. TEL has an immediately dangerous to life and health (IDLH) value of 40 milligram per cubic meter (mg/m³) and a lower explosive limit (LEL) of 1.8 percent. TEL concentrations in the subsoils were in excess of 100,000 parts per million (ppm), so reaching IDLH and/or LEL conditions were likely. To minimize

potential adverse impact to workers during remediation, it was imperative that emissions be controlled to limit worker exposure and eliminate the migration of contamination from the work area.

The wood-lined ditch was used for approximately 20 years to convey wastewater generated during the production of organic lead, a motor fuel additive, from the process area to a settling basin. When the production facility closed in 1991, the TEL-rich sludge was recovered and processed through a lead pretreatment facility. The remaining subsoils in the PWDS required remediation.



After evaluating several treatment technologies, the project team chose stabilization as the remedial option for the impacted soils in the ditch. Contaminated subsoils to an average depth of 5 feet remaining in the PWDS had to be mixed with 25 percent Type I Portland cement and 5 percent activated carbon. This stabilization was performed to both reduce leachate and increase the geotechnical characteristics of the subsoil, which enabled the material to be placed in an existing hazardous waste management unit on the facility.

Based on the remediation technology selected, controlling emissions using vapor suppression foam and clean cover systems were ruled out. Foam has a limited life



after application and must remain in a static state in order to provide a vapor barrier, and clean fill would increase the total waste volume. The limitations of these controls were recognized as both costly and impractical for this application.

For this reason, the project team chose a technology used throughout the asbestos industry, the use of enclosures. It was selected based on costs and the ability to meet the emissions criteria. This technology required enclosing the work area and ventilating the air through carbon adsorbers.

modular vinyl enclosure system connected to high flow carbon absorption units were selected.

System Description

Two separate enclosures were required to meet the needs of the project. The enclosures selected measured 20 feet by 30 feet or 16 feet by 30 feet, depending on available space. The enclosures were constructed with 16-ounce weight fire-resistant vinyl stretched across galvanized tube frames. At each end of the enclosure, slotted doors allowed personnel

ed to the air inlets on each carbon unit. The pneumatic blowers were then connected to the enclosures using 18-inch-diameter flexible vent hose. To ensure the efficiency of the air system, anemometer testing was conducted daily to document air velocity and volume.

Remediation Activities

The approved stabilization method required the addition of predetermined amounts of carbon and Portland cement to the subsoils. The mixing process and excavation of the stabilized material were



Critical design concerns included the ability to capture all emissions, control ambient organic lead concentrations within the enclosure, effectively treat emissions and provide adequate working space. The selected enclosures would have to be fire resistant, due to the low flashpoint of TEL, and portable enough to be moved along the PWDS in an active chemical manufacturing facility. Also, the enclosures needed to be configured around existing obstructions, but large enough to allow a small excavator and several personnel to work safely inside. Based on these concerns, a

and equipment to move in and out freely. The enclosures were placed one behind the other, and as work was completed in one enclosure, it was dismantled and reassembled on the other side of the remaining enclosure.

A ventilation system capable of maintaining a minimum flow rate of 3,300 cubic feet per minute (CFM) was required to capture and treat emissions within the enclosure. The ventilation system consisted of two 6-ton granular activated carbon units. The units were loaded on "low-boy" trailers for ease of movement. Two pneumatic blowers were mechanically connect-

performed using a compact tracked excavator. The stabilized material was allowed to reach minimum compressive strength prior to removal from the PWDS.

Prior to full-scale operations, a pilot study area was selected where TEL concentrations were representative of the rest of the PWDS. This would allow careful review of the systems' ability to capture and treat emissions. The pilot study began in August when ambient temperatures would have the greatest effect on volatile emissions. The project team theorized that TEL levels inside the enclosure would be proportional to

Controlling Tetraethyl Lead Emissions During Remediation

the amount of material disturbed. Based on this, a surface area limit of 50 square feet of material was stabilized, excavated and packaged at any one time. The team also focused on a tightly sealed enclosure maintaining a slightly negative pressure.

The excavation and disposal of the stabilized material were also critical in the emissions control process. The use of woven, polypropylene bags with 6mil polyethylene liners allowed the stabilized material to be packaged and sealed inside the enclosure. The bags proved strong enough to handle the weight of the material and were configured to allow the use of mechanical materials handling equipment. This capability allowed the use of a telescoping boom forklift to shuttle bags in and out of the enclosure without compromising the pressure within the enclosure. Because the bags were sealed at the point of origin, the off-gassing of TEL during the transportation, placement and final disposition of the material was essentially eliminated.

Air Sampling Program

The air sampling program was designed to quantify TEL concentrations both inside and outside the enclosure. The National Institute for Occupational Safety and Health (NIOSH) Method 2533 was selected for the collection and analysis procedure. Samples were collected when activities involved disturbance of the PWDS subsoils. Inside the enclosure, the project team collected two area samples and one personal sample. Personal samples were placed on the employee with the greatest exposure potential, usually the excavator operator. Area samples were set up in fixed locations at heights equivalent to the workers' breathing zone. Outside the enclosure, one upwind and three downwind samples were collected to determine the effectiveness of the enclosure. Additionally, one personal sample was collected on the employee outside the enclosure with the greatest exposure potential.

Evaluation Criteria

The project team evaluated sample results based on the location of the col-

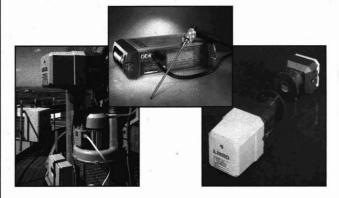
lection. Samples outside the enclosure were not to exceed the permissible exposure limit (PEL) of 0.075 mg/m³. Samples inside the enclosure were not to exceed half the IDLH value or 20 mg/m³. Combustible gas readings were not to exceed 0 percent LEL at any time. The operation was immediately ceased as action levels were exceeded, until further operational or engineering controls were instituted.

Initial sample results ranged from 0.003 mg/m3 to 0.01 mg/m3 outside the enclosures, demonstrating that emissions were effectively controlled below the PEL. Inside enclosure measurements ranged between 0.2 mg/m3 and 2.0 mg/m3. As the project progressed to full scale, areas of high TEL concentrations in subsoil were encountered. Sample results outside the enclosures remained constant: however, inside the enclosure results began exceeding the action level. Operations were discontinued for three days and an additional carbon unit was added to increase air flow. Additionally, exhaust

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Controlling Tetraethyl Lead Emissions During Remediation

ducting that was connected directly to the enclosures' vinyl cover was moved inside, physically closer to activities.

Personal Protective Equipment

Personal protective equipment (PPE) levels were established based on the tasks to be conducted. Stabilization and excavation activities inside the enclosure system required full-face supplied air respirators (positive pressure/pressure demand) with a 5-minute escape bottle. Saranex® fully encapsulated seamless suits with nitrile gloves and butyl overboots provided dermal protection. Employees were equipped with cool jackets that circulated compressed air through tygon tubing. This circulation created evaporative cooling, reducing the risk of heat stress. The compressed air also pro-

Critical design concerns included the ability to capture all emissions, control ambient organic lead concentrations within the enclosure. effectively treat emissions and provide adequate working space.

vided a positive pressure inside the Saranex suit, further eliminating the potential for TEL absorption.

Support activities outside the enclosure required a full-face air-purifying respirator with organic vapor/acid gas/high efficiency particulate air (HEPA) cartridges. Saranex suits with elastic hoods, wrists and ankles taped to nitrile gloves and butyl over-boots provided dermal protection. Ice vests were worn, and work rest regimens were established to reduce heat related problems. An exclusion zone was established to delineate the areas where PPE was required.

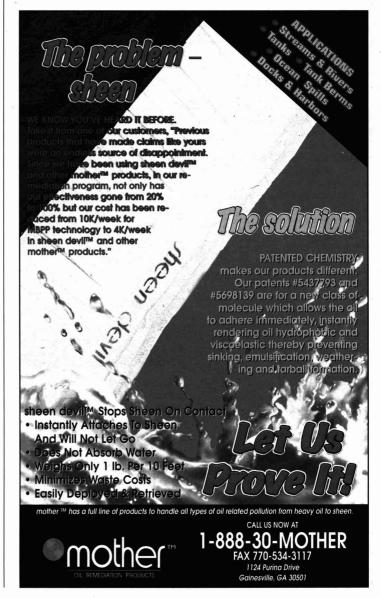
The project extended over an 8month period with an average crew size of 30 men and amassed 32,000 safe man-hours. A total of 3,621 lineal feet of PWDS were remediated, resulting in 42,000 cubic yards of material. The total project cost approximately \$3 million.

The PWDS was remediated and closed in a cost-effective (less than 5 percent cost over-run) manner. The enclosure and air treatment systems were a tremendous success. Their flexibility and durability survived many reconstructions, uneven terrain and severe weather conditions with limited maintenance costs. Air emissions were successfully captured and treated, protecting workers and preventing emissions from migrating to surrounding plant areas.

Brian Ambrose, CHMM, is a senior health and safety specialist; William I. Barnes is a project health and safety specialist; and Mary L. Glowacki, CHMM, is a regional safety manager with DuPont Corporate Remediation Group in Wilmington, Del.

The authors would like to thank Lucian J. Janik, environmental engineer, Andrew T. Meloy, project manager, and A. Dwight Bedsole, business team leader, for their technical and editorial contributions.

For more information, circle 281 on card.



HORIZONTAL WELLS ACCESS JET FUEL CONTAMINATION

Remediation project uses horizontal wells at New York's JFK Airport to clean up spilled jet fuel

By Jeff Griffin

leaning up underground soil and groundwater contamination can be complicated by what has been built on the surface and activities occurring above contaminated areas.

Contamination plumes are often under paved areas such as driveways to businesses, parking and service areas, and beneath buildings, streets and other areas where large excavations and their subsequent repair can be as expensive—or even more costly—than the remediation itself.

Technology using horizontal wells for soil and groundwater, especially *in situ* methods, is attracting attention in environmental circles.

For many situations, environmental engineers are finding that horizontal wells offer advantages over other methods of accessing contamination plumes. Installed with directional drills, wells can be installed under paved drives, parking areas, streets and other obstructions without disrupting activities on the surface. Because many underground contamination plumes spread horizontally rather than vertically, horizontal wells can establish greater contact with contaminated media and achieve more efficient remediation.

The same horizontal directional drilling equipment now used for installing underground power and telecommunications cable and natural gas and water pipe can place horizontal remediation wells in the ground without extensive excavations or disrupting surface activities. Wells can be positioned under drives and streets while in use and can be placed directly beneath buildings and other structures.



bring to environmental cleanup operations and is broadening interest in horizontal well techniques.

tants in the United States have not used it. The largest remediation project to date using horizontal wells is under way at New York's John F. Kennedy International Airport, says Dawn Kaback, director of the Colorado Center for Environmental Management, an environmental organization that promotes horizontal well procedures and keeps records of horizontal well installations.

While there has been a steady increase in

the number of horizontal remediation wells

placed in service, the technology is still new

enough that most environmental consul-

The multi-million-dollar airport project dramatically illustrates the significant advantages horizontal wells can

Remediation at the airport was necessary to clean up underground free-product contamination caused by jet fuel spilled over time during refueling operations at gate areas. Total contamination covered less than one-half square mile below the surface. The Port Authority of New York and New Jersey, which operates JFK International, initiated the project.

More than 50 horizontal remediation wells were installed at the airport. Fortytwo were placed under paved tarmacs and aprons outside the airport's Terminal 4 (previously known as the Interna-

Photo courtesy of Baroid Industrial Drilling Products

tional Arrivals Building). Another 10 were installed at Terminal 2. Well placement was completed in April 1996.

After the wells were installed, they were connected to remediation equipment that treats contaminants in situ. Remediation will be accomplished by soil vapor extraction, air sparging and bioremediation procedures.

Terra Vac, of Houston, Texas, was part of a joint venture with the general contractor for installing the remediation system at Terminal 4. Under contract with Terra Vac, Michels Environmental Services, of Brownsville, Wis., installed 30 wells. Terra Vac crews installed the additional wells and were responsible for well completion. Fluor Daniel GTI Inc., of Norwood, Mass., had a separate contract for the work at Terminal 2. A&L Underground Inc., of Greer, S.C., placed 10 wells for Fluor Daniel GTI.

The key factor in the Port Authority's decision to use horizontal wells was that airport operations could continue during construction. If horizontal wells had not been used, options were to excavate contaminated soils, which would require digging through the paved tarmac, or drilling numerous vertical wells and digging trenches for piping necessary to connect wells to remediation equipment.

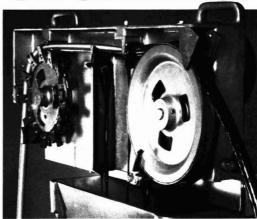
"Either procedure would have effectively shut down operations of Terminal 4," said Frank Zitkovic, Terra Vac's drilling superintendent, "and that was unacceptable.

The need for fewer wells and related piping reduced construction costs. In addition, the horizontal wells also will achieve more-efficient remediation, because they provide maximum screen exposure to contaminated areas. Each horizontal well influences the full plume length, whereas a vertical well affects a much smaller area.

Tim McGuire, Michels Environmental Services project manager, added that the anticipated efficiencies of the remediation process, along with lower operational and maintenance costs, will reduce expenses during the life of the project.

Four directional drilling machines were used to install the wells. All were relatively small and required little space for setup and operation. To install a well, a pilot bore enters the surface at an angle and proceeds downward until reaching the necessary depth. The bore's path is leveled and guided to a designated exit point. Drill head depth and location are monitored by a crew member using electronic tracking equipment, which also

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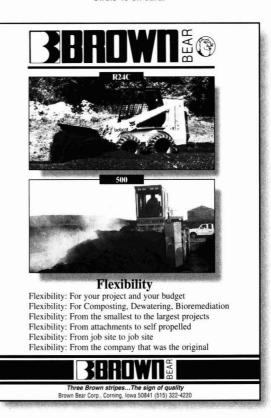
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Horizontal Wells Access Jet Fuel Contamination

provides information necessary for making steering adjustments. Sections of drill pipe are added as the bore progresses.

After the drill head is brought to the surface, a backreamer and well screen (pipe containing slots) are attached to the drill string and the length of screen is pulled back through the pilot bore. Drill pipe is removed as the screen is brought back toward the starting point of the

bore. Drilling fluid is used both while making the initial bore and for pulling back sections of screen (See sidebar).

Zitkovic said that bore lengths ranged from 300 to 700 feet. Screen lengths varied from 70 to 500 feet (riser is attached to each length of screen). The depth of soil vapor extraction wells was from 2 to 4 feet and air sparging wells were placed at depths from 10 to 12 feet. Screen was

Drilling Fluid

Drilling fluid is one of the most important elements in horizontal directional drilling operations. In fact, some experienced drill operators consider fluid as much a downhole tool as a bit or a backreamer.

Correct mixing and using the right drilling fluid for soil conditions is an important factor in any directional boring project—both for making the pilot bore and for pulling back material being installed. Fluid cools the bit, displaces cuttings and maintains the integrity of the bore hole. During installation, fluid maintains the walls of the bore and lubricates the material being pulled through the hole. Experienced drillers recognize that drilling fluid often determines the job's success or failure.

Fluids commonly used in directional drilling to make utility installations often are not suitable for environmental work because they can damage the formation and clog slots in the screen. Sodium bentonite, widely used for underground utility applications, was not acceptable for remediation work at John F. Kennedy International Airport.

For wells at JFK, one vital function of drilling fluid was stabilizing bore holes in highly-unstable sandy soil conditions. It had to accomplish this without reducing porosity or permeability of surrounding soils or clogging slots in well screen. Otherwise, remediation would be affected adversely.

The drilling fluid chosen for the JFK project was Baroid Bio-Bore, a proprietary blend of polymers developed by Baroid Industrial Drilling Products specifically to meet the environmental market's unique needs.

JFK contractor Michels Environmental Services began using the new product in mid-1995 as it was being developed, said Tim McGuire, Michels project manager. "Several organic, biodegradable drilling fluid products were previously tested and used by Michels in an effort to reduce drilling-related formation damage while installing horizontal wells," said McGuire. "However, none provided the properties that are critical to successful completion of directional-drilled horizontal wells, including a rapid high-yield point and consistent gel strength with optimal fluid loss control."

McGuire said while it is possible to achieve similar fluid properties with a mixture of conventional gel products, the initial solids content introduces unwanted solids into the formation as drilling continues. This increases the potential for inadvertent porespace blockage and subsequent reduction in formation permeability around the bore hole and well screen.

"Since Bio-Bore offers the desired directional drilling fluid properties without initial solids content, along with biodegradability and ease of mixing, it is the ideal product for this type application for both the driller and the owner." McGuire said

The polymer additive is soluble in water and disperses easily with moderate shear. It is compatible with a wide range of make-up waters. Mixed with fresh water, it produces a clay-free, biodegradable drilling fluid ideally suited for use in environmentally sensitive areas. Following well installation, fluid viscosity can be chemically broken or the solution can degrade naturally into nonhazardous substances. Time required for natural degradation varies with soil conditions and temperatures.

Michels proposed that the additive be used at JFK, and its effectiveness was proven during field tests at the airport in October 1995. Following those tests, Terra Vac and A&L began using the product for their drilling operations.

For more information on Bio-Bore, circle 198 on card.



4½-inch diameter HDPE (high density polyethylene) with 0.020 slots spaced between ¼ and 1¼ inches, depending on each well design.

Drillers encountered varying soil conditions. The airport is built on highly abrasive hydraulic fill-sand pumped from Jamaica Bay prior to airport construction. "There were 18 inches of steel-reinforced concrete on top," said Phil Kendig, division manager for A&L Underground. "Under the concrete was compacted and very abrasive sand to depths of 5 feet. Under that was loose sand from 5 to 11 feet. Below 11 feet, there was peat."

Kindig said that wells at Terminal 2 were

from 405 to 710 feet in length. Total footage was 5,400 feet. Average screen length was 440 feet containing various slot sizes.

"The size of the plume, surface condition, and the fact that construction did not alter airline operations contributed to the cost-effectiveness of using horizontal wells," he added.

Work at JFK involved situations crews had not encountered previously and the area had greater activity than normally encountered. Twenty-five airlines continued regular flight schedules during construction. Aircraft, baggage carriers, fuel trucks and other vehicles crowded confined construction areas. Close communication and cooperation were required among Port Authority staff, drilling crews, well development workers and construction contractor personnel.

"This project," said Zitkovic, "gives horizontal drilling technology a fair chance to prove itself on a large-scale remediation project."

Jeff Griffin is a contributing author based in Oklahoma City, Okla.

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WASTE MANAGEMENT IN THE AGE OF ELECTRONIC COMMERCE

Waste generators and waste management companies can enhance services and operations through electronic commerce

By Eliot Cooper and Janet Gellici

ou've probably used the Internet to send an e-mail to a friend or to search for information on discounted airfares or a good restaurant. Maybe you've even ordered golf clubs on-line or checked out the homepage of your favorite musical group.

The Internet has become more than just a leisure-time activity, and is an integral part of doing business for many professionals. In fact, the World Wide Web is now providing opportunities for waste generators and waste management companies

to enhance their services and operations.

Colorado-based TSDX Corporation operates a one-stop business site on the Web—TSD Central® (http://www.tsdcentral.com) —for the industrial waste industry. TSD Central focuses on business-to-business commerce needs, ranging from purchasing and evaluating waste management services, to selecting innovative cleanup technology, to selling residual and surplus materials, to supplying information on employment opportunities, recent industry developments and regulatory updates.

The Electronic Marketplace

TSDX Corporation's primary service is the TSD Central Industrial Waste Management Network, which allows waste generators to electronically search for vendors and request competitive quotes for waste disposal and support services. The system was designed to simplify and streamline the purchase of treatment, storage and disposal facility (TSDF) services, which has traditionally been characterized as an expensive, slow and confusing process.

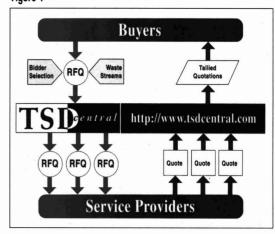
The industrial waste market in the United States today is represented by about 200,000 companies, spending more than \$10 billion a year on environmental products and services provided by over 4,000 vendors. TSD Central's \$1.5 billion network of the nation's leading hazardous and special waste management companies, benefits both buyers and sellers.

Waste generators can access information on prospective vendors and electronically submit requests for quotations (RFQs) in a standardized format, ensuring receipt of timely and competitive service bids (See Figure 1). The TSD Central service is free to waste generators, who also benefit from the cost savings

resulting from direct-to-vendor bidding process. TSD Central is not a broker; the company provides buyers with quotations directly from the service providers.

TSD Central-participating vendors, in turn, are provided with new ways to sell underutilized disposal or technology capacity. The fee-based membership includes a listing on the TSD Central network, a hyperlink to the vendor's Web sites and the opportunity to participate in the competitive bid-

Figure 1



ding process for waste management services. Industrial waste service providers pay for the cost of implementing the TSD Central system.

How It Works

After logging on and registering at the TSD Central Web site, waste generators can immediately participate in the RFQ process. The first step involves completing a Waste Stream Characterization form (ten wastes per RFQ), which requires input on the type and volume of waste.

This data is then attached to an RFQ form that details information on deadlines and preferred vendors, as well as appropriate logistical information. Waste generators have the opportunity to search for TSD Central-listed vendors on the basis of market reach, waste category and/or desired service option. Hyperlinks to vendor Web sites can help buyers secure answers to questions they may have regarding prospective service providers' capabilities.

Generators then submit their RFQs to TSD Central's network for distribution to buyer-selected vendors. Bids are returned to TSD Central within the deadlines specified on the RFQ, where they are then assembled and tabulated to provide the buyer with a line item-by-line item competitive analysis (See Figure 2).

By providing a wide range of competitive options directly from vendors and securing standardized quotations based on standardized RFQs, TSD Central helps cut costs associated with the traditional purchasing process.

In addition to TSDFs, the TSDX network also provides access to transporters, technology companies, remediation contractors, equipment manufacturers and other industry service providers. If a service provider is not currently participating in TSD Central, TSDX will, at the buyer's request, contact them to provide additional competitive options.

The Evaluation Component

Recognizing that the selection of a TSDF involves careful evaluation of that company's operations, TSD Central also provides for quick and easy access to audit reports on waste management facilities located in the United States and Canada. The Web site's Audit Center features a comprehensive list of audit reports, along with pricing information and a convenient method for ordering.

Working with the National Environmental Management Institute (NEMI), CHWMEG Inc. and e date resources inc. (EDR), TSD Central currently offers more than 600 Site Audit and TSD Facility Information Reports. Reports are available for \$495 to \$3,000 and benefit both waste generators and waste management facilities. Generators save time and money associated with conducting their own audits; TSD facilities achieve savings through the elimination of redundant audits. See Environmental Audits Catalogged Online for more detailed information on the TSD Central Audit Center.

Other Services

In addition to its Electronic Marketplace and Audit Center, TSD Central offers a number of other commercial services, including a Residual Materials Exchange, Surplus Materials Catalog, Employment Center and Bookstore.

