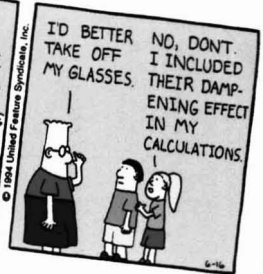
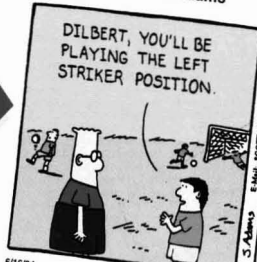


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 - 806 Handheld Photometers
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 - 808 BOD Analyzers
 - 809 Mobile Laboratories
 - 810 Instrument Leasing
 - 811 Oil/Water Separators
 - 812 Reverse Osmosis System
 - 813 Pumps
 - 814 Ultrafiltration Systems
 - 815 Ozonators
 - 816 Chlorinators
 - 817 Stormwater Treatment Systems
 - 818 Stormwater Samplers
 - 819 Water Quality Monitors
 - 820 Aeration Systems
 - 821 Activated Carbon Systems
 - 822 Bioretreatment Systems
 - 823 Recorders
- What is your projected budget for the product(s)/service(s)?
 - 824 over \$200,000
 - 825 \$100,001-\$200,000
 - 826 \$50,001-\$100,000
 - 827 \$10,001-\$50,000
 - 828 \$5,000-\$10,000
 - 829 under \$5,000
- How immediate is your need for the selected products/services? (select one)
 - 830 3-6 months
 - 831 7-9 months
 - 832 10-12 months
 - 833 over 12 months

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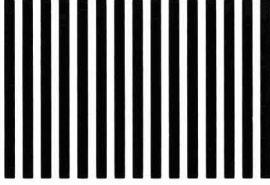
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- A. Function which best describes your activity in Pollution Control (check only one):
- A Corporate responsibility for Pollution Control at this location
 - B Manage all Pollution Control Operations at this location
 - C Supervise sub-group in Pollution Control Operations
 - D Provide professional consulting service on Pollution Control
 - E Provide staff environmental service on Pollution Control
 - Z Other _____
- B. Type of Business (check only one):
- A Manufacturing. If manufacturing, please check the appropriate SIC (check only one):
 - (20) Food
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 - B Mining
 - D Engineering & Contracting
 - 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
 - O Training
 - Z Misc. Services
 - N Labs
 - P Real Estate
- C. Number employed at this location:
- A 1-19
 - D 100-249
 - G 1000-1499
 - B 20-49
 - E 250-499
 - H 1500-2499
 - C 50-99
 - F 500-999
 - I 2500 and up
- D. In your job function do you recommend, specify or purchase? (check all that apply)
- A Pollution Control Equipment
 - B Instrumentation
 - C Chemicals
 - D Parts & equipment for maintenance operation & control
 - E Services/Consulting
 - F None of the above
- E. What types of Pollution Control are you responsible for? (check all that apply)
- A Air
 - C Noise
 - E Industrial Hygiene
 - F Toxic & Hazardous Material
 - G Energy Control/Energy Conservation
 - H None of the above
 - B Water
 - D Solid Waste Disposal
- F. Which of the following publications do you receive personally addressed to you? (check all that apply)
- A Pollution Engineering
 - B Environmental Today
 - C Environmental Solutions
 - D Pollution Equipment News
 - E The National Environmental Journal
 - F Water Environment & Technology
 - G None of the above



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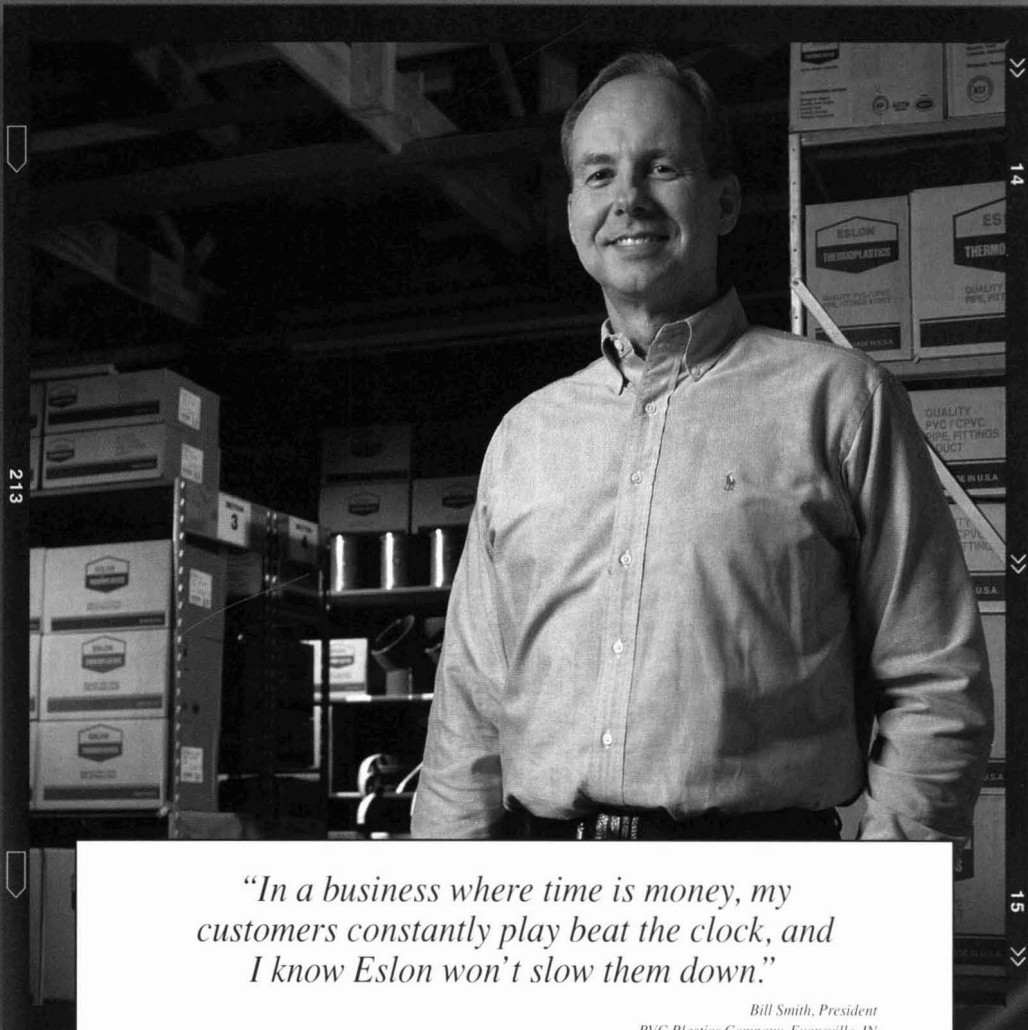
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About the cover:

Overcoming chronic odor problems at wastewater treatment plants can present real challenges to plant operators. The perimeter odor control system featured on our cover successfully fights unpleasant smells at an urban publicly owned treatment works' primary clarifier by using a spray unit that delivers a water-carried odor counteractant. To find out about a different approach to battling wastewater odors, turn to our article starting on page 14 that highlights how the Augusta Sanitary District in Augusta, Maine, virtually eliminated odors from its trunkline.

Photo courtesy of ©Westfall EcoImages. Mark Howard, photographer.

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Sniffing Out the Best Ways to Control Odors

Today's wastewater treatment plant operators understand the first rule about community relations: Bad odors make bad neighbors.

Any number of sources at a wastewater treatment plant (WWTP) can create smells that are a nightmare for nearby residents. The odor-causing culprits can include septic wastewater loaded with malodorous compounds like hydrogen sulfide, industrial wastes discharged to the collection system, organically overloaded biological treatment processes, scum on primary settling tanks, sludge incinerators, digested sludge in drying beds and sludge-composting operations.

Unlike hazardous air pollutants, air contaminants that cause a public nuisance due to unpleasant odors don't have numerically based thresholds or acceptable concentrations. The lack of numerical values exists because odor thresholds vary significantly among different people. The standards usually originate from a number of individuals who complain publicly and petition a regulatory body for relief. Adjacent landowners who don't appreciate the pungent aroma of fresh sludge-cakes wafting on to their property may seek redress by joining together and filing a suit in which they fight for monetary damages and an injunction to stop their neighbor's sludge processing operations.

One example of litigation prompted by offended noses is a 1996 West Virginia case, *Brooke County Solid Waste Authority vs. Valero Terrestrial Corp.* In this lawsuit, the court ruled that a 192-acre landfill—where large amounts of sewage sludge imported from other states were converted to compost—was a public nuisance and ordered it to be closed. The court made this determination because the landfill's operations could be smelled several miles away in adjoining counties. The trial judge noted the company had made little progress in complying with an earlier agreement with the state Division of Environmental Protection to spend \$3.5 million to eliminate the noxious odors.

To avoid litigation and the ill-will of neighbors, savvy WWTP operators should try to aggressively combat offensive smells at their facilities. Indeed, they may have to become olfactory sleuths to solve odor problems. Such detective work starts with a thorough investigation of odor formation. One way to evaluate odors is to put together a group of people to quantify the intensity, character and persistence of samples taken at odor sources. Another method is to analyze the odorous air samples and quantify the odor-causing constituents using chromatographic and spectrophotometric laboratory equipment.

WWTP operators can then select the appropriate odor-control techniques once the odor assessment has been successfully performed. Various methods include installing covers; passing odorous gases through beds of activated charcoal; oxidizing odorous compounds with chemicals like chlorine, ozone and hydrogen peroxide; routing odorous gases through specially designed scrubbing towers; spraying perfume scents in fine mists near offending process units to mask objectionable odors; and using odorous gases as process gases for activated-sludge aeration tanks.

By carefully analyzing their plants' odor problems, WWTP personnel often find that the best odor control methods are right under their noses.

Angela Neville

Angela Neville, JD, REM
Editor, *Environmental Protection*

Environmental PROTECTION

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Group Publisher	Dana Cornett
Associate Publisher	Randy Dye
Editor	Angela Neville, JD, REM
Managing Editor	Ashley E. Blyth E-mail: ablyth@mail.cmpu.net
Assistant Editors	Kristie L. Guillotte Ingrid Truemper
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Raising Industry Standards

New Research Evaluates Efficiency in Wastewater Operations

ALEXANDRIA, Va.—A new study on municipal wastewater treatment facilities and the public servants who work in them has identified characteristics of organizations that are efficient, competitive and continually striving to improve and reinvent themselves. The report is published in *Benchmarking Wastewater Operations: Collection, Treatment and Biosolids Management* and is based on research from the Water Environment Research Foundation (WERF).

The study focused on wastewater collection, wastewater treatment, biosolids and management issues and identified characteristics common among efficient low-cost operations.

The research discovered that leading utilities demonstrated many best practices by:

- Sharing workforce with other utilities or other parts of their organization;
- Avoiding unnecessary costs by influencing regulatory outcomes based on good science;
- Using efficient communications technology and work order generation;
- Understanding asset condition, flow monitoring and process modeling to optimize asset sizing;
- Managing competition to challenge the work force and outsourcing for reduced costs when applicable; and
- Providing extensive training and cross-training.

WERF Executive Director Glenn Reinhardt said, "Wastewater managers are identifying opportunities every day to become more efficient, and this research, by revealing what the best practices are around the country, will help them achieve their goals."

For additional information, call the Water Environment Federation (WEF) at 1-800-666-0206, or e-mail pups@wef.org.

Group Turns to EPA to Protect Children

WASHINGTON, D.C.—The Natural Resources Defense Council issued a report calling for the U.S. Environmental Protection Agency and other federal agencies to aim for cutting children's exposure to lead, pesticides, air pollu-

tion, contaminated drinking water and secondhand smoke.

The report urges the EPA and other government agencies to set a target to reduce the number of children with high blood lead levels by 50 percent, and to reduce the average of all children's blood lead levels by 50 percent during the next five years. The council wants similar targets for reducing the human exposure benchmarks for pesticides, air pollutants and drinking water contaminants.

NRDC scientist Lawrie Mott wrote the report. She said, "We don't know whether there is a direct link between these exposures and the increase in children's illnesses, but it certainly warrants careful study."

