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- 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 (please specify) _____

2. Type of Business (check only one):

A **Manufacturing. If manufacturing, please check the appropriate SIC (check only one):**

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- B Mining
- C Agriculture
- D Engineering & Contracting
- L Consulting
- M Insurance
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- F Govt. including municipal or district sanitary water or wastewater trmnt. sys. or plants

Type of Govt:

- G City
 - I State
 - K Transportation
 - N Labs
 - Z Misc. Services _____
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- C 50-99
- D 100-249
- E 250-499
- F 500-999
- G 1000-1499
- H 1500-2499
- I 2500 and up

4. 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 and control
 - E Services/Consulting
 - F None of the above _____
- (please specify)

5. What types of Pollution Control are you responsible for? (check all that apply):

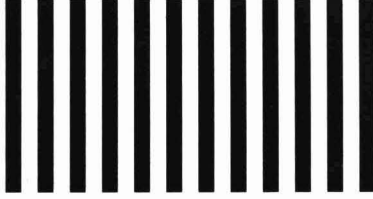
- A Air
 - B Water
 - C Noise
 - D Solid waste disposal
 - E Industrial hygiene
 - F Toxic & hazardous material
 - G Energy control/energy conservation
 - H None of the above _____
- (please specify)

6. Which of the following publications do you receive personally addressed to you? (check all that apply):

- A Pollution Engineering
 - B Environment Today
 - C Hazmat World
 - D Pollution Equipment News
 - E The National Environmental Journal
 - F Water Environment & Technology
 - G None of the above _____
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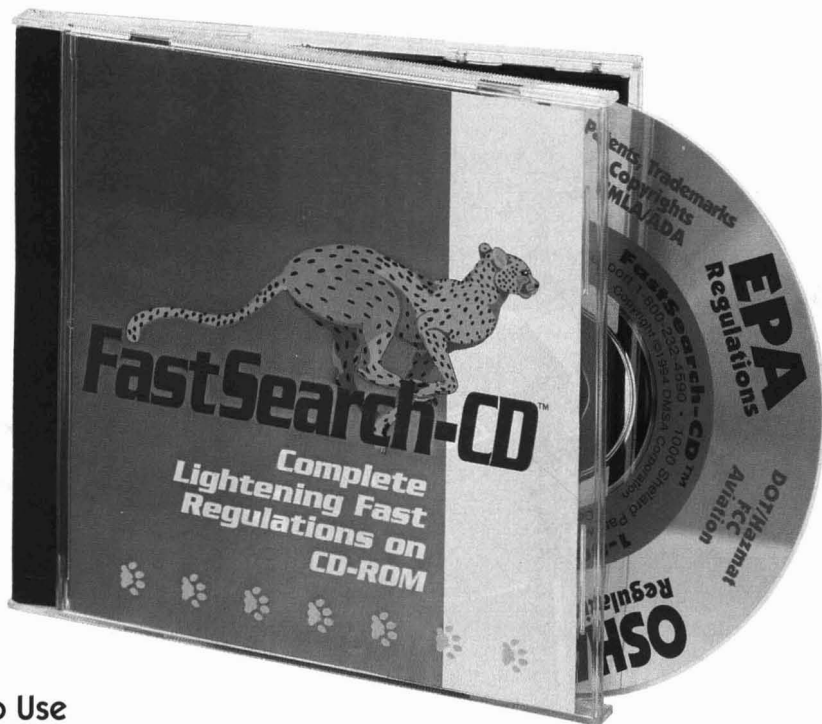
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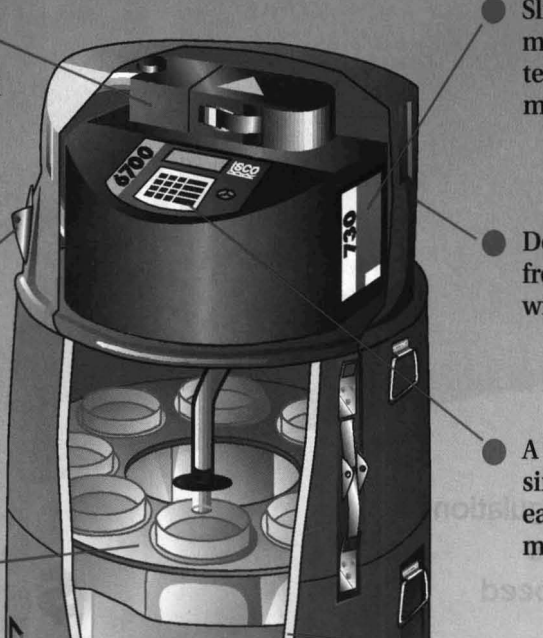
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Cover:
Innovative technologies for wastewater and groundwater are shaving treatment and cleanup costs. *EP* looks at several up-and-coming technologies that are beginning to make their mark.

Photo: The Stock Market

Environmental PROTECTION

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จุฬาลงกรณ์มหาวิทยาลัย คณะเทคโนโลยี

Technology Combinations to the Rescue

New technologies to treat industrial and municipal wastewater and contaminated groundwater are knocking old standard-bearers out of the way. The benefits are often two-fold: improved treatment efficiencies and lower treatment costs.

Groundwater remediation of volatile organic compounds (VOCs) provides a classic example. Pump-and-treat regimens relying on carbon adsorption are giving way to combinations of new technologies, such as air stripping in conjunction with ultraviolet oxidation, or more recently, biofiltration.

Federal facilities provide an ideal proving ground for new groundwater treatment regimens, as KSE consultants J.R. Kittrell and C.W. Quinlan note in an article beginning on page 15. Several U.S. Air Force bases, including Dover AFB in Delaware, are tackling VOC-contaminated groundwater using novel technology combinations.

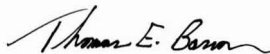
In the wastewater arena, technology advances on several fronts are paying dividends to both industrial and municipal wastewater treatment operators. Associate editor Beth Cahape reports on three promising applications, including a new reverse osmosis design that allows its use with heavily polluted wastewaters and groundwaters, in an article beginning on page 10. Also profiled are systems that combine UV disinfection with ozone and hydrogen peroxide treatment and the growing use of UV disinfection for municipal wastewater.

This month's Water Focus also features a roundup of new water-related software, including regulatory management, reporting and modeling applications. Our annual Water Software Guide begins on page 24.

* * *

With the future of the Clean Water Act hanging in the balance, EP conducted an informal survey this month to see where readers stand on plans to overhaul the 26-year-old regulatory program. Not surprisingly, few were satisfied with the current regulatory framework. But opinions diverged on proposals to make it more efficient, including a call for more cost-benefit analyses of CWA regulations, replacing mandatory requirements with voluntary guidelines and other proposals from a Republican-led Congress. And no clear consensus emerged on which component of the Act is most in need of re-vamping, with percentages evenly divided among effluent guidelines, pretreatment standards, water quality standards, wetlands, stormwater and nonpoint source pollution.

But on the question of whether tough clean water regulations are beneficial, a resounding 85% of our respondents agreed that they are. It seems that both the regulated community and environmental service providers value one of our most precious resources.



Thomas E. Barron
Editor-in-Chief

Environmental PROTECTION

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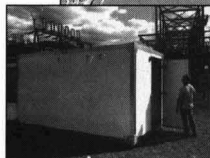
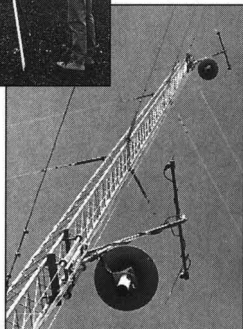
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NEWS UPDATE

House Votes Big Cuts In EPA's Budget

By the narrowest of margins, the House of Representatives voted to clip EPA's wings, just before Congress left for its summer recess. Representatives voted to cut EPA's budget by one-third, and also agreed to a number of provisions restricting the agency's enforcement authority. All the action happened just before Congress left Washington for its August recess.

A few days earlier, the House had voted to remove from its appropriations bills a host of provisions that would restrict EPA's ability to enforce environmental laws. But a few days later, House Republicans fought back, defeating an attempt by Democrats and moderate Republicans—led by Rep. Sherwood Boehlert (R-N.Y.)—to remove the EPA provisions from the bill. The amendment to take out the EPA-limiting provisions failed, 210-210.

Part of the 33 percent budget cut included a 50 percent cut in EPA's enforcement budget, which administration officials warned would result in endangering human health and the environment. House Republicans said they wanted to limit an agency that was "out of control."

Despite all the activity, it appeared unlikely that the House cuts would make it into the final budget. The Senate still has to review the House action, and President Clinton has said he would veto the House bill if it came to his desk.

Seventeen legislative "riders" attached to the bill would limit the circumstances when EPA could use appropriated funds to enforce the Clean Water Act, the Clean Air Act, Superfund, and community right-to-know and pesticide regulations.

Only 1 Of 3 Superfund Sites Posed Risks: GAO

Of 225 Superfund sites whose records of decision were signed between 1991 and 1993, only 71 posed health risks serious enough under current land uses to warrant cleanup, a new study has found. Of those 71 sites, 40 did not pose threats substantial enough to warrant removal actions, largely because the contaminated groundwater had not migrated to drinking water.

The General Accounting Office, an investigatory arm of Congress, found that another 119 sites posed no serious health risks currently, but posed risks under EPA's projections for future changes in land use. The rest of the sites—35 in all—posed no health risks under either scenario, GAO

found. "However, EPA may decide to clean up these remaining sites to comply with other federal or state regulations or because of a threat to the environment, such as contamination endangering a wetland," the report said.

GAO studied these non-federal National Priorities List sites at the request of Sen. Christopher Bond (R-Mo.), who said the findings show that Superfund sites do not threaten millions of Americans as is generally believed and that the program "is even more broken than we realize."

"These are the sites that will soon be moving into the expensive construction phase and will be driving a big portion of the Superfund budget in the next few years," Bond said. As it is structured, the "risks to current use" category is overly inclusive, Bond said, because it includes sites where there "could be a risk in the future if, for example, a groundwater plume migrated to a currently used drinking water source," he said.

Bond, who chairs the Senate subcommittee that sets EPA appropriations, said EPA "will simply have to get used to doing more with less. The Superfund program will not be exempt from these changes . . . It is only prudent to plan for smaller budgets by focusing on prioritizing among Superfund NPL sites," he said.

EPA Gives \$200,000 For Brownfields Projects

As part of President Clinton's Brownfields Economic Redevelopment Initiative, EPA will provide 15 urban communities with up to \$200,000 for pilot projects to develop abandoned industrial sites.

The grants will go to Brownfields projects in Baltimore, Md.; Birmingham, Ala.; Bridgeport, Conn.; Cape Charles-Northampton County, Va.; Cleveland, Ohio; Detroit, Mich.; Indianapolis, Ind.; Knoxville, Tenn.; Laredo, Texas; Louisville, Ky.; New Orleans, La.; several Oregon mill sites; Richmond, Va.; Rochester, N.Y.; Sacramento, Calif.; St. Louis, Mo.; Trenton, N.J.; and the West Central Municipal Conference, a group of Chicago suburbs. The new pilot projects join those already underway in Bridgeport, Conn., Cleveland, Ohio and Richmond, Va.

In addition to providing grants, the Brownfields initiative aims to clarify liability issues, promote public participation and provide job development and training.

continued on page 48

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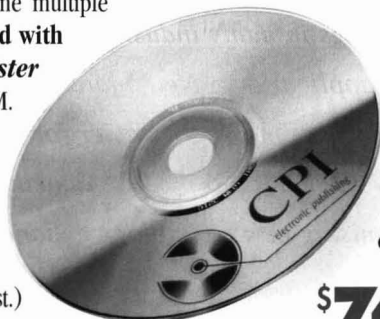
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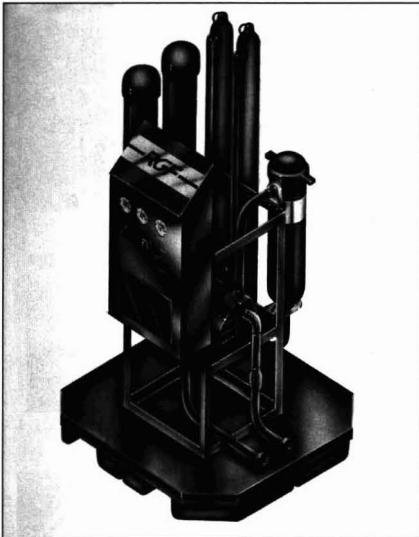


WASTEWATER TREATMENT...

New Technologies Lowering Treatment Costs

By Beth Cahape

Technology enhancements are delivering not only more muscle, but more cost savings in many industrial and municipal wastewater treatment applications. New materials, techniques and treatment objectives are making it easier for both facility managers and POTW managers to meet treatment goals. Here's a look at some promising new technology enhancements.



Disc Tube Membranes May Change the Face of RO

A NEW DISC TUBE DESIGN FOR REVERSE OSMOSIS systems holds potential for broad new industrial wastewater treatment applications.

Historically, RO systems based on spiral wound membranes have been applied by industry only as a last-stage polishing technique. The reason is the inability of RO systems to treat heavily polluted wastewaters due to membrane fouling and premature clogging. Spiral wound membranes make up 90 percent of the market.

The disc tube RO technology shows promise for grittier applications. Indeed, the disc tube design has its roots in landfill leachate treatment overseas. Preliminary results from a recent EPA SITE (Superfund Innovative Technology Evaluation) Program for similar applications here are very positive. More importantly, the membrane separation process may have even greater value for industrial wastewater treatment. RO has begun to garner the interest of environmental managers in areas as diverse as cogeneration plants, food and beverage facilities, and petroleum refineries.

Made up of stacked membranes and cushions that alternate with hydraulic discs, disc tube systems are housed in a pressurized vessel that, in basic models, operates as high as 900 psi. The key to its design is a serpentine flow path de-

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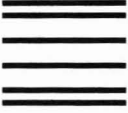
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signed for greater width and length that promotes larger feed flow channels, higher feed flow velocity and less membrane fouling than spiral wound configurations. In SITE tests, recovery rates of permeate have averaged 75 percent. Two other models by its manufacturer—Rochem Separation Systems Inc. of Torrence Calif.—have psi ratings of 1800 and 2800 and yield as much as 90 percent permeate.

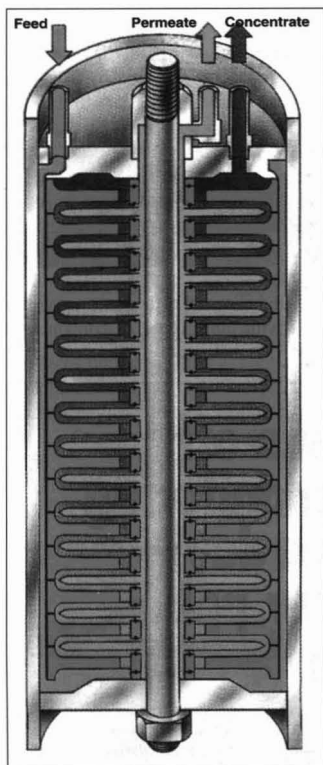
According to Rochem Vice President Tom Aarts, these systems can remove suspended solids, heavy metals, ammonia and hazardous non-degradable organics without extensive pretreatment systems. Pure water is clean enough for direct discharge into the environment.

One such heavy metal application was the removal of nickel contaminants from water generated at Chevron's Pascagula, Mississippi refinery by hydro-drilling spent catalyst from hydrotreating reactors. Before switching to the DT membrane system, says Chevron Process Engineer Cameron McCord, they had been using a traditional chemical approach (caustics) to remove the metal from wastewater. "The old approach was working fairly well, and my first reaction was that I didn't want to have anything to do with switching to this new technology," McCord admits.

But the dual draws of cost savings and a simplified treatment regimen convinced McCord and his managers to allow Rochem to run a small pilot at their facility in August 1994. Within a few months, everyone was so pleased with the results that they set up a full scale system by autumn.

"The quality of the water is far and away better than what we were getting with the previous treatment," says McCord. "We're also pleased because we aren't using any chemicals." Permeate water quality is so high, he adds, that the refinery plans to eventually reroute this water from the effluent system into the boiler feedwater system. "It's condensate quality," he adds.

McCord says that because the operation is less labor-intensive the savings have been substantial. Rochem promotes their product as a low-maintenance system, with only the membranes and a pump to service. The typical life of membranes is three to five years. There is no need for a full time operator. "It's been amazingly trouble-free," he says. "We running 15 to 40 gallons per minute, depending on the drilling operation, and I'd have to say that we're probably saving about 40 percent over our previous treatment."