The Web site provides a clearinghouse for buyers and sellers of residual and surplus materials, including off-spec, used or virgin, chemicals, raw materials and other products. The Residual Materials Exchange and Surplus Materials Catalog offer cost-saving opportunities for buyers and sellers.

Raw material buyers can obtain information on available surplus materials or post requests for information on materials such as acids, alkalis, oils and waxes, solvents, organic/inorganic chemicals, plastics/rubbers and metals/metal sludges. Those with residual or excess materials can turn disposal costs into profits. Sellers can either list their materials "for sale" or check the posts of prospective buyers.

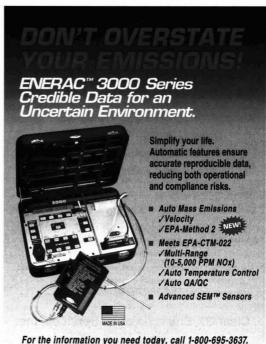


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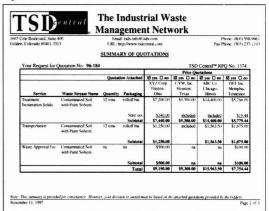
Waste Management in the Age of Electronic Commerce

Site visitors can also purchase an environmental book, industry publication or subscription service through TSD Central. And visitors can either look for jobs or post job openings online through the site's Employment Center.

In addition to its commercial services, TSD Central also serves as a resource for varied information on the industrial waste industry. Users can obtain information on business opportunities in the environmental management industry, innovative and best-cost technology options and industry associations and publications.

Daily news articles, Web resources and featured guest columns round out the sites information sources. Of particular interest is the latest TSD Central link to Resource Conservation

Figure 2



and Recover Act (RCRA) Training Modules, which provides direct access to guidance documents used by EPA counselors in interpreting complex RCRA regulations.

TSDX Corporation has provided the means for those in the industrial waste industry to enter the electronic age, quickly, easily and beneficially.

Eliot Cooper is President of TSDX Corporation. Janet Gellici is a contributing writer to Environmental Protection.

For more information on TSD Central, circle 199 on card.

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60 Circle 52 on card. March 1998

Surviving a Government Inspection

A game plan on what to do when government inspectors come knocking at your door

ederal, state and local governments routinely inspect all types of facilities under various environmental statutes. Inspections are prompted by agency compliance monitoring programs, citizen or employee complaints, administrative plans of enforcement, accidents or publicity. A lone inspector may perform a routine inspection or a "SWAT team" of specialists may conduct a "multimedia" inspection to ferret out criminal conduct.

Governmental enforcement activities are a fact

of life for the business community. Companies must prepare for unannounced and close scrutiny of their operations. How a company handles an inspection may be directly related to what sort of enforcement action is taken.

Inspections provide an opportunity to develop a rapport with the agency representatives and gain insights into economical

pre-enforcement compliance. A relationship based on professionalism and courtesy is a company's first inspection response strategy, but pre-inspection preparation is necessary to accomplish this goal.

Inspection Authority

The provisions of environmental statutes authorizing inspections by the U.S. Environmental Protection Agency and state governments differ significantly. Because of such differences, a company must review the applicable statute to determine what inspection authority may be exercised in a particular circumstance.

How a company handles

what sort of enforcement

an inspection may

action is taken.

be directly related to

Search Warrants

Although EPA is authorized to inspect facilities to enforce environmental statutes, that power is subject to certain Fourth Amendment constraints, including the requirement to obtain a search warrant.

Federal environmental inspections do not require the presence of criminal "probable cause." Instead, only "administrative" probable cause is required; therefore, there need only be an inspection program supported by "reasonable legislative or administrative standards" or specific evidence of an existing violation. Administrative probable cause may be based on an employee complaint, a citizen complaint, prior inspections of a facility, reports submitted by the facility or simply a regulatory program that identifies likely targets for inspection.

A warrant is not necessary if any competent management official gives consent. Consent does not need to be stated verbally and can be implied by nonverbal actions. In fact, the failure to object to a search may constitute consent. The failure to warn the company of its right to request a warrant does not render the consent unknowing or involuntary.

Consent may be limited to specific areas of the facility and may be revoked during an inspection. No warrant is necessary if the condition is visible from an area open to the public, i.e. in "plain view," or where the business is "pervasively regulated."

EPA can obtain a warrant easily. Requesting a search warrant will normally only delay the entry into the site for as little as several hours. While denying access provides a window of opportunity to correct problems, it may lead to a higher level of scrutiny when the inspection occurs.

An inspection under warrant proceeds according to the terms of the warrant that may be very broad or vague. If access is permitted, the facility may, through discussions with the inspector, be able to limit the inspection and what documents are produced.

Inspections

The first step in any inspection preparation program is to designate those individuals who will respond to the inspection. These individuals may be personnel with continuing responsibility for compliance, but there may be reasons not to assign the front-line compliance personnel to an inspection. Whatever its composition, the inspection response group should be kept small.

The company also must establish certain standard procedures that apply when an inspector ar-

R. Henry Moore, JD, and Heather A. Wyman, JD, are attorneys with the environmental law group of the law firm of Buchanan Ingersoll in Pittsburgh, Pa. Stephen G. Allen, JD, is with the firm's Lexington,

Ky., office.

rives at the site. These standard procedures should include the following steps:

- · Assure that appropriate personnel are notified;
- Assure that the inspector is accompanied; and
- · Determine the procedures to follow during inspections.

The planning process also should involve selection of legal counsel to assist in an inspection, although it is usually not preferable to have the company's lawyer participate in inspections.

Scope Of Inspections

Inspections should be limited to the locations, equipment and information that have a direct relationship to the regulated equipment or process. If advance notice is given, a request should be made that the inspector specify the scope of the inspection in writing. In the absence of advance notice, the inspector should be asked to explain the nature and scope of the inspection, which records he or she wishes to review, whether cameras or tape recorders will be used and whether samples will be taken. If a warrant is presented, it should be read to determine the scope of the inspection.

The Walk-Around

The company's inspection response group should accompany the inspector at all times. One person should be assigned to take detailed notes describing what the inspector saw, remarked, asked, which employees were interviewed and the inspector's visible reactions.

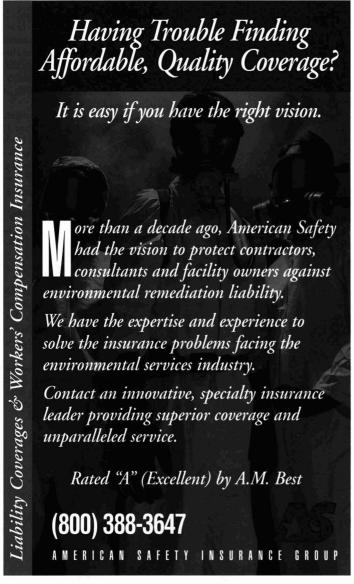
It is of vital importance in defending against enforcement actions to know exactly what happened during the inspection. The inspector will document the inspection and be able to later reconstruct the inspection. The company should prepare to rebut any allegations with detailed and clear

Requesting a search warrant will normally only delay the entry into the site for as little as several hours. While denying access provides a window of opportunity to correct problems, it may lead to a higher level of scrutiny when the inspection occurs.

testimony to the contrary. If notes are taken, a copy should not be given to the inspector.

Although the company may use other techniques of documenting the inspection, such as recording a running commentary on audiotape or with videotape, the inspector may construe this as obstructing the inspection.

While the inspection will be limited to the areas identified in the warrant or to the areas consented to by the company, the company's inspection response group should avoid making overly technical objections to an inspector viewing a particular area. The company may terminate a voluntary inspection at any time, although any



information obtained to that point can be used against the company.

The inspector must take "reasonable precautions" not to cause any hazard and must obey all of the employer's safety and health rules.

The inspection response group must be careful about what they say to the inspector. While making a good impression is important, probably the best approach for the inspection response group to take is one of firm, and somewhat restrained, politeness. Misrepresenting facts or lying to the inspector is a federal criminal offense.

Photographs

Typically, inspectors take photographs of the facility and the site. The company should either take the same photographs as the inspector or request copies of the inspector's photographs, although the inspector is under no legal obligation to provide such copies. The inspection response team should be responsible for having the proper photography equipment readily available.

Samples

Often, inspectors will take samples. It is in the company's best interests to ask for a split sample if the sample is one that permits it. In fact, the Resource Conservation Recovery Act (RCRA) and the

> It is of vital importance in defending against enforcement actions to know exactly what happened during the inspection.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) provide an absolute right, upon request, for split samples collected by the regulatory personnel. The company should prepare for such sample

splitting by developing and following proper chain of custody procedures and using EPA-approved quality assurance/quality control (QA/QC) procedures for sample analysis.

However, if the inspector will not agree to splitting samples, the results should be requested and company sam-

ples obtained.

Because enforcement action often is based upon an inspector's samples, the company's inspection response group should record, in detail, the sampling procedure and equipment used by the inspector. Having such information is the only way to challenge the validity of the inspector's sample.

Documents

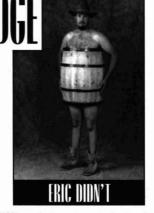
The company should:

- · Show the inspector only those documents he or she is legally entitled to see;
- · Always retain the original documents unless seized or subpoenaed; and
- · Ask that all appropriate documents be kept confidential.

An inspector is required to inform







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Surviving a Government Inspection

the company of its right to claim confidentiality and the procedures necessary to make the claim to shield information from public access. When companies fail to assert a confidentiality claim, it is waived.

Public Disclosure

The information obtained during inspections is subject to public disclosure under the federal Freedom of Information Act (FOIA).

While FOIA establishes certain ex-

emptions to public disclosure, a company must recognize that the information it provides in an inspection may be subject to public disclosure. The company's inspection response team should advise the inspector about any areas containing trade secrets.

Inspector Misconduct

In rare instances, an inspection will involve misconduct by an inspector. The remedies for such problems are not easy to accomplish. Sometimes, a firm assertion of the company's rights presented to the inspector can remedy what is perceived as misconduct. If the inspection is being conducted by consent, it can be terminated. In that event, the misconduct should be immediately brought to the attention of the inspector's supervisor in a non-confrontational manner. If the inspection is conducted pursuant to a warrant, the company can seek to quash or set aside the warrant in United States District Court.

At the conclusion of the inspection, the company should always request the inspector's findings and a copy of the inspection report. The company should

The inspection response group must be careful about what thay say to the inspector. While making a good impression is important, probably the best approach is for the inspection response group to take is one of firm, and somewhat restrained, politeness.

ask what areas of the facility concerned the inspector most. The company may ask the inspector for any recommendations for improvements at the facility. The company may not want to respond to the inspector until it has assimilated the inspector's comments and the data collected.

An inspection of a facility need not be a traumatic event. Prior planning and the exercise of care during the inspection will help minimize its impact. It is simply part of a company's overall compliance process.

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MERCURY SITE **CHARACTERIZATION**

A review of characterization protocols for mercury-impacted soils at manometer sites

By Douglas E. Birkbeck, MS and John N. Veenstra, PhD, PE

potential concern for the natural gas industry over soil remediation at former or current manometer sites appears to be on hold. The U.S. Environmental Protection Agency-proposed Hazardous Waste Identification Rule "Requirements for Management of Hazardous Contaminated Media" Federal Register, April 29, 1996, (HWIR-Media) has been taken back for reconsideration and is not scheduled for review for the next two to four years.

Currently each state dictates cleanup levels. For example, Kansas, which has been in the forefront of mercury response actions, set the action level at 2.0 parts per million (ppm) in residential and/or recreational areas for the first foot below grade and 20.0 ppm for any depth below one foot. This 20 ppm level applies for all depths for all other land use classifications.

. Under current Kansas Department of Health and Environmental (KDHE) guidelines, when mercury-impacted soils at manometer sites are identified with concentration levels greater than the KDHE action level, a Toxicity Characteristic Leaching Procedure (TCLP) analysis is required to determine if the soil is characterized as hazardous or nonhazardous. The TCLP results are compared with EPA-established guidelines. If the TCLPderived mercury concentration level exceeds 0.20 ppm (fails TCLP) and exceeds a 260 ppm total mercury concentration level the soil is classified as an EPA-listed hazardous waste D009. This waste would require treatment prior to disposal at an approved Subtitle C hazardous waste landfill. The most accepted best demonstrated available technology (BDAT)

method of treatment is roast and retort.

The roast and retort process is an expensive heating process for elemental mercury recovery that uses heat to volatilize mercury and distillation of the gaseous emissions to recover mercury in the elemental form. If mercury-impacted soils fail TCLP and are less than the

The U.S. Environmental **Protection Agency**proposed Hazardous Waste Identification Rule "Requirements for Management of Hazardous Contaminated Media" Federal Register, April 29, 1996, (HWIR-Media) has been taken back for reconsideration.

260 ppm total mercury concentration level, the impacted soil can be directly transported to a Subtitle C landfill without treatment. One alternate remedial method accepted by KDHE involves treating impacted soils that fail TCLP and have total mercury concentration levels less than 260 ppm by an onsite mobile treatment unit (MTU). Treated soils may be returned to the site when the total mercury soil concentration levels are reduced to below the KDHE action levels and pass TCLP.

Regardless of the total mercury concentration level, mercury-impacted soils can also be transported for disposal at a nonhazardous Subtitle D landfill if the representative sample does not fail TCLP. However, many pipeline companies are electing to transport mercury-impacted waste soils to Subtitle C hazardous waste landfills to limit potential future liabilities. Acceptance of waste at Subtitle D nonhazardous landfills is less restrictive than at Subtitle C hazardous waste landfills.

Through its interim agreement program and natural gas pipeline industry cooperation, the KDHE estimates between 9,000 and 10,000 current and-or former mercury manometer sites exist in Kansas. In October 1995 KDHE reported that natural gas companies have characterized 3,800 sites, 1,093 of which were contaminated with mercury above the Kansas action levels and 663 that were remediated. Prior to September 1994, the KDHE required companies to conduct total mercury and TCLP laboratory analysis for site characterization. The requirement was based on the Land Ban restrictions, set out under the Resource Conservation and Recovery Act, for mercury-contaminated soil. After that date, KDHE reviewed its earlier ruling and revised it, stating only mercury-contaminated soil that was excavated required TCLP analysis prior to landfill disposal.

Natural gas pipeline companies in Kansas have access to the statistical findings of recent TCLP analytical testing of mercury-impacted soils at current and/or

Mercury Site Characterization and Behavior of Mercury in Soil

former mercury manometer sites. If a soil sample fails TCLP and the concentration level of total mercury exceeds 260 ppm, then BDAT is required. As of August 1996, out of 1,093 soil samples analyzed for TCLP, only six failed, requiring BDAT or roast and retort prior to landfill. Soil samples have passed TCLP and exceeded the total concentration of 260 ppm.

Important in statistically evaluating TCLP results of mercury-impacted soils at manometer sites in Kansas is binding capacity of elemental mercury. The impact of elemental mercury releases in soil is specifically related to the forms of mercury present. When a mercury spill occurs, the liquid state of elemental mercury, its high density, high-surface tension and volatility largely control its immediate transport and fate.

Concentrations of mercury and its distribution in soil, surface water and/or groundwater are primarily subject to the metal's physical dissolution or adsorption properties. A soil's capacity to bind mercury depends on the interaction between

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mercury and soil constituents. Movement of elemental mercury vapor and the ionic states of mercury in soils may be hindered by the tendency of the mercury forms to bind on to natural organic matter, clays and to a lesser extent, finegrained minerals. Inorganic mercury compounds and elemental mercury are therefore subjected to more physical controls of their transport and fate.

In reducing environments low in oxygen or with no oxygen, such as waterlogged or wet soils, and with an available sulfide source, mercury may be precipitated as a sulfide. A high concentration of mercury sulfide compounds in soil will also decrease the amount organic mercury compounds transformed to the toxic organic form and decrease the leaching rate of the metal.

Mercury in native soils can have a high degree of solubility if the environment is highly oxygenated. Highly oxygenated

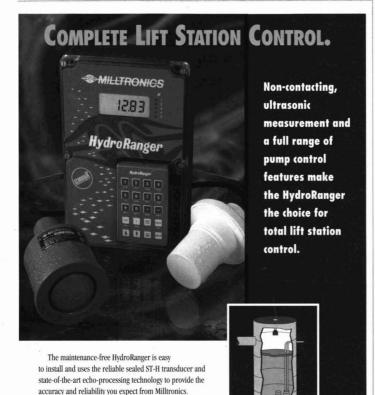
As of August 1996, out of 1,093 soil samples analyzed for TCLP, only six failed, requiring BDAT or roast and retort prior to landfill.

soil allows the ionic states of mercury to combine with hydroxyl and chloride ions. Chlorides enter the soil and water from multiple sources-such as agricultural fertilization, de-icing of roadways and naturally occurring saline or sodic soils.

The availability for the leaching of mercury into solution is very unlikely in soils with a high organic matter, clay and mineral content. Except soils with chloride concentrations and pH conditions suitable for the formation of mercury chloride compounds, the leaching of mercury into groundwater is negligible. KDHE findings and natural gas industry efforts support these conclusions.

The objective of mercury manometer site characterization of the soil is to first identify and quantify total mercury concentration levels.

To initiate characterization, a historical review of gas-measurement files comparing positive displacement manometers with orifice meters followed by a pur-



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chase order or accounting review should assist in identifying currently owned, leased and/or operated meter and regulating stations. This comparison allows the further identification of manometer locations by section, township, range and county. However, first a field survey that includes a field personnel questionnaire should be conducted to further develop an accurate listing for potential mercury manometer sites to be characterized.

Once the manometer sites are identified, the soil sampling program for manometer site characterization should be conducted by following a series of KDHE-approved procedures, including visual surveys to identify type and condition of meter houses, observations of free mercury, drainage pathways, imported fill material covering native soil, topography, land use, distance to residential or recreational areas and structural deficiencies in the building or flooring (such as cracks and evidence of vegetation growing in expansion joints).

At least three samples are required to characterize a site effectively. Locations with concrete floors, dirt or gravel floors or former locations where no physical evidence exists are three typical types of manometer sites.

Sampling of meter houses with concrete floors involves collecting a discrete sample 6 inches deep and an additional discrete sample 18 to 24 inches deep at a location perpendicular to the center of the door frame or entrance.

Sampling from a site with gravel or dirt floors requires collection of a sample the same depth beneath the location of the former manometer, as described above. A composite sample from the surface to 6 inches in depth and containing 3- to 4-point aliquots is required at a distance of 3 to 4 feet from the discrete sample.

One discrete sample should be collected from the surface to 6 inches in depth at the estimated former manometer location at sites where no structural fixtures are present, but identification of the meter is apparent. Composite samples containing 3-point aliquots should be collected from the surface to 6 inches in depth at locations 3 feet and 6 feet from the discrete sample.

Quality-control measures require a field duplicate for more than 20 samples collected and standard laboratory quality assurance/qaulity control protocols.

Development of sampling protocols and site-characterization programs similar to the KDHE guidelines would appear effective in identifying elemental mercury release conditions at manometer sites in Kansas. Since conditions for elemental mercury spills at manometer sites are unique, pipeline companies should review their site-specific conditions for determination of their characterization requirements.

Doug Birkbeck, MS, is a senior environmental engineer and geologist with Burns & McDonnell Waste Consultants Inc. in St. Louis, Mo. John N. Veenstra, PhD, PE, is a professor of civil and environmental engineering at Oklahoma State University, Stillwater, Okla.

The authors would like to thank the personnel of the Hazardous Waste Section, Kansas Department of Health and Environment for their help in providing data.

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Duke Finds That Marine Organism Retards Learning in Animals

The toxic marine organism *Pfiesteria piscicida*, which has killed millions of fish and sickened people in North Carolina and Maryland, also interferes with the learning process in rats, according to a series of studies completed at Duke University Medical Center.

The findings, which appeared in the December 1997 issue of the journal *Environmental Health Perspectives*, are the first published results of scientific

experiments showing exposure to *Pfiesteria* toxin can cause learning deficits.

In the laboratory experiments, toxins produced by the one-celled organism appear to interfere with new learning tasks, but don't impair the memory of previously learned tasks, according to Edward Levin, associate professor of psychiatry and director of the Integrated Toxicology program at Duke.

"The rats exposed to *Pfiesteria* toxin were significantly retarded in their learning," said Levin. "The effect persisted throughout the 10 weeks the ani-

mals were retested after the injection."

Pfiesteria is a type of dinoflagellate, which forms plankton, tiny marine organisms that provide food for many small marine animals. Most dinoflagellates are harmless. However, some dinoflagellates are toxic, producing powerful nerve poisons to deter fish from eating them. Pfiesteria, in contrast, uses its toxins to attack and eat fish flesh.

The researchers were prompted to begin the animal study after several scientists accidentally exposed to the organism in a research laboratory experienced a range of worrisome symptoms, including dramatic mental impairment, serious disorientation, mood swings, immune system problems and skin sores.

Since then, doctors at Duke, Johns Hopkins and the University of Maryland found that some people who had been exposed to *Pfiesteria* before or during a *Pfiesteria*-related fish kill showed evidence of neurological problems. Other people have reported burning skin and respiratory irritation, followed by problems with concentration.

In all reported cases, exposure occurred through inhalation of the toxin, with the majority of those affected working in the fishing industry.

Electrical Fields Could Clean Oil-Contaminated Soil

A pilot demonstration of a novel environmental technology that uses electrical fields to help clean soil contaminated by oil spills and other petroleumbased chemicals and hydrocarbons is underway by Electrokinetics, Inc., Baton Rouge, La., and Argonne National Laboratory, Argonne, Ill.

The technology, called electrokinetic soil processing, applies electric fields to contaminated soil to enhance the delivery of injected nutrients that help natural biological organisms degrade hydrocarbons. Researchers are conducting pilot demonstrations in the field to evaluate the enhanced bioremediation action by electrokinetics.

In the project's first phase, researchers are injecting nutrients into the soil to study their movement through different layers. These tests use layers of clean soil types with different permeabilities such as sand, silt and clayætaken from U.S. Department of Energy sites, such as the Idaho National Engineering Laboratory, Idaho Falls, Idaho, or the Westinghouse Savannah River Company Facility, Aiken, S.C.



Argonne and Electrokinetics will evaluate the data and results from these tests. If the tests are successful, funding could be made available to use electrokinetic injection for the bioremediation of contaminated soil at the same DOE sites. This one-year project was funded by DOE's Small Business Innovation Program.

3D Visualization Software to Help with **Information Overload**

Starlight, an advanced three-dimensional visualization technology, has been developed by Pacific Northwest National Laboratory in Richland, Wash., to help solve the problem of information overload in decision-making.

"Advanced data sources and rapid communication technologies generate massive collections of information rich with facts. However, such an information overload can hide critical details and subtle relationships that are integral to effectively interpreting the data," said Randy Woodson, Pacific Northwest program manager. "Starlight provides an easy-to-use interactive tool for exploring and integrating data needed for effective decision-making.

"For example, an organization like the Centers for Disease Control could use Starlight to help assess potential public health effects that may result from global warming," Woodson said. "Starlight could enable CDC analysts to search and interpret massive and diverse amounts of information on global warming trends."