Library of Congress Announces Digital Map Project

WASHINGTON, D.C.—One million historical fire insurance maps will be found on the World Wide Web starting this summer. The electronic images are being made available through an agreement between the Library of Congress and EDR Sanborn.

EDR Sanborn holds the copyright to 700,000 fire insurance maps in the Library's custody and has several thousand others in its custody. Sanborn Maps™ represent the most detailed graphic record of the growth of urban America. The maps cover over 12,000 American cities and towns from the 1850s to the present.

These maps are frequently used by environmental professionals in the preparation of Phase 1 environmental site assessments for commercial real estate transactions.

"We already have more than one-half million historical materials on-line now and this project represents a substantial addition to the educational and research value of our Web site," said Librarian of Congress James H. Billington.

There will be a development phase before the first maps become available. During this phase, the Library and EDR Sanborn will coordinate scanning procedures, investigate the display of maps on standard World Wide Web browsers and construct the links between the Library of Congress electronic finding aid and the EDR Sanborn Web site.

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Tough soil cleanup problems? Solve them with In Situ Thermal Desorption from TerraTherm.

In Situ Thermal Desorption technology remediates most shallow and deeper contamination problems without excavation or shutdown of normal operations. On site experience indicates this is a fast, safe, cost-effective and predictable solution. And it works on a variety of volatile and semi-volatile organic compounds.

The technology

This patented technology is based on Shell Oil's two decades of work with thermal processes for enhanced oil recovery. In Situ Thermal Desorption uses very high temperatures applied through Thermal Blankets for shallow contamination



Following treatment with five Thermal Blankets, this remediated soil tests at clean-up concentrations well below targeted levels, and is ready for normal revegetation procedures.

and Thermal Wells for deeper zones to remediate soil.

Thermal Blankets

The Thermal Blankets are a surface treatment of contaminated soils, capable of generating enough heat to vaporize most contaminants.

A vacuum system then draws remaining vapors out of the soil and through the Blanket. Most contaminants

are destroyed in the ground. Extracted vapors receive final "scrubbing" in the Vapor Treatment System. As a result, carbon dioxide and water are the primary air emissions.

Thermal Wells

Thermal Wells allow for treatment at greater vertical depths for contaminated soils. A vacuum is used to draw the vapors out of the ground through the wells.

Most contaminants are destroyed in the ground.

Remaining vapors are processed through the Vapor Treatment System.

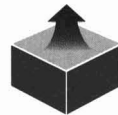
Wells can be drilled directly into the contaminated zone,

either vertically or horizontally. They may reach horizontally under operating facilities, roadways and through concrete and other obstacles.

Site analysis available

A site analysis can be performed by the professionals at TerraTherm as part of developing a customized remediation solution.

In Situ Thermal Desorption is marketed by TerraTherm Environmental Services Inc., an affiliate of Shell Technology Ventures Inc. (STV), which develops commercial applications of Shell Oil Company's technology.

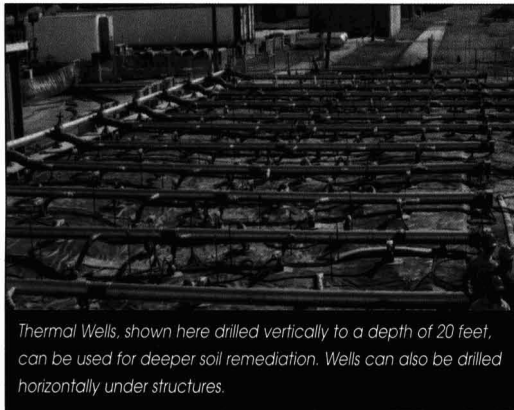


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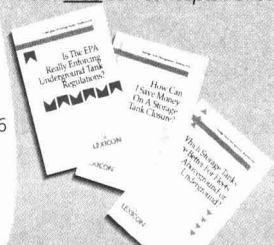
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the grapevine *Compiled by Kristie Guillotte*

URS Corporation acquired the privately held Woodward-Clyde Group Inc., creating the fifth largest engineering/architectural design firm in the U.S.

Degussa Corp. opened an emission-control technical center in Auburn Hills, Mich.

Carbonair Environmental Systems Inc. acquired the assets of the Environmental Division of U.S. Filter/Geopure.

Emilcote-dga Inc. will provide instruction design, develop the training materials and furnish instructors for the Fundamentals of Industrial Hygiene course this year.

Eli Eco Logic Inc. received full board approval from its Japanese partner Nippon Sharyo for a full commercial license agreement to destroy PCBs in Japan.

BOOM® Environmental Products signed an export agreement with Spill Control Systems of Newcastle, South Wales to distribute recyclable absorbents.

Lorick Associates Consulting Inc. received \$94,500 from Charlotte County, Fla., to evaluate road maintenance operations.

Moyno Industrial Products and Moyno Oilfield Products joined together to open a technology center in Conroe, Texas, which is dedicated to research in the field of progressing cavity technology.

Retired U.S. Navy Capt. Gerald Coffee will deliver the keynote address March 19th at the 11th Annual Convention and Exposition of the Institute of Scrap Recycling Industries (ISRI).

Daily Mail and General Trust invested \$10 million in e data resources inc. (EDR).

Betz Dearborn Inc. acquired Argo Scientific, a privately-held membrane support technology company headquartered in San Marcos, Calif.

Air Products and Chemicals Inc. signed two contracts to provide on-site gas management services to the LaPorte, Texas, DuPont plant and the Chalk River Atomic Energy Canada Limited (AECL) facility. The company will place its employees at both facilities to assume responsibility for industrial and specialty gas requirements.

Environmental Resources Management (ERM) awarded 12 excellence awards and three Paul H. Woodruff Awards to its employees whose innovative environmental solutions and technical achievements best satisfy clients' needs in a cost-effective manner.

Matheson Gas Products was named an Atlanta Works "Elite Supplier" by Lucent Technologies for continued excellence in the areas of product quality, on-time delivery, customer service and partnership fulfillment.

Dana J. Wagner has been named a partner and shareholder of B.A. Liesch Associates Inc.

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NSI ENVIRONMENTAL Solutions Inc.'s catalog includes



a line of interlaboratory certified quality control samples for wastewater and drinking water testing. The catalog also lists an expanded line of soil and solid matrix quality control samples, standardized so-

lutions, buffers and titrants and EPA-certified organic chemical standards. NSI Environmental Solutions Inc. Research.

Circle 47 on card.

"GUIDE TO VOC CONTROL Systems" provides an over-

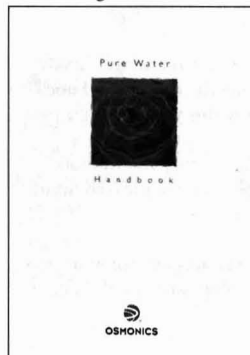


view of VOC oxidation systems. The systems feature up to 99.99 percent destruction efficiencies and 97 percent

heat recovery. They are also appropriate for a variety of VOC-releasing manufacturing processes. Wahlco.

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THE "PURE WATER Handbook" is a guide to water



purification technologies. This book explores the overall problems of water purity, identifies common impurities

and discusses popular methods of water purification. Osmonics.

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"ON PATROL REMOTE Monitoring" outlines protocol



programs designed to provide businesses with proper procedures and practices for envi-

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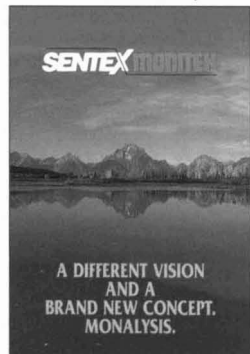
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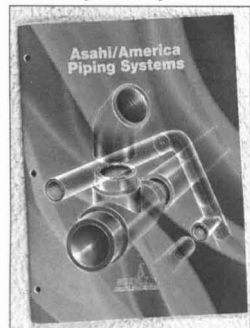
ronmental compliance. The brochure also describes tank polling, remote programming and alarm notification services with options for inventory reconciliation, database and product management and on-site response service. **Lexicon.** *Circle 50 on card.*

"MONALYSIS INSTRUMENTATION" describes a variety of



standard and customized solutions available for the monitoring and analysis of liquids and gases. Solutions are offered for monitoring suspended solids in a liquid process, recognizing a color upset in an intermediary product and analyzing harmful VOCs in water. **Sentex/Monitek.** *Circle 51 on card.*

ASAHI/AMERICA'S 40-PAGE "Thermoplastic Pipe Cata-



log" describes the line of corrosion-resistant thermoplastic piping systems. Included are polypropylene, polyethylene, Halar and

PVDF system descriptions and detailed specifications. It also offers numerous styles of thermoplastic valves, pneumatic and electric actuators, welding systems, vortex flow meters and backwashable filters. **Asahi/America Inc.** *Circle 52 on card.*

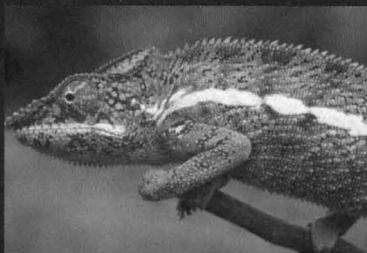
MODUTANK'S CATALOG offers modular, low-cost storage systems from 250 to

1,000,000 gallons. Now, it can be found on the Internet. The web site address is <http://www.modutankinc.com>. Applications, technical features, site assembly and linear availability are reviewed. **Modutank.** *Circle 53 on card.*

WHEELABRATOR'S "GENERAL Capabilities Brochure" describes the company's air pollution

control products and services. Wheelabrator offers fabric filters, electrostatic precipitators, wet or dry scrubbers, NO_x (SNCR) control and flue gas conditioning systems that control particulate and acid gas emissions. Services include equipment retrofit or rebuild capabilities, technical support and replacement parts. **Wheelabrator.** *Circle 54 on card.*

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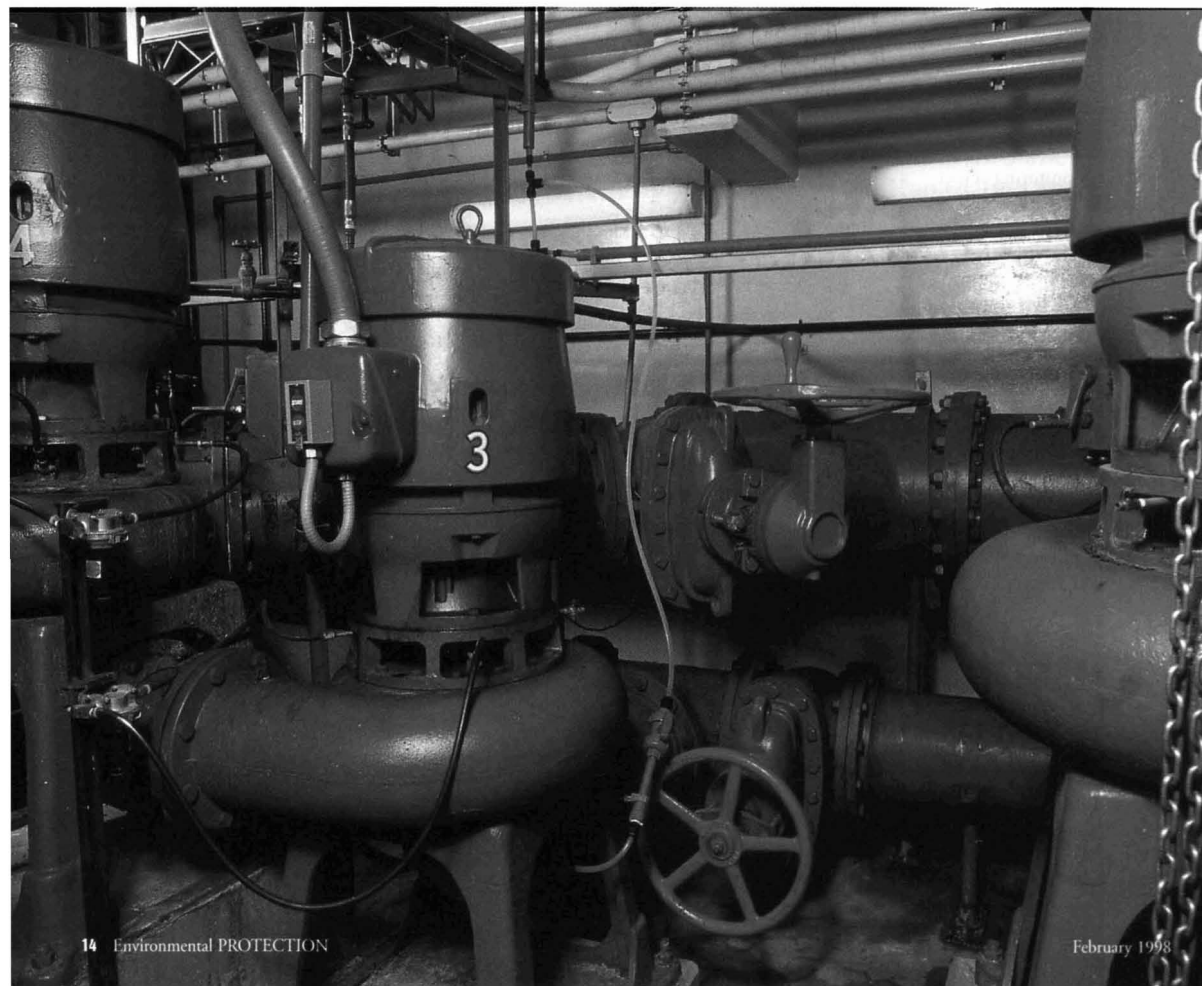
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CONQUERING WASTEWATER TRUNKLINE ODORS