New Treatment Combines UV, HO₂, and Ozone in a Closed-Loop System

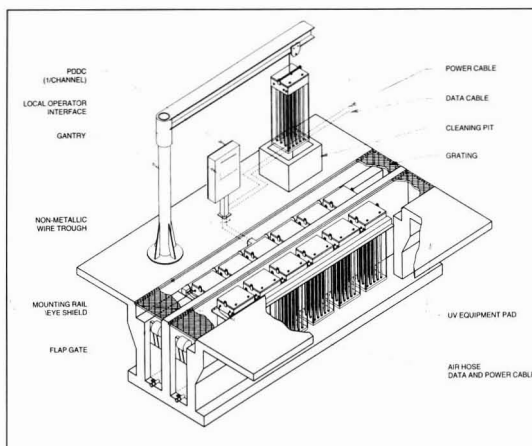
A SYSTEM THAT COMBINES UV DISINFECTION with ozone and hydrogen peroxide treatment may have applications for a number of industries seeking to recycle their wastewater. Designed to be used at the end of a treatment process, one of the system's key benefits is a redundant source of oxidizing potential. RGF Environmental Systems, of West Palm Beach, Fla., has emphasized the CO3P system's

strength in keeping BOD controlled in recycling wash or treatment water.

Says Dale Birosh, RGF director of engineering, "I like to refer to these three key aspects of the CO3P as a triangle effect: all work together in conjunction to produce a synergistic effect greater than the parts." He cautions, however, that a combined unit like this should be used for those contaminants that don't settle or coalesce, so users will want to make certain their water isn't, for example, murky or heavy in oil as it enters the unit.

Washington Equipment of Texas (WET) of San Antonio, Texas, has tried the CO3P system with some

success. President Dave Poirier explains that his company contracts to do tractor trailer cleaning for food products. WET employed a series of separation and treatment steps for their waste water, including a centrifugal cone bottom tank and a backflush filter. But their efforts to control a serious odor problem with various treatments, including chlorine and hydrogen peroxide, proved unsuccessful. "The chlorine was difficult to control," explains Poirier, "and the other treatments still left us with the problem. We'd worked with RGF be-



Wastewater Treatment

fore, and they had just introduced the CO3P. We'd never used all three products in a closed loop system before."

"We had excellent results," adds Poirier. "It eliminated the odor problem completely and we now rely solely on this unit." Poirier is also generous in his praise of the unit's reliability. "The original application was for a customer who had to clean up to four trailer at a time, on a 24-hour basis, and they can't afford to have downtime." Now, WET is using it on other jobs.. "In smaller applications, we're seeing good results, as

well. Even in basic systems, it seems to be a great enhancement. The clarity and quality of the water is just incredible."

Poirier has good things to say about cost considerations, too. "The turn over on the initial investment was pretty fast; it's cut our costs by about 35 percent. So I'd have to say that, although this system isn't for everybody, for anyone who's recycling wash water, it's a serious solution. This is a winner."

RGF believes that the system may work well with other types of contaminants.

"We believe that this unit might be used by many industries that create waste streams high in organics," says RGF's Birosh. "If they are recycling now, this unit can still help them improve the odor and color quality of their recycled wash water."

UV Treatment the Toast of the Town

IN 1993, THE CITY OF SALINA, KAN., learned it would be required to meet new effluent coliform limits at its wastewater treatment plant by year's end. It meant that the plant, which was not designed to disinfect effluent flows, would have to disinfect wastewater prior to discharging it into the receiving river.

The city commissioned an engineering firm to identify, select, and design a suitable disinfection system. At that time, the consensus was that while ultraviolet (UV) disinfection was effective, it was limited in application to small facilities processing less than one million gallons per day (MGD), and thus would be unsuitable for the Salina plant, which processed an average of 7.25 MGD, with peaks of up to 15 MGD. The alternative was more chemical-based disinfection strategies.

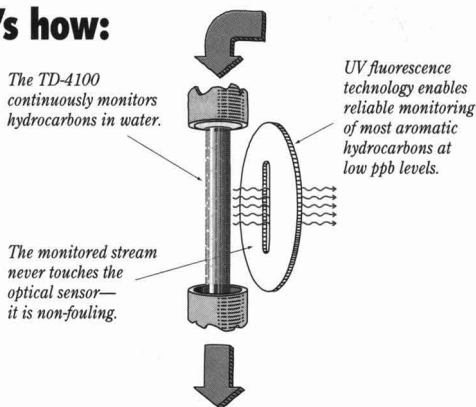
Enter the local electric utility, Western Resources. Using a team that included the engineering firm city officials, state regulators, and other Western Resources employees, their research suggested that recent breakthroughs had resulted in commercially available UV systems which could handle higher flow rates and require less maintenance.

UV treatment involves disinfection through the exposure of water or wastewater to a series of ultraviolet lights rather than relying on chlorine. In addition to being more effective than chemical alternatives, UV also eliminates the need for on-site storage and the other health and safety hazards associated with chemical disinfection.

Because UV also eliminates chemical releases into streams and rivers, it is gaining acceptance in the municipal wastewater market as a cost-effective alternative

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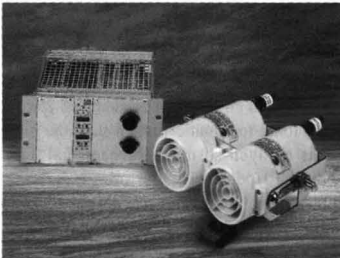
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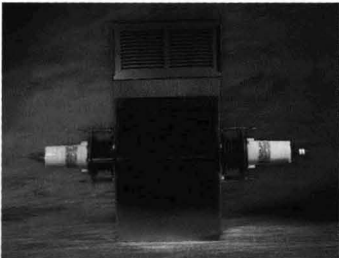
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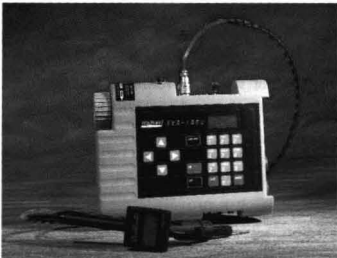
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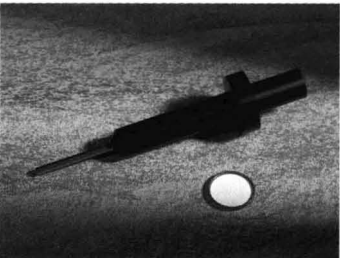
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Wastewater Treatment

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Several other recently designed Kansas wastewater facilities required to disinfect effluent discharge have chosen UV systems. Western Resources partnered with Salina in developing their large scale application. They chose a vertical lamp system utilizing a proven lamp array which promotes a semi-turbulent plug flow. This ensures that every particle of water on its way through the lamp array sees maximum exposure to the UV light by coming into very close proximity with many of the

lamps in the system.

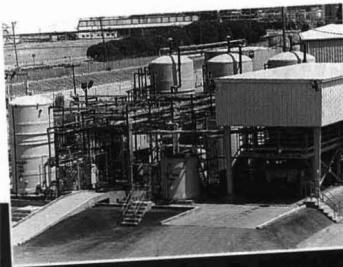
Water runs perpendicular to the lamps in a vertical system, allowing each particle of water—and therefore the microorganisms—to encounter the maximum UV intensity as they complete their path. All calculations for UV wastewater disinfection systems are based on the UVDIS program, as recommended by EPA.

Completed in time to meet the new regulations, in December, 1993, this system has provided many benefits already for the city of Salina: capital cost and operating

cost savings; improved job site safety; environmental and regulatory compliance; elimination of chemical storage and handling; and elimination of chemical residuals toxic to aquatic life. In fact, the plant has enjoyed so much success that more than 70 percent of the new wastewater treatment capacity within Western Resources' service territory have utilized UV disinfection.

Beth Capahe is associate editor of Environmental Protection.

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ON SEVERAL U.S. AIR FORCE SITES, SPILLS, LEAKS, AND seepage from disposal have resulted in groundwater contaminated with VOCs, including chlorinated compounds. One of those contaminated sites is Dover Air Force Base in Delaware, where monitoring wells have shown relatively high concentrations of chlorinated hydrocarbons.

The Dover AFB Groundwater Reclamation Project demonstrated advanced technologies to control groundwater contamination, including comparisons of traditional countercurrent air strippers to a crossflow air stripping technology. Another demonstration involved an advanced photocatalytic VOC destruction technology, which operates on the effluent air from the stripper. The combination of air stripping and photocatalytic destruction was shown to be effective for remediation of groundwater contaminated with chlorinated organic compounds, both because of its low cost and its ability to prevent toxic air emissions.

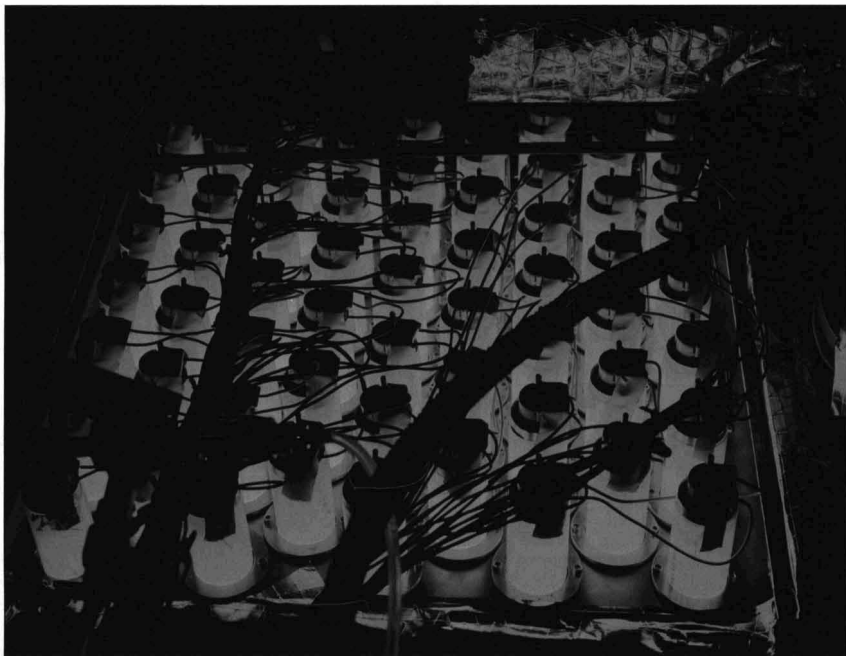
In the past, a variety of air stripper designs have been used for groundwater remediation. Designs have used various heights, flow patterns, air usage rates, pressure drop, and cost characteristics. But until now, there have been no detailed field performance comparisons of those designs. In general, strippers' air emissions have been at concentrations ranging from parts per billion to parts per million, depending on the concentration of VOCs in the groundwater and the stripping air rate. At such low concentrations, thermal incineration requires substantial supplemental fuel and can produce undesirable byproducts. Catalytic oxidation is similarly costly at such low concentrations of VOCs. The widely used process of carbon adsorption can be employed to treat the effluent air leaving the stripper, but since it is not a destruction process, it leaves spent carbon that must be treated and disposed of.

Studies at the National Renewable Energy Laboratory in Golden, Colo., have shown that stripping of groundwater combined with treatment of the effluent stripper air costs less than carbon adsorption, UV/water treatment, or aqueous phase UV/titania photocatalytic treatment.

The main reasons for the lower remediation costs were faster reaction kinetics and less interference from other water constituents. In the Dover AFB program, we successfully demonstrated a new, highly active photocatalyst, which effectively removed the low concentrations of chlorinated hydrocarbons in the stripper effluent air.

AIR STRIPPING & PHOTOCATALYTIC OXIDATION

A Winning Team For Groundwater Remediation



By J.R. Kittrell and
C.W. Quinlan

Air Stripping

Table 4. Advantages of an Effective Photocatalytic Technology for Air Stripping

Comparison Category	Photocatalytic Process	Thermal Incineration	Catalytic Oxidation	Carbon Adsorption
Useful Inlet Composition	Low or High	High	High	Low
Destruction Process	Yes	Yes	Yes	No
Operating Temperature	Ambient to 300° F	>1200°F	>600°F	<100°F
Energy Requirement	Low	Higher	Higher	Higher (regen)
Byproduct Potential	Low	High	Low	High

CFAS vs. CCAS

Air stripping towers typically are designed in a conventional countercurrent flow arrangement. In an alternative crossflow air stripping design, a number of partial baffles are spaced evenly throughout the tower, and packing is placed in the center of the tower's cross section between the baffles. Water enters the top of the tower,

and air enters at the bottom. The air is deflected by the internal baffles, causing it to pass through the packing at about 90 degrees. The crossflow arrangement could reduce energy costs for the air blower. Compared to conventional countercurrent towers, higher air-to-water ratios could also be achieved without flooding.

The two tower designs were tested side

by side under identical operating conditions to provide a large-scale field comparison. Both the crossflow air stripping (CFAS) tower and the conventional countercurrent air stripping (CCAS) tower were 17 feet packing height. The packing used was 1-inch polyethylene pall rings. Two cylindrical sections (8.3 and 8.5 feet high) were used to contain the packing in the CCAS tower. The packing in the CFAS tower was contained in eight sections, six of which were two feet long and two which were 2.4 feet long, all with flanged ends. Baffles were made of thin aluminum sheets of size similar to the flanged ends. The packed portion of each tower was installed on a 2.9-foot-long tower base, mounted to a trailer. A 1.5-foot distributor section was placed on top of each tower to complete the construction. Both towers were made of aluminum, and all connections were made with flanges. Each tower was 22.1 feet high.

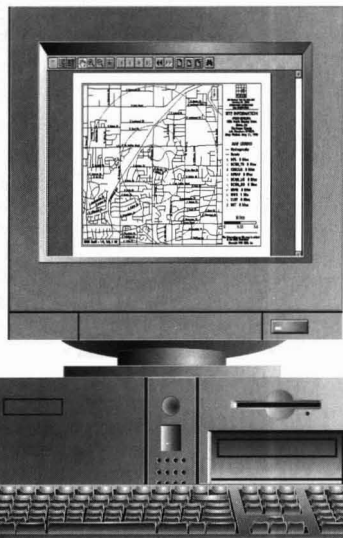
Photocatalytic Technology

Technology to control dilute concentrations of air pollutants is very much in demand. Better methods are needed to con-

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Air Stripping

trol indoor air pollution associated with solvent degreasing, electronics manufacture, aircraft hangars, or urethane foaming operations. Air stripping of contaminated groundwater produces dilute emissions for which current technology provides no economic solutions. Chlorinated volatile organic compound (CVOC) destruction is particularly important, as about one-third of the 189 targeted hazardous air pollutants in the Clean Air Act Amendments of 1990 are chlorinated hydrocarbons. The new photocatalytic technology demonstrated at

Dover AFB and developed by KSE Inc., uses a catalytic adsorbent to adsorb CVOCs, which then are continuously destroyed by photocatalysis (see box, page 16).

Many researchers are exploring photocatalysis, using variations of a titania catalyst. Although a useful photocatalyst may comprise titania along with other semiconductors, it is unlikely to consist solely of titania. By analogy, platinum has been known for decades to be an active catalytic component. However, its commercial performance is dictated by its dispersion on

supports such as alumina or zeolite, and is greatly improved by co-components such as rhenium. Similarly, studies of titania have only begun the important mission of exploiting the combinations of titania with other materials which will form the commercial basis for photocatalysts for decades to come. The addition of UV light adds a very important dimension to the classical variables of industrial catalyst synthesis. The development of the catalyst exploited analogous industrial catalysis expertise.

In May 1994, at the request of Battelle Memorial Institute of Columbus, Ohio, KSE delivered an AIR Process Unit designed for 50 standard cubic feet per minute (SCFM), which met this design basis and which provided flexibility for accommodating higher conversions, flow rates, or additional chlorinated hydrocarbons. As will be

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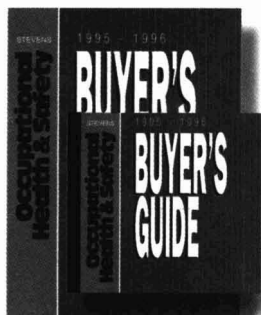


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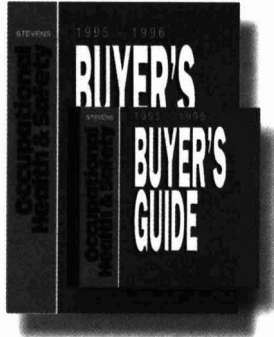
discussed, the KSE AIR Process Unit was operated at Dover AFB at an average flow rate of 55 SCFM and at conversion levels of 95 percent to 99-plus percent for destruction of total hydrocarbons.