The U.S. Environmental Protection Agency could also use the technology in its comparison of the compliance of Superfund sites to environmental regulations. Currently there are 1,200 designated Superfund sites in the nation and thousands of other potential sites.

"The versatility of Starlight enables users to analyze massive volumes of information contained in various media, including structured and unstructured text, maps, digital data, video and even satellite imagery," said John Risch, Pacific Northwest principal researcher. "Users can analyze both information content as well as complex interrelations among individual elements of large information collection."

Starlight, which operates on Windows NT platforms, has two functional components. The first is an information preprocessing and modeling system. This component characterizes information content, models associations

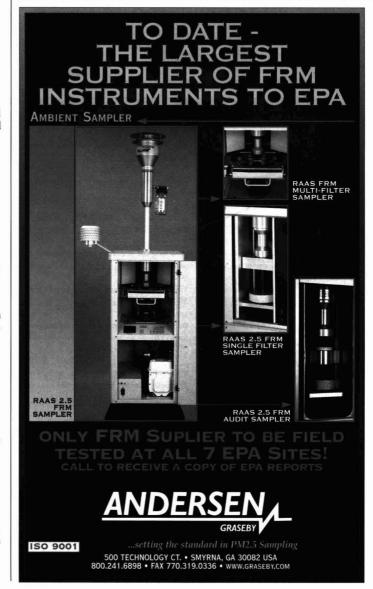
among input data elements and stores the modeled information for later retrieval and analysis.

The other component is a visualization system/user interface, which is used during exploratory analysis of the information model. Collections of information are graphically represented as sets of 3D shapes, or glyphs, distributed throughout the 3D work space.

Each glyph stands for an individual piece of information, such as a document or news-wire report. Topically related items form groupings, or clusters, providing a graphical table of contents to guide general browsing. Analysts can interactively navigate the clusters internally to inspect local conceptual interrelations, or they can view the entire collection to get a sense of general trends in the information.

Already in use by the U.S. intelligence community, Starlight can be applied to a variety of other fields, such as medical data analysis, environmental security and current events monitoring.

For more information on Starlight, contact Randy Woodson at phone: (509) 372-6420 or e-mail: randy.woodson@pnl.gov.



Environmental Protection 1998 Salary Survey



Please check the appropriate boxes and mail or fax your response by April 15, 1998 to Angela Neville, Editor-in-Chief, *Environmental Protection*, 5151 Beltline Road, Suite 1010, Dallas, Texas 75240. Fax (972) 687-6799.

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your current position?		company?		□ PE	\square PG	□ REM
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☐ Scientist		How long have you	been in your current	\square CSP	\square REA	\square CEP
☐ Consultant		position?	•	☐ QEP	\square DEE	
☐ Regulatory Complia	nce Specialist	.•		Other (please	e specify)	
☐ Health/Safety Super		What was your job	title just prior to your	Company of the contract of the	1	
Other (please specify)		current position?		How many years of environmental work		
				experience do you have?		
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☐ Government ☐ Academia		What will your annual gross salary be for		Give us your o	omments abou	t current trends
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☐ Air			to be? (Please give a range if			
☐ Water/Wastewater		you are not sure.)				
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Age:		☐ High school	•	Name:		
☐ 29 or younger	□ 30 to 39	☐ Master's				
	☐ 50 or older	Other (please speci		Telephone:		

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Wastewater Sampler

The Global Wastewater Sampler WS300 is designed



specifically to meet the sampling requirements for industrial discharges, sewers, rivers and streams. It takes a "timeweighted" composite sample in a 2-gallon bottle, to meet the wastewater sampling guidelines. Also provided is a sample pickup hose and a battery charger. Global Water.

Circle 206 on card.

Internet Services

RegScan Inc. offers Internetbased services. Subscribers can



browse, search and read the most current full text regulations from EPA, OSHA, DOT, FDA and the *Federal Register*. The Web site address is www.regscan.com. RegScan Inc.

Circle 207 on card.

Stack Emission Monitor

The Testo 360 is a portable stack emission monitor with RATA accuracy. It can measure



NO_x, CO, SO₂, CO₂, O₂, H₂O, fpm, number per HR and F. Its accuracy meets standards of 40 CFR App. A, B and 40 CFR 75 Subpart C for backup monitors. The system consists of a notebook computer, an analyzer unit and probes. **Testo Inc.**

Circle 208 on card.

Product Interface Probe

Model 122 Interface Meter is %-inch in diameter and can

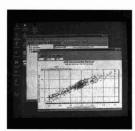


be used for narrow drive-in equipment and 1-inch wells. It measures the depth and thickness of non-aqueous product layers in monitoring wells and tanks. Batteries give 120 hours of use and are located in easy-access drawers in the faceplate. Solinst Canada Ltd.

Circle 209 on card.

Sewer Flow Software

Profile™ is a Windows-based software that allows users to transform sewer-flow monitoring data into collection system management information. Users can perform data management on large volumes of flow data, as well as flow quan-



tification, system performance analysis and report generation. ADS Environmental Services. Circle 210 on card.

Robotics Chamber

The Robotics Chamber is designed for automated pro-



cesses and delicate or hazardous procedures. The HEPA filter removes .03-micron size particles. The positive-pressure enclosure tent surrounds experiments in Class 100 air. Includes three-way viewing and access capabilities. Available with ULPA and carbon filtration systems. HEMCO Corp.

Circle 211 on card.

Interface Level System

Model 2505 was specifically designed for large plants with re-



quirements for multiple interface level monitoring and/or control instruments. A digital display of the interface on the analyzer and a retrievable clarifier profile allows the operator to observe the visual condition of the clarifier. Royce Instrument Corp.

Circle 212 on card.

Flowmeter

The Flo-Tote™ II Portable Electromagnetic Open Channel



Flowmeter features a 'robust, non-fouling sensor; Auto-Cal™ to eliminate the need for site calibration in most cases; a Q-Stick™ band-sensor insertion tool for no-manhole-entry installations; and an ATC Level™. Marsh-McBirney Inc.

Circle 213 on card.

Industrial Equipment

Each industrial equipment package is custom-designed to provide specific solutions to process treatment needs for oil, solids, heavy metals, soils, groundwater and organic and pH controls, including packages for industrial wastestream pretreatment. Engineer design assistance is available. GeoPure Systems & Services Inc.

Circle 121 on card.

Environmental Software

EQuIS® for Windows is software used in the EQWin™ environmental data management system. It manages the chemistry and geology required to support decisions regarding site analysis. It interfaces to three-dimensional visualization, GIS, CAD, statistics and other software. EarthSoft®.

Circle 115 on card.

Safety Spectacles

The Uvex Bandit[™] has a patented replaceable single-lens design with integral sideshields and browguards. The dual-lens look provides protection. It meets ANSI Z87.1-1989 standards, provides 99.9 percent UV protection and is available in a variety of tints. Uvex Safety.

Circle 214 on card.

Spill Kit

The universal spill kit from Thomas Scientific contains pH Nine, an all-purpose acid/base WE HELP YOU MANAGE RISK BEFORE IT AFFECTS YOUR BOTTOM LINE



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neutralizer as well as an organic absorbent. The kit is designed specifically for laboratory use and contains enough pH Nine to neutralize, clean up and safely dispose of 2 to 6 quarts of acids, 1 to 3 quarts of base or 2 to 6 quarts of organic solvent/hydrocarbons. Thomas Scientific.

Circle 215 on card.

Perforated Rolls

Tear Perforated Rolls into small, easy-to-manage pieces



without sharp blades. Oil Only Roll absorbs common industrial fluids while repelling water, Static Resistant Roll cleans up oil and flammable liquids by reducing static charge build-up and Universal Roll can be used for common and hazardous fluid absorption. Breg International.

Breg International.

Circle 216 on card.

Container Handling

The Dumpster-Veyor™ is a container-handling system designed to evenly distribute material into a roll-off container. Containers are unloaded from a truck, then powered back and forth for



even distribution. Helps reduce labor, operating, maintenance and building costs. Cordell and Associates.

Circle 217 on card.

Gas Transmitter

The GasPlus-IR is an infrared combustible gas trans-



mitter. There is no risk of sensor poisoning, no sensor saturation, no oxygen required for operation, no reductions in sensor life from exposure to gas, continuous monitoring, faster response time and fewer effects from temperature and humidity. EIT.

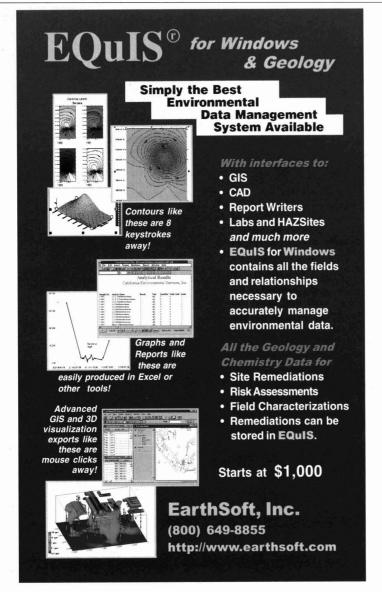
Circle 218 on card.

Gas Instrument

The SA 2000 four-gas portable instrument displays peak



sensor readings, along with the lowest oxygen reading detected by the instrument. It also can be programmed to display Spanish language prompts, in addition to standard English prompts. The instrument has a

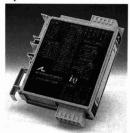


low battery and sensor replacement message. Scott Health & Safety Products.

Circle 219 on card.

Alarm

The Model Q116 RTD Input Dual Limit Alarm with



Touch Sample™ technology is a high-density, field configurable DIN rail-mount device. It accepts most RTD input types and provides two relay output functions. The input range is configured via dip switches to maximize setpoint resolution. Action Instruments.

Circle 220 on card.

Conductivity Analyzer

The Model C53 has two sensor inputs that can be inde-



pendently configured to measure conductivity, resistivity or total dissolved liquids. It accepts the Model 3400 series Enhanced Performance Conductivity Sensor and others. The Dry Calibration™ method provides accuracy across the conductivity ranges of ultrapure water to two Siemens. GLI International Inc.

Circle 221 on card.

Oil Absorbant

Wesorb-Oil-Klean is a compound of natural fibers treated to absorb oil and is water repellent. Chips can be vacuumed with the spilled product. The natural fibers biodegrade at approximately the same rate as petroleum fibers in a landfill. Available in mats, booms, chips, swabs, mini-paks and custom-paks. Wesorb Corp.

istom-paks. Wesorb Corp Circle 222 on card.

Interactive Training

Training on a Disk is an interactive training system. Each course was developed by a

team of instructional designers, educators, computer technologists, Certified Safety Professionals and Certified Industrial Hygienists. Uses include reducing administrative, scheduling and recordkeeping problems. BNA Communications Inc.

Circle 223 on card.

Oil/Water Separator

Fluid Containment Oil/ Water Separator Systems pro-



vide corrosion resistance and meet performance requirements of oil/water separators under Subject 2215, Outline



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of Investigation of oil/water separators. The systems are designed to process contaminated stormwater runoffs from fuel stations, airports and parking lots. Underwriters Laboratories Inc.

Circle 224 on card.

Modular Tank

ModuStor tanks hold wastewater, potable water, sewage, sludge, slurries and other liquids. The tanks are



bolted together from modular components with standard hand tools. Dozens of standard sizes and custom sizes are available. Options include liners, covers, drains and more. Modu Tank Inc.

Circle 225 on card.

Velocity Analyzer

The portable Quattro Flow velocity analyzer is density



compensated and provides readings for altitudes up to 10,000 feet. The full package consists of a lightweight measurement instrument with four sensor ports, a choice of low-profile or clip-on ruggedized interchangeable AFS airflow sensors and an optional printer. Cambridge AccuSense Inc.

Circle 226 on card.

Transportable Analyzer

When the HNU Model 311 Transportable Analyzer is cou-



pled with the Model 650 Sparging System, ppb levels of a variety of VOCs in water can be measured. The analyzer is capable of performing spot checks for waste treatment, municipal treatment and industrial effluents. HNU Systems Inc.

Circle 227 on card.

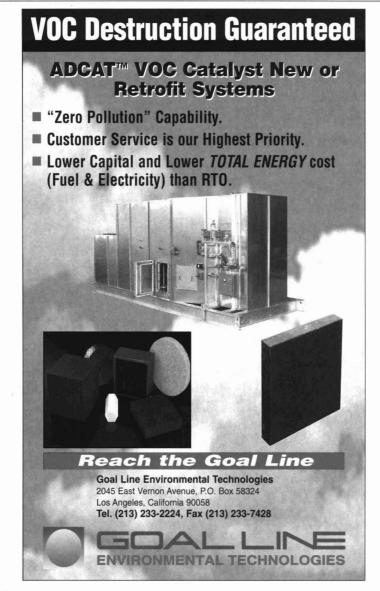
Spectrometer

The I Series Industrial FTIR spectrometer systems are de-



signed for on-line, at-line and near-line QC applications. Each system contains a 0.5-centimeter to 1 FTIR spectrometer in a hermetically sealed enclosure. Sampling accessories attach to the front of the instrument. The systems are controlled with a computer. Midac Corporation.

Circle 228 on card.



Portable FID

The Model 680 HVM is a fully integrated fugitive emis-



sions monitoring solution. The three-key interface is ideal for fugitive emissions, hazwaste, spill response and industrial hygiene monitoring. It integrates a highly sensitive flame ionization detector, data logger and optional laser bar code scanner. Thermo Environmental Instruments Inc.

Circle 229 on card.

Gas Dryer

Perma Pure® gas dryers remove water vapor from gaseous



samples without altering the analyte gas concentrations. Drying is a self-regenerating, continuous process. No routine maintenance is required because the dryers are ruggedly constructed, with no moving parts and high corrosion resistance. Perma Pure Inc.

Circle 230 on card.

Polishing Reactor

The Lemna polishing reactor is ideal for supplemental



BOD and ammonia-nitrogen polishing. The LPR can be built to utilize any existing infrastructure or be incorporated into a new design to provide treatment results as low as 10 mg/BOD and 1 mg/1 NH3-N. Lemna USA Inc.

Circle 231 on card.

Self-Sustaining RTO

The Combu-Changer® Regenerative Thermal Oxidizer System supplies 70,000 scfm process with 98 percent emission efficiency and 95 percent heat recovery. Stack, fans and



sound-reduction equipment are available. It is self-sustaining with the process heat contribution. ABB Air Preheater Inc.

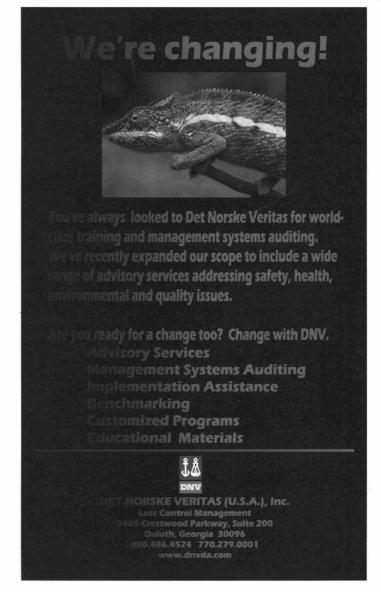
Circle 232 on card.

Regenerative Oxidizer

Compressed into an 8-footby-12-foot frame, the MAC-



Therm module handles gas flows of 500 to 10,000 scfm with VOC concentration as low as ½ percent. It has no flow control valves or dampers with start up under 15 min-



utes. Roof mounting next to existing stack is available. ARTCO Marketing. Circle 233 on card.

Cyclone

The PM-2.5 In-Stack Cyclone performs aerodynamic removal of particulate above 2.5 microns. Each Cyclone set is available in Teflon or stainless steel and includes a 25millimeter filter holder and a set of 6 nozzles in a foam lined



carrying case. Environmental Supply Company Inc. Circle 234 on card.

Grinder Pumps

The Series KG grinder pumps feature a shredding rotor with



steel blades that revolve within a stationary cutting ring to grind suspended solids and fibers. The shredding action minimizes particle size and permits the use of small diameter discharge pipes necessary for a low flow, high head pressurized transport system. Pumpex Inc. Circle 235 on card.

Adsorbers

High Pressure Liquid Phase Adsorbers treat contaminated



groundwater and wastewater. Single units that handle flow to 100 gpm and 75 psi are available. The units are constructed of fiberglass-wound epoxy resin. Adsorbers provide a broad range of chemical resistance. Carbtrol Corp.

Circle 236 on card.

Certification Services

SGS International Certification Services offers a net-



work of worldwide offices to minimize registration costs for multisite and international clients. Accredited ISO 9001, 9002 and 9003, QS-9000, BS-7750 and ISO 14001 registrations are available. Software, training and CE marking are available. SGS International Certification Services Inc.

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Flowmeter

The DryCal model CD Lite is a dry primary flowmeter



that is lightweight and compact for use in industrial hygiene, environmental and laboratory applications. It is immune to flow source pulsation without the need for in-line dampers. BIOS International.

Circle 238 on card.

Water Evaporator

Evaporation is the only disposal method available that disposes of the water component in water-based waste streams and separates oil for



recycling. Designed for fully automatic, 24-hour unattended use with a wide range of evaporative rates and fuel sources. Samsco Inc.

Circle 239 on card.

Treatment System

The ESP 250 is designed for the treatment of wastewater from a variety of operations, including latex or paint and die manufacturing, silk screen printing, photo emul-



sions and more. It is available in both manual and automatic and can process up to 500 gallons of water per hour. RGF Environmental Systems Inc.

Circle 240 on card.

D-Line Instrument

The Scott D-Line instrument is used for methane and natural gas detection in utility



and construction-related applications. It features a tough aluminum-casted case and an impact-resistant plastic battery compartment. D-cell batteries power the instrument. Scott Health & Safety.

Circle 241 on card.

Air Sampler

The Air Sampling G.C. has a PID detector and a simultaneous FID/DELCD detector system. VOCs in air are sucked through the built-in concentrator using the software controlled vacuum pump and then desorbed automatically into

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the GC where detection is performed at ppb and ppt levels by three series mounted detectors. SRI Instruments.

Circle 242 on card.

Liquid Analyzer

The Modbus digital output protocol has been added to



the Model 2700 SoluCube® multiparameter liquid analyzer. Available in 1/4 DIN size, the SoluCube accommodates up to 8 sensor inputs measuring pH, ORP, conductivity, resistivity, temperature and percent concentration. Rosemount Analytical Inc.

Circle 243 on card.

Pinch Valve

The Series 5400 Control Pinch Valve features centerline



closure, compact size, enclosed mechanical parts and accurate, repeatable variable venturi flow control. The valves are available in sizes of 4 inches to 36 inches with linear, pneumatic or electropneumatic positioners. Red Valve Company Inc.

Circle 244 on card.

Shredder

The Super Shredder™ consumes rags, plastics, wood



and cans, eliminates clogging in pumps and valves and prevents premature failure of other major equipment. Features include stainless wetted interior construction, mechanical seals, precision tapered roller bearings, oil bath lubrication and more. Franklin Miller Inc.

Circle 245 on card.

All-Round Beveler

The TKF 700-0 is a powerful, all-round machine that can be used in vertical, horizontal or inverted positions. It weighs 12 pounds and is adept





at processing pipes, sheets with internal cutouts, curved edges and deburs sheets and metal work pieces. Trumpf Inc.

Circle 246 on card.

Gasoline Vapor Recovery

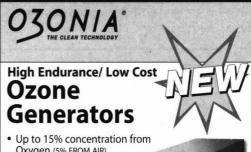
The Recogen Unit recovers gasoline vapors by using a small amount of the vapor to fuel a generator which in turn powers the unit. The generator operates the unit by using 15 percent of the vapors and saving the other 85 percent for reuse. The Recogen Unit meets all government regulations. Edwards Engineering Corp. Circle 247 on card.

Hose

The Fluoroflex® DLH hose has a convoluted inner liner of



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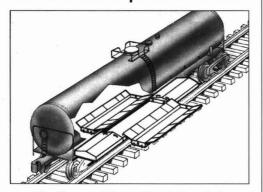
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resin. The space between the liners is monitored through a port in an end fitting to detect leaks. Dupont.

Circle 248 on card.

Analyzer

The Ultrameter is a 6-parameter analyzer that is water-



proof to 3 feet. It tests pH, ORP, conductivity, temperature, total dissolved solids and resistivity. The Ultrameter is

ideal for boilers, cooling towers, reverse osmosis/deionization water treatment systems and on-line controller calibration. Myron L. Co. Circle 249 on card.

Wastewater **Treatment System**

The VS-Series wastewater treatment system provides



treatment for both disposal to sewer and recovery of valuable water-based fluids. The system is based on ultrafiltration technology for temperatures up to 170 degrees Fahrenheit. It has a clean-in-place tank for connection to a process tank. Dynatec Systems Inc.

Circle 250 on card.

Contaminant Transport

RIP, a PC-based software, probabilistically simulates the release, transport, and fate of contaminants within complex engineered or natural environmental systems. It provides risk assessments and decision support during the development and licensing of radioactive and hazardous waste disposal facilities. Golder.

Circle 251 on card.

Analyzer

The Model P33 pH/ORP analyzer accepts many different types of pH/ORP sensors, including GLI differential sensors, conventional electrode pairs or standard combination elec-



trodes. The large backlit LCD simultaneously displays the measured pH and process temperature. GLI International Inc.

Circle 252 on card.

Cleaning Spills

Boom absorbents can be used for cleaning up oil and chemical spills. They are made of fiber-locked polypropylene material. They absorb 25 times their weight and can be reused up to 100 times. Boom Environmental Products.

Circle 253 on card.



Liquid Sampler

The Series 250 liquid sampler is designed for direct sam-



ple transfer from the sample location to the collection bottle. The sampler line, rod and plunger are not removed from the drum during the extraction process. Applications range from RCRA, waste testing, environmental compliance, product quality and HazMat response. G/O Corp.

Circle 254 on card.

Sulfate Elimination

The Sulfate Wastewater Process is a three-step approach to



wastewater minimization. Extreme sulfate levels and heavy metal concentration are reduced to nondetectable levels. Primary and secondary drinking water standards are achieved through a removal process. The sytem uses a lime-based process. Hoffland Environmental.

Circle 255 on card.

Photometer

Rosemount Analytical added an ultra low carbon monoxide (ULCO) analyzer to its NGA 2000 MLT gas analyzer series.



The series offers up to four photometric channels and one non-photometric channel for gas analysis. The ULCO instrument ranges from 0 to 2,500 PPM CO, with better than 1 percent accuracy. Rosemount Analytical.

Circle 256 on card.

Extraction Disks

The Bakerbond Speedisk™ oil and grease extraction disk provides filtration capacity and inlet characteristics that maximize access of analyte molecules to micro-particulate sorbent. It resists clogging and ex-



hibits high throughput rates even when samples contain solids. J.T. Baker.

Circle 257 on card.

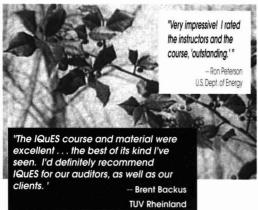
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Circle 76 on card. Circle 77 on card. 83

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in semivolatile samples. The system protects the capillary analytical column from semi-volatile components in the sample and reduces analysis time. Perkin-Elmer.