A combination of field work and bench-scale tests detected problems with an old odor-control system and helped one wastewater plant cut trunkline odors dramatically

By Hugh G. Tozer, PE, and Dale Glidden



New chemical feed systems and the cooperation of local industry are eliminating odors from a wastewater trunkline. As a result, the Augusta, Maine Sanitary District (ASD) receives fewer complaints from the community.

For over two decades, unpleasant odors seeped from the 16-mile trunkline (Figure 1) that serves four communities and two textile mills. ASD tried, with limited success, to control the odors with caustic and sodium hypochlorite. These chemical additions reduced the odors for a few years, but they grew less effective with time and were insufficient during the warm summer months.

In 1993, ASD and Woodard & Curran implemented a three-phase program to develop an effective odor-control system. The phases included:

- Phase 1: Field work to characterize the odors and understand the trunkline dynamics;
- Phase 2: Bench-scale tests to evaluate the odor formation and control methods;
- Phase 3: Implementation of effective odor control measures.

The new odor control systems use treatment chemistries similar to what had been only marginally successful in the past. Their current success is largely due to the approach used to understand the odors and treatment options. The combined field and bench-scale work identified problems with the existing odor control systems and solutions that led to the current system. The approach demonstrated that simple application of chemicals—without a thorough understanding of the problems and issues—may not provide adequate treatment.

Possible Causes of Trunkline Odors

Woodard & Curran evaluated the odors, their sources and possible controls during Phase 1. Operators collected samples from five locations up and downstream from the textile mills. They measured the dissolved oxygen (DO) concentration along the trunkline. Historical pretreatment data provided by each textile mill supplemented the sampling program.

The field investigations found the textile mills measurably changed the wastewater characteristics and possibly contributed to odors from the trunkline. Both mills added large quantities of sulfates and raised the wastewater temperature. The increased temperature may have indirectly contributed to odor for-

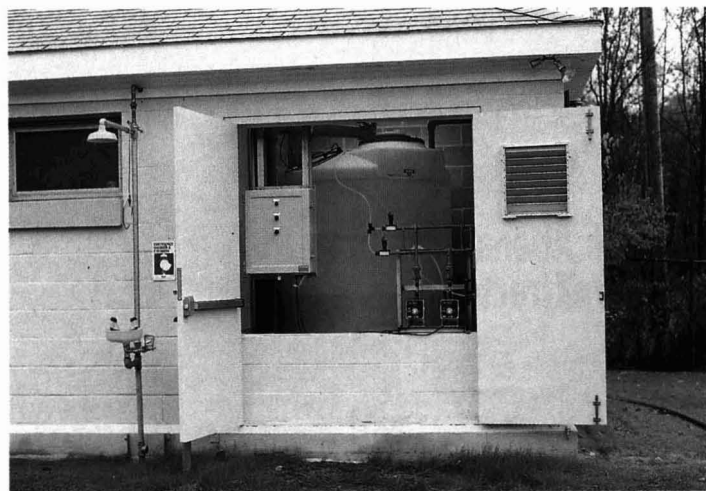
mation and release by increasing biological activity and the volatilization rate of odorous compounds. The sulfates probably had little effect on the trunkline odors, however, because the domestic wastewater in the trunkline prior to the industries' wastewater contained enough sulfates to produce sulfide odors.

The data also suggested the trunkline itself may have contributed to odor formation and release. Several long force mains and inverted siphons had very low

Phase 2 - Bench-Scale Tests Explain Odor Formation

Woodard & Curran simulated the trunkline conditions to evaluate the impact of Textile Mill #2 on the odor formation and to test three odor-control methods (aeration, hydrogen peroxide and chlorination).

Twelve reactors were filled with one of three wastewater mixtures: (1) domestic wastewater collected prior to the mill; (2) a composite of domestic and Textile Mill #2 wastewater; or (3) Textile Mill #2



DO concentrations, which were believed to function as low oxygen odor incubators. Turbulence in the downstream gravity sewers volatilized and released the odors to the surrounding communities.

Phase 1 - Odor Panelists Associate Odors With Textile Mill #2

During Phase 1, a panel of trained odor analysts worked with the ASD operators to characterize and measure odors from the trunkline and around the mills. They found that the most objectionable odors were dominated by a mixture of tarry, animal and sulfide compounds. The tarry odors were described as burnt sulfides and digester gas-like, the animal odors as fatty and oxidized oils and the sulfides as rotten egg. The rotten egg smell of hydrogen sulfide was present near both textile mills, but the animal and tarry smells were evident only after Textile Mill #2. It was hypothesized that the odors formed under the low oxygen conditions of the trunkline force main and were released downstream in the gravity sewers. The mill wanted additional proof of its responsibility before spending money or changing its operations.

wastewater. The reactors were periodically mixed to simulate mixing in the trunkline.

Some reactors were treated with air, hydrogen peroxide or sodium hypochlorite, while others served as untreated controls. The treatment frequency mimicked chemical addition at the pumping stations along the trunkline. The odors from each reactor were sampled four times during the 22-hour test, along with pH, temperature, DO and oxygen reduction potential (ORP).

Reactors Containing Mill Wastewater Produce The Worst Odors

Odors comparable to those identified in Phase 1 were found in the reactors containing some or all mill wastewater, but not in the reactors containing only domestic wastewater.

Figure 1 illustrates the three wastewater mixtures and their associated odors using three separable bar charts. The bars in each chart represent particular odor groups. Related odor types, such as leather and animal, were grouped to simplify the data. The length of each bar indicates the average relative odor intensity.

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Conquering Wastewater Trunkline Odors

During Phase 1, the most objectionable trunkline odors were described as digester gas, animal, hydrogen sulfide and burnt sulfides. Of these, only hydrogen sulfide was detected in the domestic wastewater. The other odor types were observed in the reactors containing only textile wastewater or a composite of textile and domestic wastewater. This indicated the mill wastewater was probably responsible for some of the worst trunkline odors.

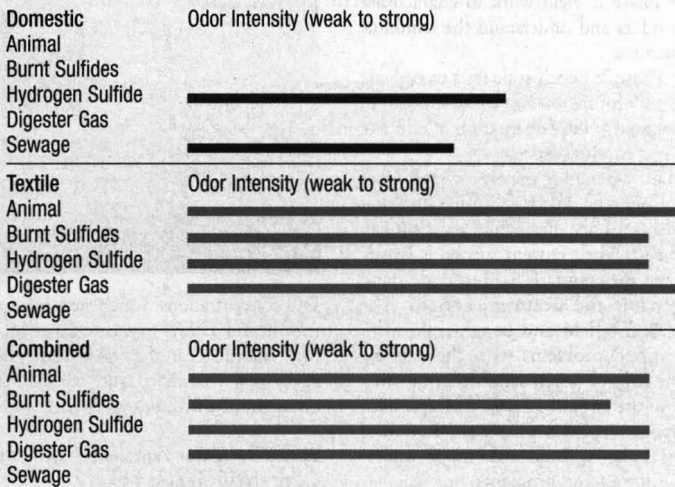
Of the three odor control methods tested in Phase 2, aeration and hydrogen

using it in the trunkline. An investigation identified differences between the trunkline chemical addition systems, the bench-scale tests and the full-scale system.

As listed in Figure 2, the full-scale chemical feed system faced problems with storage, dosage and mixing. The hypochlorite was stored in direct sunlight, which rapidly degraded its strength. The change in solution strength made accurate dosing difficult without daily testing and adjustment of the chemical feed rate. In addition, the dosage was not flow-

Figure 1

Augusta Sanitary District Odor Analysis: Domestic, Textile Mill and Combined Wastewaters



peroxide were only marginally effective. Periodic aeration seemed to prevent some odors from forming, but not the animal odors. Similarly, hydrogen peroxide did not prevent the objectionable odors from developing over time.

Chlorination effectively controlled odors in the composite wastewater. A 10 milligram per liter chlorine dose, similar to that used historically for odor control in the trunkline, was sufficient to control animal, digester gas and sulfide odors.

Chlorine Success Surprises

The success of using chlorine in controlled bench-scale tests appeared to conflict with ASD's mixed experience

paced. At low wastewater flows, the dose was relatively high. At high flows, it was relatively low. Finally, the chlorine was not mixed well with the wastewater. Inadequate mixing meant that some of the wastewater was treated with chlorine while some was not.

New Systems Control Trunkline Odors

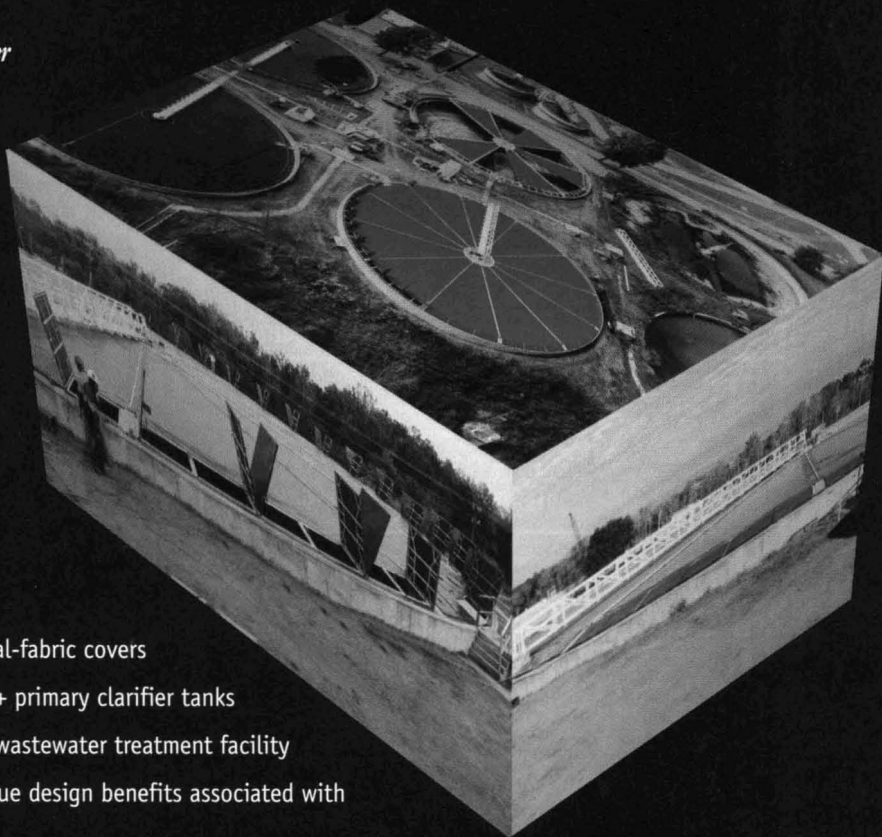
Improved odor control systems along the trunkline and changes at Textile Mill #2 have dramatically reduced the odors from the trunkline.