The AIR Process Unit at Dover AFB was a single, rack-mounted system on wheels, and received air directly from the air stripper without further treatment. Actual system pressure drop was six inches (water). The reactor consisted of a single vessel (not parallel modules) containing the KSE photocatalyst, illuminated by black light UV bulbs. Because of the reactor design, it can be scaled up to any larger size with engineering procedures typical of the petroleum or chemical industry, and continues to achieve economies of scale with increased size. Approximately 60 bulbs were provided in the reactor for flexibility, although only a fraction of the bulbs were illuminated during the Dover AFB demonstration program. The unit was fully instrumented with flow, pressure, and temperature instruments. The unit was provided with automatic shutdown devices on



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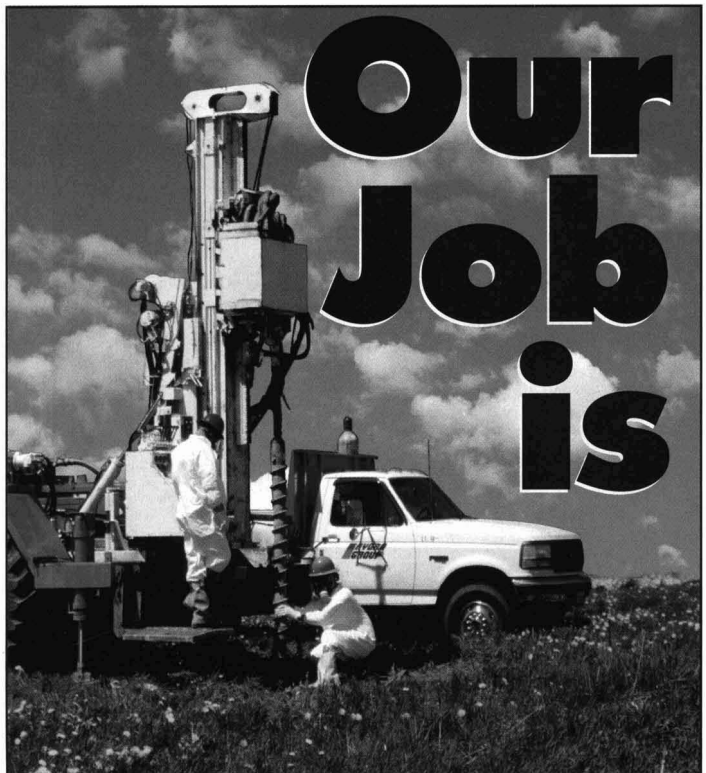
As illustrated in Table 1, the technology is effective for a variety of contaminant compounds, at reactor residence times as low as 0.2 seconds. This residence time for 99-plus percent conversion at ambient temperature corresponds to a space velocity higher than many high-temperature catalytic processes for the destruction of CVOCs. For comparison purposes, titania photocatalysts used in the destruction of CVOCs have been reported to exhibit residence times for trichloroethylene oxidation exceeding 8 seconds, with 34 seconds required to eliminate all reaction byproducts.

No products of incomplete combustion (PIC's) were observed in the experimental program, and no PIC's were identified by Battelle in the Dover AFB Program. Other studies of photocatalytic oxidation by titania have reported up to 75 ppm phosgene in the effluent gas at 98 percent TCE conversion. By contrast, no detectable levels of phosgene were found at 99 percent TCE conversion in laboratory studies with the AIR Process. Studies of effluent samples performed at the University of Massachusetts, on a GC/AED system specific to chlorinated and oxygenated species, also showed no byproducts.

For the AIR process, no catalyst deactivation has been observed after thousands of hours of continuous operation both in the laboratory and in the Dover AFB field demonstration. Laboratory tests of TCE conversion at KSE have shown no detectable catalyst deactivation at 300 ppm TCE feed concentrations, at test durations exceeding three weeks. Titania sol gel photocatalysts have been reported to deactivate within 48 hours at 50 ppm contaminant, and within six hours with 500 ppm contaminant levels.

Demonstration Program Results

An extended test lasting 10 weeks was conducted on the air stripping towers and the photocatalytic VOC destruction unit. The CFAS tower was tested using nine baffles. Both towers were operated at a 20 gpm water flow rate. The air flow rates were selected based on the results of preliminary tests to obtain 95 percent removal of dichloroethane (DCA) in each tower. The CFAS tower was operated at 250 SCFM while the CCAS tower was operated at 160 SCFM. The photocatalytic VOC destruction unit was operated at 50 to 60 SCFM, as a slip stream off the combined effluent



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Air Stripping



The KSE-developed AIR Process unit used at Dover AFB is pictured above. The unit operated at an average flow rate of 55 SCFM and at conversion levels of 95 percent to 99-plus percent for destruction of total hydrocarbons.

from the two towers. The AIR Process design destruction efficiency was set at 95 percent of total inlet hydrocarbon.

The performance of the two towers over the 10-week test period showed that the CFAS tower was capable of the same stripping efficiency as the CCAS tower, but at a higher air-to-water ratio. Both the stripping efficiency and pressure drops remained constant throughout the test. The average stripping efficiency over the test period was 96.4 percent for the CCAS tower, and 94.4 percent for the CFAS tower. Even at the higher air flow rate, the pressure drop in the CFAS tower was an order of magnitude lower than in the CCAS tower.

The feed to the photocatalytic VOC destruction reactor averaged about 55 SCFM during the test period, increasing continuously over the test period. The inlet concentration of DCA to the unit varied between 900 ppb and 3 ppm, predominantly between 1.5 and 2.8 ppm. The inlet air stream was saturated with water vapor. The unit operated with unattended operation, except for gas sampling activities. Several power interruptions during the test program resulted in au-

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tomatic shutdown of the unit, which was then restarted uneventfully by resetting the startup power switches.

The AIR Process for photocatalytic VOC destruction easily exceeded the design target of 95 percent conversion of entering hydrocarbon. The data include those taken during the restart operations discussed above, and show occasional startup transients. Initially, about half the bulbs were placed in service, resulting in an average destruction efficiency of 96 percent. Then, an additional seven bulbs were illuminated in the unit, and the conversion averaged over 96 percent. Finally, another eight bulbs were illuminated in the unit, and the conversion averaged about 99 percent. The DCA destruction efficiency responded to increased UV light, and therefore to effective reactor residence time, in reasonable agreement with first order kinetics.

The field gas chromatograph was not calibrated to identify the presence of byproducts, although no byproduct issues were apparent. However, an extensive program of selectivity studies on DCA was conducted in the laboratory, consisting of

gas chromatography and chlorine atom balances using an Interscan Model LD-36 HCl analyzer, a Mil-Ram Model 01-2306D Tox-Array HCl analyzer, a Mil-Ram Model 01-2301D Tox-Array Chlorine analyzer, and Drager tubes. No byproducts were detected with DCA destruction. From chlorine atom balances, about 85 percent of the chlorine in the DCA entering the reactor is converted to HCl, and about 15 percent is converted to chlorine.

The factors that influence UV light power consumption in photocatalytic VOC destruction are (1) the inherent photocatalyst activity and its ability to efficiently utilize UV light, (2) the ability to scale up the reactor size while maintaining UV light utilization efficiency, (3) the target conversion desired, (4) the specific contaminant compound to be destroyed, (5) the relative humidity of the inlet air, and (6) the size of the air stream which must be treated. The first five of these factors are directly related to the required residence time or contact time in the reactor.

Considering first the residence time effects, UV power consumption is propor-

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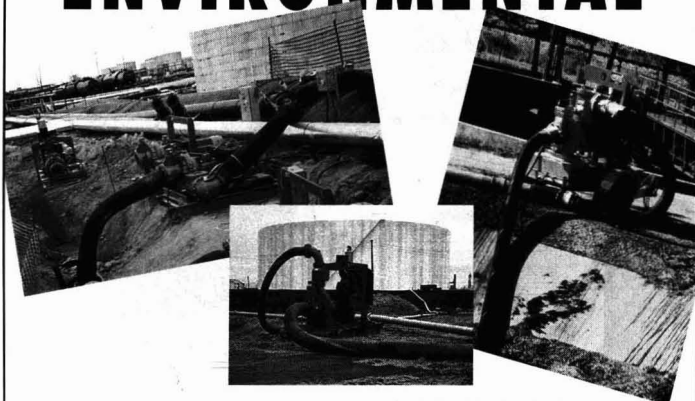
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21

Air Stripping

tional to residence time. The higher the residence time required to effect the target destruction, the greater the UV power required. Residence time is primarily affected by the activity of the catalyst. The Dover unit was based on KSE's AIR photocatalyst, which exhibits particular strengths with respect to inherent activity and reactor scale-up. In any case, however, a higher catalyst activity will translate di-

rectly to lower UV power consumption.

The specific feed compound and the stream humidity level affect the required residence time and therefore UV power consumption. DCA is a particularly difficult compound for photocatalysis. Comparing conversion data on trichloroethylene (TCE) to that for DCA, it is generally agreed that TCE can be destroyed at much lower residence time than required

for DCA. This would substantially reduce the required UV power consumption for TCE compared to DCA.

As with any kinetic system, a higher target conversion will require an increased residence time. Hence, increased conversion targets will increase the required power consumption in accordance with the photocatalytic kinetic equations.

Finally, a major factor impacting UV power consumption is the flow rate of the air to be treated in the photocatalytic unit. Clearly, as more contaminated air is processed, a larger bed volume and more UV lights are required to achieve the target residence time and contaminant conversion. The UV power consumption depends strongly on unit capacity.

An effective gas phase photocatalytic technology will enjoy many key advantages over competing technologies for air pollution control. The table compares an effective photocatalytic technology to thermal incineration, catalytic oxidation, and carbon adsorption, three technologies commonly employed for pollution control. The photocatalytic technology has advantages over the competing technologies in every comparison category of Table 3.

The combination of air stripping and photocatalytic destruction is an attractive option for remediation of groundwater contaminated with chlorinated organic compounds. It is a low-cost system that prevents air emissions of toxic compounds. A detailed performance comparison of stripper designs shows that the crossflow air stripper design was comparable in effectiveness to the conventional countercurrent air stripper at high air-to-water ratios, but at a substantially lower pressure drop. **EP**

JR. Kittrell and C.W. Quinlan are with KSE Inc., Amherst, Ma. Also assisting with this article were Arun Gavaskar and B.C. Kim with Battelle Memorial Institute, Columbus, Ohio, and Mark H. Smith and Paul F. Carpenter of Armstrong Laboratories, Tyndall AFB, Florida. The authors wish to acknowledge the sponsorship of the U.S. Air Force for part of the work presented herein. This was presented at the Air & Waste Management Association 88th annual meeting in San Antonio, Texas, June 18-23, 1995.

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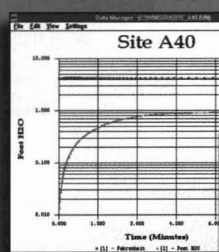

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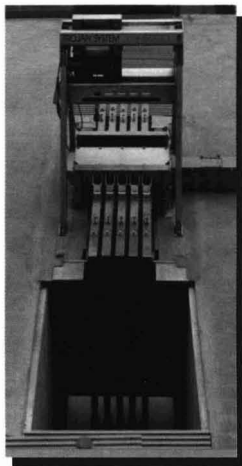
WEFTEC SHOWCASE

WATER ENVIRONMENT FEDERATION 68TH ANNUAL CONFERENCE & EXPOSITION

The following products will be featured at the Water Environment Federation's 68th Annual Conference and Exposition, Oct. 21-25.

Cyclone Action

Vanton Pump and Equipment announces the PVDF cyclone separator, which keeps the bearings of the Vanton thermo-plastic sump pump free of wear from dirt-laden abrasive fluids. The separator is installed in the discharge line of the pump. Because the separator utilizes centrifugal force to achieve separation, there are no moving parts to wear. **Vanton Pipe & Equipment Corp.** Circle 70 on card.



Trojan Technologies Inc.

TPH Detection

Hach's new "TPH in Water Test Kit" allows on-site detection of total petroleum hydrocarbons in water in approximately 30 minutes. The kit uses immunoassay technology to monitor PH at nine threshold levels between 200 ppb and 100 pm. It can be used to mon-

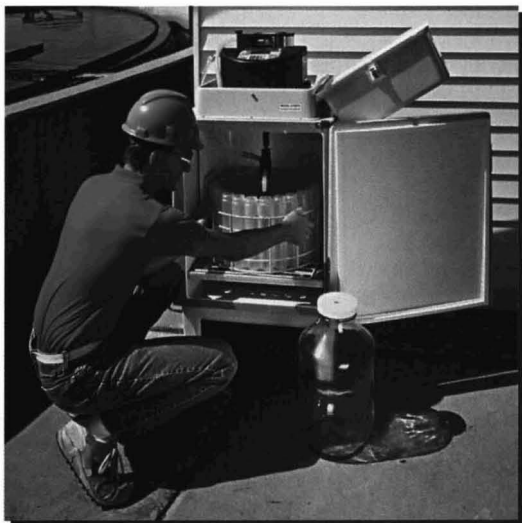
itor leakage from underground storage tanks, aquifers, groundwater supplies, influent at wastewater treatment plants, and water contamination at fuel refining facilities. A plastic carrying case includes all the reagents, apparatus, and instrumentation for testing, as well as illustrated procedures, antibody tubes, a timer, and a test tube rack. **Hach Co.** Circle 71 on card.

BOD Analyzer

A new fully automated, on-line BOD analyzer from Anatol operates exactly like a miniature wastewater treatment plant, says its manufacturer. The "Bio-Monitor" uses cascade reactors that decrease the required biodegradation time and allow a response time of four minutes. A reference cascade continuously monitors the endogenous rate of the sludge and immediately reports toxicity or other changes in sludge activity. The self-cleaning unit also includes a patented clog-proof sampling device and a rugged design. **Anatol Corp.** Circle 72 on card.

Quick Access to Regs

"EarthLaw for Windows," new from IHS Regulatory Products, is a comprehensive collection of federal, state, and military regulations on CD-ROM and online. The CD-ROM is updated monthly; the online service, updated daily, is available through a modem or across the Internet. Users can search the entire database or any part of it. *Federal Register* and *CFR* books can be searched simultaneously. Additional features include electronic bookmarks and notes. Users can also define their own hypertext links. **IHS**



Isco Inc.

Regulatory Products. Circle 73 on card.

Refrigerated Wastewater Sampler

Isco Inc. has introduced a refrigerated sampler the company says "combines a sealed, state-of-the-art controller with a corrosion resistant refrigerator." The new 6700FR Refrigerated Sampler uses R-134a, which is CFC-free. Features of the sampler include a built-in pump, flash memory for easy programming changes, and a plug-in module port for added versatility. The pump delivers samples at the EPA-recommended velocity of two feet per second. Samples can be collected in 1, 2, 8 or 24 glass or plastic containers. The controller is fully interchangeable with 6700 Series portable samplers. **Isco Inc.** Circle 74 on card.

Air Compressor

Trojan Inc.'s large single-stage

integral gearbox air compressor produces large volumes of low-pressure air for aeration of the biological process. Aeration blowers are the largest consumer of power in a wastewater plant. Controls incorporating interface color monitors will be demonstrated by Turblex instrumentation engineers at WEFTEC '95. A cut-away unit revealing internal design features also will be exhibited.

Turblex Inc. Circle 75 on card.

UV Disinfection System

Trojan System UV3000 uses electronic ballasts and solid-state circuitry with full local or remote system control and monitoring capability. System UV 4000 (left) makes use of variable output, high-intensity lamps and fully automated, self-cleaning technology ideal for primary effluents, CSO and stormwater applications.

Trojan Technologies Inc. Circle 76 on card.