Circle 258 on card.

Transmitter

The Series QV Quick-View® valve position indicator/trans-



mitter is ideal for use with rotary and linear valves and actuators, manual valves, gear operators and positioners. Control is provided by four mechanical or reed switches or also by a 4-20mA transmitter output with up to two switches. Dwyer Instruments Inc.

Circle 259 on card.

Portable Drinking Water System

PortaPure™ combines five stages of microfiltration with



high intensity ultraviolet exposure to produce safe drinking water from contaminated sources. The unit produces up to 700 gallons per day, uses AC or 12-volt DC power and will service a vertical head of approximately 14 feet. Oberg Environmental Products.

Circle 260 on card.

Printer

The Avery Dennison™TTX-1050 printer processes contain-



er, hazard, product identification and shipping labels up to 10 inches wide. It produces bar codes, human-readable text, chemical symbols and logos in print widths up to 8.5 inches and maintains a print resolution of 300 dots per inch. Avery Dennison.

Circle 261 on card.

Waste Handling

The E-Zee Drum is made of durable, light-weight, tubular



steel parts and can be assembled in less than a minute. Its open wall construction allows bags to be removed from the side. Ideal for restaurants, laundries, building maintenance, industrial plants, and other work sites where waste is handled. G/O Corp.

Circle 262 on card.

Industrial Wastewater Treatment Systems

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Protection Valve

The MicroMatic valve is designed for use with hazardous



and non-hazardous substances. It features a "keyed" coupler, so it can only be connected to the matching valve in each container. The valve can also be used with containers that hold a pressurized nitrogen blanket. Spartanburg.

Circle 263 on card.

Calibration Bench

The Span Lab™ TO-14 Cal Bench is a group of 30 individually controlled permeation



tube ovens. Each oven is selfregulating at a preset, fixed temperature. The carrier flow through each oven is individually controlled. The temperature range available is 30 degrees Celsius to 150 degrees Celsius. Kin-Tek Laboratories Inc.

Circle 264 on card.

Ozone Treatment

NOVAZONE's ozone generators are fully integrated and include ozone generating cells, power supplies, air dryer and computer control system in a

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single weatherproof cabinet. The generator uses thermoelectricity and air cooling and automatically adjusts ozone output to maintain the desired dosage at all times. NOVAZONE.

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Liquid & Gas Flowmeter

The "S" Series flowmeters are available in 14 ranges from 13-



100 ml/min. to 2000-10,000 ml/min. Measurements are displayed on a 3½ digit LCD digital display with a 0-5 VDC output provided for recording data. An AC-DC adapter plug for operating on conventional AC power is optionally available. McMillan Co.

Circle 266 on card.

Electronic Meter Register

The EMR-100 provides equivalent mechanical meter register functions and adds features like



electronic registration, volume preset shutdown, electronic temperature compensation and in-cab printing. The EMR-100 has a printer that sits right in the cab. Veeder-Root.

Circle 267 on card.

Oil Boom

The MK 10 boom is made from Du Pont's Kevlar materi-



al, which is woven and coated with urethane. The polyethyl-

ene float surfaces are densified to a solid skin by a molding process that enhances toughness, abrasion resistance, and ease of cleaning. Slickbar.

Circle 268 on card.

Multifunction Analyzers

The Moisture Series Analyzers (MSA) perform a variety of



measurements, including trace moisture (to ppb levels), trace oxygen, percent oxygen, gas composition, temperature and pressure. All of these functions can be done through one analyzer in combination with sensors and transmitters. Panametrics.

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Hazardous Locations Poster

"Classification of Hazardous Locations" gives a guide for



using electrical equipment in hazardous environments. The poster details complicated safety classifications into a colorful, easy-to-understand chart, complete with definitions and explanations. Visual Inspection Technologies Inc.

Circle 270 on card.

MSDSFILE Software

Material Safety Data Sheet Version 4.0 is compatible with Windows 95 32-bit architecture and also runs on a net-

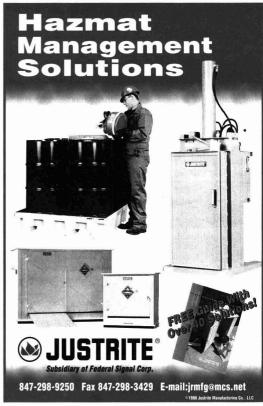


work with Windows NT. The system has the ability to scan and index in one step. The 4.0 version can be loaded into scanners equipped with an automatic document feeder. HazMat Control Systems Inc. Circle 271 on card.

Protect Wastewater Pumps

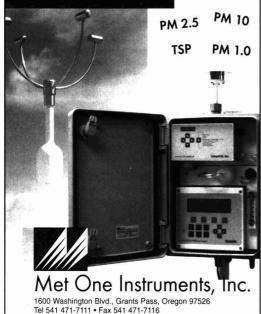
The silicon carbide bellows seal protects the pump shaft and





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motor on wastewater pumps. The low co-efficients of heat and elasticity of the seal resist extreme friction and corrosion presented by wastewater particles. The seal is an optional feature on 10 hp to 50 hp pump configurations for wet or dry pit mounts. Pumpex.

Circle 272 on card.

Measuring Instruments

The Testo models 950, 650 and 400 multi-function measur-



ing systems include large LCD displays, drop-down menus, assignable function keys and userfriendly keypads. The in-struments can store up to 1,000 measurement locations and set limits and alarm parameters. Testo.

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Composite Cases

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mount cases constructed from strong, lightweight composite materials. The cases are ideal for transport and field operation of electronic instruments. There are 220 standard and 308 custom sizes. Zero Enclosures.

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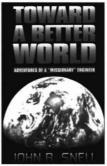
eliminate solid residues and prevent damage to the system. The scrubbers consist of a rugged housing filled with an inert ceramic substrate impregnated with reagent grade phosphoric acid. Perma Pure Inc.

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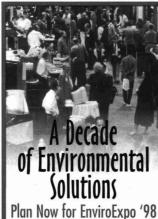
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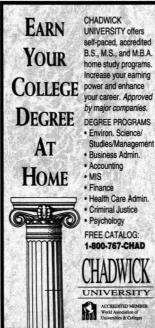
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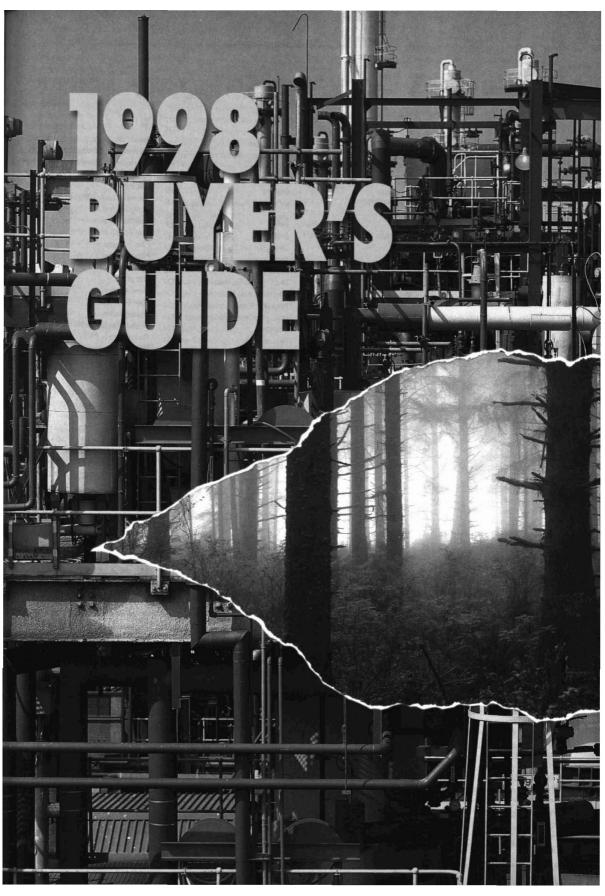
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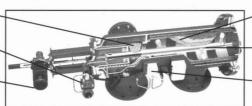
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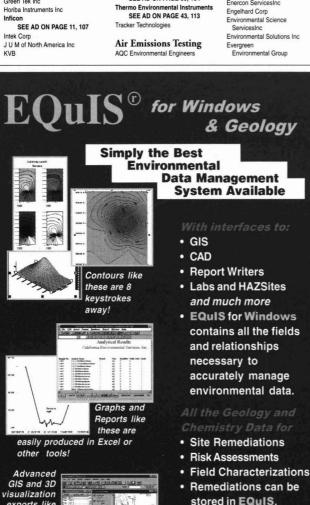
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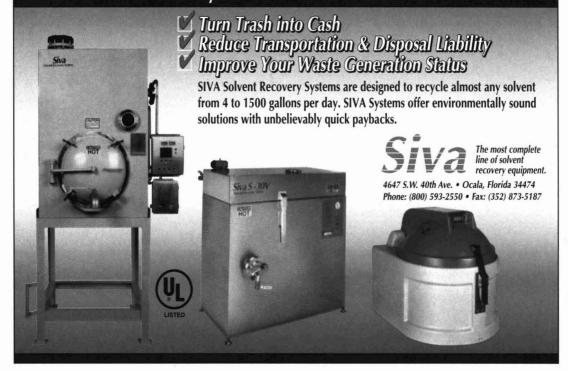


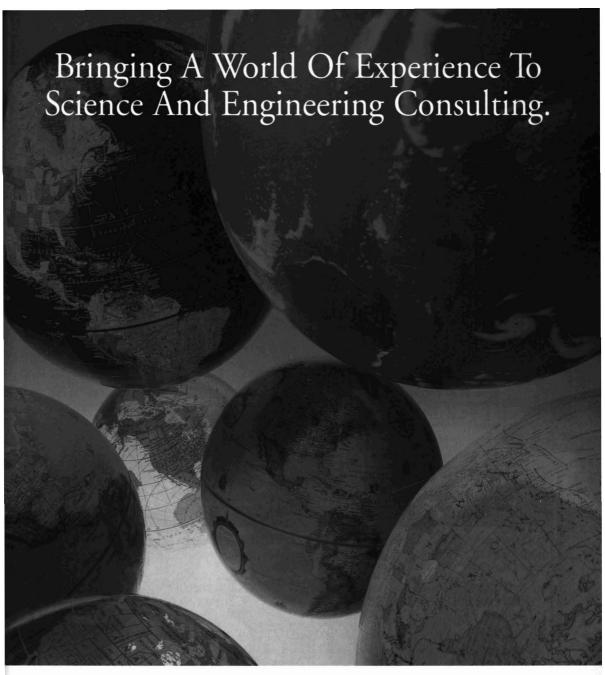
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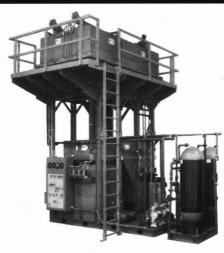
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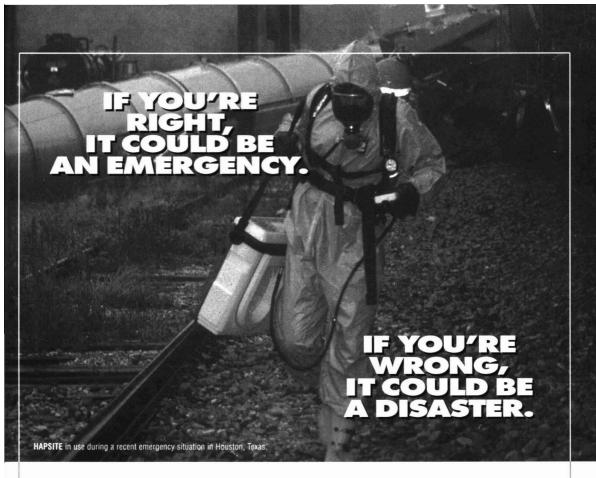
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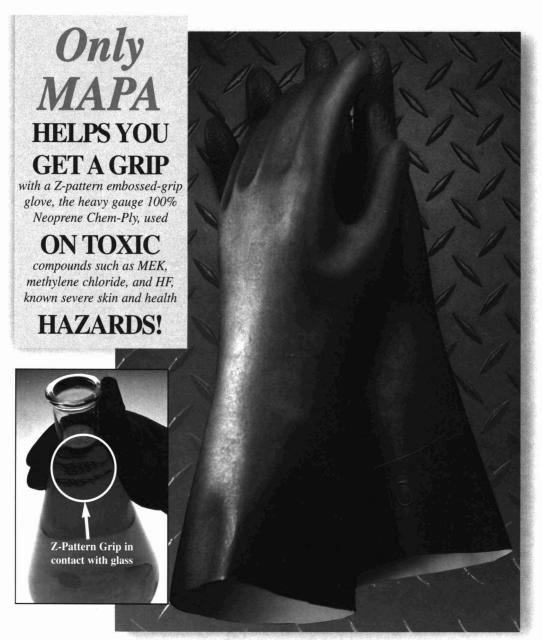
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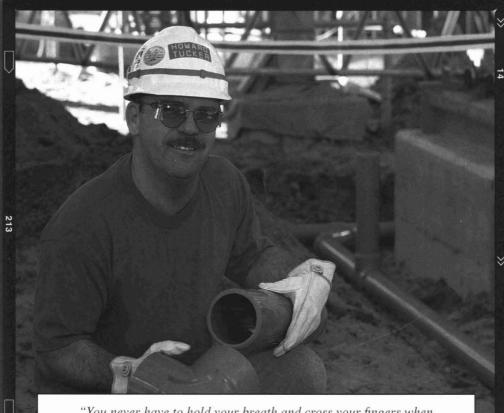
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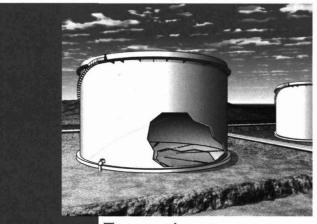
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Carboline Co Corrosion Control Intl LLC ITW Devcon Engineered Coatings Metal Samples

Cortest Instrument Systems Nassef Engineering & Equipment Co Inc PolySpec Corp Reef Industries Inc US Filter/Lo-Cat

Couplings Hilliard Corp Little Beaver Inc SEE AD ON PAGE 57, 108

MMC International Corp Midland Metal Mfg Co

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Premier Services Corp Smith Fiberglass Products Co

Victaulic Co of America Covers/Domes

ILC Dover Inc SEE AD ON PAGE 123, 141

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Crushers

Franklin Miller Inc J V Manufacturing Inc/"Cram-A-Lot" Justrite Manufacturing Co Morlan & Morlan Inc New Pig Corp RMT Machinery Inc SRS Industrial Engineering Inc Waste Control Systems Inc Wyssmont Co Inc.

Cyclones Abresist Corp Aercology



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Airotech Inc Andersen 2000 Inc Clean Gas Systems Inc ERS Services Inc. Environmental Supply Co Inc.

Misonix Inc

Debris Baskets

SEE AD ON PAGE 18, 143

Morlan & Morlan Inc Roberts & Schaefer Co Thiel Air Technologies Turner Enviro Logic Inc

Dampers

Bayou City Pump Works Inc Boiler & Burner Systems Chem Pruf Door Co Turner Enviro Logic Inc

Data Acquisition Equipment ASOMA-WTC Engineering Inc

American Sigma Inc Auburn International Inc Bristol Bahcock Inc. Climatronics Corp Cochrane Associates Inc Contec Systems Industrial Corp Controlotron Dancer Communications Inc Data Electronics USA Inc Green Tek Inc. H2NS Environmental Inc In-Situ Inc Interon Corp KVR Logic Beach Inc MIE Inc (Monitoring Instruments

for the Environment) Magellan Systems Corp Met One Instruments Inc SEE AD ON PAGE 87, 162

Metrosonics Inc Mil-Ram Technology Inc Monarch Instrument Omega Engineering Inc

SEE AD ON PAGE 2 133

Pace Environmental Products Inc. SRI Instruments Scientific Sales Inc Sierra Monitor Corp TEAC America-Information Products Div Undata America

Zone Automation **Data Loggers**

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Monarch Instrument Omega Engineering Inc

SEE AD ON PAGE 2, 133 Onset Computer Corp Response Rentals Stevens Water Monitoring Systems TEAC America-Information Products Div Telatemp Corp



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American Sigma Inc Capital Controls Co Inc Chemetrics Inc Control Co. Danfoss-Instrumark Engineered Systems & Design Enviro-Equipment Inc. Hanna Instruments Orion Research Inc. Response Rentals Rosemount Analytical Inc/ Uniloc Division

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Drum Pumps Bayou City Pump Works Inc

Justrite Manufacturing Co Lutz Pumps Inc Omega Engineering Inc SEE AD ON PAGE 2, 133

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Drums

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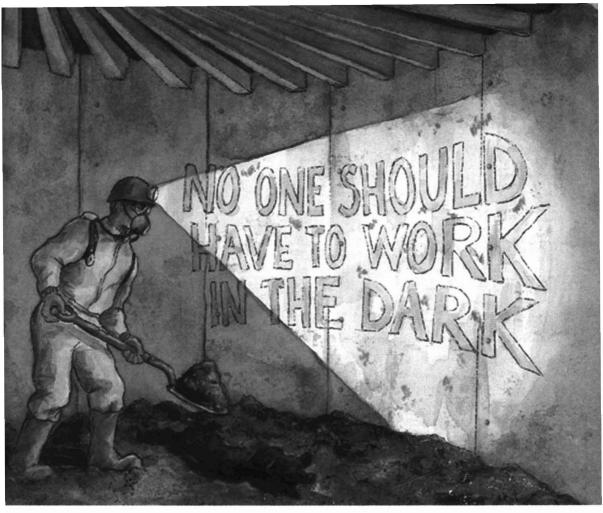
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SEE AD ON PAGE 165

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SEE AD ON PAGE 52, 101

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Environmental Personnel Agency G O Environmental Inc Golder Associates SEE AD ON PAGE 27 105

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Lexicon Environmental SEE AD ON PAGE 7, 135

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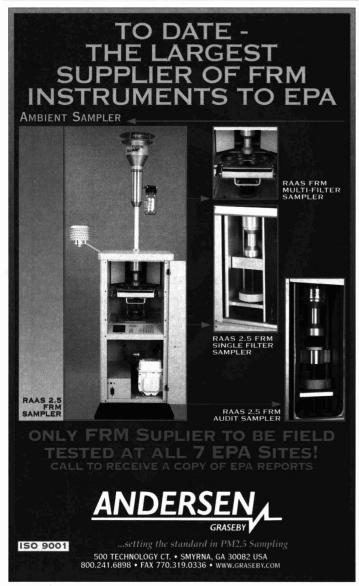
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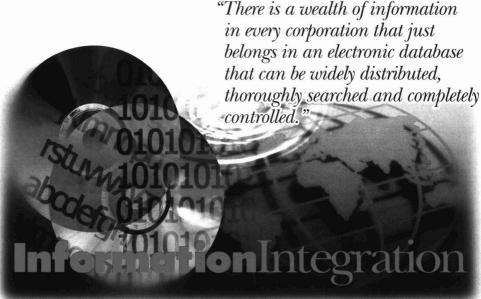
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Roy F Weston Inc. Rust Environment & Infrastructure

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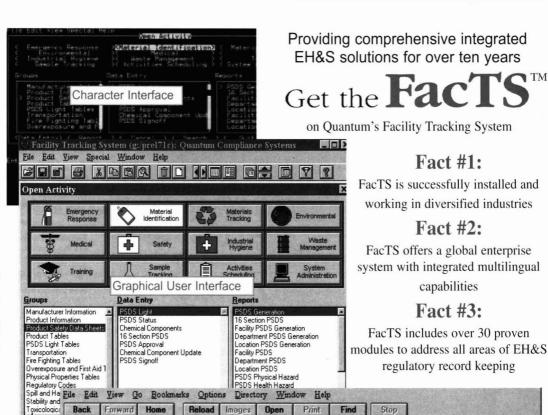
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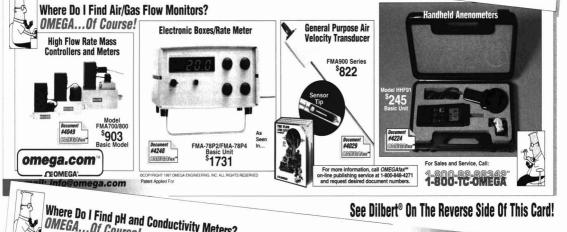
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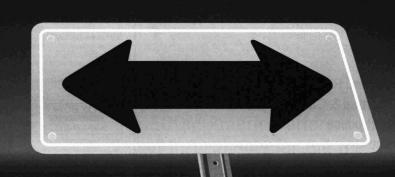
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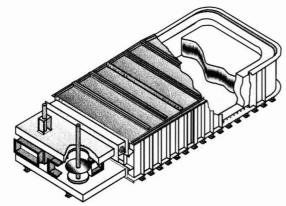
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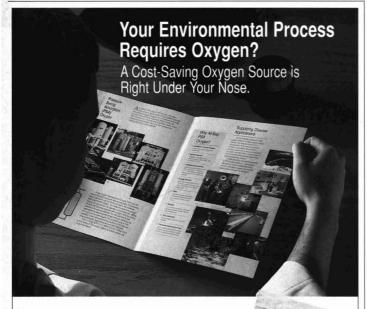
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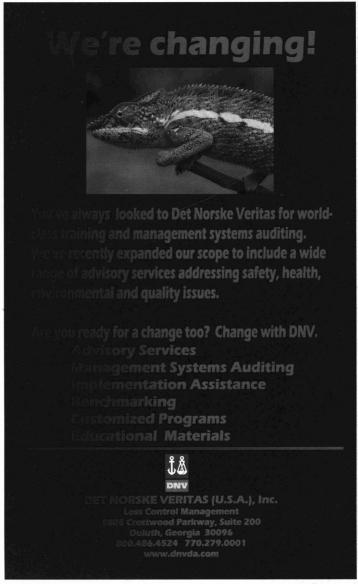
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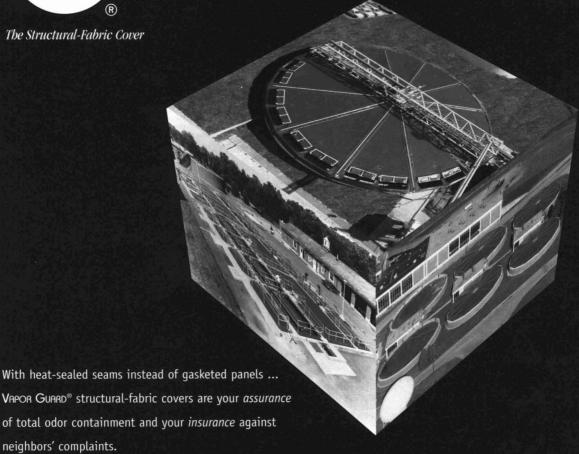
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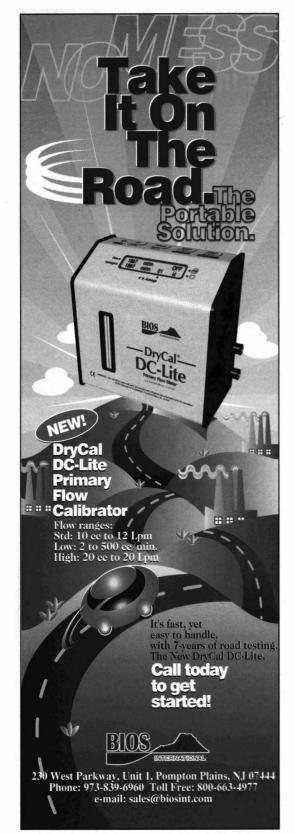
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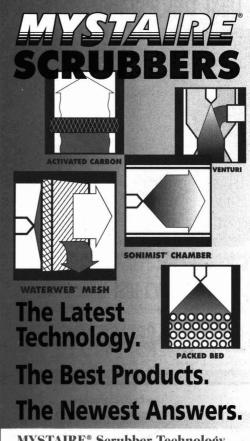
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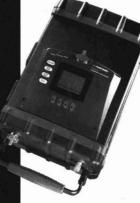
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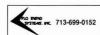