New chemical storage and feed systems were designed and constructed at the Maple Street, the Winthrop and the Manchester Pumping Stations. Bulk



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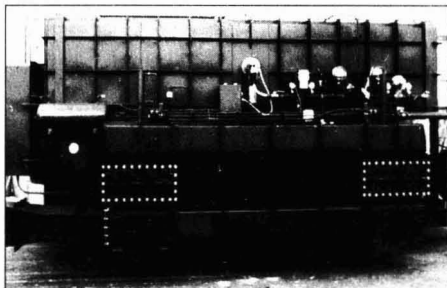
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Conquering Wastewater Odors

storage facilities were built to provide safe storage of sodium hypochlorite. The storage tanks are protected from sunlight and heat and sized to permit the less expensive bulk deliveries.

Improved mixing and dosing were also built into the feed systems. The sodium hypochlorite is fed into the suction side of the pumping station pumps. The metering pumps operate at the same time the pumping station pumps run, which improves the operator's control of dosage. Also, the pumping action thoroughly mixes the chlorine with all of the wastewater.

The system was completed in late summer of 1994 for a design-build construction cost of approximately \$125,000. ASD operated the system during 1995 for \$60,000; \$11,700 in labor and \$48,300 for 60,670 gallons of sodium hypochlorite.

The sanitary district operators have learned how to adjust the system and improve its performance. The hypochlorite

Figure 2

Comparison of Chlorination in Phase 2 Tests to Full-Scale System

Sodium Hypochlorite Strength

Full-Scale: 12.5% as purchased
Bench Scale: 5.25%, measured on the day of use

Storage Method

Full-Scale: 55-gallon drums in direct sunlight
Bench Scale: 1-gallon bottle in room

Storage Period

Full-Scale: 1 to 14 days on-site
Bench Scale: ½ day on-site

Dose

Full-Scale: Varied with solution strength and flow
Bench Scale: 10 mg/L

Mixing

Full-Scale: Fed into Winthrop Flume but not mixed in wetwell
Bench Scale: Reactor completely mixed

Controls

Full-Scale: Continuous feed
Bench Scale: Measured dose

dose had to be increased for low flows during the summer to allow for the added residence time in the trunkline. A continuous high chlorine dose could not be used because it produced chlorine odors and increased operating costs. The future flows were difficult to predict, and consequently, the dosages were difficult to control. The solution to date has involved close attention and manual adjustment of the metering pumps.

In addition to improving the chemical

In addition to improving the chemical metering systems, the mill improved its wastewater pretreatment system to limit odor formation. It reduced the residence time in its treatment lagoons by bypassing two ponds, one of which had contributed to odors due to its low oxygen levels.

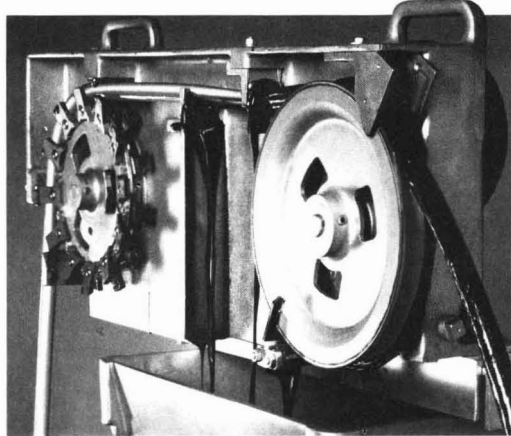
metering systems, the mill changed its wastewater pretreatment system to limit odor formation. It reduced the residence time in its treatment lagoons by bypassing two ponds, one of which had contributed to odors due to its low oxygen levels. The mill also eliminated its cascade aerator, and thus a significant source of odors.

The combined efforts of ASD and Textile Mill #2 have greatly reduced odors from the trunkline. Additional operating experience should improve the system and eliminate odors. **EP**

Hugh G. Tozer, PE, is a project manager at Woodard & Curran in Portland, Maine. Dale Glidden is the superintendent with the Augusta Sanitary District in Augusta, Maine.

For more information about Woodard & Curran, circle 67 on card.

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IN SITU THERMAL DESORPTION

A new two-fold process uses thermal blankets to vaporize soil contaminants and a vacuum to draw gases out of the ground

By Jude R. Rolfes

Shell's *in situ* thermal desorption technology is a revolutionary approach to handling difficult soil contamination problems in a cost-effective manner. For certain types of dangerous and environmentally unacceptable chemicals, it provides a solution that previously did not exist.

Although TerraTherm Environmental Services Inc., an affiliate of Shell Oil Co., was formed last year to develop and utilize thermal desorption, the process itself is hardly new. TerraTherm has applied decades of Shell's research and experience in oil field technologies to this environmental issue.

The technology is unique because of its *in situ* nature, which allows it to remediate an entire site without moving any soil. The process desorbs and destroys the contaminants. The destruction of the contaminants occurs directly in the soil, which is heated to temperatures ranging to 1,000 degrees Centigrade within a closed system.

Currently, there are two applications of *in situ* thermal desorption. The thermal blanket works on soil contamination at the surface, like a powerful electric blanket combined with a vacuum cleaner, while thermal wells clean the soil at greater depths, making use of heating elements placed in wellbores.

There are two components to the integrated system. Thermal blankets or thermal wells are used to heat the soil and destroy the contaminants while a separate vapor treatment system handles the offgases.

In situ thermal desorption can be applied to a wide range of volatile and

semi-volatile organic contaminants, including chlorinated solvents, polychlorinated biphenyls (PCBs), pesticides and petroleum wastes in soils varying from low permeability clays to heterogeneous soil compositions. The process can clean sites that were once deemed uneconomical for cleanup.

Man-made chemicals like PCBs are very stable compounds that don't decay by nature. They won't go away. Bioremediation won't work. In the past, treatment methods required digging up the soil and hauling it away for incineration or to a landfill for hazardous waste in

**The process reduces
the contaminants
in the soil to very low
levels—lower than
EPA requirements.**

compliance with the Resource Conservation and Recovery Act (RCRA) regulations. With its new technology, TerraTherm has the capability to destroy PCBs on site, eliminating these complications and additional expense.

The process reduces the contaminants in the soil to very low levels—lower than U.S. Environmental Protection Agency requirements. Destruction is essentially complete. Nothing is carried offsite, condensed or produced on the surface. Due to the nature of the process, it is very low-profile, with low impact on a



neighborhood where a site is located. There is virtually no odor or dust resulting from the remediation process.

Unique to TerraTherm's system is that it provides tailor-made solutions for individual problems. The technology is especially effective in handling difficult cleanup problems that occur in the chemical and refining industries, pipelines and distribution processes, utilities, railroads and military installations. The *in situ* nature of the system makes it most appropriate for these facilities.

Remediating pesticides at a chemical plant or cleaning the complex mix found in a waste pit at a refinery are ideal uses for this technology.

In the utility industry, PCBs were used as insulation and coolant oil in transformers and large electric motors and capacitors over a 30-year period. *In situ* thermal desorption is especially useful in cleaning up sites where this equipment was manufactured, stored or serviced. The same is true for manufactured gas plants (MGPs), which were in operation a hundred years ago in the eastern and midwestern United States, and left

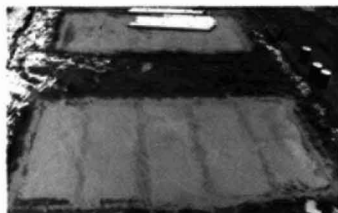


behind tar residues and other carcinogenic compounds.

Railroads provide another good example of this technology's flexibility. In the Northeast, where railroads have been electrified for many years, there are significant PCB problems in rail-yard shops that overhaul engines. *In situ* thermal desorption can be used to remediate the soil without moving tracks or shutting down the rail yard.

TerraTherm has put this new technology to the test at sites around the country, and has proven it to be effective and safe. In 1996, thermal blankets were applied at an upstate New York Superfund site where PCB contamination was as high as 5,000 parts per million (ppm). After treatment, soil target levels of less than 2 ppm PCBs were met, and air emissions were well below New York and EPA regulatory limits.

Actually, *in situ* thermal desorption had its inception in the oil fields of California. Since 1959, Shell has been doing thermal enhanced recovery in its oil fields there. Scientists at Shell's Houston, Texas, research center began developing a remedi-



ation process using these same principles in 1988. *In situ* thermal desorption was the result. Drs. Harold J. Vinegar, George L. Stegemeier and Eric DeRouffignac are credited as being the key developers of this breakthrough technology.

Thermal wells deliver heat below the surface using heating elements placed in wellbores drilled on a regular pattern. The typical well spacings can be 7 to 10 feet. As the heat from the wells vaporizes the soil contaminants, a vacuum applied to the same wells draws the contaminants out of the ground. Dr. Vinegar has observed that the wells can be drilled vertically to the contaminated zone, possibly as deep as several hundred feet, and can reach horizontally under obstacles.

Thermal blankets, 8-foot-by-20-foot rectangular steel boxes, can be used side-by-side in remediating surface contamination. Shell's simulations suggest they will work to a depth of approximately 3 feet. With blankets placed over the area, contaminants are vaporized by heating the soil. Heating elements in each blanket can reach 800 to 1,000 degrees Centigrade at the surface. As the heat front moves through the soil, contaminants are vaporized and a vacuum system draws the vapors toward and through the blankets. Most contaminants are destroyed in the soil near the heat source.

The vapor treatment system is the second major component of the technology, treating contaminated vapors drawn out of the soil. Any remaining vapors not destroyed by the thermal wells or thermal blankets are drawn through this closed system. Effluent vapors are processed using a cyclone separator to capture particulates while a flameless thermal oxidizer destroys organics, and activated carbon adsorbers provide both final polishing and a significant margin of safety. As a result, carbon dioxide and water are virtually the only air emissions. The site is then ready for immediate revegetation.

Individual remediation activity is designed through the aid of sophisticated computer simulations. Temperatures are monitored throughout the remediation process, and soil samples are taken pre- and post-treatment. **EP**

Jude R. Rolles is the president and chief executive officer of TerraTherm Environmental Services Inc. in Houston, Texas.

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LIVING WITH THE CE AND CAM RULES

Two new air quality regulations, the Credible Evidence (CE) and Compliance Assurance Monitoring (CAM) rules, are stepping into the spotlight

By Paul S. Farber, PE, DEE, and Dixie Lee Laswell, JD



The U.S. Environmental Protection Agency recently issued two Clean Air Act regulations that are coming to the attention of not only industry, but the legal and environmental consulting communities. These are the Credible Evidence (CE) rule (*Federal Register*; February 24, 1997; Vol. 62, No. 36; pages 8313 to 8328) and the Compliance Assurance Monitoring (CAM) rule (*Federal Register*; Oct. 22, 1997; Vol. 62, No. 204; pages 54899 to 54947), both of which will cause the owners and operators of facilities to rethink how their systems will be operated and how their permits need to be written. The history of these rules is long and complex, starting in 1993 with the EPA's attempt to promulgate an enhanced monitoring rule under mandates from the Clean Air Act (CAA).