1995 WATER SOFTWARE GUIDE

Company	Software	Description	Stormwater Mgmt.	Groundwater Mgmt.	Combined Water Mgmt.	Wastewater	Water Quality	Parameters	Permit Tracking	Monitoring	Modeling	Reporting	Demo	Cost: \$100 - \$500	Cost: \$500 - \$1000	Cost: >\$1000
Achieve! Technology, Inc. P.O. Box 668, Amherst, NH 03031-0668 603-595-1414, Fax 603-595-0088 Carol Jacobs, Dir., Sales & Marketing	• FastRegs	Regulation management software that provides federal & state regs on CD-ROM or diskettes.	✓	✓	✓	✓										
Alternative Systems, Inc. (ASI) 225 S. Cabrillo Hwy., Suite -C Half Moon Bay, VCA 94019 415-726-5700, Fax 415-726-7846 Michael Brinck, Sales Consultant	• TINIA	Integrated ESOH data management system.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
AV Systems, Inc. 4657 Platt Road, Ann Arbor, MI 48108-9796 313-973-3000, Fax 313-677-4480 Karen Wilson	• MIRS	Comprehensive, modular, integrated software for environmental management & compliance.	✓			✓	✓	✓	✓	✓	✓	✓				✓
	• NPDES	MIRS module for water-related environmental data management & compliance.	✓			✓	✓	✓	✓	✓	✓	✓	✓			✓
Citation Publishing, Inc. 1435 N. Hayden, Scottsdale, AZ 856577 602-994-9560, Fax 602-994-4456 Toll Free 800-808-3372 P. Thornodsgard, Vice President Marketing	• FESA	Comprehensive regulatory compliance database, covering all OH&S related topics	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
Computational Mechanics, Inc. 25 Bridge St., Billerica, MA 1821 508-667-5841, Fax 508-667-7582 Dee Halzack, Marketing Manager	• PRISE	Calculates air- or water-borne effluent dispersion					✓				✓					✓
	• Applied Envirometrics	Calculates air- or water-borne effluent dispersion St of three scientific tables: hydrological, oceanographic, and meteorological														✓
Dakota Software Corp. 7 Tobey Village Office Park, Pittsford, NY 14534 716-381-8710, Fax 716-381-1614 Arlene Davidson, Marketing/PR	• Audit Master	Walks users through an audit to develop profile of compliance status with EPA, OSHA, & DOT regulations.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Earth Info, Inc. 5541 Central Ave., Boulder, CO 80301 303-938-1788, Fax 303-938-8138 Andrea J. Lee, Sales Support Manager	• USGS Daily Values	Streamflow data for more than 100 yrs. in all 50 states as well as U.S. provinces & territories.	✓	✓				✓	✓	✓	✓	✓	✓			
	• USGS Peal Values	Flood flow data & ranking information for annual & partial peaks	✓	✓				✓	✓	✓	✓	✓	✓			✓

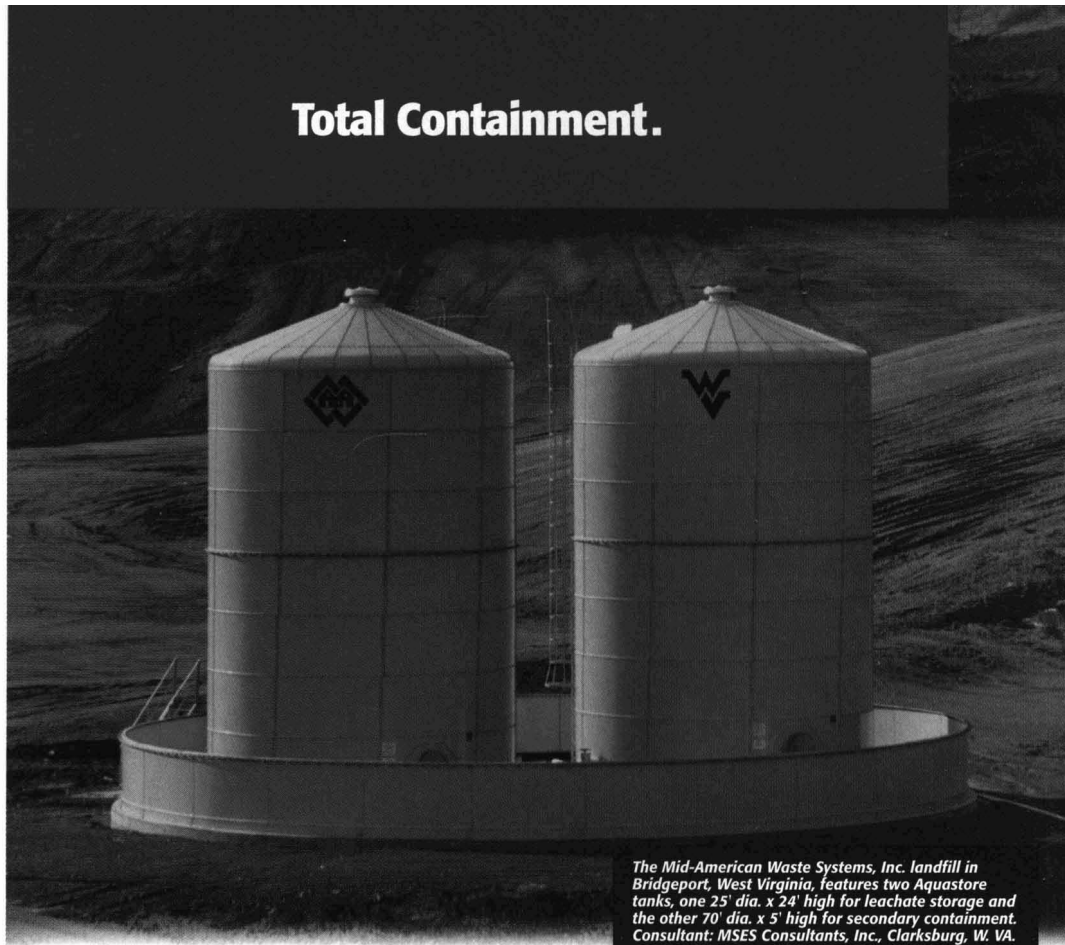
Company	Software	Description	Environmental Software 1995														
			Stormwater Mgmt.	Groundwater Mgmt.	Drinking Water Mgmt.	Combined Sewer Mgmt.	Wastewater	Water Quality	Parameters	Permit Tracking	Monitoring	Modeling	Reporting	Demo	Cost: \$100 - \$500	Cost: \$500 - \$1000	Cost: >\$1000
Earth Info, Inc. 5541 Central Ave, Boulder CO 80301 303-938-1788, Fax 303-938-8138 Andrea J. Lee, Sales Support Manager	• USGS Quality of Water	More than 34 million analysis of 5,000 water quality parameters, including organics, inorganics, metals & pesticides.	✓					✓	✓		✓	✓	✓				
	• EPA STORET	More than 150 million analysis of chemical & physical water quality parameters at more than locations across the U.S., including coastal & international waters.	✓						✓	✓		✓	✓				
	• NCDC Summary of the Day	Daily observations of temperature, precipitation, snowfall, & evaporation from more than 25,000 stations nationwide.	✓									✓	✓	✓		✓	
	• NCDC Hourly	Hourly data from more than 5,000 stations. Precipitation nationwide.	✓									✓	✓	✓		✓	
	• NCD 15-Minute Precipitation	Data for runoff studies & stormwater drainage planning.	✓									✓	✓	✓		✓	
EcoAnalysis, Inc. 221 E. Matilija St., Suite A, Ojai, CA 93023 805-646-1461, Fax 805-646-4141 S. Johnson, Senior Environmental Scientist	• TOXIS	Automatically stores data, calculates statistics & generates reports for aquatic bioassays.	✓						✓	✓		✓	✓		✓		
Environmental Systems & Technologies (EST) 2608 Sheffield Drive, Blacksburg, VA 24060-8270 703-552-0685, Fax 703-951-5307 Jack Parker	• SPILLCAD	Powerful but simple hydrocarbon spill site assessment models	✓							✓		✓	✓		✓		
	• ARMOS	Numerical model for groundwater & NAPL migration/recovery	✓									✓	✓		✓		
	• BIOTRANS	Numerical models for multispecies groundwater transport with oxygen-limited decay	✓								✓		✓	✓		✓	
	• BIOVENTING	Model for assessing soil vapor extraction, bioventing, & bioslurping.	✓								✓		✓	✓			
	• MODELPRO	Database for selecting from more than 250 soil & groundwater models.											✓			✓	
	• SITEVIEW	Powerful tool for 3-D visualization of site data for PCs.											✓			✓	
Enviro Metrics Software, Inc. 92 Reed Way, New Castle, DE 19720 302-324-9136, Fax 302-324-9138 Thomas Perkowski, Marketing Manager	• PlantWare/Water	Tracks water emissions to comply with NPDES permits	✓	✓	✓	✓			✓	✓	✓	✓				✓	

1995 WATER SOFTWARE GUIDE

Company	Software	Description	Stormwater Mgmt.	Groundwater Mgmt.	Drinking Water Mgmt.	Combined Water Mgmt.	Wastewater	Water Quality	Parameters	Permit Tracking	Monitoring	Modeling	Reporting	Demo	Cost: \$100 - \$500	Cost: \$500 - \$1000	Cost: >\$1000
ERM Computer Services, Inc. 912 Springdale Drive, Exton, PA 19341 610-594-440, Fax 610-594-4481	• ENFLEX Federal & State Regulations	Current, comprehensive full-text coverage of federal & state	✓	✓	✓	✓	✓	✓					✓			✓	
	• ENFLEX Register Tracking	Biweekly summaries of federal & state EHS regulations activity.	✓	✓	✓	✓	✓	✓					✓			✓	
	• ENFLEX International	Full-text English translations EHS regulations from eight countries.	✓	✓	✓	✓	✓	✓					✓			✓	
	• ENFLEX Federal Register	Complete text of Federal Register, with six months archived	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	
Facility Management Technology, Inc. 3005 16th Ave. N., Suite 500 Plymouth, MN 55441 612-557-6749, Fax 612-557-6929 David Ching, President	• SYSTEM/VIEW-WIN	Real-time display client & server.	✓	✓	✓	✓	✓	✓				✓	✓			✓	
	• REPORT/VIEW-WIN	Data management, reporting, & charting.	✓									✓	✓		✓	✓	✓
	• MAINTENANCE/VIEW-WIN	Maintenance management.	✓				✓					✓	✓				
Haestad Methods 37 Brookside Road, Waterbury, CT 6708 203-755-1666, Fax 203-597-1488 Michael Barnes	• StormCAD for Windows	Storm sewer design & analysis.	✓									✓	✓		✓		
	• SewerCAD for Windows	Sewer design & analysis.	✓									✓	✓			✓	
	• FlowMaster for Windows	Pipe & open channel flow design & analysis	✓					✓				✓	✓		✓		
	• Pond Pack (Pond-2 & Quick TR-55)	Urban stormwater management & detention pond design.	✓					✓				✓	✓			✓	
	• CYBERNET	Water network modeling.	✓					✓				✓	✓		✓		
	• KYPIPE2	Water network modeling.	✓					✓				✓	✓			✓	
Hydromantis, Inc. 1685 Main St., Suite 302, Hamilton, Ontario L85 1G5 905-522-0012, Fax 905-522-0031 Laurence Smith, Business Manager	• GPS-X	Unix-based modeling & simulation software for WWTP optimization.					✓	✓	✓			✓	✓			✓	
	• Simworks	MS Windows software for analysis of WWTP optimization.						✓	✓			✓	✓			✓	

Company	Software	Description	Stormwater Mgmt.	Groundwater Mgmt.	Drinking Water Mgmt.	Combined Water Mgmt.	Wastewater	Water Quality	Parameters	Permit Tracking	Monitoring	Modeling	Reporting	Demo	Cost: \$100 - \$500	Cost: \$500 - \$1000	Cost: >\$1000
Hydromantis, Inc. 1685 Main St., Suite 302, Hamilton, Ontario L8S 1G5 905-522-0012, Fax 905-522-0031 Laurence Smith, Business Manager	• CAPDET-PC	DOS-based software for preliminary cost estimation of new WWTP construction.					✓	✓				✓	✓			✓	
IHS Regulatory Products 15 Inverness Way East, Edgewood, CO 80112 Toll Free 800-320-4555, Fax 303-267-1360 Diane Belts, Marketing Specialist	• Earthlaw	Regulatory information on CD-ROM, pertaining to EPA, OSHA, & NIOSH. Available for DOS & Windows	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Intec Controls, Inc. 55 West St., Walpole, MA 508-660-1221, Fax 508-660-2374 Valerie Harding, D. Marketing Manager	• Paragon TNT	Automation software for process monitoring & control of environmental applications	✓	✓	✓	✓	✓	✓	✓	✓			✓				✓
	• Paragon 550	Automation software for monitoring & controlling environmental applications like water, wastewater & air pollution.	✓	✓	✓	✓	✓	✓	✓				✓				✓
	• Paragon 500	Industrial software for controlling & monitoring environmental applications	✓	✓	✓	✓	✓	✓	✓				✓	✓			✓
Alan A. Smith, Inc. 17 Lynndale Drive, Dundas, Ontario L9H 3L4 905-628-4682, Fax 905-628-1364 Alan Smith, President	• MIDUSS	DOS-based software for interactive design of unlimited sized stormwater system.	✓						✓			✓	✓	✓			✓
Simulation Sciences 601 S. Valencia Ave., Brea, CA 92621 714-579-0412, Fax 714-579-7929 B. Betteridge, Marketing Communications Mgr.	• INPLANT	Multiphase fluid-flow simulator for plant piping networks.	✓	✓	✓	✓	✓					✓					
	• PRO/II	General-purpose flow sheeting & process design/optimization program.	✓	✓	✓	✓	✓					✓					
	• PROVISION	Graphical computing environment for process engineering software.	✓	✓	✓	✓	✓					✓					
Tahoe Desing Software P.O. Box 8128, Truckee, CA 96162 916-582-1525, Fax 916-582-8579 Bran Haulman, Sales Engineer	• HYDRONET 4	Hydraulic network analysis software for MS-DOS.	✓				✓	✓				✓	✓	✓			
	• HYDROFLO II	Parallel & series pump analysis software for MS-DOS.	✓				✓	✓				✓	✓	✓			
	• H-CALC	Hydraulic calculator for MS-DOS.	✓				✓	✓				✓	✓	✓			
Trecom Computer Software Cochrane Associates, Inc. 155 Massachusetts Ave., Boston, MA 2115 617-247-0444, Fax 617-247-2785	• TREDAT (R)	Data handling & process control.	✓	✓	✓	✓	✓	✓				✓	✓				✓
	• TREMAIN (R)	Maintenance management & inventory control.	✓	✓	✓	✓	✓	✓				✓	✓				✓
	• TRELIMS	Data handling & process control.	✓	✓	✓	✓	✓	✓				✓	✓				✓

Total Containment.



The Mid-American Waste Systems, Inc. landfill in Bridgeport, West Virginia, features two Aquastore tanks, one 25' dia. x 24' high for leachate storage and the other 70' dia. x 5' high for secondary containment. Consultant: MSES Consultants, Inc., Clarksburg, W. VA.

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APPLIED SECONDARY CONTAINMENT AND LEAK DETECTION

By K.W. Wyatt and M.D. Webber

Tinker Air Force Base in Oklahoma provides a lesson in thinking ahead when installing tank and piping systems.

A new groundwater extraction and treatment system at Tinker Air Force Base in Oklahoma uses both conventional and innovative techniques to satisfy double containment requirements. The design and implementation of these techniques at Tinker highlight some important needs, including the importance of keeping the containment pipe clean and dry during construction and the value of an accurate leak detection system.

Located near Oklahoma City, Tinker AFB is home to one of the Air Force's major air logistics command and aircraft overhaul facilities. As the center of Tinker's aircraft overhaul operation for the past few decades, Building 3001 has been the site of plating and degreasing activities that have contaminated the underlying shallow aquifer. An EPA Record of Decision was signed in 1990 requiring remediation of the shallow aquifer, which was contaminated with

Leak Detection

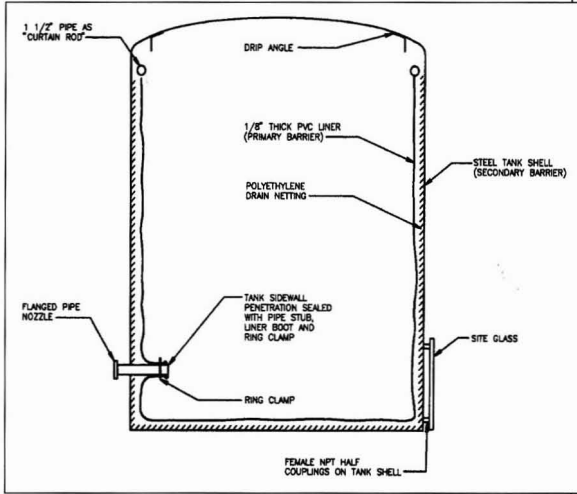


Figure 1

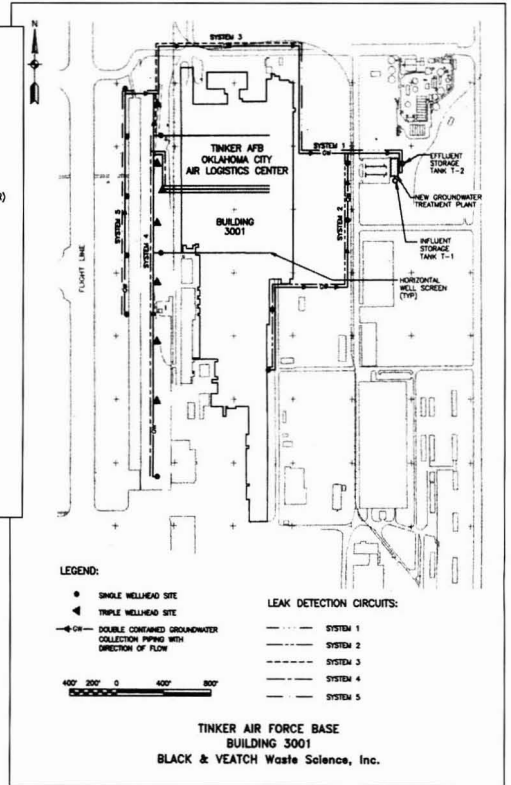


Figure 2

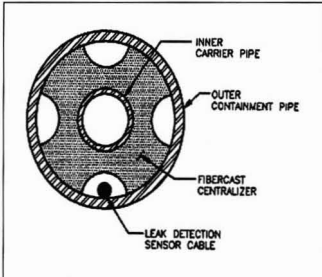


Figure 3

chromium and industrial solvents—mostly trichloroethylene, or TCE. The remediation design completed by Black & Veatch Waste Science Inc. of Kansas City, Mo., under contract with the U.S. Army Corps of Engineers, Tulsa District, included 33 new groundwater extraction wells and a new 200-gallon-per-minute groundwater treatment plant. The project included approximately three miles of buried pipeline to collect the flow from the new wells. Extracted groundwater is pumped through the collection pipeline to a 250,000-gallon influent storage tank at the treatment plant. Federal law requires that the entire collection pipeline as well as the influent storage tank be double-contained and monitored for primary containment leaks.