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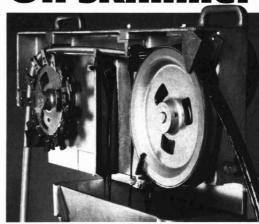
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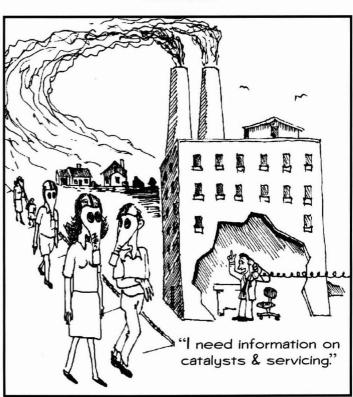
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G O Environmental Inc **Odor Control**

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Johnson Matthey Environmental Products

Mazzei Injector Corp SEE AD ON PAGE 87, 160 Misonix Inc SEE AD ON PAGE 18, 143



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Monsanto Enviro-Chem Systems Munters Corporation-Zeol Division **NuTech** 800-321-8824

NuTech Environmental Corp Odor Control Co Inc Odor Management Inc Odor Management Technologies Orec Ozonation Systems/Osmonics Process Technologies Inc REECO RaySolv Inc Ross Air Systems Rusmar Inc



Trinity Air Technologies Turner Enviro Logic Inc US Filter/Lo-Cat

Temcor



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Odor Control Treatment

Betz Dearborn Bio-Systems Corp Brown, Vence & Associates Inc Clean Gas Systems Inc Gregory Leonardos-Environmental Odor Consultant Hydrocarbon Environmental

Recovery Systems Lemna USA Inc. Mazzei Injector Corp SEE AD ON PAGE 87, 160

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Process Technologies Inc Rusmar Inc Solvay Interox Inc US Filter/RJ Environmental

Oil Skimmers

• ABANAKI

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QED Environmental Systems Inc Slickbar Products Corp

Oil Spill Control **Equipment/Services** naki Corp/Oil Skimmer Div

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Adirondack Environmental Associates Inc. Andax Environmental Corp Arbill Glove & Safety Products Basic Concepts Inc Bayou City Pump Works Inc CSR Hydro Conduit Dialogic Communications Corp Direct Safety Co Inc. Drexelbrook Engineering Co Ecosorb International Inc



Eldredge Inc Foss Environmental Services Geotech Environmental Equipment Inc

Hudson Industries Hydrocarbon Environmental Recovery Systems Industrial Marine Services48 Inc Kepner Plastics Fabricators Inc MPC Environmental McPhee Environmental Supply

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New Pig Corp



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MMC International Corp

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Turner Designs Veeder-Root Co Wilks Enterprise Inc World Water Systems Inc

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Highland Tank & Manufacturing Co Hilliard Corp Hudson Industries Hydro Quip Inc Jeffrey-Tropodyne Kenner Plastics Fabricators Inc. Landa Water Cleaning Systems McPhee Environmental Supply Megator Corp

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Safety & Environmental Resources Inc Schumacher Filters America Inc Sorbent Products Co Inc.

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KVB

Land Combustion SEE AD ON PAGE 50, 166

Pace Environmental Products Inc Resochem Corp Thermo Environmental

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Operation & Maintenance Services

Abbottsfield Industrial Training Inc Brown, Vence & Associates Inc Chanman Inc. ERS Services Inc Eco Services Inc GeoCore Services Inc Hyde Consultants Inc Industrial Marine Service Inc Jones & Henry Engineers Ltd Killam Associates Consulting

Engineers Roy F Weston Inc Sevenson Environmental Services Inc. ToxGon Corp

Zorbit Technologies Inc

ORP Instrumentation Cole-Parmer Instrument Co Engineered Systems

& Design Hanna Instruments Innovative Sensors Inc Myron L Co Newport Electronics Inc Omega Engineering Inc

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Oxidizers



Dürr Environmental Inc Eco Services Inc Glenro Inc. Global Technologies



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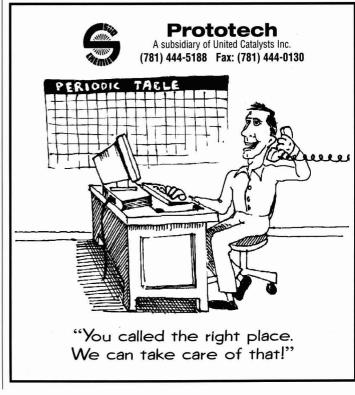
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Passive Hydrocarbon Recovery Systems

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Thielsch Engineering Inc Toxikon Corp Van Note-Harvey Associates PC

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Jacobs Environmental Inc Lan Associates Inc Midwest Research Institute Miguel A Antonetti & Associates NES Inc

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Resource Management Group Inc. Rosengarten, Smith & Associates Inc Rust Environment & Infrastructure

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Hach Co

Hanna Instruments Horiba Instruments Inc. Innovative Sensors Inc. Lakewood Products/Osmonics Martin Marietta Magnesia

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Wilkens-Anderson Co

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Flowserve Corp Fluid Controls Inc Godwin Pumps of America Inc Hobas Pipe USA Inc Rain for Rent Victaulic Co of America

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Pressure Boosters



Air Dimensions Inc

Pressure/Vacuum Instrumentation Alicat Scientific Inc

Bailey-Fischer & Porter Co Control Co. Dwyer Instruments Inc. Furness Controls Inc

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Process Control Instrumentation

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DataTest Inc Dwyer Instruments Inc Gems Sensors Inc **HNU Systems Inc**

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Professional & Trade Associations

Academy of Certified Hazardous Materials Managers Air & Waste Management Association American Institute of Chemical Behavioral Science Technology Inc National Registry of Environmental Professionals

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Protective Clothing

ABBS/Guard-Dogs DSC Distributors Service Corp Direct Safety Co Inc EnviroLine Inc ILC Dover Inc

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Air & Waste Management Association American Institute of Chemical Engineers Donley Technology

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Godwin Pumps of America Inc

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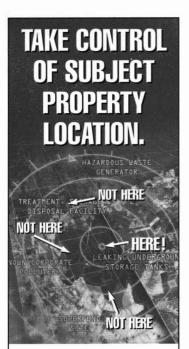
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West Group SEE AD ON PAGE 4, 111 Western Research Institute

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Advanced Environmental
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Environmental Solutions
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Jacobs Environmental Inc
King Buck Technology
Komex-H2O Science
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Philip ServicesCorp/
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Boelter & Yates Inc
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Probiotic Solutions

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Remediation Services

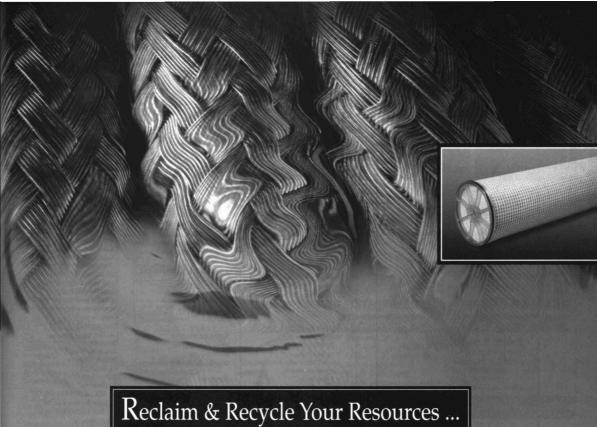
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MST-Modern Safety Techniques Mapa Professiona **SEE AD ON PAGE 109, 187**

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Sedimentation Equipment

Sample Containers



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Entech Instruments Inc

Envirol ine Inc.

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Sampling Systems

Advanced Concepts & Design Inc



Air Dimensions Inc. Air Resource Specialists Inc American Sigma Inc. Apex Instruments Inc Associated Design & Manufacturing Co Clean Environment Equipment



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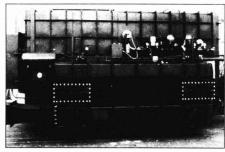
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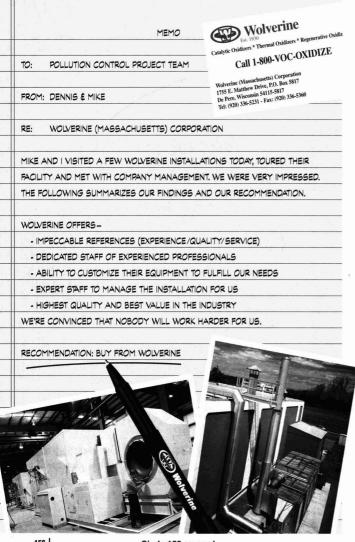
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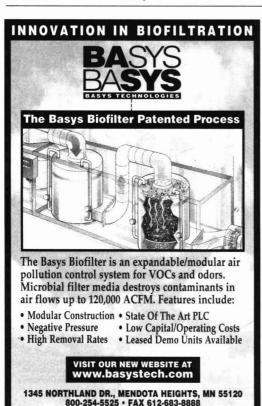


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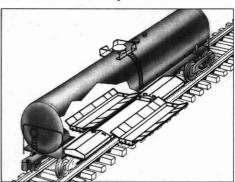
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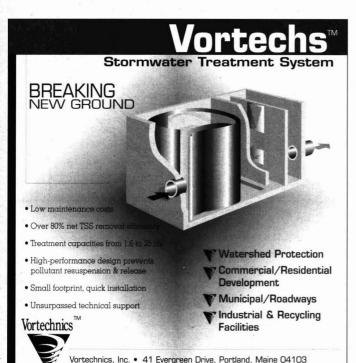
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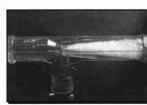
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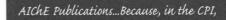
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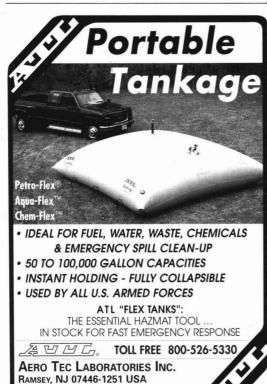


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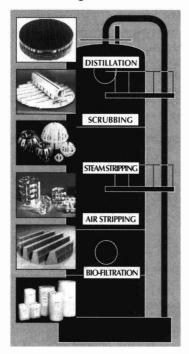


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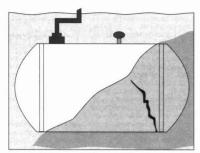
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PO Box 80410 Fairbanks, AK 99708-0410 Phone: 907-455-6777 Fax: 907-455-6781 Web Site: www2.polarnet.com/~abr E-Mail: info@abrinc.com

ABS Pumps Inc 140 Pondview Dr Menden, CT 06450 Phone: 203-238-2700 Fax: 203-238-0738 Web Site: www.abspumps.com

AIL Systems Inc 455 Commack Rd Deer Park, NY 11729 Phone: 516-595-6219 Natl: 800-944-1180 Fax: 516-595-5582 Web Site: www.ail.com

AIM Safety USA Inc

8403 Cross Park Dr Ste 1A Austin, TX 78754 Phone: 512-832-5665 Natl: 800-275-4246 Fax: 512-832-2188 Web Site: www.aimsafety.com

105 Harrison American Falls, ID 83211 Phone: 208-226-2017

Natl: 800-635-7330 Fax: 208-226-7280 Web Site: www.ams-samplers.com E-Mail: ams@ams-samplers.com

APEX Environmental Services Inc. PO Box 85337 Westland, MI 48185 Phone: 313-422-5500 Fax: 313-422-7047

AOC Environmental Engineers 5582 McFadden Ave Huntington Beach, CA 92649 Phone: 714-379-8888 Fax: 714-379-8894 Web Site: www.aqc-inc.com E-Mail: jeffrey@crc-aqc.com

ASC Professionals 15075 E 11 Mile Rd Roseville, MI 48066 Phone: 810-771-0060 Natl: 800-327-4260 Fax: 810-771-0098 Web Site: www.ascnro.com

ASOMA-WTC Engineering Inc 11675 Jollyville Rd Austin, TX 78759 Phone: 512-258-6608 Natl: 800-580-6608 Fax: 512-331-9123 Web Site: ww.thomasregister.com/asoma

ATC Associates Inc 11356 Mathis Ave

F-Mail: sales@asoma.com

Dallas, TX 75229-3157 Phone: 972-556-2204 Fax: 972-556-1753 Web Site: www.atc-enviro.com E-Mail: taylor74@atc-enviro.com

Abanaki Corp/Oil Skimmer Div 17387 Munn Rd Chagrin Falls, OH 44023 Phone: 440-543-7400 Natl: 800-358-7546 Fax: 440-543-7404 Web Site: www.abanaki.co F-Mail: info@ahanaki.com SEE AD ON PAGE 46, 152

Abbott Enterprises Inc 901 W Fourth Ave. Pine Bluff, AR 71601 Phone: 870-535-4973 Natl: 800-643-5973 Fax: 870-535-4970 E-Mail: tachtech@ipe.net

Abbottsfield Industrial Training Inc 10157 SW Barbur Blvd Ste 200C Portland OR 97219-5910 Phone: 503-244-0183 Fax: 503-244-0324 Web Site: www.abbottsfield.com

Abresist Corp PO Box 38 Urbana, IN 46990 Natl: 800-348-0717 Fax: 219-774-3832 Web Site: www.abresist.com F-Mail: info@abresist.com

Academy of Certified Hazardous Materials Managers

PO Box 1216 Rockville, MD 20849 Phone: 301-916-3306 Natl: 800-437-0137 Fax: 301-916-3308 Web Site: www.gn.net/~achmm E-Mail: jsachmm@aol.com

Acculab Environmental Services Inc 2274 Hollywood Dr Jackson, TN 38305-4331 Phone: 901-668-2008 Fax: 901-668-2002 Web Site: www.acculab.com E-Mail: mbutler@usit.net

Accustandard Inc 25 Science Pk New Haven, CT 06511 Phone: 203-786-5290 Natl: 800-442-5290 Fax: 203-786-5287 Web Site www.connix.com/~accustnd E-Mail: usa@accustandard.com

Acme Engineering Products Inc 2330 Champlain St Trimex Bldg Mooers, NY 12958 Phone: 518-236-5659 Fax: 518-236-6941 Web Site: www.i-factory.com/acme E-Mail: excelpress@aol.com

Acton-Mickelson Environmental Inc 5050 R J Mathews Pkwy El Dorado Hills, CA 95762

Phone: 916-939-7550 Fax: 916-939-7570

Adirondack Environmental Associates Inc

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Advanced Concepts & Design Inc

77 Symons St Richland, WA 99352 Phone: 509-943-1431 Fax: 509-943-1431 Web Site: www.rux.com/samplers E-Mail; srsomers@urx.com

Advanced Dust Solutions Inc 11919 N Janzen Ave Ste 434 Portland, OR 97217 Phone: 360-546-0072 Natl: 800-811-4366 Fax: 360-546-0073 Web Site: www.nodust.com E-Mail: ads@hargray.com

Advanced Environmental Recycling Co LLC

3 Gold Mine Rd Flanders NJ 07836 Phone: 973-691-7300 Natl: 800-554-2372 Fax: 973-691-7326 Web Site: www.aerc-mti.com E-Mail: jgresk@aol.com

Advanced Environmental Systems Inc Oldfield Point Rd Elkton, MD 21921 Phone: 410-620-1800 Natl: 800-220-5330 SEE AD ON PAGE 30

Advanced Geoservices Corp Business Campus, Brandywine One Ste 202

Chadds Ford, PA 19317-9676 Phone: 610-558-3300 Natl: 888-824-3992 Fax: 610-558-2620 Web Site: www.agcinfo.com E-Mail: agc@agcinfo.com

Advanced Pollution

Instrumentation Inc 6565 Nancy Ridge Dr San Diego, CA 92121-2251 Phone: 619-657-9800 Natl: 800-324-5190 Fax: 619-657-9816 E-Mail: sales@advpol.com

Adwest Technologies Inc 1175 N Van Horne Way Anaheim, CA 92806 Phone: 714-632-9801 Fax: 714-632-9812 Web Site: www.adwe E-Mail: adwestusa@ioc.net SEE AD ON PAGE 28, 153

Adwest Technologies Inc VOC Control Division Wellsville, NY 14895 Phone: 716-593-1405 Fax: 716-593-6614 Web Site: www.adwestusa.com E-Mail: adwestny@eznet.net SEE AD ON PAGE 28, 153

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Aeromix Systems Inc 2611 N Second St Minneapolis, MN 55411 Phone: 612-521-8519 Natl: 800-879-3677 Fax: 612-521-1455 Web Site: www.aeromix.com F-Mail: aeromix@aeromix.com

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Web Site: www.lrbcg.com/aes E-Mail: aes@lrbcg.com Ag Environmental Products

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Ag-Chem Equipment Co Inc 5720 Smetana Dr Minnetonka, MN 55343 Phone: 612-933-9006 Fax: 612-933-7432 Web Site: www.anchem.com F-Mail: bcameron@agchem.com

Air & Waste Management Association

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Air Products & Chemicals Inc 7201 Hamilton Blvd Allentown, PA 18195-1501 Phone: 610-481-4911 Fax: 610-481-3765 Web Site: www.apci.com

Air Resource Specialists Inc 1901 Sharp Point Dr Ste E Fort Collins, CO 80525 Phone: 970-484-7941 Fax: 970-484-3423 Web Site: www.air-resource.com E-Mail: info@air-resource.com

AirSep Corp – Industrial Division 260 Creekside Dr Buffalo, NY 14228-2075 Phone: 716-691-0202 Natl: 800-320-0303 Fax: 716-691-8304 Web Site: www.airsep.com E-Mail: marketing@airsep.com SEE AD ON PAGE 138

Aires Consulting Group Inc 1550 Hubbard Batavia, IL 60510 Phone: 630-879-3006 Natl: 800-247-3799 Fax: 630-879-3014 Web Site: www.airesconsulting.com

Airflow Systems Inc 11370 Pagemill Rd Dallas, TX 75243 Phone: 214-503-8008 Natl: 800-818-6185 Fax: 214-503-9596 Web Site: www.airflowsystems.com E-Mail: airflow@onramp.net

E-Mail: aires@compuserve.com

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Fax: 724-898-3377 Web Site: www.airotechinc.com E-Mail: tgombo@aol.com Akzo Nobel Geosynthetics

PO Box 1057 Enka, NC 28728 Phone: 704-665-5010 Natl: 800-365-7391 Fax: 704-665-5009

Alaco Ladder Co 5167 G St Chino CA 91710 Phone: 909-591-7561

Fax: 909-591-7565 Albany Intl High Performance Materials PO Box 9114 Mansfield MA 02048-9114

Phone: 508-337-3008 Natl: 888-PYROPEL Fax: 508-337-8550 Web Site: www.albanvint.com/hpm/

Albax Inc 100 Aniline Ave Holland, MI 49424 Phone: 616-396-2411 Natl: 800-535-2411 Fax: 616-396-9426

Alfa Laval Sharples 955 Mearns Rd Warminster, PA 18974-0556 Phone: 215-443-4000 Natl: 800-782-3751 Fax: 215-443-4139 Web Site: www.alfalaval.com

Alicat Scientific Inc 2200 N Wilmot Rd Tucson, AZ 85712 Phone: 520-290-6060 Natl: 888-290-6060 Fax: 520-290-0109 E-Mail: alicat@rtd.com

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Morristown, NJ 07962 Phone: 973-455-5531 Natl: 800-626-4974 Fax: 973-455-5722 Web Site: ww.alliedsignal.com/em/envsys.htm E-Mail: environmental systems@alliedsignal

Altro Floors 467 Forbes Blvd South San Francisco, CA 94080 Natl: 800-382-0333 Fax: 415-583-9564 Web Site: www.altrofloors.com

Alvord, Burdick & Howson Engineers

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Amcec Inc 2525 Cabot Dr Ste 205 Lisle, IL 60532 Phone: 630-577-0400 Fax: 630-577-0401

Ameri-Shred Corn PO Box 46130 Monroeville, PA 15146 Phone: 412-798-7322 Natl: 800-634-8981 Fax: 412-798-7329 Web Site: www.ameri-shred.com E-Mail: info@ameri-shred.com

American Aquatic Testing Inc 1111 Union Blvd Allentown, PA 18103 Phone: 610-434-9015 Fax: 610-434-2510 E-Mail: americanagua@aol.com

American Institute of **Chemical Engineers** 345 E 47th St New York, NY 10017-2395 Phone: 212-705-7661 Natl: 800-242-4363 Fax: 212-705-7812 Web Site: www.aiche.org E-Mail: loisd@aiche.org

American Orthopedic Appliance **Group Inc** 236 Main St Cornwall, NY 12518 Phone: 914-534-9087 Fax: 914-534-4880 Web Site: www.icnweb.com

American Rolloff PO Box 5757 Trenton, NJ 08638 Phone: 609-588-5400 Fax: 609-588-4104 Web Site: www.americanrolloff.com

erican Safety Insurance Group 1845 The Exchange Ste 200 Atlanta, GA 30339 Phone: 770-916-1908 Natl: 800-388-3647 Fax: 770-916-0618 SEE AD ON PAGE 62, 134

American Sigma Inc 11601 Maple Ridge Rd Medina, NY 14103 Phone: 716-798-5580 Natl: 800-635-4567 Fax: 716-798-5599 Web Site: www.americansigma.com E-Mail: americansigma.com

American Waste Services Inc One American Way Warren, OH 44484-5555 Phone: 330-856-8800 Fax: 330-856-8483

Ameron International Fiberglass

Pipe Group 5300 Hollister Ste 111 Houston, TX 77040 Phone: 713-690-7777 Fax: 713-690-2842 Web Site: www.ameron-net.com

Ametek-Regenerative Blower Group 75 North St Saugercies, NY 12477 Phone: 914-246-3401 Fax: 914-246-3802 Weh Site: www.ametek.com

Ametek-Rotron Biofiltration 75 North St Saugerties, NY 12477 Phone: 914-246-3711 Fax: 914-246-3802 E-Mail: heuckeroth@msn.com

Amiad Water Systems Technologies PO Box 5547 Oxnard, CA 93031-5547 Phone: 805-988-3323 Natl: 800-969-4055 Fax: 805-988-3313 SEE AD ON PAGE 67, 100