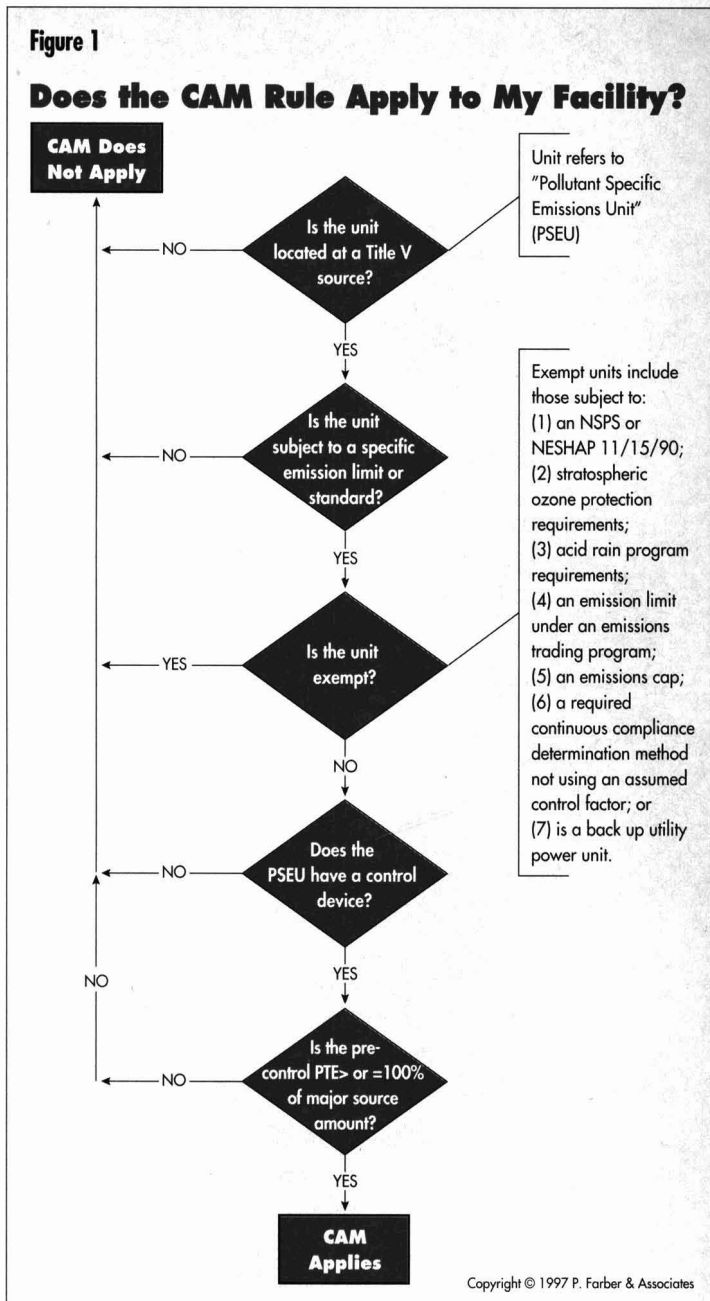
A Brief History

The Credible Evidence rule was issued in final form by the EPA in the *Federal Register* on February 24, 1997, and became effective April 25, 1997. This rule was originally part of the 1993 proposed enhanced monitoring rule. The EPA announced the stand-alone Credible Evidence rule in the spring of 1996. There are several appeals of this rule pending.

The credible evidence provisions are based on the EPA's authority under the Clean Air Act, and on amplified authority that was provided to the agency by the 1990 CAA amendments, specifically, Sections 113(a), 113(c), 114(a)(3), and the Title V monitoring provisions.

The Compliance Assurance Monitoring (CAM) rule had been under consideration by the EPA for over a year when the EPA issued the rule in October, 1997. This rule can be viewed in the same light as the old saying, "Is the glass half empty or is it half full?" On one hand, the CAM rule can be looked at as just another rule that is going to require more paperwork, recordkeeping and effort by industry to comply with the regulations. On the other hand, it may be considered a rule that lets industry select the means to demonstrate that its operation is within permit conditions.

The Compliance Assurance Monitoring rule is a response to the mandates of the 1990 CAA Amendments. The EPA made an attempt to issue a rule on enhanced monitoring that would have broadly expanded the regulatory authority of the agency and required industry to supply operating information across a broad spec-



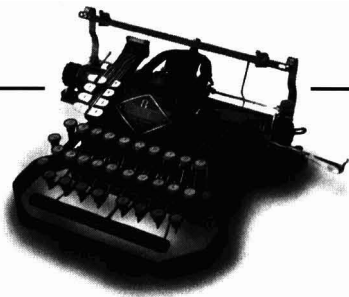
trum of its processes. Due to the vast number of comments that the agency received from the stakeholders, such as industry, the public and consultants, the enhanced monitoring rule was withdrawn for reconsideration. In August of 1996, the EPA issued a draft of the proposed CAM rule for public comment with the comment period ending in November 1996. The EPA ad-

ministrators signed the final CAM rule on October 3, 1997.

What Is the Credible Evidence Rule?

The Credible Evidence rule—also called the Any Credible Evidence (ACE) rule—basically will allow industry, regulatory agencies or the public to use any credible evidence or information to show

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Living with the CE and CAM Rules

compliance or non-compliance with emission standards and limitations. Credible evidence is not defined. In promulgating the rule, the EPA stated that any credible evidence or information relevant to whether a source would have been in compliance with applicable requirements if the appropriate performance or compliance test procedures or methods had been performed may be used. The forms of other information that may be used include continuous emissions monitoring data, continuous opacity monitoring data, expert opinions, emission factors, engineering calculations including mass balance and reverse engineering, as well as parametric monitoring data from plant operations.

What Does the Credible Evidence Rule Affect?

The Credible Evidence rule amends four parts of Title 40 of the *Code of Federal Regulations* (CFR): Part 51, requirements for preparation, adoption and submittal of state implementation plans (SIPs); Part 52, approval and promulgation of SIPs; Part 60, new source performance standards (NSPSs); and Part 61, national emission standards for hazardous air pollutants (NESHAPs). Although the regulations have been modified so that there is not an exclusive method of determining compliance, the reference test methods still remain the benchmark against which all other data and information will be evaluated.

What Is the CAM Rule?

The CAM rule lets a regulated industry select the means to demonstrate that its operation is within permit conditions. Specifically, the CAM rule is intended to assure agencies that properly designed control measures are installed; that these measures can achieve applicable requirements; and that once installed/employed they are operated and maintained so the system remains in compliance. To accomplish this, emission sources covered by the CAM rule will identify proper performance indicators that provide some reasonable assurance of compliance with emission limits, and will specify to regulatory agencies what the operating ranges for these performance parameters will be, the basis for their choice and how compliance will be tracked.

Who Is Covered by the CAM Rule?

Almost all sources required to have a Title V permit will be covered by the CAM

rule, although the specific applicability must be determined for each pollutant-specific emissions unit (PSEU). The pathway for determining if a source is covered under the CAM rule is shown in Figure 1.

The CAM rule covers sources (40 CFR 70, Subpart B) required to obtain a state operating permit, if the unit is subject to an emission standard or limitation for the applicable regulated air pollutant, and the unit uses a control device to achieve compliance, and also if the pre-control potential to emit (tons per year) would classify this unit as a major source. Other sources that are required to follow the CAM rule are those that are required to obtain a state operating permit, are not considered exempt sources and have PSEU that are not covered under Subpart B.

The agency has excluded many sources from CAM rule coverage, although within the rules covering these excluded units many CAM rule-type provisions already exist. These excluded sources include: backup utility power units (especially emergency generators); sources for which a NESHAP has been proposed; sources such as utilities or refineries that are included in the Acid Rain program; any source required to meet stratospheric ozone protection standards; and sources that are participating in an emissions trading program or are operating under an emissions cap.

When Does the CAM Rule Take Effect?

CAM rule implementation will begin 180 days after publication of the final

rule in the *Federal Register*, on April 20, 1998. If a Title V Permit has not yet been filed, then a CAM plan must be included as a part of the permit application. A state agency may request that an already submitted Title V application be revised to include a CAM plan if the agency considers the filed application incomplete. For sources where the potential to emit, including the removal efficiency of the control device, would be over the major source limit for the area in which the source is located, then a CAM plan is required if: the Title V application has not been filed; the application is deemed incomplete; a significant permit revision is filed; or upon renewal. For all other major sources which have already filed their Title V applications, a CAM plan is required upon permit renewal.

How Do the CAM and Credible Evidence Rules Relate to Each Other?

The Credible Evidence rule allows the use of non-reference method data to show compliance or non-compliance with emission standards and limitations. Consequently, operating data that are collected and recorded under a CAM plan might be able to be used as proof of compliance under the Credible Evidence rule. The EPA's current thinking is that in addition to CAM rule data, there will be data available from Title V permit recordkeeping as well as reportable data available from other sources that could be used under the Credible Evidence rule to demonstrate compliance or non-compliance.

Elements Of A CAM Plan

Background: Describes the facility, process and emission source that pertain to this CAM plan. Identification of the emission point, the pollutant that is addressed in the plan, the regulation that covers its emission and the emission limit. Description of the control technology that is used to control the pollutant.

Monitoring Approach: What indicator is going to be used to monitor compliance? What is the monitoring frequency and how often will data be collected? What is the performance criteria for this monitoring approach and how will data be verified?

Data Availability Percentage: The percentage of monitoring period during which the process was operating in a semi-annual reporting period. The agency is assuming that the data availability percentage will be at least 90 percent.

Indicator Range(s): What is the range that will be maintained for each monitored indicator?

Corrective Action Commitment: What action(s) will the operator take if an excursion, or exceedance, in an operating range occurs? When will the Quality Improvement Plan (QIP) be triggered?

Documentation: What was the rationale for the selection of this monitoring approach and the indicator range(s)? What is the corporate experience or regulatory precedence that validates this monitoring approach?

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How Will the Credible Evidence and CAM Rules Affect Operations?

Industry sources that have to comply with the CAM rule and do not want to have reported information used against them under the Credible Evidence rule will have to carefully select the parameters that will be monitored for compliance. Additionally, the operating ranges for these parameters need to be established so that the ranges do not affect operation of the industrial process while assuring that compliance is maintained. To establish both the parameters and

their ranges, an extensive knowledge of the process being monitored is critical, as well as the recognition that some combined emissions and process testing may have to be performed to establish the relationships that do not affect operations. Since not only provisions within the CAM rule but also other permit monitoring requirements require recordkeeping of relevant data and other information, it is important that the information in these records minimizes the possibility of its use under the Credible Evidence rule.

What Is the CAM Plan?

The heart of compliance with the CAM rule is the development and use of a CAM plan. In a CAM plan the background for the process to be monitored, the choice and applicability of the monitoring approach, data availability, indicator ranges for the parameters to be chosen and the commitment to a corrective action plan are detailed. A well-defined knowledge of the process around which the CAM plan is being written is important in selecting the indicators of compliance as well as their ranges. Indicator ranges should allow for flexibility of operations, but should be set with enough of a safety allowance that an excursion outside of the range will not take the process out of compliance.

Conclusion

The Credible Evidence rule is final and in effect. The change that the Credible Evidence rule has on the demonstration of compliance with emission standards and limitations is to allow more than just the published EPA reference methods to be used as evidence of compliance or non-compliance. To date, there have been no test cases of enforcement actions being brought based on the Credible Evidence rule. The Compliance Assurance Monitoring rule was signed by the EPA administrator on October 3rd, 1997. The CAM rule affects most Title V sources with active control equipment that are not covered by other EPA rules such as NESHAPs or Emissions Trading Programs. The CAM rule gives the owner or operator of an affected facility how it will demonstrate compliance. Both the CAM rule and the existence of the Credible Evidence rule mean that affected sources need to carefully consider how they will confirm compliance and what information will be recorded for the agency to prove this compliance. Application of the CAM rule will continue to evolve over the next several years and the effect of the Credible Evidence rule on compliance and enforcement has only just begun. **EP**

Paul S. Farber, PE, DEE, is principal of P. Farber & Associates in Willowbrook, Ill. Dixie Lee Laswell, JD, is a partner at the law firm of Seyfarth, Shaw, Fairweather & Geraldson in Chicago, Ill.