Influent Storage Tank

The influent storage tank is a closed-top, welded steel tank, located above ground outside the treatment plant. The tank is about 35 feet in diameter and 30 feet high. The space available for the tank was quite limited, ruling out the use of earth-lined berms or exterior concrete containment structures.

The tank is a conventional field-fabricat-

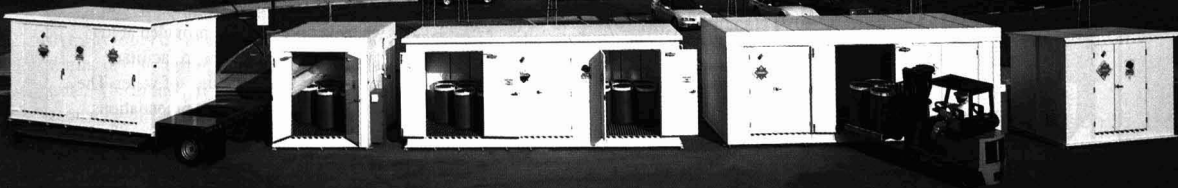
ed, single-wall tank. Double containment was achieved by hanging a 1/8-inch-thick flexible PVC liner inside the single-wall tank. Polyethylene netting was installed behind the PVC liner to provide a flow path between the liner and the steel tank shell. The liner was hung curtain-style from the inside, top perimeter of the tank with U-bolts, acts as the "curtain rod." Figure 1 (above) shows a schematic representation of the liner arrangement. With this design, the PVC liner serves as the primary containment barrier, and the steel shell serves as the structure for the PVC liner and the secondary containment barrier. To the extent that it was practical, piping connections were brought through the roof of the tank to avoid penetrating the liner. Where necessary, side wall penetrations were accommodated by extending the pipe approximately six inches inside the tank and sealing the liner to the pipe stub by using a liner boot and ring clamp.

Leak detection for the primary containment barrier (the PVC liner) is provided by a simple site glass installed at the bottom of the steel tank shell. Water passing through

a leak in the liner drains down through the polyethylene netting and can be observed in the site glass.

This innovative method of achieving secondary containment and leak detection provides several advantages. The liner costs a lot less than a double-walled steel tank and also eliminates the need for containment structures around the outside of the tank. Such external structures are not only large and expensive, but also collect stormwater, which must be sampled and disposed of. The treatment plant operators check the site glass once per day to verify that there has been no leakage through the primary containment.

It is worthwhile to note that the liner and site glass methods used for secondary containment and leak detection can easily be retrofitted to existing single-walled tanks. Using a tank shell site glass for detection of primary containment barrier leaks does require daily manual logging to satisfy regulatory requirements. In applications where the tank is at a remote or unmanned location, a float switch or capacitance probe can be installed in the site glass to automatically sound an alarm in case of a leak in the primary liner. In applications where aggres-



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Leak Detection

“Important Lessons Learned”

The Tinker AFB groundwater extraction and treatment system has been in daily operation since November of 1993. The construction and first year of system operation have highlighted the importance of a few key issues:

- 1.** The influent tank was built with a domed roof. Condensation that forms on the inside surface of the roof dome runs to the edge of the roof and behind the PVC liner. This condensation then shows up in the leak detection site glass. This nuisance can be prevented by attaching a drip angle near the dome edge so that the condensation drops into the tank rather than running behind the liner.
- 2.** Even when a double-contained pipe system is provided with a continuous leak detection system, sloping the pipeline to known and accessible low points can significantly reduce the effort required to dry the system if and when a leak occurs.
- 3.** The containment pipe must be kept

clean and dry during construction.

- 4.** Containment access ports should, whenever possible, be provided at low spots along the pipeline to facilitate removal of gross amounts of water. The access port spacing recommendations of the leak detection system manufacturer are maximums for cable pulls and do not consider pipeline drying.
- 5.** Containment pipe centralizers that provide as much free area as possible will facilitate drying the containment annulus and ease pulling of the leak detection cable.
- 6.** A leak detection system that provides accurate leak location can tremendously reduce the cost of finding and repairing leaks in either the carrier or containment pipes.
- 7.** Installation of isolating valves at key locations would allow maintenance on piping sections while the remainder of the extraction system stays in operation.

sive or corrosive chemicals are involved, the liner method provides a chemically resistant primary containment barrier without the expense of special coatings.

Buried Collection Pipeline

The buried collection pipeline for the Tinker AFB project carried contaminated groundwater from the extraction wells to the influent tank. The collection pipeline system was designed as a forced main. The pipeline extends for nearly three miles around Building 3001 (see Figure 2, above). The pipeline is made of factory-engineered, double-walled, fiberglass pipe. Both the inner carrier and the outer containment pipes are fiberglass and are designed as pressured lines. FRP was selected because it provides a combination of strength and chemical resistance.

A continuous type leak detection system was installed to detect, alarm, and locate water in the containment annulus. The leak detection sensor cable is made of two sensor wires, an alarm signal wire, and a continuity wire embedded in a kynar rod. The sensor cable is a known resistance per foot enabling the system alarm panel (using Ohm's Law) to determine the distance from the beginning of the detection circuit out to the wet point. The system has proven to be

accurate on the Tinker project to within plus or minus one foot over an entire circuit.

When water gets into the annular space between the carrier and containment pipes, it will flow to and pool up at the low points. Without direct access to the containment annular space at these low points, removing pooled water is extremely difficult. The profile of the pipeline had to be field-determined during construction as the existing buried utilities were excavated. Long runs of the pipeline were installed essentially flat. Because no trench excavation is perfectly level, the “flat” sections of collection pipe actually represent numerous shallow low spots as the pipe profile gently waves up and down. The number and locations of the low spots were indeterminate; as a result, containment access port locations were dictated by pull length limitations and branching connector locations required by the leak detection system.

During construction of the pipeline, mud and stormwater were allowed into the annular containment space. Cleaning and drying the annular space required many months of effort. If the pipeline had been built with slopes to accessible low points, gross amounts of water could easily have been removed, making drying and cleaning the containment space much less costly and time-consuming.

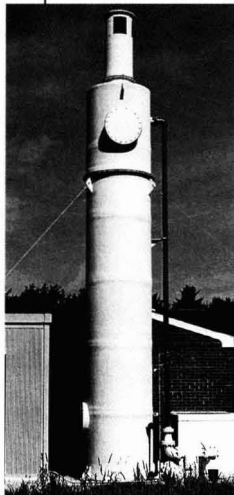
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The double containment pipe used a centralizer consisting of a solid disk with four small, half-moon-shaped openings (see figure 3, page 30). Without direct access to the containment pipe low points, the only effective way to dry the annular space was to blow warm, dry air through it to evaporate the water. The limited free area provided by the geometry of the centralizer represented a significant air flow restriction, prolonging the drying effort. A centralizer that provides more free area would be a worthwhile improvement, particularly in applications (such as Tinker) where direct access to pipeline low points is not possible. In addition, larger openings in the pipe centralizers would make it easier to pull the leak detection system into the annular space. Although the openings in the centralizers were large enough for the leak detection cable and connectors to pass through, their shape made the pull rope, cable, and connectors prone to snagging. It is important that the fabrication features of the double containment pipe be coordinated to accommodate leak detection system needs.

Leak detection system design for the Tinker AFB project evaluated continuous and low-point-only systems. As described above, a continuous system was chosen primarily because the pipeline low points were indeterminate. The length of the pipeline and planned system service life of 30 years suggested that an eventual leak would be likely. A continuous system allows location of the leak without excavating long sections of pipeline, thus justifying the added initial expense.

Manufacturers' installation instructions must be closely followed in assembling and installing the pipeline and leak detection system in order to achieve a dry, airtight containment space. All continuous leak detection systems must be installed in a clean, dry space in order to function correctly. Consideration must also be given to the materials that make up the leak detection system components (jumper cables, connectors, etc.) to insure they are compatible with the liquids they may be exposed to in the event of a leak. A final consideration is the design of the access ports. Ideally, the ports will allow access to the leak detection cable connectors without opening the containment space. **EP**

K.W. Wyatt is the mechanical engineering group supervisor for the mechanical/process department at Black & Veatch Waste Science in Kansas City, Mo. M.D. Webber is a project electrical engineer at Black & Veatch Waste Science.

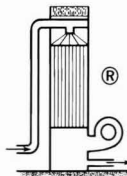


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Air Modeling

Air Dispersion Models: Regulatory Applications and Technological Advances

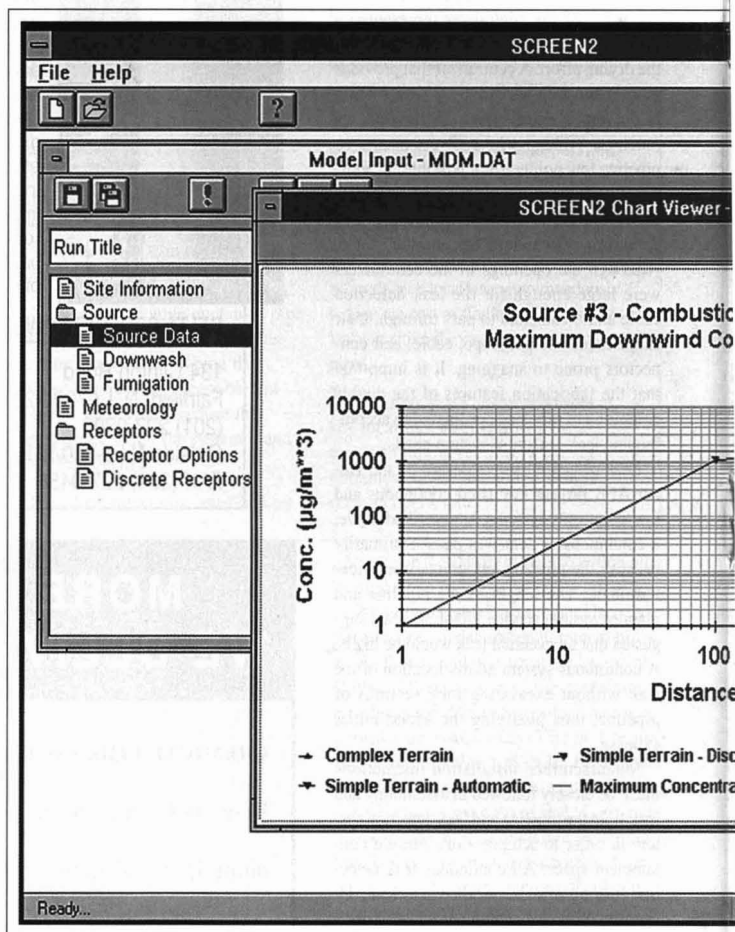
By Mark Miller and Robert Liles

The use of air dispersion models is a widely accepted, cost-effective technique for arriving at reasonable estimates of air pollution concentrations. Alternatives such as ambient monitoring are expensive, burdensome, and inflexible. Dispersion modeling calculations can be made at thousands of locations using a computer model for less than the price of a single set of ambient monitoring measurements. In essence, the inherent inaccuracies of dispersion models are deemed tolerable because the cost of a comprehensive measurement program is prohibitive.

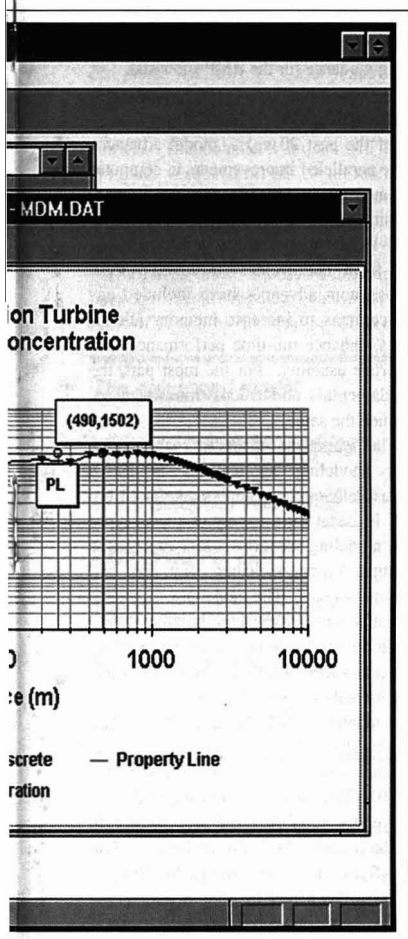
Historically, dispersion models have

been applied by industry as both an engineering tool and a regulatory tool. As an engineering tool, computer models are used to determine an optimal stack height and optimal stack location, select appropriate pollution control equipment, estimate real-time or worst-case impacts from accidental releases of toxic gases, and manage potential odor problems.

However, since about 1973, the regulatory uses of dispersion modeling have overshadowed the engineering uses. These regulatory applications include: development of regulations (SIP revisions), compliance with ambient air quality standards (AAQS) under New Source Review (NSR) regulations, compliance with federal AAQS when included by a state as an applicable require-



Trinity Consultants' Windows-based version of the SCREEN2 dispersion model allows modelers to easily perform model runs and create graphics.



ment under a Title V Operating Permit Program, compliance with regulations concerning "Prevention of Significant Deterioration" (PSD) permitting, demonstration of air quality improvement in non-attainment areas, determination of the zone of vulnerability and population affected for planning purposes under SARA Title III, estimation of concentrations when reporting

toxic gas releases under SARA Title III, and preparation of a Clean Air Act Section 112(r) Risk Management Plan.

Development of Regulations

Under the Clean Air Act of 1970, each state was required to develop a plan to meet air quality standards. These State Implementation Plans (SIPs) dictated a minimum control to be applied to certain sources. Following the application of the controls, states were required to demonstrate compliance with the standards. However, because of limited modeling resources and sparse data, this demonstration was difficult to make.

Today, SIPs are frequently modified based on information produced by dispersion models run by the states. The degree of non-compliance and the amount of emissions reduction required for a region to meet the federal standards can be predicted, and subsequently, a set of regulations (e.g., RACT rules) can be developed.

New Source Review

Many states require that off-property concentrations of a pollutant be estimated before a permit for a minor modification will be issued. The predicted concentrations are compared to the state or federal AAQS, or to threshold limits for toxic air pollutants. When predicted concentrations are compared to the threshold values for toxics, regulatory agencies will frequently allow a limited number of "threshold violations" before the risk to health is considered significant.

A few states may define the National AAQS as an applicable requirement under the Title V Operating Permit Program. As such, major sources must demonstrate through a modeling analysis that all subject sources meet the appropriate AAQS. For nearly all states, the AAQS are not an applicable requirement and modeling is not required as part of the Operating Permit application submittal.

PSD Requirements

In attainment areas, major sources of air pollution are required to demonstrate that major modifications will not cause or con-

tribute to significant deterioration of the environment or ambient air. This is accomplished through a detailed permitting process called Prevention of Significant Deterioration (PSD). Under PSD regulations, a source must use an air dispersion model to determine whether or not the proposed modification may have a significant impact on the environment. Predicted concentrations are compared to a modeling significance level, and a potential impact area is determined.