Amistco Separation Products 23221 W Hwy 6 Alvin, TX 77511 Phone: 281-331-5956 Fax: 281-585-1780

Analah Inc Spring Hill Rd Sterling, PA 18463-0034 Phone: 717-689-3919 Natl: 800-ANALAB-X Fax: 717-689-9360 Web Site: www.analab1.com E-Mail: info@analab1.com

Analytical Measurements Inc 621 Ramsey Ave Hillside, NJ 07205 Phone: 908-964-8686 Natl: 800-635-5580 Fax: 908-964-6622

Anatel Corp 2200 Central Ave Boulder, CO 80301 Phone: 303-442-5533 Natl: 800-373-0531 Fax: 303-447-8365 Web Site: www.anatel.com E-Mail: info@anatel.com

Andax Environmental Corp PO Box 144 Rutherford, NJ 07070 Phone: 973-227-7118 Natl: 800-999-1358 Fax: 973-227-1091 Web Site: www.andax.com E-Mail: customerservice@andax.com SEE AD ON PAGE 63

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Anguil Environmental Systems Inc 8855 N 55th St Milwaukee, WI 53223 Phone: 414-365-6400 Fax: 414-365-6410 Web Site: www.anguil.com E-Mail: sales@anguil.com

Apex Instruments Inc 125 Quantum St Holly Springs, NC 27540 Phone: 919-557-7300 Natl: 800-882-3214 Fax: 919-557-7110 Web Site: www.apexinst.com E-Mail: apexinst@mindspring.com

Aqua-Chem Inc 7800 N 113th St Milwaukee, WI 53224 Phone: 414-359-0600 Fax: 414-577-2723 Web Site: www.aqua-chem.com E-Mail: sales@aqua-chem.com

Arbill Glove & Safety Products 10450 Drummond Rd Philadelphia, PA 19154 Natl: 800-523-5367 Fax: 215-501-8122 Web Site: www.arbill.com F-Mail: arbill@arbill.com

Areo Power Unitized Fueler 103 Smithtown Blvd Smithtown, NY 11787

Phone: 516-366-4362 Natl: 800-242-2736 Fax: 516-366-0905

Arizona Instrument Corp 4114 E Wood St Phoenix, AZ 85040-1952 Phone: 602-470-1414 Fax: 602-470-1888 Web Site: www.azic.com E-Mail: azi@azic.com

Art's Manufacturing & Supply 105 Harrison American Falls, ID 83211 Phone: 208-226-2017 Natl: 800-635-7330 Fax: 208-226-7280 SEE AD ON PAGE 88

Arthur Technology Inc PO Box 1236 Fond du Lac, WI 54936-1236 Phone: 920-922-6970 Natl: 800-328-7518 Fax: 920-922-1085

Asahi/America Inc 35 Green St Malden, MA 02148 Phone: 781-321-5409 Natl: 800-343-3618 Fax: 781-321-4421 Web Site: www.asahi-america.com E-Mail: asahi@asahi-america.com

Ashland Chemical Co 5200 Blazer Pkwy Dublin, OH 43017 Phone: 614-790-3278 Natl: 800-545-8779 Fax: 614-790-4294 Web Site: www.ashchem.com/ E-Mail: csr@ashchem.com

Aspen Technology Inc Ten Canal Pk Cambridge, MA 02141-2201 Phone: 617-949-1000 Fax: 617-949-1719 Web Site: www.aspentech.com E-Mail: info@aspentech.com

Assmann Corporation of America 300 N Taylor Rd Garrett, IN 46738 Phone: 219-357-3181 Natl: 888-357-3181 Fax: 219-357-3738 Web Site: www.assmann-usa.com E-Mail: sales@assmann-usa.com

Associated Design & Manufacturing Co 814 N Henry St Alexandria, VA 22314-1619 Phone: 703-549-5999 Natl: 800-837-8257 Fax: 703-548-0919 E-Mail: pamv@erols.com

Athena Controls Inc 5145 Campus Dr Plymouth Meeting, PA 19462 Phone: 610-828-2490 Natl: 800-782-6776 Fax: 610-828-7084 Web Site: www.athenacontrols.com

Atlantic Fluidics Inc 21 S St S Norwalk, CT 06854 Phone: 203-853-7315 Fax: 203-866-8218 Web Site: www.atlanticfluidics.com

Atlantic Screen & Mfg Inc 118 Broadkill Rd Milton, DE 19968 Phone: 302-684-3197 Fax: 302-684-0643 Web Site: www.ce.net/atlantic

Auburn International Inc PO Box 2008 Danvers, MA 01923 Phone: 978-777-2460 Natl: 800-255-5008 Fax: 978-777-8820

ww.world.std.com/~auburn E-Mail: auburn@world.std.com

August Mack Environmental Inc 8007 Castleton Rd Indianapolis, IN 46250 Phone: 317-579-7400 Natl: 800-579-0770 Fax: 317-579-7410 E-Mail: amack@inetdirect.net

Automatic Filters Inc 2672 S La Cienega Blvd Los Angeles, CA 90034 Phone: 310-839-2828 Natl: 800-336-1942 Fax: 310-839-6878 Web Site: www.tekleen.com E-Mail: tekleen@aol.com

mation Products Inc 3030 Maxroy St Houston, TX 77008-6294 Phone: 713-869-0361 Natl: 800-231-2062 Fax: 713-869-7332

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B L Myers Bros Inc PO Box 500 Glenmoore, PA 19343 Phone: 610-942-2030 Natl: 800-947-5552 Fax: 610-942-2294 Web Site: www.blmyers.com

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BCAM Interanational Inc 1800 Walt Whitman Rd Melville, NY 11747 Phone: 516-752-3550 Natl: 800-248-3746 Fax: 516-752-3558 Web Site: www.bcamergo.com

E-Mail: 74103.2413@compuserve.com **BDM International Inc** 415 W Wall Ste 1818 Midland TX 79701 Phone: 915-682-0008 Fax: 915-682-0028 Web Site: www.bdm.com F-Mail: bdmmid@apex2000.net

BEE-Line Software PO Box 7348 Asheville, NC 28802 Phone: 704-258-1895 Fax: 704-258-1821 Web Site www.beeline-software.com E-Mail: info@beeline-software.com

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BOC Gases 575 Mountain Ave Murray Hill, NJ 07974 Phone: 908-464-8100 Natl: 800-742-4726 Fax: 908-464-3379 Web Site: www.boc.com

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Bacharach Inc 625 Alpha Dr Pittsburgh, PA 15238 Phone: 412-963-2000 Natl: 800-736-4666 Fax: 412-963-2091 Web Site: www.bacharach-inc.com E-Mail: help@bacharach-inc.com

Badger Meter Inc 4545 W Brown Deer Rd Milwaukee, WI 53223 Phone: 414-355-0400 Natl: 800-876-3837 Fax: 414-371-5980 Web Site: www.hadgermeter.com

Bailey-Fischer & Porter Co 125 E County Line Rd Warminster, PA 18974 Phone: 215-674-6000 Fax: 215-674-7183 Web Site: www.ebpa.com/bfp E-Mail: bfp.mktg@bailey.com

Baker Tanks Inc 19618 S Susana Rd Rancho Dominguez, CA 90221 Phone: 310-763-5766 Natl: 800-635-7349 Fax: 310-763-6476 Web Site: www.bakertanks.com E-Mail: sales@bakertanks.com

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2555 Kesper Blvd Dubuque, IA 52001 Phone: 319-556-2241 Natl: 800-553-0039 Fax: 319-589-0516 Web Site: www.barnsteadthermolyne.com F-Mail adv@barnsteadthermolyne.com

Barnstead/Thermolyne

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Web Site: www.barrettinc.com

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Bay Gen Power USA Inc 80 Amity Rd Warwick, NY 10990 Phone: 914-258-5660 Natl: 800-946-3234 Fax: 914-258-3213 F-Mail: www.freenlay@nair.com

Bayou City Pump Works Inc PO Box 23342 Houston, TX 77228-3342 Phone: 713-631-6451 Fax: 713-631-1319 Web Site: www.texserve.com/bayoucity E-Mail: bcpumps@oal.com

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BioRenewal Technologies Inc 2800 S Fish Hatchery Rd Madison, WI 53711 Phone: 608-276-8980 Natl: 888-276-8908 Fax: 608-273-6989 Web Site: www.biorenewal.com E-Mail: info@biorenewal.com

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Blue-White Ind 14931 Chestnut St Westminster, CA 92683 Phone: 714-893-8529 Fax: 714-894-9492 Web Site: www.bluwhite.com E-Mail: bluewhite@msn.com

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Brown & Caldwell 3480 Buskirk Ave Pleasant Hill, CA 94523 Phone: 510-937-9010 Natl: 800-727-2224 Fax: 510-937-9026 Web Site: www.brownandcaldwell.com F-Mail: solutions@hrwncald.com

Brown Bear Corp PO Box 29 Corning, IA 50841 Phone: 515-322-4220 Fax: 515-322-3527 SEE AD ON PAGE 55, 149

Brown, Vence & Associates Inc 120 Montgomery St Ste 1000 San Francisco, CA 94104 Phone: 415-434-0900 Fax: 415-956-6220 E-Mail: bva-sf@brownvence.com

Brown-Minneapolis Tank, A Div of ITEQ Storage Systems 3017 N 35th S Birmingham, AL 35207 Phone: 205-841-0403

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Buchart-Horn Inc PO Box 15040 York, PA 17405-7040 Phone: 717-852-1400 Natl: 800-274-2224 Fax: 717-852-1401 Web Site: www.bh-ba.com E-Mail: corpinfo@bh-ba.com

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Buffalo Drilling Co Inc 10440 Main St Clarence NY 14031 Phone: 716-759-7821 Fax: 716-759-7823 E-Mail: bdcbwp@aol.com

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Chemical Lime Co

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PO Box 910 Holly Springs, NC 27504 Phone: 919-552-0554 Natl: 800-399-4236 Fax: 919-552-3991

Chlorinators Inc.

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Chums Ltd

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Clayton Group Services Inc 91650 Gardenbrook Rd Ste 155 Nori, MI 48375

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Clean Environment Equipment

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Phone: 847-549-7600 Natl: 800-323-4340 Fax: 847-247-2929 Web Site: www.coleparmer.com E-Mail: info@coleparmer.com

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dsconly@compuserve.com Dahl & Associates Inc.

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Louisville, KY 40206 Phone: 502-636-2811 Natl: 800-666-2811 Fax: 502-635-9304 Web Site: www.louladder.comm

Lutz Pumps Inc

1160 Beaver Ruin Rd Norcross, GA 30093 Phone: 770-925-1222 Natl: 800-843-3901 Fax: 770-923-0334

M

M J S & Associates

2916 Nordman Ave New Smyrna, FL 32168 Phone: 904-428-0978 Fax: 904-428-0978 Web Site: www.freeyellow.com/ members2/funzilintex E-Mail: mjsspagquonsb.net

MEGA Systems & Chemicals

450 N Mckemy Ave Chandler, AZ 85226 Phone: 602-437-9105 Natl: 800-690-6342 Fax: 602-705-4319 Web Site: www.megasyschem.com

MGS Inc

178 Muddy Creek Church Rd Denver, PA 17517 Phone: 717-336-7528 Natl: 800-952-4228 Fax: 717-336-0514

MIE Inc (Monitoring Instruments

for the Environment)
7 Oak Park
Bedford, MA 01730
Phone: 781-275-1919
Natl: 888-643-4968
Fax: 781-275-2121
Web Site: www.mieinc.com

MITI Manufacturing

2996 Teller Ct Grand Junction, CO 81504 Phone: 970-243-9500 Fax: 970-243-9200 Web Site: www.mitico.com E-Maii: services@mitico.com

MKS Instruments -

HPS Vacuum Products 5330 Sterling Dr Boulder, CO 80301 Phone: 303-449-9861 Natl: 800-345-1967 Fax: 303-442-6880

MMC International Corp

60 Inip Dr Inwood, NY 11096 Phone: 516-239-7339 Natl: 800-645-7339 Fax: 516-371-3134 Web Site: www.mccintl.com F-Mail: mmcinnd@aol.com

MPC Containment Systems Ltd 4834 S Oakley

Chicago, IL 60609 Phone: 773-927-4120 Natl: 800-621-0146 Fax: 773-650-6028

MPC Environmental

301 W Rising Davison, MI 48423 Phone: 810-658-1700 Fax: 810-653-5655

MST-Modern Safety Techniques

PO Box 87 Hicksville, OH 43526 Phone: 419-542-6645 Natl: 800-542-6646 Fax: 419-542-6475

Magellan Systems Corp 960 Overland Ct

San Dimas, CA 91773 Phone: 909-394-5000 Natl: 800-669-4477 Fax: 909-394-7050 Web Site: www.magellangps.com

Malcom Co-Leister Hot Air Systems

Hot Air Systems 25 Abbot St Andover, MA 01810 Phone: 401-683-3199 Natt: 800-289-7505 Fax: 401-682-1904 Web Site: www.malcom.com E-Mail: malcom@aqua.net

Mapa Professional 512 E Tiffin St Willard, OH 44890

Phone: 419-933-2211 Natl: 800-537-2897 Fax: 419-933-2710 Web Site: www.mapaglove.com E-Mail: sales@mapaglove.com SEE AD ON PAGE 109, 187

Mar Mac Manufacturing Co Inc PO Box 278

McBee, SC 29101-0278 Phone: 803-335-8211 Natt: 800-845-6962 Fax: 803-335-8599 Web Site: www.marmac.com E-Mail: info@marmac.com

Mark Schultz Associates

1202 West St Annapolis, MD 21401 Phone: 410-263-8538 Fax: 410-626-6194 E-Mail: msahvdro@compuserve.com

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International Inc PO Box 9870 Santa Fe, NM 87504 Phone: 505-982-9792 Fax: 505-982-1306

Mars Mineral

PO Box 719 Mars, PA 16046 Phone: 412-538-3000 Fax: 412-538-5078

Martin Marietta Magnesia Specialties



Martin Marietta Magnesia Specialties Inc PO Box 15470 Baltimore, MD 21220-0470 Phone: 410-780-5500 Nati: 800-648-7400 Fax: 410-780-5777 Web Site:

www.martinmarietta.com SEE AD ON PAGE 165

Maxon Industries Inc 3204 W Mill Rd Milwaukee, WI 53209 Phone: 414-351-4000 Natl: 800-236-9944 Fax: 414-351-9057 Web Site: www.maxon.com E-Mail: sales@maxon.com

Mazzei Injector Corp 500 Rooster Dr Bakersfield, CA 93307 Phone: 805-363-6500 Fax: 805-363-7500 Web Site: www.mazzei-injector.com SEE AD ON PAGE 87. 160

McGill Airclean Corp 1779 Refuge Rd

Columbus, OH 43207-2119 Phone: 614-443-0192 Fax: 614-445-8759

McMillan Co PO Box 1340

PO Box 1340 Georgetown, TX 78627 Phone: 512-863-0231 Natl: 800-861-0231 Fax: 512-863-0671 Web Site: www.mcmillancompany.com E-Mail: info@mcmillancompany.com

McPhee Environmental Supply 11460 N Cave Creek Rd Ste 1

Phoenix, AZ 85020 Phone: 602-943-9565 Natl: 888-608-4637 Fax: 602-944-6559 Web Site: www.mcphee-env.com

Medic-Air Corp of America 1963 Palmer Ave

1963 Palmer Ave Larchmont, NY 10538 Phone: 914-834-2727 Natl: 800-247-7455 Fax: 914-834-2045

Medical Coaches Inc PO Box 129 Oneonta, NY 13820

Phone: 607-432-1333 Fax: 607-432-8190 Megator Corp 562 Alpha Dr

Pittsburgh, PA 15238 Phone: 412-963-9200 Natl: 800-245-6211 Fax: 412-963-9214

Mercury Technologies Intl LP 3 Gold Mine Rd Flanders, NJ 07836 Phone: 973-691-7300 Natl: 800-554-2372 Fax: 973-691-7326

Web Site: www.aerc-mit.com

E-Mail: jgresk@aol.com

Met One Instruments Inc 1600 Washington Blvd Grants Pass, OR 97526 Phone: 541-471-7111 Fax: 541-471-7116 Web Site: www.metone.com E-Mail: metone@metone.com

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Metal Samples/Cortest Instrument Systems

152 Metal Samples Rd Munford, AL 36268 Phone: 205-358-4202 Fax: 205-358-4515 Web Site: www.alspi.com E-Mail: msc@alspi.com

Metco Environmental PO Box 598 Addison, TX 75001 Phone: 972-931-7127 Natl: 800-394-1194

Fax: 972-931-8398

Metropolitan Manufacturers Association 10733 Big Bend Rd St Louis, MO 63122-6027

Phone: 314-966-1006 Metrosonics Inc PO Box 23075 Postporter NV 14600

Rochester, NY 14692 Phone: 716-334-7300 Fax: 716-334-2635 Web Site: www.metrosonics.com E-Mail: salesinfo@metrosonics.com

Metrotech Corp 488 Tasman Dr Sunnyvale, CA 94089 Phone: 408-734-1400 Natl: 800-446-3392 Fax: 408-734-1415 Web Site: www.metrotech.com E-Mail: sales@metrotech

Microbial Insights Inc 2340 Stock Creek Blvd Rockford, TN 37853 Phone: 423-573-8188 Fax: 423-573-8133 Web Site: www.microbe.com E-Mail: microbe@microbe.com

Mid America Railway Supply Inc PO Box 779 Bridgeton, MO 63044 Phone: 314-770-2233 Fax: 314-770-1994

Midac Corp 17911 Fitch Ave Irvine, CA 92614 Phone: 714-660-8558 Fax: 714-660-9334 Web Site: www.midac.com E-Mail: info@midac.com

Midland Metal Mfg Co 1219 Lydia Ave Kansas City, MO 64106 Phone: 800-821-5725 Fax: 800-877-5391 Web Site: www.midlandmetal.com E-Mail: midbrass@aol.com

Midwest Center for Occupational Health & Safety 640 Jackson St

St Paul, MN 55101 Phone: 612-221-3992 Fax: 612-292-4773

Midwest Research Institute 425 Volker Blvd Kansas City, MO 64110 Phone: 816-753-7600 Fax: 816-753-8420 Web Site: www.mriresearch.org

E-Mail: bduncan@mriresearch.org Miguel A Antonetti & Associates 19 Willowlawn St Buffalo, NY 14214-2328

Phone: 716-835-6824 Fax: 716-835-1529 E-Mail: latinecol@aol.com

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Milltronics Inc 709 Stadium D Arlington, TX 76011 Phone: 817-277-3543 Fax: 817-277-3894 Web Site: www.milltronics.com E-Mail: freelit@milltronics.com **SEE AD ON PAGE 66, 124**

Mincy Inc PO Box 81692 Mobile, AL 36689 Phone: 334-342-0024 Fax: 334-344-8027 Web Site: www.concentric.net/~mincy E-Mail: mincy@cris.com

Mine Safety Appliances Co PO Box 426 Pittsburgh, PA 15230 Phone: 800-672-2222 Fax: 800-967-0398 Web Site: www.msanet.com

E-Mail: info@msanet.com Miox Corp 5500 Midway Park Pl Albuquerque, NM 87109 Phone: 505-343-0090

Natl: 888-MIOX-H2O Fax: 505-343-0093 Web Site: www.miox.com F-Mail: info@miox.com

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Monarch Instrument 15 Columbia Dr Amherst, NH 03031 Phone: 603-883-3390 Natl: 800-999-3390 Fax: 603-886-3300 Web Site www.monarchinstrument.com sales@monarchinstrument.com

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314-275-5907

Monsanto Enviro-Chem Systems 14522 S Outer Forty Rd St Louis, MO 63017 Phone: 314-275-5700 Fax: 314-275-5701 Web Site: www.enviro-chem.com E-Mail: enviroch@monsanto.com

Morlan & Morlan Inc PO Box 5945 Shreveport, LA 71135 Phone: 318-797-3560 Fax: 318-797-3560



Morrison Knudsen Corp PO Box 73 Boise, ID 83729 Phone: 208-386-5000 Fax: 208-386-5658 Web Site: www.mk.com



Morton International 100 N Riverside Plaza Chicago, IL 60606 Phone: 312-807-3127 Fax: 312-807-3460 Web Site: www.morton.com

Moshman Environmental Engineering 2700 Central Park Ave Evanston, IL 60201 Phone: 847-869-6770 Fax: 847-824-2647 Web Site: www.meridianone F-Mail: dmoshman@msn.com

Mother Oil Remidiation 1124 Purina Dr Gainesville, GA 30501

Phone: 770-534-3119 Fax: 770-534-3117 SEE AD ON PAGE 53, 110

Mott Corp 84 Spring Ln Farmington, CT 06032 Phone: 860-747-6333 Natl: 800-289-6688 Fax: 860-747-6739

Mountain Valley Ventures Inc PO Box 85097 Tucson AZ 85754 Phone: 520-743-4036 Natl: 800-597-0618 Fax: 520-743-4072

Munters Corporation -Zeol Division 79 Monroe St Amesbury, MA 01913 Phone: 978-241-1103 Natl: 800-843-5360 Fax: 978-241-1220 Web Site: www.munters.com/zeol sales-zeol@americas.munters.com

Myron L Co 6115 Corte Del Cedro Carlsbad, CA 92009 Phone: 760-438-2021 Fax: 760-931-9189

Mystic Air Quality Consultants Inc 1204 North Rd Groton, CT 06340 Phone: 800-247-7746 Fax: 860-449-8860 E-Mail: magcz@aol.com

N B Olewine Co Inc 120 Broadway Ste 1117 New York, NY 10271 Phone: 212-227-7220 Natl: 800-521-9244 Fax: 212-732-4037 Web Site: www.mar.com/rodcite nolewine@ix.netcom.com

NEEP Systems 17 Technology Dr West Lebanon, NH 03784 Phone: 603-298-7061 Fax: 603-298-7063

NES Inc. 44 Shelter Rock Rd Danbury, CT 06810 Phone: 203-796-5000 Fax: 203-796-5117 E-Mail: bbeck01

NW Center for Occupational Health & Safety 4225 Roosevelt Way Ste 100 Seattle, WA 98105 Phone: 206-543-1069 Fax: 206-685-3872 www.sphcm.washington.edu/deh E-Mail: ce@u.washington.edu

Nagle Pumps Inc 1249 Center Ave Chicago Heights, IL 60411 Phone: 708-754-2940 Fax: 708-754-2944

Nalco Chemical Co One Nalco Ctr Naperville, IL 60563-1198 Phone: 630-305-1000 Fax: 630-305-2900 Web Site: www.nalco.com

901 Janesville Ave Fort Atkinson, WI 53538-0901 Phone: 920-563-2446 Natl: 800-558-9595 Fax: 920-563-8296 Web Site: www.nascofa.com E-Mail: info@nascofa.com

Nassef Engineering & Equipment Co Inc 301 W Nine Mile Rd Pensacola, Fl. 32534-1819 Phone: 850-484-2700 Fax: 850-484-0706 E-Mail: last2kh

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National Technical Information Service 5285 Port Royal Rd Springfield, VA 22161 Phone: 703-605-6000 Natl: 800-553-6847 Fax: 703-321-8547 Web Site: www.ntis.gov E-Mail: orders@ntis.fedworld.gov