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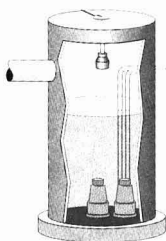
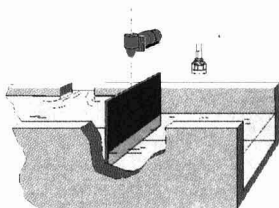
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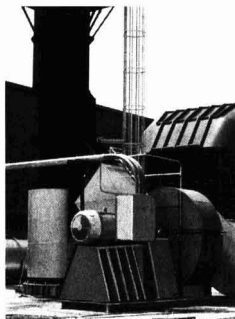
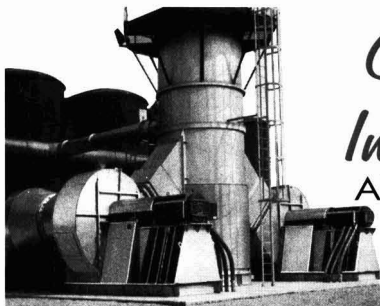
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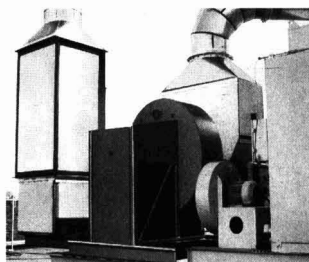
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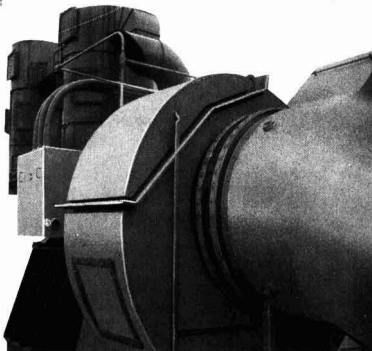
AF-Forty Fans in thermal oxidation system exhausting hot, clean gases.



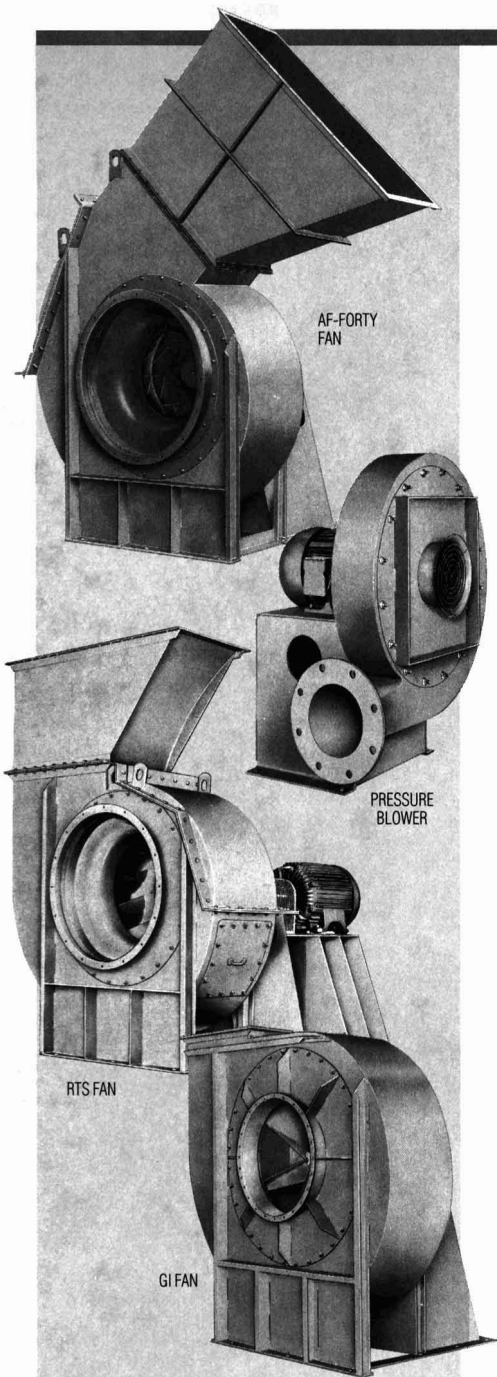
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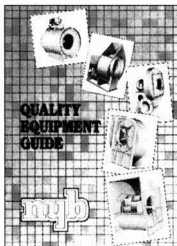


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PRODUCT STEWARDSHIP: A NEW MINDSET

Part one of a two-part series covers the EH&S issues a company faces when developing a program to responsibly manage its products throughout their life cycles

By Gregory G. Bond, PhD

Product stewardship is a basic requirement for every business operating in today's atmosphere of concern for the environment. To be practiced successfully, product stewardship must affect business operations, views and planning. In effect, product stewardship must be more than a contributing discipline—it must be a mindset shared by everyone in the business.

The purpose of product stewardship is obvious: to protect employees, community neighbors, customers and the environment. A definition of product stewardship that is used at The Dow Chemical Company puts it into perspective: "Product stewardship is a commitment to ensuring our own and our customers' success via responsible management of products throughout their life cycles." This definition is embodied in Dow's environmental, health and safety (EH&S) policy:

"Protecting people and the environment will be a part of everything we do and every decision we make. Each employee has a responsibility in ensuring that our products and operations meet applicable government or Dow standards, whichever is more stringent. Our goal is to eliminate all injuries, prevent adverse environmental and health impacts, reduce wastes and emissions and promote resource conservation at every stage of the life cycle of our products. We will report our progress and be responsive to the public."

Development of Product Stewardship

Most companies that develop a product stewardship program discover that they have already been doing it for some time, often without calling it product stewardship. That happened at Dow.

Managing risk is a primary activity of the businesses, advancing us toward the eventual EH&S goals of eliminating injuries, preventing adverse environmental and health impacts, reducing emissions and promoting resource conservation.

For example, Dow's program goes back to 1970, when company management committed Dow to a "product stewardship" role, and 1972, when product stewardship was formally defined. In the 1972 annual report, chief executive officer Ben Branch wrote: "Dow's product stewardship program represents the

coordination and acceleration of a number of *ongoing activities, some 40 years or more standing*. Their purpose is responsible care for Dow products" (emphasis added).

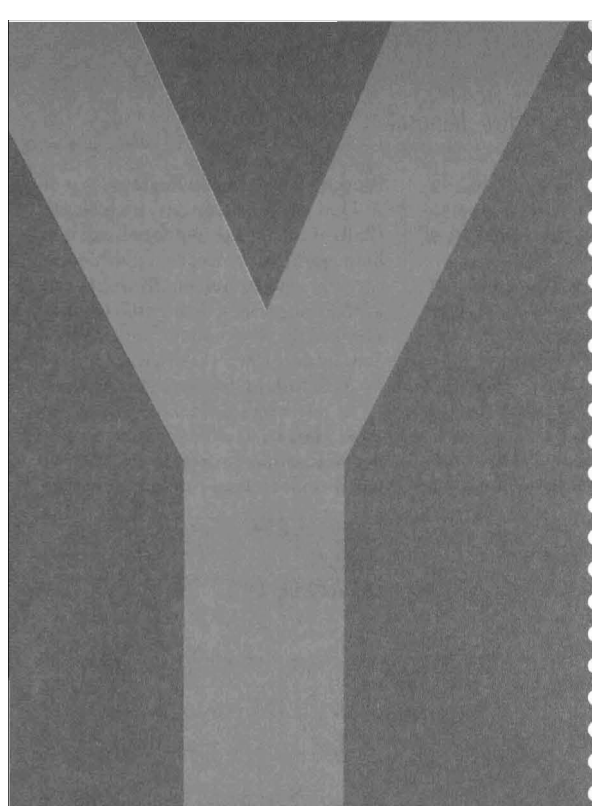
As the company developed, product stewardship progressed. The most recent development has been to align the EH&S function with the global businesses. In a new global organization plan, we have assigned a product steward to every product, and a global EH&S product leader to every global business. This product leader is accountable to the global business research and development director (coordinator) and to the corporate director of product responsibility.

Industry's Commitment to Product Stewardship

An important development in recent years on the global business scene is the approval of the Product Stewardship Code of Management Practices, part of the Responsible Care™ initiative of the Chemical Manufacturers Association. This is both mandatory for all CMA members and recommended to all companies who handle chemical products.

This sixth code of the initiative provides a directive and checklist for proper product stewardship practice. Among the management practices in this code are:

- Requirements for leadership of and commitment to product stewardship by company management;

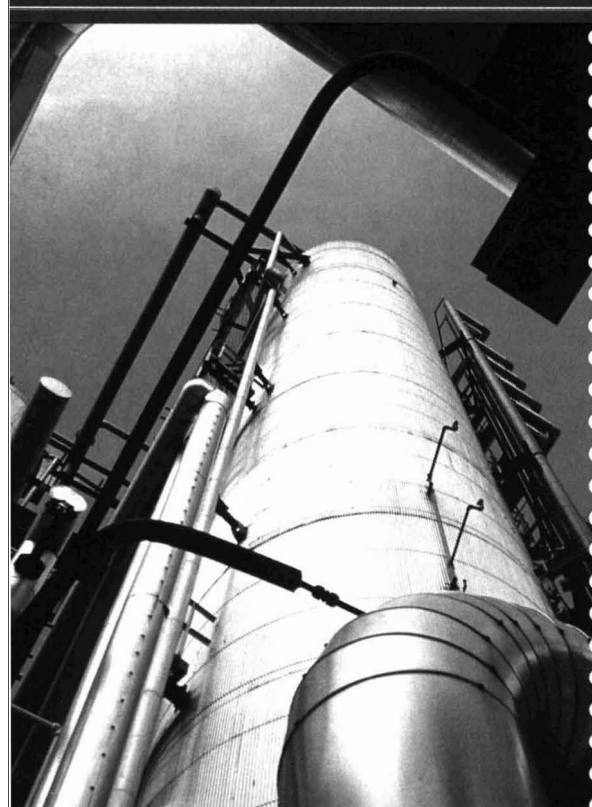


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Product Stewardship: A New Mindset

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- Requirements for risk management practices; and
- Requirements to provide EH&S information to customers and other direct receivers of the products.

Risk Management Tools

Managing risk is a primary activity of the businesses, advancing us toward the eventual EH&S goals of eliminating injuries, preventing adverse environmen-

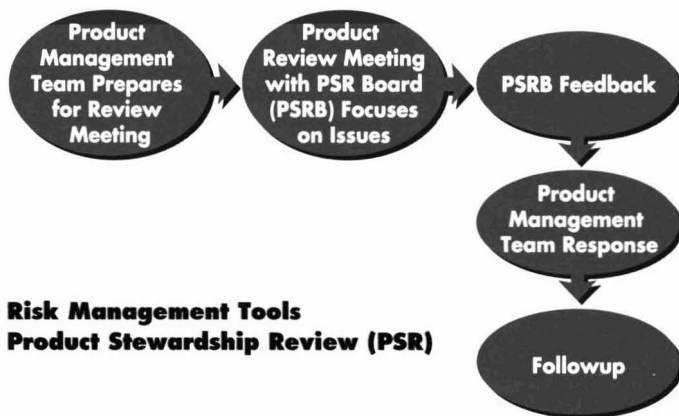
Product Stewardship Review

At Dow, the product stewardship review (PSR) is a required tool for all existing businesses. This procedure follows management guidelines codified by the EH&S function, as well as the requirements of the Responsible Care Product Stewardship Code (Management Practice 6.6, Risk Management System).

Its purpose is to identify and minimize potential adverse impacts on people and the environment throughout the life cycle of products, process-

Figure 1

Viewing the World through the Product Stewardship Lens



Risk Management Tools Product Stewardship Review (PSR)

tal and health impacts, reducing emissions and promoting resource conservation. Risk must be managed throughout every stage in the life cycle of a product, from production to disposal. Several basic tools, such as thorough EH&S evaluations, are available to do this.

At the developmental stage of a new product or a new process, an evaluation must be made to address all EH&S considerations, including the energy required, the natural resources that will be used, the waste developed, the impact of the product or process on the human and natural environment and the eventual methods of disposal/recycle. Results of the EH&S evaluation must be integrated into the development of the product or process and its applications.

In the case of existing products and processes, information from life cycle assessments can be applied at all steps of production, transportation, use and disposal to improve eco-efficiency at each stage of the life cycle.

es, applications and services. All PSR recommendations are documented and addressed.

The PSR process is implemented at least once every 3 years, possibly more often commensurate with the risk of the product or other triggers. The process follows a specific agenda (See Figure 1):

- Scheduling and preparation;
- PSR meeting;
- Feedback to the business management team; and
- Business response and follow-up.

A PSR board brings together persons from all levels of management, as well as several functions, in addition to EH&S representatives. Research and development, materials management, medical, legal, engineering, manufacturing and business group management may all take part in the process.

The recommendations which come from a PSR may touch on many issues. Typical of the subjects covered are:

- The material safety data sheet (MSDS) and the label;
- Toxicology testing;
- Industrial hygiene monitoring;
- Disposal methods; and
- Environmental emissions of a Dow product.