Another modeling analysis must then be performed that includes plant-wide sources as well as all other sources within the impact area plus 50 kilometers. Resulting concentrations are compared to the National AAQS to determine the post-modification air quality of the area. Additional air dispersion modeling may be required to demonstrate that visibility in nearby Class I Areas is not adversely affected. For the foreseeable future, PSD regulations will continue to require that extensive modeling be performed.

Non-Attainment Areas

Permits can be granted to major sources in non-attainment areas provided certain conditions are met and the new level of emissions is less than the former level. This is frequently accomplished through the acquisition of offsets from off-site sources. These offsets must be provided in a ratio greater than 1:1, thus resulting in a net environmental benefit. Much like sources subject to PSD requirements, regulatory agencies may require that a source in a non-attainment area perform air dispersion modeling to demonstrate that an exceedance of the National AAQS does not occur.

Further, regulatory agencies may perform an area-wide modeling analysis to determine the attainment status of the area. The modeling results, supplemented with ambient monitoring data, can be used to designate an area as attainment or non-attainment.

SARA Title III Planning

Section 303 of the Superfund Amendments and Reauthorization Act (SARA) of 1986, Title III, requires that an emergency

Air Modeling

plan be developed if a firm has the potential for a toxic gas release affecting a nearby community. Part (b)(5) of this section requires that the plan include a determination of "the area or population likely to be affected by such a release." Dispersion modeling is employed to describe the maximum distance of concern, and thereby the area that could experience concentrations greater than some desirable level. A circle with a radius of the maximum distance of concern is defined as the "area of vulnerability."

Section 304 of SARA Title III requires a

notification of the release of a "reportable quantity" of over 300 extremely hazardous substances. The report shall include information on the health risks anticipated and advice regarding medical attention. Dispersion modeling is useful in estimating the concentrations to which people were exposed.

Risk Management Plans

The Clean Air Act requires that sources that store or use more than a threshold quantity of a listed substance submit a Risk

Management Plan (RMP) to local authorities. This RMP must include an estimate of the area that would be affected in the event of a catastrophic release. Such a release must be modeled using worst-case meteorological conditions such that the highest possible concentrations that people may be exposed to are predicted. The U.S. EPA is presently refining its 112(r) definition of catastrophic release, and will publish modeling guidance for the RMP submittal.

Technological Advances

Over the past 20 years, model advances have paralleled improvements in computer technology, specifically desktop PC processing power and storage capacity. In the mid-1980's, modelers began porting models from mainframes to desktop PCs. Subsequent advances have included enhancements to increase memory allocations, enhance run-time performance, and improve usability. For the most part, the fundamentals and calculations have remained the same.

The "workhorse" model for many regulatory modeling applications is EPA's Industrial Source Complex model (ISC). ISC is useful for a variety of source types and modeling scenarios. ISC can handle multiple sources, including point, area, and volume sources. The model also simulates the effects of aerodynamic building downwash on nearby point sources and settling and removal of large particulates. ISC's versatility makes it popular in both the domestic and international modeling communities.

This model has been through several revisions since its inception in the late 1970's. The latest major release, ISC2, improves the reliability and maintainability of the model. ISC2 also included several bug fixes and a more robust handling of building downwash for shorter stacks.

Paradigm Shift

Many scientists and engineers have described air modeling as an art rather than a science. However, a major paradigm shift in air dispersion modeling is about to change this view. The American Meteorological Society's (AMS) and EPA's Regulatory Model Improvement Committee (AERMIC) is incorporating the latest science into air dispersion modeling in order to create a model that will: use current science to describe the physical processes of pollutant dispersion; provide reasonable estimates under a variety of conditions with minimal transport and dis-

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The screenshot displays the i-STEPS software interface. At the top, a menu bar includes 'File', 'Edit', 'Reports', 'Builder', 'Accessories', and 'Help'. Below the menu is a toolbar with various icons. The main window is titled 'Process Unit Information' and contains the following data:

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County Code	063	DURHAM CO					
Facility Id	0478	ISTEPS PRODUCTION FACILITY					
Group Number	067	BOILERS					
Process Number	01	COAL FIRED BOILER					
Process Description	01	COAL FIRED BOILER					
Units	3	Groups	1	Process Units	3	Year	95

Below this is a 'Family Selection' bar chart showing three bars of increasing height. To the right, there are several data tables for 'Stack #001, Stack From Process Number Emisiones' and 'Abatement of Process Stream'.

Stack #001, Stack From Process Number Emisiones				
PM10	0.305	0.8742	0.305	0.8742
METHYLOXIDINE	175	28.5381	175	28.5381
PARTICULATE MATTER 10 μm	175	17.9862	175	17.9862

Abatement of Process Stream				
PARTICULATE MATTER 10 μm	100.000	67.000	FABRIC FILTER - HIGH TIE	
PARTICULATE MATTER 10 μm	175	68.5381	175	68.5381
PARTICULATE MATTER 10 μm	100.000	67.000	67.000	67.000

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continuity; be easy to maintain and change; be user-friendly with respect to ease of use and computer resource requirements, and secure regulatory promulgation and Appendix A Guideline Status.

The result of AERMIC's efforts will be AERMOD, a model based upon ISC2's input and output architecture, but with new or improved algorithms for dispersion in both convective and stable boundary layers, plume rise, buoyancy, and penetration into elevated inversions, and treatment of elevated, near-surface, and surface level sources. The enhanced model will also compute vertical profiles of turbulence, wind, and temperature, and treatment of receptors in simple, intermediate, and complex terrain

One of the most significant differences between current regulatory models and AERMOD will be the handling of terrain.

The enhanced model will also compute profiles of turbulence, wind, and temperature, and treatment of receptors in simple, intermediate, and complex terrain.

AERMOD will use a consistent and continuous approach to calculate concentrations for all receptor elevations, regardless of whether receptors are above or below the release height.

As a result, AERMOD will eliminate the regulatory need to differentiate between simple, intermediate, and complex terrain receptors. AERMOD will also include a terrain preprocessor enabling the use of U.S. Geological Survey's Digital Elevation Mapping (DEM) data.

Unfortunately, AERMOD will continue to use ISC2's discontinuous approach to simulate the effects of aerodynamic building downwash. However, AERMIC plans to address and eliminate discontinuities in the building downwash approach in subsequent releases.

The "alpha" release of AERMOD is now available on the EPA's SCRAM BBS for

review and comment. But AERMOD will have to survive the long and arduous regulatory promulgation process to become an official regulatory model.

Conclusion

Air dispersion models are a useful and practical tool for both industry and regulatory agencies. They serve as tools for engineering, permitting, and regulations development. Their cost effectiveness and ease of implementation compared to ambient monitoring is perhaps their most-ap-

pealing trait.

Based on the current momentum within the U.S. EPA to develop better models and contain regulatory burdens on industry, it is likely that air dispersion modeling will be a major player in future air regulatory initiatives. **EP**

Mark Miller is product marketing manager for the Software Service Group of Trinity Consultants Inc. Robert Liles is a project manager in Trinity Consultants' Dallas office.

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PROGRESS OR PERIL

TWO VIEWS ON CWA REAUTHORIZATION



Photos by Steve Barrett

ROBERT PERCIASEPE

ASSISTANT ADMINISTRATOR
FOR WATER, EPA

CHARLES INGRAM

CLEAN WATER
INDUSTRY COALITION

THE CLEAN WATER ACT IS ONE OF THE NATION'S MOST FAR-REACHING ENVIRONMENTAL laws. It regulates discharges of pollutants into waterways, gives EPA the authority to set technology-based effluent standards on an industry-by-industry basis, and makes it unlawful to discharge any pollutant from a point source into navigable waters unless a National Pollutant Discharge Elimination Permit is obtained. It also requires EPA to set water quality standards for contaminants in surface waters, but provides for delegation to the states of many of the law's permitting, administrative and enforcement aspects. Everyone from industry to environmental groups acknowledges that the act has been extremely successful in reducing pollution, but there has been a push recently to give states and local permitting authorities more power to administer the law. Recently the House of Representatives voted to do just that, prompting an outcry from EPA officials and environmentalists, not to mention the congressmen who voted against the bill. The future of CWA reauthorization this year is uncertain; significant support for a similar measure in the Senate has yet to emerge. For an insider's view of the diverging opinions over the reauthorization, EP spoke with two key participants in the debate over CWA. Robert Perciasepe is EPA's assistant administrator for water, a position he assumed late in 1993 after serving three years as Maryland's Secretary of the Environment. Charles Ingram, associate manager for environment policy at the U.S. Chamber of Commerce, is also director of the Clean Water Industry Coalition, a collection of more than 250 companies representing a broad range of industries. Ingram has been working on water issues since 1986, and almost primarily on Clean Water Act reauthorization since 1993.

ROBERT PERCIASEPE

ASSISTANT ADMINISTRATOR FOR WATER, EPA

EP: Supporters say HR 961 is going to give them the flexibility they need to comply with Clean Water Act regulations. What do you think of that assessment?

Perciasepe: How much time do you have? The underpinnings of the current law have served very well over the last 25 years. We've seen real water quality improvements. One of the reasons for that is the Act's technology standards. Through the 1960s there was a debate much like you're hearing now, over the cost of regulations and what should be done about particular water bodies. But in the early '70s that debate was resolved in a very bipartisan way and we said, all right, all the sewage treatment plants are going to achieve secondary treatment and we're going to do these economically achievable effluent guidelines, which require the best available technology for industry.

So now we've got about 15,000 sewage treatment plants nationwide meeting secondary treatment and we've published 80-some effluent guidelines. But this bill has exemptions from these requirements. For instance, it says that if you have 10,000 people living in your town, you can apply for a waiver. I don't know specifically how

continued on page 40

CHARLES INGRAM

CLEAN WATER INDUSTRY COALITION

EP: How significant is the [House] vote passing the reauthorization?

Ingram: This vote was historic and it's significant not only for all it's going to do for business but because it sets the foundation for a new era in water pollution control and environmental protection. The House has changed the direction of the Clean Water Act and basically the direction that all environmental policy is going. They've taken a statute based on a very rigid command-and-control framework, something based on compliance and avoiding fines and penalties, and they've turned it around and based it on a strategic approach. It's focused on results. What this bill says is, "Here's the goal, you decide how to get there. We're not going to bog you down in the process or micromanage." In other words, it provides the motivation and incentives to go beyond the requirements of current law.

What it's going to mean for businesses large and small is greater flexibility. It allows EPA to take into consideration the site-specific problems, the regional and watershed differences from stream to stream or water body to water body. There's a whole host of small things: 10-year permits, for example. That's not an issue that has

continued on page 41

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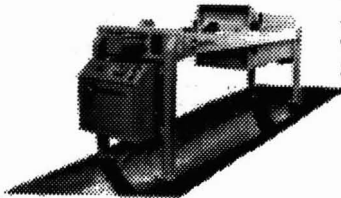
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Newsmaker Interview

PERCIASEPE, CONT. FROM PAGE 39

many of the 15,000 sewage treatment plants that would include, but in Maryland we had 350 plants and I would bet that 300 of them were serving populations less than 10,000.

EP: What about the bill's provision on water quality standards?

Perciasepe: On water quality standards,

this bill has something we support, watershed planning.

But if you read this watershed planning provision, you discover that if a state does a watershed plan for even one pollutant and they promise that by "some date certain," they will meet water quality standards, then they can issue permits that don't meet water quality standards. That's no way to create a watershed management regime.

The other thing I think is interesting in this debate is the rhetoric that this is providing states more flexibility. I can show you

places where it takes states' rights away. In the stormwater provisions, if any source can demonstrate that it's not contributing to stormwater, the states must let them off from having a permit. The states, in my opinion, like some aspects of this bill, and I think we could be shown to like some aspects of the bill. But the true intent here was to get people off from doing anything, so when push came to shove, the states' authorities were pushed aside.

EP: Can you give another example?

Perciasepe: In the existing law, there's a section called 401: water quality certification. Existing law said states are responsible for setting water quality standards and achieving them. They also have the authority to certify that permits or licenses issued by the federal government will not cause a problem with water quality standards. For instance, if the Army Corps of Engineers has to issue a wetlands fill permit, the state would have to issue a 401 certification that it's not going to affect water quality. And



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Our objectives are to get

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strengthened and more

flexible, and we need the

Superfund law strengthened

and more flexible. Clean Water

is lower on our priority list.

the Supreme Court recently found that also extends to Federal Energy Regulatory Commission hydropower licensing, which can have a profound effect on downstream water quality.

Well, over the objection of the Western Governors' Association and everyone else, this Congress—listening to industry as opposed to states—eliminated this ability. So

**PERCIASEPE,
CONT. FROM PAGE 40**

with this bill, they're allegedly giving the states more flexibility, and states are still responsible for meeting water quality standards, but they have taken away the states' ability to deal with certain sources. And if the hydropower industry is going to do something to your streams, they have no ability to deal with it under Section 401. I just want to give you a flavor of the kinds of things we think are problematic.

EP: How about the 10-year permits? (The bill extends the length of permits from five to 10 years).

Perciasepe: I don't think we're opposed to that, but I think we would rather see it in a watershed context. In other words, if you have a good watershed plan, you can create flexibility for what the permit terms would be. There are some permits that you may want to do more frequently than that. I wouldn't say it's a major problem, but I do think that flexibility ought to be based on some rigorous approach to solving the watershed's problems. We recommended 10-year permit terms in last year's reauthorization effort, but in the watershed context.

EP: What happens now? Will you be discussing passing Clean Water Act legislation with members of the Senate?

Perciasepe: Generally, our priorities are the Safe Drinking Water Act and Superfund. We know the Senate Environment and Public Works Committee will have hearings on the Clean Water Act. Their priorities are the Safe Drinking Water Act, Superfund, and the Endangered Species Act. No Congress has ever done more than one major environmental law. Now maybe this one can do two. I don't know, but I doubt it. Our objectives are to get the Safe Drinking Water Act strengthened and more flexible, we need the Superfund law strengthened and more flexible. Clean Water is lower on our priority list. **EP**

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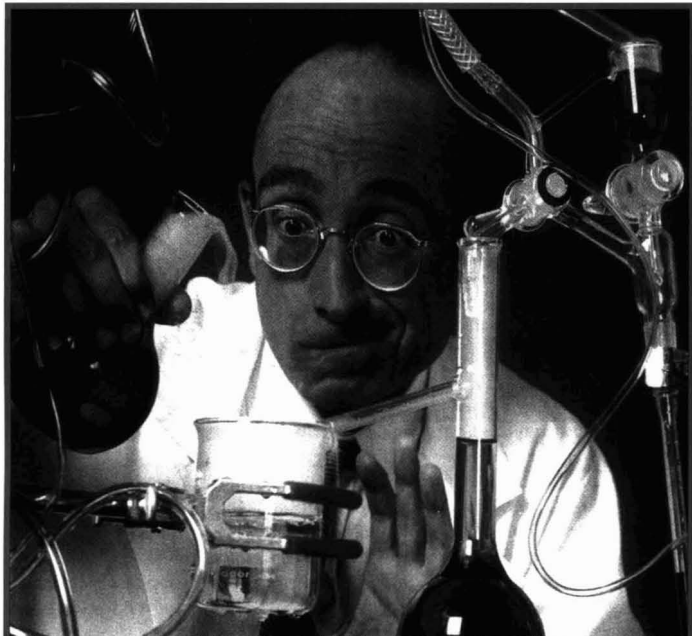
INGRAM, CONT. FROM PAGE 39

gotten lot of attention but it will make a big difference for businesses in terms of planning and paperwork and just relieving some of the regulatory burdens and bureaucracy that they have to go through on almost a day-to-day basis.

EP: Will you be able to take into account the development of new technology during the course of

those 10-year permits?

Ingram: Yes, absolutely. This bill encourages newer and up-to-date technology. It'll actually encourage people to invest more in pollution control technologies because it allows you to modify your permit to employ pollution prevention equipment and technologies where there is a net overall environmental benefit. That's the key phrase there. When some of the critics say it allows loopholes and waivers for industry, yes, it allows a waiver but that's not the



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Newsmaker Interview

whole story. It allows a waiver for you to modify your permit to do these kinds of activities when there is a net overall benefit to the environment or the watershed.