National Technical Systems 5743 Smithway St City of Commerce, CA 90040 Phone: 213-838-9250 Natl: 800-434-7431 Fax: 213-838-9252 Web Site: www.ntscorp.com

Neoterik Health Technologies Inc 401 S Main St Woodsboro, MD 21798 Phone: 301-845-2777 Fax: 301-845-2213 E-Mail: sales@neoterik.com

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Neptune Mixer Co PO Box 247 Lansdale, PA 19446 Phone: 215-699-8701 Fax: 215-699-0370 Web Site: www.neptunel.com E-Mail: pump@neptunel.com

Network Environmental Systems Inc 10933 Trade Center Dr Ste 108 Rancho Cordova, CA 95670 Phone: 916-853-9400 Natl: 800-637-2384 Fax: 916-853-8526 Web Site: www.nes-hazmat.com E-Mail: nesstaff@ix.netcom.com

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New Pig Corp One Pork Ave Tipton, PA 16684 Phone: 814-684-0101 Natl: 800-HOT-HOGS Fax: 800-621-7447 Web Site: www.newpig.com E-Mail: hothogs@newpig.com

New York Blower Co 7660 Quincy St Willowbrook, IL 60521 Phone: 630-794-5700 Fax: 630-794-5776 Web Site: www.nyb.com E-Mail: nyb@nyb.com

Newport Electronics Inc 2229 S Yale St Santa Ana, CA 92704-4426 Phone: 714-540-4914 Natl: 800-NEWPORT Fax: 714-546-3022 Web Site: www.newportelect.com E-Mail: info@newportelect.com

Nielsons Inc PO Box 1660 Cortez, CO 81321 Phone: 970-565-8000 Fax: 970-565-0118 E-Mail: ceastin@nielsons.com

Niro Inc 1600 O'Keefe Rd Hudson, WI 54016 Phone: 715-386-9371 Fax: 715-386-9376

Niro Inc 9165 Rumsey Rd Columbia MD 21774 Phone: 410-997-8700 Fax: 410-997-5021 Web Site: www.niroinc.com E-Mail: smb@niroinc.com

Normandeau Associates 25 Nashua Rd Bedford, NH 03110-5500 Phone: 603-472-5191 Fax: 603-472-7052 E-Mail: nai@nh.ultranet.com

North Safety Products 2000 Plainfield Pike Cranston, RI 02921 Phone: 401-943-4400 Fax: 401-946-9285

NuTech anvironmantal corp. 800-321-8824 **NuTech Environmental Corp**

5350 N Washington St Denver, CO 80216 Phone: 303-295-3702 Natl: 800-321-8824 Fax: 303-295-6145 Web Site: www.nutechenvironmental E-Mail: nutech@sni.net

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Ol Analytical PO Box 9010 College Station, TX 77842 Phone: 409-690-1711 Natl: 800-653-1711 Fax: 409-690-0440 Web Site: www.oico.com E-Mail: oimail@oico.com

Occupational Training & Supply Inc 12601 S Springfield Ave Alsip, IL 60803 Phone: 708-385-1325 Fax: 708-385-1751 E-Mail: otstrain@aol.com

Occusate Inc 240 E Lake St Addison II 60101 Phone: 630-941-3001 Natl: 8003237597 Fax: 630-941-3865 Web Site: www.quikpage.com/o/occusafe

Odor Control Co Inc PO Box 5740 Scottsdale, AZ 85261-5740 Phone: 602-948-3956 Natl: 888-948-3956 Fax: 602-451-1010 Web Site: www.odorcontrolco.com E-Mail: noodors@msn.com

E-Mail: occusate@compuserve.com

Odor Management Inc 18-4 E Dundee Rd Ste 200 Barrington, IL 60010 Phone: 847-304-9111 Natl: 800-662-6367 Fax: 847-304-0989

Web Site: www.odormanagement.com E-Mail: ecosorb@goldengate.net

Odor Management Technologies PO Box 86 Lesueur, MN 56058

Phone: 507-665-8800 Natl: 888-665-6367 Fax: 507-665-3520 Web Site www.prairie.lakes.com/~plonske E-Mail: plonske@prairie.lakes.com

Off-Road Conversions Inc -MATTRACK

Route 2 Box 299 Badger, MN 56714 Phone: 218-528-4828 Fax: 218-528-2761

Ohaus Corp 29 Hanover Rd Florham Park, NJ 07932 Phone: 973-377-9000 Natl: 800-672-7722 Fax: 973-593-0359 Web Site: www ohaus com

Oil Skimmers Inc PO Box 33092 Cleveland, OH 44133 Phone: 440-237-4600 Natl: 800-200-4603 Fax: 440-582-2759 SEE AD ON PAGE 55, 145

Oklahoma State University

512 Engineering N Stillwater, OK 74078 Phone: 405-744-5714 Fax: 405-744-5369 Web Site www.master.ceat.okstate.edu/grad gcollin@okway.okstate.edu

Omega Engineering Inc One Omega Dr Stamford, CT 06907 Phone: 203-359-1660 Natl: 800-826-6342 Fax: 203-359-7700 Web Site: www.omega.com E-Mail: info@omega.com SEE AD ON PAGE 2, 133

Omega-Vanzetti Inc Six Merchant St Pinehill Pk Sharon, MA 02067 Phone: 617-784-4733 Fax: 617-784-2447 Web Site: www.vanzetti.com E-Mail: info@vanzetti.com

Omegadyne Inc 149 Seltzer Ct Sunbury, OH 43074 Phone: 614-965-9340 Natl: 800-872-3963 Fax: 614-965-9438 Web Site: www.omegadyne.com E-Mail: info@omegadyne.com

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Onset Computer Corp 470 MacArthur Blvd Bourne, MA 02532 Phone: 508-759-9500 Fax: 508-759-9100 Web Site: www.onsetcomp.com E-Mail: sales@onsetcomp.com

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63 Polson St 2nd FI Toronto ON Canada, M5A 1A4 Phone: 416-778-5264 Fax: 416-778-5624 Web Site: www.oceta.on.ca F-Mail: oceta@oceta.on.ca

Optimal Technologies Inc 575 William Pitt Way Pittsburgh, PA 15238 Phone: 412-828-7330 Natl: 888-838-7330 Fav. 412-828-7338 F-Mail: optimaltechnologies@woldnet.att.net

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Oxford Molecular Group Inc/CIS 2105 S Bascom Ave Ste 200 Campbell, CA 95008 Phone: 408-879-6300 Natl: 800-876-9994 Fax: 408-879-6302 Web Site: www.oxmol.com E-Mail: products@oxmol.com

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PCI-Wedeco Environr Technologies Inc
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PE Photovac 761 Main Ave Norwalk, CT 06859-0211 Phone: 203-761-5330 Natl: 888-732-4766 Fax: 203-761-2677 Web Site: www.perkin-elmer.com/photo E-Mail: pvemktg@perkin-elmer.c SEE AD ON PAGE 79, 144

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PRO Scientific Inc PO Box 448 Monroe, CT 06468 Phone: 203-452-9431 Fax: 203-452-9753 Web Site: www.proscientific.com E-Mail: prosci@aol.com

PacTec Inc PO Box 8069 Clinton, LA 70722 Phone: 504-683-8602 Natl: 800-272-2832 Fax: 504-683-8711 Web Site: www.eatel.net/~pactecjd F-Mail: nactecmsa@eastel.net

Pace Environm **Products Inc** 5240 W Coplay Rd Whitehall, PA 18052 Phone: 610-262-3818 Natl: 800-303-4532 Fax: 610-262-4445 Web Site: www.pacecems.com E-Mail: pacecems@juno.com

Pacific Environmental Services Inc 560 Herndon Pkwy Ste 200 Herndon, VA 20170-5240 Phone: 703-471-8383 Fax: 703-481-8296 Web Site: www.pes.com/pes E-Mail: tlipuma@hrn.pes.com

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Pall Corporation 2200 Northern Blvd East Hills, NY 11548 Phone: 516-484-5400 Natl: 800-873-7255 Fax: 516-484-0364 Web Site: www.pall.com E-Mail: custsvc@pall.com

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Perma Pure Inc 8 Executive Dr Toms River, NJ 08754 Phone: 732-244-0010 Natl: 8003373762 Fax: 732-244-8140 Web Site: www.industry-net/perma-pure E-Mail: perma-pure@industry.net

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Phyto Works Inc 1400 Mill Creek Rd Gladwyne, PA 19035 Phone: 610-896-9949 Fax: 610-896-9950 E-Mail: phytoworks@aol.com

Plast-O-Matic Valves Inc 1384 Pompton Ave Ceder Grove, NJ 07009 Phone: 973-256-3000 Fax: 973-256-4745 Web Site: www.plastomatic.com

Plasti-Fab Inc 9665 Tualatin-Sherwood Rd Tualatin OR 97062 Phone: 503-692-5460 Fax: 503-692-1145 Web Site: www.plasti-fab.com E-Mail: sales@plasti-fab.com

Plastic Film Enterprises Inc 1921 Bellaire Ave Royal Oak, MI 48067 Phone: 248-399-0450 Natl: 800-574-6553 Fax: 248-399-2534

Pneumafil Corp PO Box 16348 Charlotte, NC 28297-8804 Phone: 704-399-7441 Natl: 800-525-1560 Fax: 704-398-7529

Pollution Research & Technology Inc 12 Medici Ste 200 Laguna Hills, CA 92656 Phone: 714-588-9473 Fax: 714-588-9573 E-Mail: prt4env@aol.com

Polylonix Separation Technologies Inc PO Box 1004 Dayton, NJ 08810-1004 Phone: 732-274-3103 Natl: 888-249-4469 Fax: 732-274-3144 E-Mail: brickera@pginw.com

PolySpec Corp 6614 Gant Rd Houston, TX 77066 Phone: 281-397-0033 Fax: 281-397-6512 Web Site: www.polyspec.com E-Mail: info@polyspec.com

der Coating Institute 2121 Eisenhower Ave Ste 401 Alexandria, VA 22314 Phone: 703-684-1770 Fax: 703-684-1771 Web Site: www.powdercoating.org

ers Process Controls 3400 Oakton Skokie, IL 60076 Phone: 847-673-6700 Fax: 847-673-9044

Precision Analysis Inc 22 Orvieto Florissant, MO 63031 Phone: 314-838-5052 Fax: 314-838-5052

Precision Multiple Controls

Precision Multiple Controls 33 Greenwood Ave Midland Park, NJ 07432 Phone: 201-444-0600 Fax: 201-445-8575 precisionmultiple@worldnet.att.net

Precision Wire Products Inc 207 E Brown St Blairsville, PA 15717

Phone: 412-459-5601 Fax: 412-459-0559

Premier Safety & Serivce Inc 516 Parkway View Dr Pittsburgh, PA 15205 Phone: 412-788-4415 Natl: 800-828-1080 Fax: 412-788-6628 E-Mail: presftyser@aol.com

Premier Services Corp 7251 Engle Rd Ste 415 Middleburg Heights, OH 44130 Phone: 440-234-4600 Natl: 800-227-4287 Fax: 440-234-5772 Web Site: www.ampremier.com

Price Pump Co PO Box Q Sonoma, CA 95476 Phone: 707-938-8441 Fax: 707-938-0764 Web Site: www.pricepump.com E-Mail: sales@pricepump.com

Princeton-Somerset Group Inc 4 Carroll Dr Somerville, NJ 08876 Phone: 908-369-6890

Probiotic Solutions 201 S Roosevelt Ave Chandler, AZ 85226 Phone: 602-961-1220 Natl- 800-961-1220 Fax: 602-961-3501 Web Site: www.probiotic.com E-Mail: probiotic@probiotic.com SEE AD ON PAGE 63, 144

Process Combustion Corp 5460 Horning Rd Pittsburgh, PA 15236-2822 Phone: 412-655-0955 Fax: 412-650-5569 E-Mail: pcc@usaor.net

Process Packaging & Centrol Inc 65 Aviation Ave Portsmouth, NH 03801

Phone: 603-430-1118 Fax: 603-430-1114

Process Technologies Inc 1160 Exchange St Boise, ID 83716 Phone: 208-385-0900 Fax: 208-385-0994 F-Mail: mswan@rmci net

Professional Analytical & Consulting Services Inc 409 Meade Dr Coraopolis, PA 15108 Phone: 724-457-6576 Natl: 800-367-2587 Fax: 724-457-1214

Web Site: www.members.aol.colm/ hnnacs/pacs htm E-Mail: hnpacs@aol.com

Progressive Equipment Corp 413 E 9th St Erie. PA 16503 Phone: 814-452-4363 Natl: 800-548-6089 Fax: 814-459-3094

Protech Co 32 Fremont St Needham, MA 02194 Phone: 781-444-5188 Fax: 781-444-0130 Web Site: www.pro E-Mail: mmorrill@protetechco.com SEE AD ON PAGE 29, 31, 145, 147 Protectorwire Co Inc PO Box 200 Hanover, MA 02339 Phone: 781-826-3878 Fax: 781-826-2045 Web Site: www.protectowire.com

Pumpex Inc 103A Molasses Hill Rd Lebanon, NJ 08833 Phone: 908-730-7004 SEE AD ON PAGE 159

Purac Engi Purac Engineering 4550 New Linden Hill Rd Ste 500 Wilmington, DE 19808 Phone: 302-996-0545 Fax: 302-996-0544

Q Financial Group 457 N Harrison St Princeton, NJ 08540 Phone: 609-924-9394 Fax: 609-924-3935

QED Environmental Systems Inc PO Box 3726 Ann Arbor, MI 48106 Natl: 800-624-2026

Quadrel Services Inc 1896 Urbana Pike Ste 20 Clarksburg, MD 20871 Phone: 301-874-5510 Natl: 800-878-5510 Fax: 301-874-5567 E-Mail: quadrel@erols.com

Quality Assurance Associates 1007 Francis Dr College Station, TX 77840 Phone: 409-694-7199 Fax: 409-694-7199 Web Site: www.netcom.com/~qaa F-Mail: gaa@ix netcom.com

Quantum Compliance Systems Inc 4251 Plymouth Rd Ste 1200 Ann Arbor, MI 48105 Phone: 734-761-2175 Fax: 734-761-3058 Web Site: www.qcs-facts.com E-Mail: quantum@qcs-facts.com SEE AD ON PAGE 13, 131

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R

R & D Dimensions PO Box 700-95 Redondo Beach, CA 90277 Phone: 310-316-3520 Fax: 310-316-0686 E-Mail: rddimen@aol.com

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R S Technical Services Inc 1327 Clegg St Petaluma, CA 94954 Phone: 707-778-1974 Natl: 800-767-1974 Fax: 707-778-1981 Web Site: www.re-technical.com E-Mail: aida@rs-technical.com

R T Corporation PO Box 1346 Laramie, WY 82070 Phone: 307-742-5452 Natl: 800-576-5690 Fax: 307-745-7936 E-Mail: rtrefmat@aol.com

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Racal Health & Safety Inc 7305 Executive Way Frederick, MD 21704 Phone: 301-695-8200 Natl: 800-682-9500 Fax: 301-695-4413 Web Site: www.racalhealth.com E-Mail; info@racalhealth.com

RadTech International North America 60 Revere Dr Ste 500 Northbrook, IL 60062 Phone: 847-480-9576 Fax: 847-480-9282 Web Site: www.radtech.org E-Mail: uveb@radtech.org

Radiac Environmental Serivces 261 Kent Ave Brooklyn, NY 11211 Phone: 718-963-2233 Fax: 718-388-5107

Rain for Rent PO Box 2248 Bakersfield, CA 93303 Phone: 805-399-9124 Natl: 800-742-7246 Fax: 805-393-1542

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Raytheon Environmental

& Quality Programs One Broadway Cambridge, MA 02142 Phone: 617-494-7100 Fax: 617-494-7953 Web Site: www.ravtheon.com pat_tracy-callahan@ccgate.ueci.com

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Reef Industries Inc PO Box 750250 Houston, TX 77275-0250 Phone: 713-507-4200 Natl: 800-231-6074 Fax: 713-507-4295 Web Site: www.reefindustries.com E-Mail: ri@reefindustries.com

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Resource Management Group Inc PO Box 487 Grand Haven, MI 49417-0487 Phone: 616-847-1680 Natl: 888-847-1680 Fax: 616-847-9970 E-Mail: rmggh@novagate.com

Response Rentals 1057 E Henrietta Rd Rochester, NY 14023 Phone: 800-242-3910 Fax: 716-424-2166 Web Site: www.responsere F-Mail: response@netacc.net

Restek Corp 110 Benner Cir Bellefonte, PA 16823 Phone: 814-353-1300 Natl: 800-356-1688 Fay: 814-353-1309

Web Site: www.restekcorp.com E-Mail: donm@restekcorp.com SEE AD ON PAGE 56, 146

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Rhodia Inc Eco Services 10777 Northwest Frwy Houston, TX 77092 Phone: 800-521-2289 Natl: 800-521-2289 Fax: 713-683-3316 Web Site: www.ecoservices-us.rhodia.com

Roberts & Schaefer Co 120 S Riverside Plz Chicago, IL 60606 Phone: 312-236-7292 Fax: 312-726-2872 E-Mail: tomb@eni.com

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Rosedale Products Inc. 3730 W Liberty Ann Arbor, MI 48103 Phone: 734-665-8201 Natl: 800-821-5373 Fax: 734-665-2214 Web Site: www.rosedale-products.com E-Mail: info@rosedale-products.com

Rosemount Analytical Inc/

Uniloc Division 2400 Barranco Pkwy Irvine, CA 92606 Phone: 714-863-1181 Natl: 800-854-8257 Fax: 714-474-7250 Web Site: www.rauniloc.com E-Mail: linda.dunham@frco.com SEE AD ON PAGE 72, 148

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Ross Air Systems

PO Box 310 Somerville, NJ 08876-0310 Phone: 908-356-4555 Fax: 908-356-6676

Ross Analytical Services Inc 16433 Foltz Industrial Pkwy Strongsville, OH 44136 Phone: 440-572-3200 Natl: 800-325-7737 Fax: 440-572-7620 Web Site: www.rossanalytical.com E-Mail: sales@rossanalytical.com

Rotronic Instrument Corp 160 E Main St Huntington, NY 11743 Phone: 516-427-3898 Natl: 800-628-7101

Fax: 516-427-3902 Web Site: www.rotronic-usa.com E-Mail: sales@rotronic-usa.com

Roy F Weston Inc 1 Weston Way West Chester, PA 19380-1499 Phone: 610-701-3000 Natl: 800-7WESTON Fax: 610-701-3124 Web Site: www.rfweston.com E-Mail: webmaster@rfweston.com

Royal Guard Corp

PO Box 6470 Longview, TX 75608 Phone: 903-759-3455 Fax: 903-759-0229 royalquardcorporation@worldnet.att.

Royce Instrument Corp 1355 Gentilly Rd New Orleans, LA 70129 one: 504-254-8888 SEE AD ON PAGE 12, 122

Old Airport Rd Sanford Municipal Airport Sanford, ME 04073 Phone: 207-324-2877 Natl: 800-289-7822 Fax: 207-324-2347 Web Site: www.rubb.com E-Mail: info@rubbusa.com

Rubbercraft 15627 S Broadway Gardena, CA 90248 Phone: 310-328-5402 Fax: 310-618-1832

Rusmar Inc 216 Garfield Ave West Chester, PA 19380 Phone: 610-436-4314 Natl: 800-733-3626 Fax: 610-436-8436 Web Site: www.rusmarinc.com F-Mail: rusmar@voicenet.com

Rust Environment & Infrastructure 15 Brendan Way Greenville, SC 29615 Phone: 864-234-3000 Natl: 800-868-0373 Fax: 864-234-2289 Web Site: www.rustei.com SEE AD ON PAGE 3, 115

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Phone: 732-932-9271 Fax: 732-932-1187 Web Site www.aesop.rutgers.edu/~ocpe E-Mail: galan@aesop.rutgers.edu

S & N Airoflo P O Drawer 1994 Greenwood, MS 38935 Phone: 800-844-4524 Fav: 800-761-4442 SEE AD ON PAGE 78, 120 S C Altman & Associates 2424 W 207th St Olympia Fields, IL 60461 Phone: 708-747-3399 Fax: 708-481-1248

S.F. International Inc. PO Box 39 Summertown, TN 38483-0039 Phone: 931-864-3561 Natl: 800-293-5759 Fax: 931-964-3564 Web Site: www.seintl.com E-Mail: seiinc@usit.net

SAMSCO Inc 18 Cote Ave Goffstown, NH 03045 Phone: 603-668-7111 Fax: 603-647-0537 F-Mail: sales@samsco.inc.co SEE AD ON PAGE 39, 127

SASSCO 212 Orange Grove St Hillsborough, NC 27278 Phone: 919-732-3115 Fax: 919-732-7670

SBP Technologies Inc 106 Corporate Park Dr White Plains NY 10604 Phone: 914-694-2280 Natl: 888-727-6514 Fax: 914-694-2286 Web Site: www.sbptech.com E-Mail: 107776,2333

SEMCOR 815 E Gate Dr Mount Laurel, NJ 08054 Phone: 609-234-6700 Fax: 609-234-7646 Web Site: www.semcor.com

SENTEX Systems Inc 553 Broad Ave Ridgefield, NJ 07657 Phone: 201-945-3694 Natl: 800-736-8394 Fax: 201-941-6064

SGL Carbon Composites Inc -HITCO 1600 W 135th St Gardena, CA 90249 Phone: 310-527-0700 Natl: 800-421-5444 Fax: 310-515-1779 Web Site: www.hitcotechnologies.com E-Mail: refrasil@hitco.com

Services Inc 201 Rte 17 N Meadows Office Rutherford, NJ 07070 Phone: 201-935-1500 Natl: 800-747-9047 Fax: 201-935-4555 Web Site: www.sasicsus.com E-Mail: sgsics@ibm.net SEE AD ON PAGE 35, 121

SGS International Certification

SGS US Testing Co Inc 291 Fairfield Av Fairfield, NJ 07004 Phone: 973-575-5252 Natl: 800-777-TEST Fax: 973-575-7175 Web Site: www.ustesting@sgsna.com E-Mail: ed_ronk@sgsgroup.com

SIMCO Drilling Equipment Inc 802 Furnas Dr Osceola, LA 50213 Phone: 515-342-2166 Natl: 800-338-9925

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SKC Inc 863 Valley View Rd Eighty Four, PA 15330 Phone: 412-941-9701 Natl: 800-752-8472 Fax: 412-941-1369 Web Site: www.skcinc.com E-Mail: skcinc@skcinc.com SKS Bottle & Packaging Inc 3 Knabner Rd Mechanicville, NY 12118 Phone: 518-899-7490 Fax: 800-810-0440 E-Mail: zehnere@aol.com

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SRS Technologies 2323 S Washington Ave Ste 209 Titusville FI 32780 Phone: 407-267-3044 Fax: 407-264-2576 Web Site: www.srs.com F-Mail: marybecker@aol.com