Transferring Product Stewardship Knowledge

It is not enough to develop a full EH&S program in your own company. Product stewardship must be transferred to distributors, customers, the customers of

in place—that MSDSs, labels, product use literature, training videos and regulatory information are readily available to the customer.

Commensurate with risk, there may be a review of the customer's storage, unloading and safe-handling practices.

This may also include a pre-delivery inspection of the customer's facilities, periodic reinspections, product safety training for employees, industrial hygiene surveys to determine the exposures of the employees, a dosimeter program to test average exposure over an

employee's shift and analytical services if the product hazard necessitates them.

In case of any discrepancies noted during an audit, a remediation program is instituted. It is our policy to cease sales of a product if the customer or distributor is unable or unwilling to take appropriate steps to handle the product safely. **EP**

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

For more information, circle 70 on card.

Depending on the hazard of the product, product stewardship transfer may also involve visiting a customer's or distributor's plant to make sure safe handling and emergency equipment and processes are in place and functioning, and to determine the appropriateness of the customer's application.

customers and other product receivers. This is particularly important for the more hazardous products.

Product stewardship transfer involves communicating all relevant EH&S product information to the customer. Depending on the hazard of the product, it may also involve visiting a customer's or distributor's plant to make sure safe handling and emergency equipment and processes are in place and functioning, and to determine the appropriateness of the customer's application. A responsible producer will not sell a product for inappropriate uses.

The producer must also make sure hazard communication procedures are

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Pollution Prevention: Improving the Bottom Line

Companies are finding that minimizing pollution can often lead to maximizing profits

The bottom line in corporate America is profit and its margins. However, a new margin is emerging, and it is one that should improve the environment. The new revolution combines total quality management along with an environmental strategy that adds to profits and cleans corporate surroundings by reducing hazardous waste at corporate facilities.

Corporate environmental policy concerning pollution prevention (P2) has matured the last few years, and the bottom line now includes comments and fact gathering about how regulations can best be met.

Corporate boardrooms had to change their train of thought in 1984 when Union Carbide's plant in Bhopal, India, was hit with an explosion. More than 1,500 people died during the following three days, and thousands more found their bodies seared and lungs scarred. Corporate America received its wake-up call.

No stranger to environmental problems, especially after the *Exxon Valdez* ran aground in Alaska on March 24, 1989, Exxon has made significant strides in pollution prevention. At

its Baytown, Texas, operations, Exxon's profits from refining have been strong in recent years, largely because of efficiency improvements. In Baytown, transforming crude into useful products, such as refined gasoline, is extremely energy intensive.

Twenty years ago, one barrel of oil was needed as an energy source in the refining process to produce five barrels of the finished product. Today, that figure is only one of ten, and one of 20 in really efficient operations.

"Some people believe that oil use is incompatible with a cleaner environment. But the truth is that we have made enormous progress over the past quarter-century in reducing the environmental impact of oil and other fossil fuels and making them much cleaner to use," said Exxon Corp. Chairman Lee R. Raymond.

Many of the changes Exxon has made over the years were made to conserve energy. Some changes depend more on technology and better thinking than on more spending.

"Since 1970, lead emissions have decreased by 98 percent and breathable particulate matter by 78 percent," Raymond said. "Sulfur dioxide emissions have dropped by more than 30 percent and are expected to be cut by some 40 percent more by the year 2000."

Though the improvements are impressive, many of the changes in emissions were driven by legal mandates that the petroleum giant improve air quality. Exxon, however, has taken the charge to heart and has essentially eliminated the disposal of toxic materials into nearby watercourses. According to Exxon officials, some of the water the plant returns to the Houston Shipping Channel is actually cleaner because of wastewater treatment than the water originally taken out of the channel for use at the plant.

In complying with federal Clean Water Act regulations, the company was mandated to eliminate all traces of benzene from its waste stream. Benzene was getting into the system because of leaks, and some of that seemed inevitable. But the company shifted its way of thinking about the leakage. Workers were trained to stop the loss of small quantities of oil throughout the refinery. It worked. What used to be a leakage of 800 barrels to 1,000 barrels per day, dropped to less than 50 barrels per day, which meant an infinitesimal one-hundredth of 1 percent of the oil flowing through the giant complex.

"The petroleum industry has taken unprecedented steps to reduce the environmental impact of its products," Raymond said. "Today, in the United States alone, industry is spending at a rate of more than \$10 billion per year on environmental improvement."



Another key pollution prevention plan that is making significant inroads is recycling hazardous wastes. Only 10 years ago, Exxon recycled slightly more than half of its wastes. The rest was treated or landfilled. Now, more than 90 percent of the hazardous waste is recycled.

The company benefits from attention to detail—Exxon does not appear on the U.S. Environmental Protection Agency's lists of top polluters in the nation, even though it is the largest oil company and one of the biggest chemical producers.

According to a Princeton University study, there is no evidence that environmental quality deteriorates steadily with economic growth. Instead, researchers found that after an initial phase of deterioration, economic growth brought environmental improvement.

"A spirit of cooperation is also needed by society as a whole as we continue to solve environmental problems," Raymond said. "I believe most thoughtful people would agree that we need to weigh costs and benefits and seek the most cost-effective solutions. Economic progress should not be put at risk to placate alarmists or ideologues. In promoting environmental improvements, we should rely more on free markets and less on government."

Because government is not as intricately involved in local issues, hundreds of communities across the United States have found that piecemeal approaches to community issues have not been adequate for solving their problems. Many communities are taking a new approach to developing long-term healthy communities based on the concepts of sustainability.

The sustainability movement underway in many U.S. communities acts as a reference source for P2 practitioners. It addresses topics such as urban sprawl, economic development, environmental justice, recycling and pollution prevention.

Many communities are taking a systems approach that attempts to deal holistically with economic, social and environmental concerns. Communities are adopting a long-term focus, and are building and fostering partnerships among key stakeholders, who are addressing problems and solutions.

In Washington state, the Department of Ecology and the Port of Seattle are proposing to study groundwater beneath Seattle-Tacoma International Airport and to enhance P2 activities at the airfield.

The study is designed to get a better understanding of the flow direction and behavior of groundwater beneath the airport, and where the contaminants are transported. The study also will determine whether existing contamination is threatening the environment or drinking water supply wells. Twelve separate areas within the active airfield are known to have jet fuel in soil and groundwater. Each of these areas have either had some cleanup work completed or have studies underway.

"Although we do not think the contamination could threaten drinking water

wells or area streams and lakes, we need more information to rule it out for sure," said Roger Nye, project manager at Ecology's northwest regional office.

In working with the Port of Seattle, the state Ecology Department expects to enhance P2 activities at airport fueling facilities to prevent future groundwater contamination.

"The agencies will significantly bolster efforts to prevent further leaks from underground fuel tanks and piping, which were the main cause of the existing groundwater pollution," Nye said.

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According to Nye, the report and any subsequent action will pave the way for airport and airline officials to examine where the product (petroleum-based fuels) is being lost in the groundwater, which will potentially save money in cleanup costs and initial fuel supplies.

The EPA also has taken a proactive role in pollution prevention, demonstrating that voluntary goals and commitments achieve real environmental results in a timely and cost-effective way. The EPA's program, known as Partners for the Environment, builds cooperative

partnerships with business, citizens, state and local governments, universities and trade associations.

The Partners for the Environment program results to this point are impressive, according to EPA officials. Thousands of organizations are working together to set and reach environmental goals, such as conserving water and energy, and reducing greenhouse gases, toxic emissions, solid wastes, indoor air pollution and pesticide risk. The partnership also stands for working cooperatively with the private sector to provide

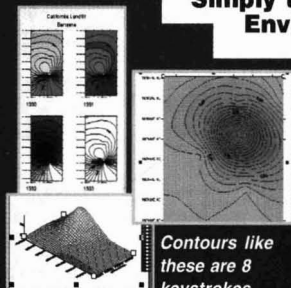
stakeholders with effective tools to address environmental issues. Optimal results are being achieved quickly and results are shown in a timely manner, and with lower costs than would be the case with regulatory approaches.

Such is the case with the sustainable community movement, where P2 practitioners have the opportunity to learn more about ongoing efforts that range from traditional academic and technical literature to hands-on practical experience for implementation.

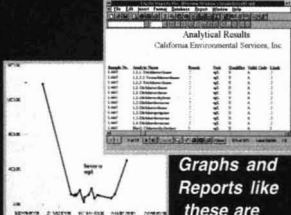
The P2 expert can use the information to expand and enhance community P2 activities with a hand-in-hand effort in community efforts. All indications show this effort will continue to gather speed and grow. As it does, P2 efforts

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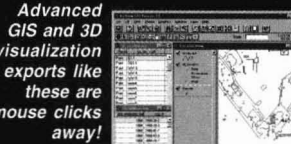
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 much cleaner to use,"**
**said Exxon Corp. Chairman
 Lee R. Raymond.**

seem likely to add impetus to the movement and to benefit from increased community interest in sustainability.

The EPA has provided a document listing governmental and private sector programs. For more information, write to: Michelle Price, Office of Pollution Prevention and Toxics (Mail Stop 7408), 410 M St. SW, Washington D.C., (202) 260-3370. 

Ralph Jensen is the news bureau chief of the newsletter division at Stevens Publishing Corp.

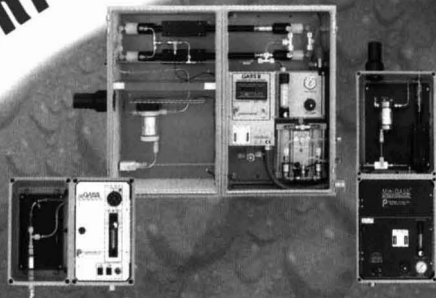
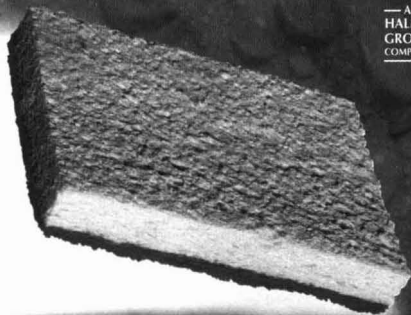
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
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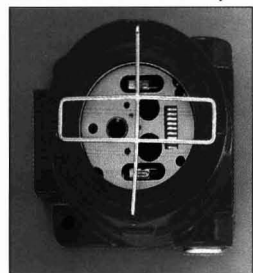


problems at wastewater treatment facilities. The flat profile minimizes emission equipment costs and leaves catwalks open to maximize space entry. The sealed surface ensures complete odor and VOC containment. ILC Dover Inc.

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Flame Detector

The Model 3100-02 flame detector has enhanced relays, a



verify relay, a lens check relay and a variable alarm relay configuration. It uses ultraviolet, infrared and visible spectrum to provide flame detection. It detects both hydrocarbon and non-hydrocarbon flames. Sierra Monitor Corp.

Circle 73 on card.

Interval Sampler

The discrete interval sampler is pressurized at the surface to



prevent water from entering, then lowered to the desired sampling depth. Pressure is released to allow the sampler to fill with hydrostatic pressure. Sampler is repressurized and

brought back to the surface with the down-hole pressurized environment. Solinst.

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Storage Structures

The range of non-occupancy hazmat storage selection offered



by P&D Solutions provides everything from a single drum pallet to individually designed multi-drum warehouse systems for the storage of thousands of drums, IBCs and smaller containers. Units are pre-engineered, modular and relocatable. P&D Solutions Corp.

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Pressure Transducers

In-Situ's pressure transducers are fully submersible and pro-



vide water level, piping pressure, barometric pressure and partial vacuum monitoring. Connecting them to a data logger completes a data acquisition system controlled by Windows®-based software. In-Situ Inc.

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Test Kit

The Isoamyl Acetate Fit Test Kit is designed for use



with elastomeric facepiece respirators. The kit includes an easy-to-assemble vinyl fit-test tent, isoamyl acetate solutions, glass jars and eyedroppers for

Ultrasonic Level Measurement

The Probe is a non-contacting, ultrasonic level measurement device for liquids. It is available in versions for hazardous or sanitary applications and ranges up to 26 feet. The self-contained unit provides a reversible 4-20 mA output proportional to liquid level or space; therefore, it can interface with virtually any analog input device. To calibrate, just press two buttons, one to set the unit's 4 mA value, the other for the 20 mA value. The unit's enclosure and transducer housing are weather, chemical and corrosion resistant. Milltronics.