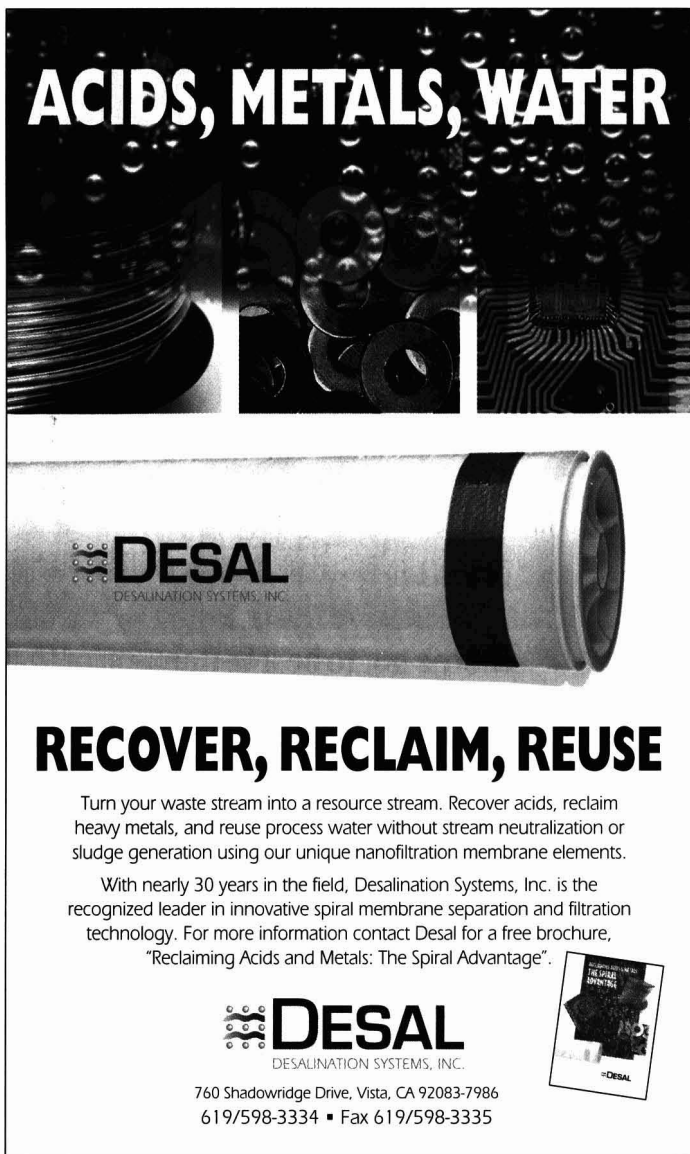
EP: If power shifts to the states for a lot of these responsibilities, are you concerned that might make it more difficult for businesses that have multiple operations in different states? Might that raise cost?

Ingram: No, I don't think so. The basic control, the technology-based standards and the water quality-based standards remain in place under this bill. What we're saying is the future regulations are going to be based more on credible science, risk, and cost-benefit. You're not doing away with the minimum guidance. This should help businesses become more efficient, should be more cost-effective for them because you're taking into consideration more of the local or regional aspects. I would think it would have the opposite effect.

Even if a company has a few different operations, the costs are going to be cheaper for those sites because you're taking into account those regional factors. That, and because you can take into account some of the local considerations, it's going to unleash more creativity at the plant or at the facility level on how to get things done. One motivating factor—or incentive, if you will—for a company is to be more efficient. That's what profits are about—how efficient or effective your operation is run. This provides the incentives for them to move in that direction.

EP: Will the changes this bill would make mean that businesses that have spent a lot of capital to comply with water regs will have spent that money in vain?

Ingram: That's not the case. The technology-based standards and the water quality-based standards remain in place, so claims by some critics that this bill relaxes or rolls back standards is simply not true. It's not going to happen unless EPA neglects to enforce the rules that are already in effect. So you have the guidance. That was the problem 25 years ago. That was part of the debate in 1972 in establishing the uniform, across-the-board technology-based standards was to avoid the competition question and whether you were going to have someone in Colorado with a lesser standard than someone in New York. That's not the case today because we've got the basic structure of the program. It works well and is in place. That doesn't change. **EP**



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LDR Phase IV Proposed

EPA has proposed the final stage of its Land Disposal Restriction program, created to address potential cross-media pollution from industrial sludges and wastewaters that are stored, treated or injected into the ground. EPA wants to ensure that the nation's 2,000 surface impoundments do not spoil local groundwater supplies. In the LDR Phase IV proposal, the agency seeks comments on three options for regulating "decharacterized" hazardous wastes.

Industrial wastes that lose their hazardous characteristics after dilution but still have underlying hazardous constituents should not automatically be subject to special land disposal restrictions, the agency said in the proposal, which was published in the Federal Register Aug. 22.

Faster, Fairer Cleanup Procedures on the Way From EPA?

EPA's new "guidance documents" on Superfund and cleanup can help turn idle brownfields into newly productive facilities.

THERE HAS BEEN MUCH DISCUSSION RECENTLY of the "greenfields-brownfields" problem. While potentially valuable industrial sites sit abandoned because of stalled environmental cleanup efforts, new industrial and commercial business parks continue to be developed in distant suburbs. This trend has been cited for contributing to the erosion of the inner-city tax base, depleting valuable farm land and open space, and exacerbating air pollution and other environmental problems.

In an effort to deal with demand for an accelerated cleanup of brownfield sites, EPA last May published several guidance documents dealing with Superfund and cleanup standards. Following is a brief discussion of aspects of the directives that are of importance to industrial facility owners and prospective purchasers.

Prospective Purchaser Guidance.

The guidance document promises greater flexibility in negotiating agreements between EPA and prospective purchasers of contaminated facilities. An earlier guidance issued in 1989 has been criticized because it limited such agreements to situations where EPA both planned to take enforcement action and would receive a direct benefit from the purchaser (in the form of compensation or the remediation of the site) in return for EPA's agreement not to sue. The new directive offers greater flexibility in structuring these agreements. It provides, for example, that EPA will agree not to sue a prospective purchaser of a contaminated facility where federal involvement has occurred or is expected to occur and there is a realistic probability of incurring Superfund liability. At the same time, it provides that the prospective purchaser may render either a direct benefit to EPA or an indirect benefit to the community (such as by creating jobs or modernizing an antiquated or blighted facility).

Guidance Regarding Contaminated Aquifers. This guidance document provides assurance to owners, lenders, and prospective purchasers of sites that are affected by an aquifer contaminated by offsite sources (a common occurrence in industrial areas). Under this directive, EPA will not pursue these parties to recover cleanup costs for contamination that they did not cause

and that they have not exacerbated. It also allows EPA to enter into settlements to protect these parties from suits by others. In return, however, the owner must agree to cooperate, such as by providing site access, evaluating the condition of the site, and implementing remediation measures.

State Deferral/Pilot Programs. EPA has agreed to defer placing sites on the National Priorities List (NPL) under Superfund where states or private individuals have initiated response actions, in order to encourage accelerated cleanups and to minimize duplicative state and federal involvement. In order to be eligible for state deferral, the facility must be listed in the inventory of sites nominated for investigation under Superfund but not listed in the NPL, and a cooperative and solvent private party must agree to perform and pay for the cleanup. In addition, the cleanup remedy must be substantially similar to one that would be required under the Superfund law.

EPA also has announced two pilot programs, one providing for the use of a neutral third party to make nonbinding allocations among several parties of a "fair share" of cleanup costs, and the other a program for EPA to enter into settlements with minor contributors and with those who have payment problems.

Guidance for Future Uses of Contaminated Facilities. EPA also issued a guidance document that authorizes EPA to take into account the intended future use of a facility when developing cleanup remedies in order to assure that the cleanup will be both cost-effective and appropriate for the site. Under this program, residual contamination at a site might be allowed if the site will continue to be used for industrial purposes, for example.

It is important to remember that these "guidance documents" are not binding on EPA and that they can be changed at any time. However, they may be the first signs of a trend toward greater flexibility and cooperation on the part of the Agency. **EP**

Carol R. Boman, founding principal of the San Francisco law offices of Carol R. Roman, specializes in regulatory issues affecting real estate and business owners. An active member of the Annual Bar Association, Bowman serves as co-chair of the Annual Conference on Environmental Law.

Clean Water Act Reauthorization

What form should it take?

THE RESULTS ARE IN, AND READERS OF *Environmental Protection* agree: Congress needs to change the Clean Water Act. But how much? Well, that depends. If you're a member of the regulated community, you probably want to see it changed "significantly." If you're a member of the consulting and environmental services segment of the readership, you're more likely to say the law needs a bit of tweaking, not a full-fledged overhaul.

As for specifics, well, EP will leave that to the elected representatives. But our admittedly unscientific sampling of EP readers did allow us to make a couple of generalizations. One is that directly regulated companies are much more likely to want less regulation, not more. Another is that service-oriented firms are less upset about the current state of affairs than those they are servicing.

EP editors spent a few days calling more than 100 readers to ask the following questions:

Are you satisfied with the current regulatory framework of the Clean

Water Act?

Do you think the act needs to be changed (and how much—significantly, a little, or not at all)?

Would you rather see more stringent or less stringent regulations? Enforceable requirements or voluntary programs?

What areas would you recommend Congress change?

Should EPA have to conduct cost-benefit analyses of regulations that cost \$25 million or more, as required in the House of Representatives' Clean Water bill?

Is the country better off with or without tough Clean Water regulation?

Some readers did not like the wording of some of the questions. Just what do "stringent" and "tough" mean, anyway? In a few cases, respondents said they simply wanted "fair" or "practical" regulations.

A full 70 percent of readers in the regulated community said they do not like the current regulatory framework of the act, while 47 percent of the services industry was unsatisfied, and 37 percent were satisfied. Sixty-five percent of the regulated community said the act should be changed significantly (29 percent said a little, and 6 percent said it's fine the way it is). On the

services side, only 21 percent said the act should be changed significantly; 74 percent said a little; and 5 percent said not at all.

More stringent or less stringent regulations? Sixty-nine percent of the regulated said less stringent, but only one-third of the services folks felt that way, with close to half (47 percent) saying they wanted more stringent regulations.

On the question of enforceability, the regulated community was split: 47 percent to 47 percent on whether we need enforceable requirements or voluntary compliance programs.

For the services industry, the numbers were stark: Eighty-five percent said we need enforceable requirements, and 10 percent favored voluntary guidelines. A handful in both groups wanted a mix.

What areas should Congress change? The regulated community did not pick any one area overwhelmingly. In the services field, wetlands was number one, chosen 24 percent of the time. Pretreatment standards were at the bottom of the list for the services industry, at 8 percent, and everything else settled in between those two.

On cost-benefit analysis, both camps were agreed: Yes, EPA should have to do it. The margin was 78 percent for the regulated community and 65 percent for the services industry.

As for the bottom line (and our last question), are we better off with or without tough clean water regulation? Even industry said yes, at 76 percent ("I don't trust big business any more than the next guy," said one respondent from a chemical company). The services people were even more adamant. A full 95 percent said we're better off with tough clean water regulations. Still, that response often came with a qualification. "Regulations need to become more realistic," said one company representative.

Definitions:

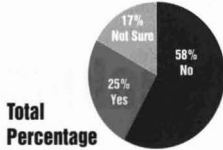
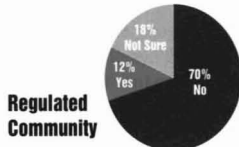
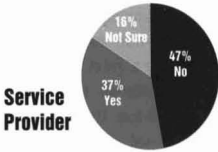
Regulated Community includes manufacturers, municipalities, and any business that must comply with some aspect of the Clean Water Act regulations.

Service Providers include engineering and consulting firms, trade associations, and any organization that provides assistance and expertise in any portion of the Clean Water Act.

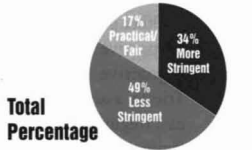
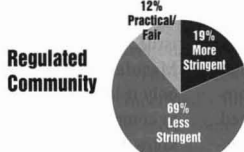
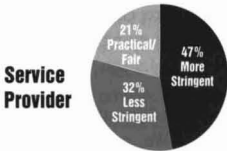
Survey Pool: 17 readers from the regulated community, 20 from the service provider category.

Readers weigh in on cost-benefit analyses, enforceable vs. voluntary requirements, and more.

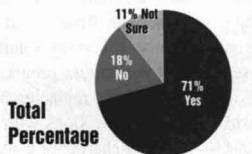
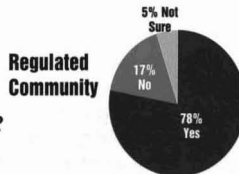
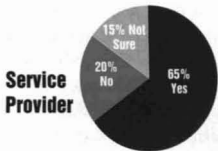
1. Are you satisfied with the current regulatory framework of the CWA?



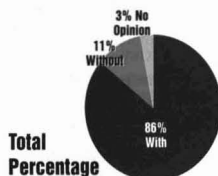
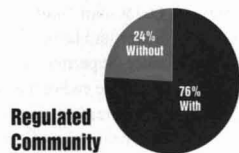
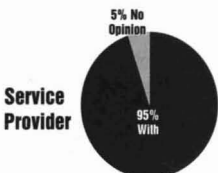
3. Would you rather see CWA regulations become:



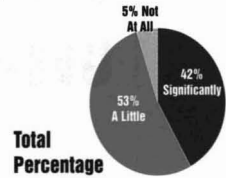
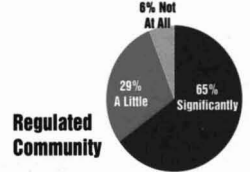
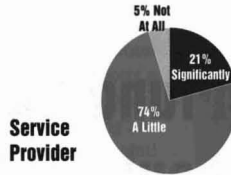
5. Should EPA have to conduct cost-benefit analysis for regulations of \$25 million or more, as required in the House Bill?



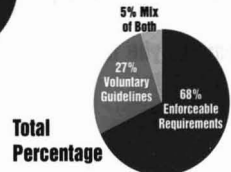
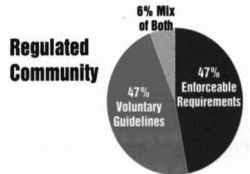
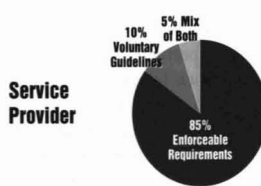
7. In the long run, is the country better off WITH or WITHOUT tough clean water regulations?



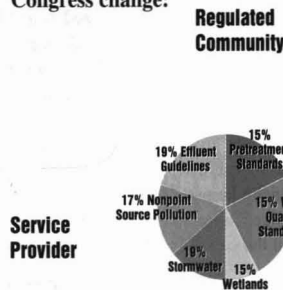
2. Do you think the CWA needs to be changed:



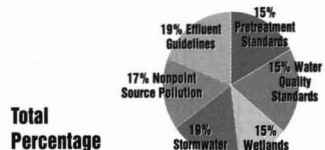
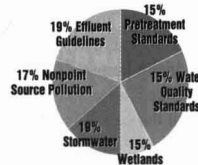
4. Would you rather see:



6. What areas would you recommend Congress change:



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Superfund Up For Overhaul— Or Tweaking

SUPERFUND IS "SLOW, COSTLY, AND UNFAIR." No, Superfund is "a tremendous success."

The quotes are from recent testimony before congressional committees trying to wade through the messy debate on Superfund reauthorization, and illustrate the deep divide that exists over how well the program is working—and how much needs to be changed.

The first assessment comes from a major manufacturer and represents the frustration felt by much of corporate America over Superfund. Many companies see too much litigation in the program—and too much money better spent on cleanups going to lawyers.

The second quote is from a representative of an environmental group. Many environmentalists emphasize the program's successes, including cleanup agreements forged among industries and community groups, as well as increased pollution prevention efforts

prompted in part by concerns over Superfund liability.

Then there is EPA. The agency has made a number of administrative changes to Superfund in the past year which it claims will make the program more efficient. Many in the agency feel the program is now running better than it has in the past—the agency is more flexible on cleanup standards, for example—and would like to see the administrative changes given a chance to work.

As for reauthorization, EPA Administrator Carol Browner keeps pointing to an agreement reached last year among a broad range of industry, environmental, and community groups, as evidence that consensus on the program's direction can be reached. That agreement, which one participant noted was "balanced on a razor's edge," ultimately fell victim to fierce partisan politics at the end of last year's legislative session.

New Election, New Agenda

Peggy Peterson, an aide to Rep. Michael Oxley (R-Ohio), has a quick answer for Browner's focus on the previous agreement: "That was then. This is now." One major change that has occurred since then is that Peterson's boss is now chairman of the House subcommittee on Commerce, Trade and Hazardous Materials, which has held a number of Superfund hearings this year.