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STAR Consultants Inc 962 Nelson PI Ste 2 Arnold, MD 21012 Phone: 410-349-9713 Fax: 410-757-0524 Web Site www.starconsultants.com E-Mail: starconsultants.com

STC Remediation Inc 7650 E Redfield Rd Ste D5 Scottsdale, AZ 85260 Phone: 602-948-7100 Fax: 602-991-3173 Web Site: www.stcremediation.com

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Stick Shop Div of Light Fabrications Inc 40 Hyter Cir Rochester, NY 14606 Phone: 716-426-5330 Natl: 800-836-6920 Fax: 800-648-5639 www.lightfad.com/stickshop E-Mail: stickshop@exnet.net

Stonehill Environmental Inc 600 State St Portsmouth, NH 03801 Phone: 603-433-1935 Natl: 800-639-4503 Fax: 603-433-1942 F-Mail: stnhillenv@aol.com

Strategic Diagnostics Inc 111 Pencader Drive Newark, DE 19702 Phone: 302-456-6789 Natl: 800-544-8881 Fax: 302-456-6782 Web Site: www.sdix.com E-Mail: ckosty@sdix.com SEE AD ON PAGE 161

Sur-Loc Inc PO Box 750 Fremont, IN 46737 Phone: 219-495-4065 Natl: 800-223-7517 Fax: 219-495-4205 E-Mail: bswager@dmci.net

Surface Combustion Inc

1700 Indian Wood Cir Maumee OH 43537 Phone: 419-891-7150 Natl: 800-537-8980 Fax: 419-891-7151 Web Site: www.sufracecombustion.com

Survivair Inc. 3001 S Susan St Santa Ana, CA 92704 Phone: 714-545-0410 Natl: 888-277-7222 Fax: 800-201-4407 Web Site: www.survivair.com F-Mail: marketing@survivair.com

Sybron Chemicals Inc PO Box 66 Birmingham, NJ 08011 Phone: 609-893-1100 Natl: 800-678-0020 Fax: 609-894-8541 Web Site: www.sybronchemicals.com T

TEAC America-Information **Products Div**

7733 Telegraph Rd Montebello, CA 90640 Phone: 213-726-0303 Fax: 213-727-7621

TECO-Westinghouse Motor Co PO Box 277 Round Rock, TX 78630-0877 Phone: 512-255-4141 Natl: 800-451-8798 Fav: 512-244-5000

Web Site: www.teco-wmc.com

TISCOR 11225 W Bernardo Ct San Diego, CA 92127 Phone: 619-451-3710 Natl: 800-227-6379 Fax: 619-451-3901 Web Site: www.tiscor.com

F-Mail: tiscor@tiscor.com

TNT Technology Co 2121 W University Dr Ste 123 Tempe, AZ 85281 Phone: 602-966-9891 Fax: 602-968-9469 E-Mail: tntinc@coodnet.com

TRAK Environmental Group Inc 4125 Market St Ste 19 Ventura, CA 93003 Phone: 805-650-5333 Fax: 805-650-7213 Web Site: www.trakenviro.com E-Mail: trak@trakenviro.com

5 Waterside Crossing Windsor, CT 06095 Phone: 860-289-8631 Natl: 800-365-8254 Fax: 860-298-6399 Web Site: www.trcec.com F-Mail: trcwindsor@aol.com

TYMCO Inc PO Box 2368 Waco, TX 76703 Phone: 254-799-5546 Natl: 800-258-9626 Fax: 254-799-2722 Web Site: www.tymco.com E-Mail: info@tymco.com

Tahoe Design Software PO Box 8128 Truckee, CA 96162 Phone: 916-582-1525 Fax: 916-582-8579 Web Site: www.ltol.com/~eds E-Mail: tds@ltol.com

Talem Inc 306 W Broadway Fort Worth, TX 76104 Phone: 817-335-1186 Fax: 817-335-9830 E-Mail: talem@airmail.net

Target Environmental Services 9180 Rumsey Rd Columbia, MD 20104 Phone: 410-992-6622 Fax: 410-992-0347 Web Site: www.targetco.com E-Mail: ntillman@targetco.com

Taurus Precision 129 Patterson Ave Little Falls, NJ 07424 Phone: 973-785-9254 Fax: 973-785-9223

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Taylor Environmental Products Inc

Taylor Technologies Inc 31 Loveton Circle

Sparks, MD 21152 Phone: 410-472-4340 Natl: 800-837-8548 Fax: 410-771-4291

Techinical Heaters 710 Jessie St San Fernando, CA 91340 Phone: 818-365-9435 Fax: 818-361-2788 SEE AD ON PAGE 19

Technical Products & Services Inc PO Box 209 Newton, NJ 07860 Phone: 973-579-3184 Fax: 973-383-3184

Technomic Publishing Co Inc PO Box 3535 Lancaster, PA 17604 Phone: 717-291-5609 Natl: 800-233-9936 Fax: 717-295-4538 Web Site: www.techpub.com E-Mail: marketing@techpub.com

mp Corp 351 S Raymond Ave Fullerton, CA 92831 Phone: 714-879-2901 Natl: 800-321-5160 Fax: 714-870-8136 Web Site: www.telatemp.com E-Mail: telatemp@pacbell.net

Teledyne Brown Engineering Control Applications 2929 N Central Expwy Richardson, TX 75080 Phone: 972-644-2525 Natl: 800-888-9056 Fax: 972-437-7712 Web Site: www.openvector.com E-Mail: sales@openvector.com

Telog Instruments 830 Canning Pkwy Victor, NY 14534 Phone: 716-742-3000 Fax: 716-742-3006

Temcor

24724 S Wilmington Ave Carson, CA 90745 Phone: 310-549-4311 Natl: 800-421-2263 Fax: 310-233-7304 Web Site: www.temcor.com E-Mail: temcor@compuserve.com

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Thel-Mar Co 134 W 5th St Lansdale, PA 19446 Phone: 215-362-2998 Natl: 800-322-9347 Fax: 215-362-2998

Therm-Omega-Tech Inc 207 Witmer Rd Horsham, PA 19044-2212 Phone: 215-674-9992 Natl: 800-288-4878 Fax: 215-674-8594 Web Site: www.thermomegatech.com E-Mail: valves@thermomegatech.com

Thermal Transfer Corn 1100 Rico Rd Monroeville, PA 15146 Phone: 412-351-3013 Fax: 415-856-0256

Thermatrix Inc 308 N Peters Rd Ste 100 Knoxville, TN 37922 Phone: 423-539-9603 Fax: 423-539-9643 Web Site: www.thermatrix.com E-Mail: info@thermatrix.com

Thermo Environmental Instruments 8 W Forge Pkwy Franklin, MA 02038 Phone: 508-520-0430 Fax: 508-520-1460 Web Site: www.thermoei.com E-Mail:

esnordkirleis@compuserve.com SEE AD ON PAGE 43 113 ThermoQuest/Finnigan Corp

2215 Grand Ave Pkwy Austin, TX 78728-3812 Phone: 512-251-1515 Natl: 800-876-6711 Fax: 512-251-1597 Web Site: www.tmqaustin.com E-Mail: fasthelp@austin.finnigan.com

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Thomas Hill Inc **Consulting Engineers** 4400 Campus Dr Ste B Newport Beach, CA 92660-1813 Phone: 714-660-1443 Fax: 714-660-0515 Web Site: www.thomashill.com E-Mail: thi@thomashill.com

Thomas Industries/Thomas Lighting PO Box 35120 Louisville, KY 40232-5120 Phone: 502-893-4600 Fax: 502-895-6618 Web Site: www.thomaslighting.com

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Toxikon Corp 15 Wiggins Ave Bedford, MA 01730 Phone: 781-275-3330 Natl: 800-488-4141 Fax: 781-271-1136 Web Site: www.toxikon.com E-Mail: jkinch@toxikon.com

Tracer Research Corp 3755 N Business Center Di Tucson, AZ 85705 Phone: 520-888-9400 Natl: 800-394-9929 Fax: 520-293-1306 Web Site: www.tracertight.com E-Mail:

s@tracertight.com SEE AD ON PAGE 68, 118 Tracker Technologie

30 Corporate Pk Ste 310 Irvine, CA 92606 Phone: 714-442-7820 Natl: 800-338-3205 Fax: 714-442-7822 Web Site: www.trkr.com E-Mail: dmaldonado@trkr.com

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Trewin & Smith Inc 100 N Central Expwy Ste 500 Richardson, TX 75080 Phone: 972-479-9138 Fav: 972-234-2123

Tri-State Environmental **Products & Equipment** PO box 25486 Tempe, AZ 85285-5486 Phone: 602-837-9092 Natl: 888-442-0628 Fax: 602-837-9072

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4875 Riverside Dr Macon, GA 31210 Phone: 912-474-6100 Fax: 912-474-8933

Trinity Air Technologies 2425 Dillard Grand Prairie, TX 75051 Phone: 972-988-2899 Natl: 800-299-4824 Fax: 972-988-2864 Web Site: www.trin.com F-Mail: dwiles@trin.com

Trinity Consultants Inc 12801 N Central Expwy Ste 1200 Dallas, TX 75243 Phone: 972-661-8100 Natl: 800-229-6655 Fax: 972-385-9203 Web Site: www.trinityconsultants.com E-Mail: information@trinityconsultants.com

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Trumpf Power Tools Hyde Rd Farmington, CT 06032 Phone: 860-677-9741 Fax: 860-676-2606 SEE AD ON PAGE 167 Trusco Tank Inc PO Box 11925 Fresno, CA 93775 Phone: 209-264-4741 Natl: 800-800-8265 Fax: 209-237-3413 Web Site: www.truscotank.com E-Mail: ttifr@aol.com

Turner Designs 845 W Maude Sunnyvale, CA 94086 Phone: 408-749-0994

Turner Enviro Logic Inc 3439 SW 11th St Deerfield Beach, FL 33442 Phone: 954-422-9787 Natl: 800-933-8385 Fax: 954-422-9723 E-Mail: tenviro@bellsouth.net



U F Strainrite PO Box 1667 Lewiston, ME 04240 Phone: 207-777-3100 Fax: 207-777-3177 E-Mail: ufs@explore SEE AD ON PAGE 10, 116

U O Equipment Co PO Box 924615 Houston, TX 77292-4615 Phone: 713-686-1869 Natl: 800-231-6372 Fax: 713-688-0001

U S Department of Commerce 14th Constitution Ave NW Washington, DC 20230 Phone: 202-482-0564 Fax: 202-482-5225

UAI Group LP 53 Vermont Rd Sinking Spring, PA 19608 Phone: 610-777-5346 Fax: 610-777-4136 E-Mail: trhoads@uaigroup.com



609-443-4845

UPE Universal Process Equipment Inc 1180 Rt 130 S Robbinsville, NJ 08691 Phone: 609-443-4545 Fax: 609-259-0644 Web Site: www.upe.com F-Mail: upe@upe.com

US Filter Recovery Serivces 2430 Rose Place Roseville, MN 55113 Phone: 612-638-1300 Natl: 8007323226 Fax: 612-633-5074

US Filter Recovery Services 5375 S Boyle Ave Los Angeles, CA 90058 Phone: 213-277-1500 Natl: 800-266-7747 Fax: 213-588-0094 www.usfilter@aol.com

US Filter/Davco 1828 Metcalf Ave Thomasville, GA 31792 Phone: 912-226-5733 Natl: 800-841-1550 Fax: 912-228-0312 102761.3457@compuserve.com

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US Filter/HPD 55 Shuman Blvd Naperville, IL 60563 Phone: 630-717-2221 Fax: 630-717-2247 Web Site: www.usfilter.com E-Mail: colangek@usfilter.com

US Filter/JWI 2155 112th Ave Holland, MI 49424 Phone: 616-772-9011 Natl: 800-245-3006 Fax: 616-772-4516 Web Site: www.iwifilters.com

US Filter/Jet Tech 1051 Blake Edwardsville, KS 66111 Phone: 913-422-7600 Fax: 913-422-7667 E-Mail: usfit@worldnet.att.net US Filter/Johnson Screens

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US Filter/Lo-Cat 1501 E Woodfield Rd Ste 200 W Schaunburg, IL 60173 Phone: 847-706-6900 Fax: 847-706-6996

US Filter/RJ Environmental 6197 Cornerstone Ct E Ste 108 San Diego, CA 92121 Phone: 619-455-7688 Fax: 619-455-7689 F-Mail: ladelman@rjenvironmental.com

US Filter/Stranco PO Box 389 Bradley, IL 60915 Phone: 815-932-8154 Natl: 800-882-6466 Fax: 815-939-9845 Web Site: www.stanco.com E-Mail: sales@stanco.com

US Filter/Wallace & Tiernan 1901 W Garden Rd Vineland, NJ 08360 Phone: 609-507-9000 Natl: 800-628-0897 Fax: 609-507-4125 Web Site: www.usfwt.com

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US Filter/Zimpro 301 W Military Rd Rothschild, WI 54474 Phone: 715-359-7211 Natl: 800-826-1476 Fax: 715-355-3335 Web Site: www.usfilter.com

US Industrial Products Co 17320 Marquardt Ave Cerritos, CA 90703 Phone: 562-802-9688 Natl: 800-663-5782 Fax: 562-802-8518

UVEX Safety 10 Thurber Blvd Smithfield, RI 02917 Phone: 401-232-1200 Natl: 800-343-3411 Fax: 401-232-1830 Web Site: www.uvex.com E-Mail: sales@uvex.com **UVP Inc** 2066 W 11th St Upland, CA 91786 Phone: 909-946-3197 Natl: 800-452-6788 Fax: 909-946-3597 Web Site: www.uvp.com E-Mail: uvp@uvp.com

Ultra Scientific 250 Smith St N Kingstown, RI 02852 Phone: 401-294-9400 Natl: 800-338-1754 Fax: 401-295-2330 Web Site: www.ultrasci.com/ultrasci E-Mail: ultra@mail.ultrasci.com

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Unipure Environmental 1440 N Harbor Blvd Ste 125 Fullerton, CA 92835 Phone: 800-323-8647 Fax: 714-870-4576 Web Site: www.unipure.com E-Mail: sales@unipure.com

United State Filter Corp 181 Thorn Hill Rd Warrendale, PA 15086 Phone: 412-772-0044 Natl: 800-525-0658 Fax: 412-772-1360 Web Site: www.usfilter.com

United States Filter Corp 40-004 Cook St Palm Desert, CA 92211 Phone: 760-340-0098 Natl: 800-525-0658 Fax: 960-341-8181 Web Site: www.usfilter.com E-Mail: mcfarlt@usfilter.com

Universal Analyzers Inc 1771 S Sutro Terrace Carson City, NV 89706 Phone: 702-883-2500 Natl: 800-993-9309 Fax: 702-883-6388 Web Site www.universalanalvzers.com tbarben@powernet.net

Universal Fabric Structures 2200 Kumry Rd Quakertown, PA 18951 Phone: 215-529-9921 Natl: 800-634-8368 Fax: 215-529-9936 Web Site: www.ufsinc.com E-Mail: sales@usfinc.com

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Valley Well Drilling PO Box 23030 Ventura, CA 93002 Phone: 805-648-6385 Fax: 805-648-6391

Van Note-Harvey Associates PC 777 Alexander Rd Princeton, NJ 08540 Phone: 609-987-2323 Fax: 609-987-0005 Web Site: w.vannoteharvey.com E-Mail: vnha@aol.com

Van Oppen & Co Insurance Services Inc 1440 N Harbor Blvd Ste 725 Fullerton, CA 92835 Phone: 714-447-3981 Natl: 888-447-3981 Fax: 714-447-8375

Vanton Pump 201 Sweetland Ave Hillside, NJ 07205 Phone: 908-688-4216 Fax: 908-686-9314 Web Site: www.vanton.com

Vara Intl, A Div of Calgon Carbon Corp 1201 19th PI Vero Beach, FL 32960 Phone: 561-567-1320 Fax: 561-567-4108 E-Mail: marley@calgoncarbon.com

Varian Analytical Instruments PO Box 954 Santa Clarita CA 91355-9054 Phone: 800-926-3000 Fax: 281-240-6752 Web Site: www.varian.com

Veeder-Root Co 125 Powder Forest Dr Simsbury, CT 06070 Phone: 860-651-2700 Natl: 800-873-3313 Fax: 860-651-2719 Web Site: www.veeder-root.com Versar Inc 200 W 22nd St Ste 250 Lombard, IL 60148 Phone: 630-268-8555 Fax: 630-268-0555 Web Site: www.versar.com F-Mail: envirohelp@versar.com

Victaulic Co of America 4901 Kesslersville Rd Easton, PA 18040 Phone: 610-559-3300

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Walter Grossman & Associates 4-59 lvy Ln Fair Lawn, NJ 07410-1652 Phone: 201-797-0612 Fax: 201-797-0942

Warminster Fiberglass Co PO Box 188 Southampton, PA 18966-0188 Phone: 215-953-1260 Fax: 215-357-7893 wfqqlass@postoffice.worldnet.att.ne

Waste Control Systems Inc. 2835 Merrymans Mill Rd Phoenix, MD 21131-1631 Phone: 410-252-9360 Natl: 888-927-8326 Fax: 410-252-9362 E-Mail: sales@wastecontrol.com

Waste-Tech Inc 1931 Industrial Dr Libertyville, IL 60048 Phone: 847-367-5150 Fax: 847-367-1787

Water Pollution Control Corp 9333 N 49th St Milwaukee, WI 53223 Phone: 414-365-2200 Fax: 414-365-2210 Web Site: www.sanitaire.com

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Water Specialties 191 W Poplar Ave Porterville, CA 93257 Phone: 209-784-3544 Natl: 800-800-3544 Fax: 209-784-1787 Web Site www.waterspecialties.com info@waterspecialties.com

Water Technology International Corp 600 East Ave Lockport, NY 14094 Phone: 716-438-9307 Fax: 716-438-9304 Web Site: www.wti.cciw.ca E-Mail: stegner@acsu.buffalo.edu

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Water-Jel Technologies 243 Veterans Blvd Carlstadt, NJ 07072 Phone: 201-507-8300 Natl: 800-275-3433 Fax: 201-507-8325 F-Mail: wateriel@aol.com

Watson-Marlow Inc 220 Ballardvale St Wilmington, MA 01887 Phone: 978-658-6168 Natl: 800-282-8823 Fax: 978-658-0041 Web Site: www.watson-marlow.com

Weil Pump Co Inc PO Box 887 Cedarburg, WI 53012 Phone: 414-377-1399 Fax: 414-377-0515

Weldas Co 128 Seaboard Ln Franklin, TN 37067 Phone: 615-377-4722 Natl: 800-524-0162 Fax: 615-377-3635 Web Site: www.nashville.net/ -weldas/index.htm F-Mail: wwldas@telalink.net

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Wheelabrator Air Pollution Control Inc 441 Smithfield St Pittsburgh, PA 15222-2292 Phone: 412-562-7300 Fax: 412-562-7617 Web Site: www.wapc.com E-Mail: apcsales@wapc.com

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Whiteford Environmental Services PO Box 428 Whiteford, MD 21160 Phone: 410-879-0563 Natl: 800-783-7867

Wilkens-Anderson Co 4525 W Division St Chicago, IL 60651-1674 Phone: 773-384-4433 Fax: 773-384-6260 Web Site: www.waco-lab-supply.com

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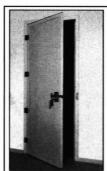




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805 Replacement Filter Bags 806 Scrubber Packing	product(s)/service(s)? 815	823 □ 10-12 months 824 □ Over 12 months
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CITY

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- C D Supervise sub-group in Pollution Control Operations
- D @ Provide professional consulting service on Pollution Control
- E D Provide staff environmental service on Pollution Control
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 - (32) Stone/Clay/Glass
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 - C Agriculture L Consulting
- D D Engineering & Contracting M 🔾 Insurance E Utilities, public, private & cooperative
- F Govt. including municipal or district sanitary water or wastewater treatment sys. or plants Type of Govt.:
- G □ City H □ County I □ State J □ Federal
- K Transportation N Q Labs P Real Estate
- O Training
 Z Misc. Services
- C. Number employed at this location: A Q 1-19 B □ 20-49 C □ 50-99 E □ 250-499 F □ 500-999 D 🖸 100-249
- G 🗆 1000-1499 H 🗅 1500-2499 I 🗀 2500 and up
- D. In your job function do you recommend, speci-
- fy or purchase? (check all that apply)
 A
 Pollution Control Equipment

B 🔾 Instrumentation

C Chemicals

ZIP

D Parts & equipment for maintenance

ZIP+4

operation & control

817 350,001-\$100,000

3. How immediate is your need for the

818 - \$10.001-\$50.000 819 2 \$5,000-\$10,000

820 D Under \$5,000

- E C Services/Consulting F \(\subseteq \text{None of the above} \)
- E. What types of Pollution Control are you responsible for? (check all that apply)
- C \(\text{Noise} D Q Solid Waste Disposal

March 1998

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- E 🛘 Industrial Hygiene
- F Toxic & Hazardous Material
- G 🗆 Energy Control/Energy Conservation
- H Q None of the above
- F. Which of the following publications do you receive personally addressed to you?
- (check all that apply)
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 - B C Environment Today C D Environmental Solutions
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 - E The National Environmental Journal
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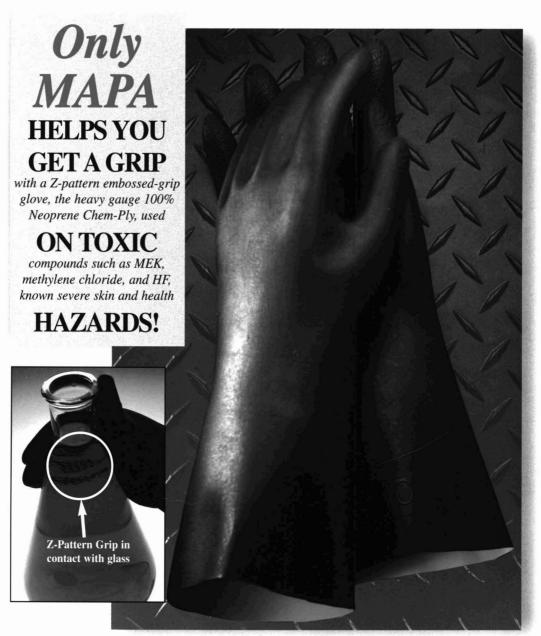
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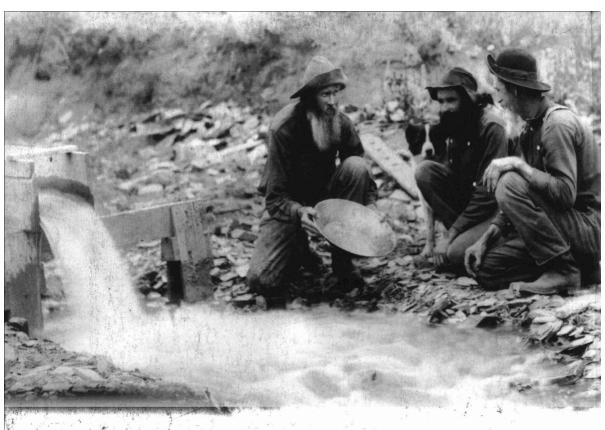


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