Circle 105 on card.

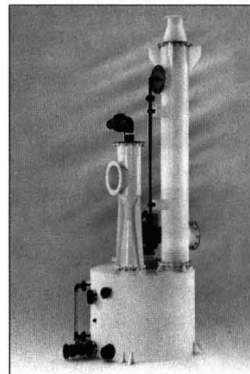


measuring and mixing, video, CD-Rom and printed instructions. Aearo.

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Scrubbers

The Mystaire® Venturi Scrubbers are used for particulate re-



moval from gas streams. Two types are available, eductor venturi and high-pressure venturi. Both are ideal for tank filling, reactor kettle venting, chemical vapor deposition and incinerator exhaust scrubbing. Misonix.

Circle 78 on card.

Containment Pallet

P&D's containment pallet provides a solution for hazardous material storage needs.



One, two or four drums sit on galvanized steel grating over a 62-gallon sump to contain spilled material. Doors open wide and the hinged cover lifts high to dispense or fill drums. P&D Solutions Corp.

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Pump Motor

The Omegaflex® pump FPU5-MT motor offers micro-



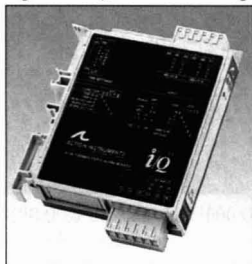
processor control and a digital display accepting two pump heads for each side or stacked together. Features include electronic braking and reversing, remote control, tachometer

feedback, thermocouple input and more. **Omega.**

Circle 80 on card.

Thermocouple Alarm

The Action I/Q® Model Q126 is a thermocouple input, dual-limit alarm with touch sample technology. This high-density, field config-



urable DIN rail-mount device accepts most thermocouple input types and provides two selectable relay output functions. **Action Instruments.**

Circle 81 on card.

Hazardous Disposal Flyer

Haz-Stor/CTI's flyer provides information on using the



model ECO 8040 drum compaction system to dispose of hazardous waste. The flyer indicates how metal, glass, plastic, oil filters, cartridges, absorbent materials, lab garments and wiping towels can be compacted with the system. **Haz-Stor/CTI.**

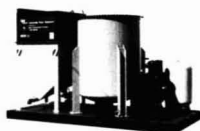
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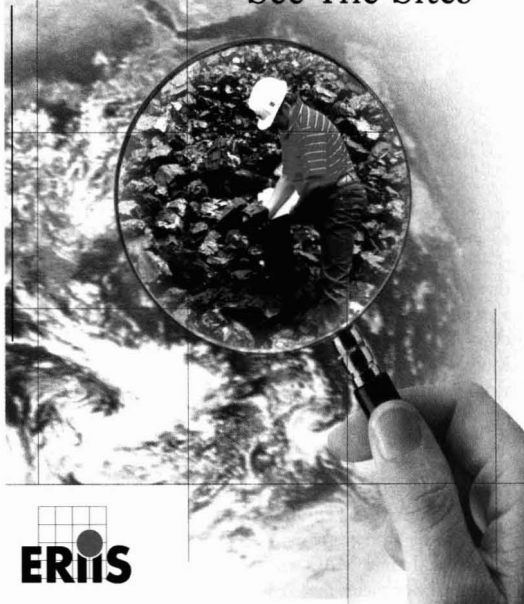
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hances liquid flow control systems. Over-ranging will not damage it. The meter's flow is zero to 3.5 gpm, and it can be used for input to microprocessor-based control devices. CTE.

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Field Test Kit

The field test kit measures the presence of trinitrotoluene



(TNT) in soil or water. The kit uses a quantitative method based on a reaction between polynitro aromatic compounds, TNT and an alkali reagent that produces coloration proportional to the concentration of TNT in the soil or water. Envirol Inc.

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Emission Analyzer

The PCO 4000/5000 is a portable emission analyzer of-



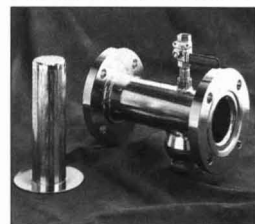
fering technology in combustion gas analysis. It is used in the measurement of gas emissions from boilers, large industrial en-

gines and other fuel burning combustion systems. The analyzer is capable of monitoring up to 5 gases. Neotronics.

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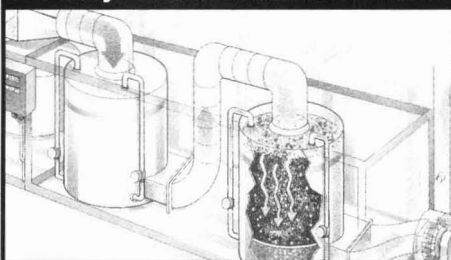
0.001 inch and up to 0.001-inch increments. Multiple support rods are covered with a coil wrap of wire. The wire and rods are welded at each intersection to create close-tolerance, continuous slots. U.S. Filter/Johnson Screens.

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waste streams ranging from oil filters to wiping towels and has 40,000 pounds of compaction force. It operates off a standard electrical outlet and does not require motor starter/disconnect. Justrite Mfg. Co.

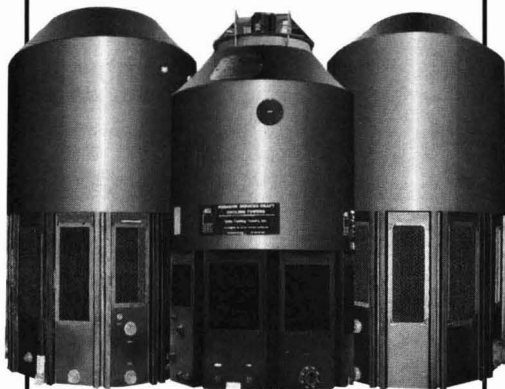
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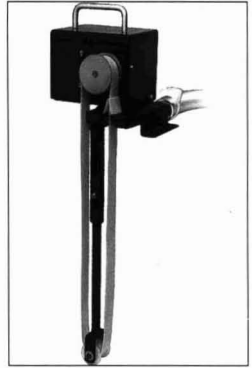


maximum output of 66 gpm or a head of 39 feet. Double silicon carbide mechanical seals with outside Viton lip seal and thermal breaker protect the motor. BJM Corp.

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The Abanaki Mighty Mini™ portable oil skimmer can be ordered with a 1-inch or 2-inch-wide belt made of stainless steel or "polybelt" material,



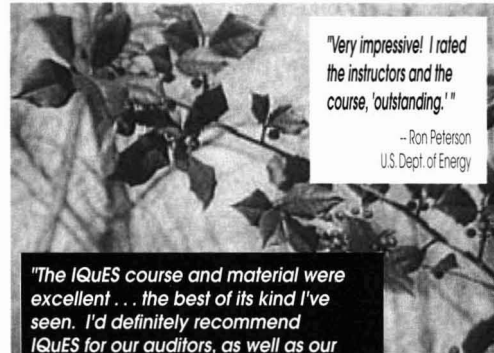
which provides greater skimming capability while minimizing water pickup. It is ideal for removing unwanted oil in coolants and parts washers. R.H. Blake Inc.

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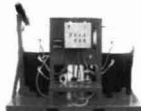


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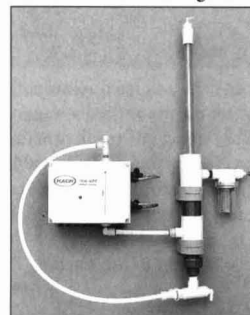


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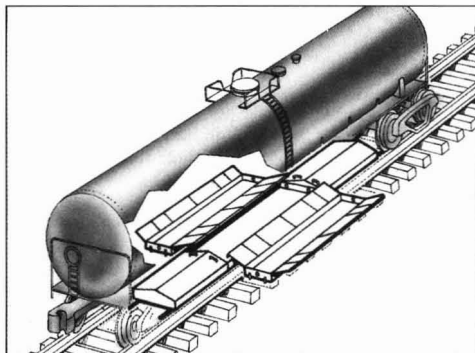
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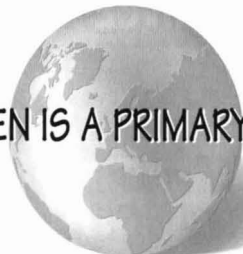
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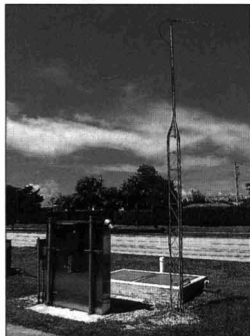
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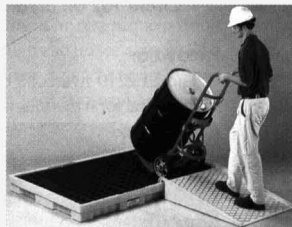
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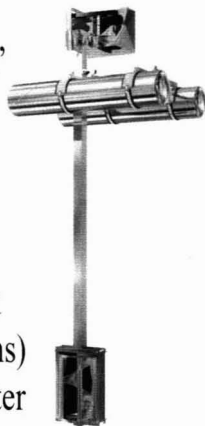
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 - 814 Ultrafiltration Systems
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 - 817 Stormwater Treatment Systems
 - 818 Stormwater Samplers
 - 819 Water Quality Monitors
 - 820 Aeration Systems
 - 821 Activated Carbon Systems
 - 822 Biotreatment Systems
 - 823 Recorders
- What is your projected budget for the product(s)/service(s)?
 - 824 over \$200,000
 - 825 \$100,001-\$200,000
 - 826 \$50,001-\$100,000
 - 827 \$10,001-\$50,000
 - 828 \$5,000-\$10,000
 - 829 under \$5,000
- How immediate is your need for the selected products/services? (select one)
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 - 831 7-9 months
 - 832 10-12 months
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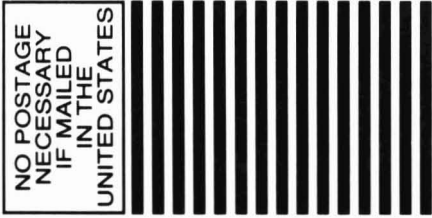
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 A Corporate responsibility for Pollution Control
 B Manage all Pollution Control Operations at this location
 C Supervise sub-group in Pollution Control Operations
 D Provide professional consulting service on Pollution Control
 E Provide staff environmental service on Pollution Control
 Z Other _____
- 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
 (22) Textile (33) Primary Metal
 (23) Apparel (34) Fab. Metal
 (24) Lumber & Wood (35) Mach., except Elect.
 (25) Furniture (36) Elect & Electron
 (26) Paper Mach
 (27) Print/Publish (37) Trans. Equip.
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 Type of Govt.:
 G City H County I State J Federal
 K Transportation N Labs
 O Training P Real Estate
 Z Misc. Services _____
- C. Number employed at this location:
 A 1-19 B 20-49 C 50-99
 D 100-249 E 250-499 F 500-999
 G 1000-1499 H 1500-2499 I 2500 and up
- D. In your job function do you recommend, specify or purchase? (check all that apply)
 A Pollution Control Equipment
 B Instrumentation
 C Chemicals
 D Parts & equipment for maintenance operation & control
 E Services/Consulting
 F None of the above
- E. What types of Pollution Control are you responsible for? (check all that apply)
 A Air B Water
 C Noise D Solid Waste Disposal
 E Industrial Hygiene
 F Toxic & Hazardous Material
 G Energy Control/Energy Conservation
 H 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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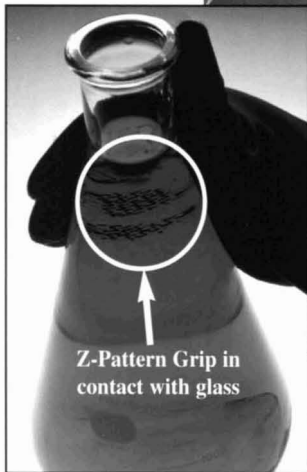


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