Oxley's counterpart in the Senate, Robert Smith (R-

N.H.), chairman of the subcommittee on Superfund, Waste Control and Risk Assessment, favors a limited repeal for pre-1981 disposal. Industry is divided on the issue, with groups such as the National Association of Manufacturers saying they could support repeal, but only if lawmakers determine where the money is going to come from. In order to support repeal, "We need to know how much [the program] is going to cost and who's going to pay," says Theresa Larson, NAM's director of environmental quality.

Other participants in the debate adamantly defend the retroactive liability scheme. "We can't eliminate retroactive liability," says the Sierra Club's Marion Trieste, associate representative with the group's Northeast Regional Office. She says that most sites were contaminated before 1981 and "I haven't heard of anyone coming up with a pot of money" to pay for cleanups.

Peterson, Oxley's aide, says "a lot of money could be saved through [reform of] remedy selection, risk assessment, and restructuring, enhancing the state role.... There are a lot of options."

Without solving the retroactive liability issue, Superfund reform is unlikely to get far this year. The retroactive liability issue "virtually defies resolution," said a recent study from the Center for the Study of American Business at Washington University in St. Louis. The study's author, Richard Mahoney, argued that the current program's structure be allowed to remain, while replacing Superfund's joint and several liability provisions with a system where polluters pay "orphan shares" of a site's cleanup costs.

Time Running Short

Oxley and Smith say they are committed to passing Superfund legislation this year. That is vitally important, since Superfund's taxing authority is scheduled to run out at the end of the year. Oxley and two other prominent House leaders would like to see funding for the program withheld unless Congress reauthorizes it. "If we cannot achieve the kind of meaningful, comprehensive reform of [Superfund] that all of us believe is necessary . . . this is a program which simply should not be continued," Oxley, Rep. Thomas Bliley (R-Va.) and Rep. Bud Shuster (R-Pa.) wrote in a letter to Rep. Jerry Lewis (R-Calif.), chairman of the subcommittee with jurisdiction over EPA's budget. They asked Lewis not to fund the program without Superfund reform.

But concern is mounting that this Congress will not be

Congressional leaders take yet another crack at reform. Maybe this year they'll succeed.

able to finish Superfund this year. Lawmakers have an ambitious agenda that includes other environmental laws such as the Safe Drinking Water Act and the Endangered Species Act, not to mention a host of major non-environmental issues. Smith and Oxley's offices said bills would be ready for debate sometime in July, but Congress will not be in session for the month of August, leaving little time to come to an agreement before the end of the year.

"We're really worried that it won't get done," Larson said. "But we're going to be part of the pressure. We don't want this to become a political football next year."

State Role

The liability question is just part of the debate. Other issues concern communities' and states' roles in the program, remedy selection, and cleanup standards. A set of principles issued by Smith would give states the power to put sites on the National Priorities List, or take them off.

Needless to say, the states will have to be part of any discussions on their role in

the program. And that may take some doing. "People have to understand this [reform] program has to be just right or we're not interested," says Laura Armstrong, former senior policy analyst for the National Governors Association. NGA supports a program allowing states to voluntarily take over responsibility if they are willing and able. Armstrong makes another point: Some of the worst sites are not on the NPL. Therefore, states are concerned how any changes in Superfund will affect their program for cleaning up non-NPL sites.

If states do get more responsibility, Armstrong says, "We don't want a lot of oversight. We don't want someone looking over our shoulder," Armstrong says.

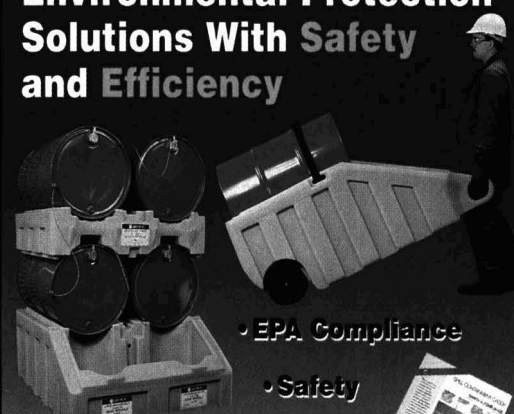
The next few months will be crucial for Superfund's future. Companies that want to have some influence on the process would do well to make their voices heard—sooner, rather than later. **EP**

Steve Davies is Senior Editor of Environmental Protection.

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NEWS UPDATE

continued from page 8

In February, EPA removed approximately 24,000 candidates from the list of potential Superfund sites.

The Brownfields Initiative also expanded the circumstances under which EPA would enter into prospective purchaser agreements. In such agreements, the agency said it would not file a lawsuit against a prospective purchaser of a potentially contaminated property based on pollution existing prior to the purchase.

In January, EPA Administrator Carol Browner told the U.S. Conference of Mayors that the agency plans to fund a total of 50 Brownfields pilot projects, 25 of which will be announced this year. However, when announcing the 15 new projects, Browner warned that future brownfields funding may be in jeopardy. "Obviously that will be affected by the decisions made ... by the House in respect to the EPA budget," she said.

Wheelabrator EOS Acquires Treatment Plant

For the first time, a private company is taking over a federal- and state-funded municipal wastewater treatment plant. Wheelabrator EOS Inc., a wholly owned subsidiary of Wheelabrator Technologies, has completed the purchase of the Franklin Area Wastewater Treatment plant in Franklin, Ohio, for \$6.8 million.

The transfer had to be approved by EPA Administrator Carol Browner, who said in the letter approving the transaction, "We look forward to hearing about the successful completion of this public-private partnership."

The sale could signal the beginning of a trend. The city of Wilmington, Del., was scheduled to choose among four bidders for its \$52.6 million wastewater treatment plant by the end of August. The companies are Wheelabrator, American Anglian, U.S. Water, and Northern Delaware Clean Water Corp., Joseph said. He added that Wheelabrator is in "preliminary discussions" regarding similar agreements with a half dozen cities "large enough to have an NFL franchise."

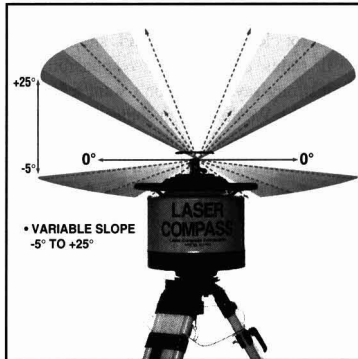
The deals benefit both the cities and the companies, said Wheelabrator manager of corporate communications Cynthia Wheeler. The cities get cash to retire outstanding debt and can use the remainder for other infrastructure needs, she said. Meanwhile, the company can improve the plant's operations because it has more cash on hand.

Under the terms of the deal negotiated among Wheelabrator EOS, the Miami Conservancy District and the communities of Franklin, Carlisle and Germantown, Ohio, the district has the option to buy back the plant in 20 years.

"The approval of our partnership concludes a two-year effort made by the District, the communities and Wheelabrator

EOS," said James L. Rozelle, the district's general manager and chief engineer. "We are extremely pleased that all state and federal approvals have been secured and the sale of the facility can proceed."

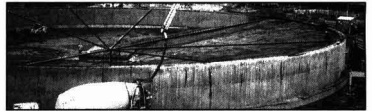
Presidents Bush and Clinton both signed executive orders allowing such deals. The Franklin plant can handle 4.5 million gallons per day. **EP**



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You Want To Do What?

THE RESPONSE TO HEARING SOMEONE SAY THEY WANT TO change a company's environmental, health, and safety (EHS) culture is often, "You want to do what?" Saying you want to change the culture, actually doing it, and doing it successfully are not the same thing.

That's not to imply that an EHS culture cannot be changed—it can be. Professional trainers, such as those certified by the National Environmental Training Association (NETA), can and should play a major role in implementing these changes.

But it's not something that happens overnight. Cultural change represents a significant organizational challenge that takes years to implement and "solidify"—a key challenge. What you want to change has already solidified in place, and it takes more than a few taps with a hammer to alter it. Large amounts of dynamite may be more effective. And, like dynamite, cultural

changes may yield loud and unpleasant noises, especially during management and staff meetings.

Culture Shift

The organization has operated in the same way for years. So what's happening now that points up the need to change? Have the violation statistics risen dramatically over the past few years? Have you been cited by EPA or OSHA? Has the company reorganized? Is it the entire culture that needs to change or simply some components within it?

Changing an organization's culture requires a considerable commitment of time, money, and effort. Organizations should be aware of the potential costs and benefits up front. There can be intangible benefits, such as an increase in employee morale and productivity, community goodwill, and stockholder satisfaction. Tangible benefits can be measured in reduced workers' compensation claims and turnover. The costs typically involve training, equipment and facility upgrades, and possibly outside consultants.

The next question is, "who has the power or authority to initiate the change?" In his book *Principal Centered Leadership*, Richard Covey writes that one person can be the catalyst for change. Most trainers

find that change is much more likely to succeed if someone high in the organization actively champions the effort. But it must go beyond a single person. Change is a process that involves the entire work force and requires everyone's acceptance and involvement.

The Stages of Change

Before beginning wholesale system changes, examine what already exists. Gain an understanding of the company's policies, procedures, and practices and how they work together. Day-to-day practices reflect a company's philosophy. If organizational goals call for zero toxic emissions or zero accidents, then this message must be reflected in all aspects of doing business. Companies with truly outstanding EHS records build their philosophy around the belief that even one toxic emission or one incident or injury is too many. Their management systems reflect this philosophy, and management is held accountable for ensuring compliance.

It is in the goals, objectives, and an examination of the everyday philosophy that you find at least partial explanations of why an existing culture is viewed as ineffective. It may be an unwritten rule that if a person isn't injured in a fall, it shouldn't be reported. Incident reports may be an exercise in futility if the information provided is of little value.

Here's an example: While walking through an area, a maintenance employee passes a work table with a piece of sheet metal protruding from the table's edge. His hand grazes the sheet metal and he receives a one-inch gash on the back of his hand. An accident report is submitted. The accident report asks if any unsafe acts were performed, to which the investigating supervisor answers "No, the employee didn't do anything that was unsafe." Unfortunately, the supervisor read the request for information only as it pertained to the worker's actions, not to others who may have contributed to it. By looking at day-to-day practices like this one, you may be able to identify types of behavior in your company that need to be changed.

Surveys explore employee perceptions of the current culture. Do your employees view the company culture as being effective, or not? What are the perceived strengths and weaknesses? How would they change it? After a survey is completed and tabulated, randomly select a percentage of the work force to participate in

Change is much more likely to succeed if someone high in the organization actively champions the effort. But it must go beyond a single person.

focus groups to clarify issues raised by the survey responses. Confidential individual interviews, a review of the facility's internal records, and an EHS audit report may provide even more information. Are there trends in types of incidents or injuries? What about individuals whose names consistently appear in the log? What is your level of internal compliance with EPA, OSHA, or DOT training? If it's less than 100 percent, find out why.

Breaking Bad Habits

One of the the most common mistakes is to give people new information and to then leave them to implement it on their own. What often happens is that when the first problem arises, they revert to the old way of doing things because it's what they know best. Old habits need to be torn down and replaced by new ones. This is where company or facility support systems come into play. Compensation systems (including bonus incentives), performance appraisals, discipline, promotional opportunities, and training must all include com-

ponents of the new culture. Management cannot allow itself to establish a, "Do as I say, not as I do," methodology.

You might choose to work on one department at a time or take on the entire facility all at once. The first approach allows time for program testing, while the second has everyone dealing with the same information and issues simultaneously. Leaving departments or areas out of the process, even on a temporary basis, allows dissenters to build strength while you are tied up elsewhere.

Don't drop the entire system into place all at once. It may overwhelm people and create resistance. Implementing small components over a period of time allows people to digest new information and incorporate it into their routine. Another approach is to gather the informal work force's leaders, those persons that employees turn to for information and guidance when they have questions, and get them involved in the process.


Don't fail to provide ongoing follow-up and reinforcement. Remember, change is

threatening for many people. Their fears and anxieties are real to them and must be recognized and treated with dignity. Approaching issues honestly and straightforwardly will draw many potentially resistant people into accepting the new system.


Try also having departmental safety committee members as a part of the selling team, in addition to publishing articles in in-house newsletters, providing status updates at employee meetings, building components of the system into informal and formal departmental EHS inspections and, above all, always setting the example through your own actions and those of management. **ED**

Carol Kefford Eshelman is a Certified Environmental Trainer and independent consultant in Baltimore. Craig A. Woodacre is a Certified Environmental Trainer currently employed by Bristol-Myers Squibb at its Syracuse, N.Y., facility. Both are active members of the National Environmental Training Association.

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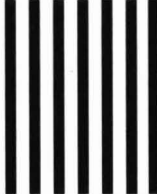
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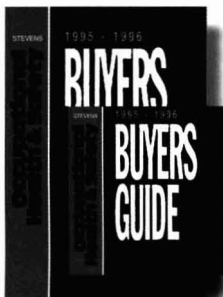
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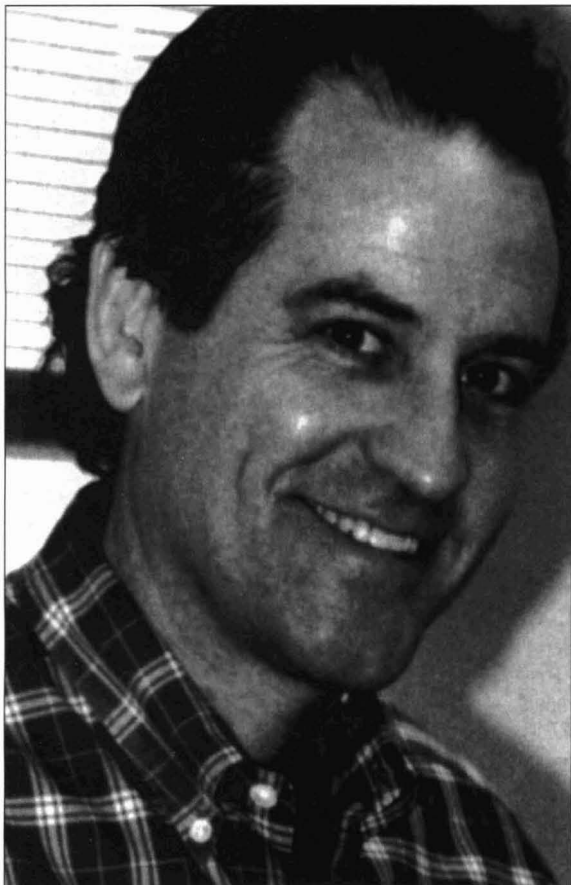
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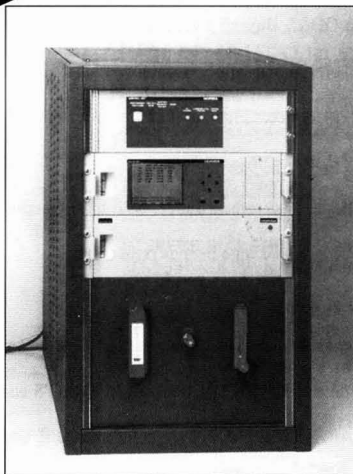


EP Exclusive

New Transportable CEMS Offers Compact Size and O&M Savings

Horiba Instruments, Inc has introduced a new series of transportable monitoring systems that are made specifically for Continuous Emissions Monitoring (CEM) and can measure up to five gases—NOX, SO2, CO, CO2, and O2—simultaneously. This unit does not use electrochemical cells, and its measurements methods of NDIR, chemiluminescent, UV, and magnetopneumatic paramagnetic are accepted technologies that allow it to be used for stack testing.

Measuring 35 x 24 x 30 inches, the ENDA-E4000T fits in the back of a standard van and meets the requirements for certification testing and annual or semi-annual relative accuracy



testing. "We've reduced the size of this analyzer so that it is anywhere from half to 80 percent the size of competitors products. We believe it's the smallest

package of its kind on the market," says Rebecca Slater, customer application engineer for Horiba, which is based in Irvine, Calif. "With such a reduction in size, the ENDA-E4000T saves room in a stack tester's van, or is easily moved into service as a backup unit," adds Slater.

Even more beneficial is the savings in operation and maintenance, says Slater. "You'll spend less money keeping this unit cool, less on power, the parts are smaller and cheaper to replace, and components like diaphragms last longer," she adds.

"Horiba also designed this to have one sample inlet to the analyzer box, so sample flow is reduced and plumbing is simplified," Slater says. All in all, total system flow is reduced to only three liters/minute versus traditional systems that draw upwards of ten liters/minute. "I think that customers will see an almost immediate cost reduction in most applications, should they need to measure a large number of gasses," she adds.

"If you look at other products, this one is impressive because it's designed specifically for CEM application," says Slater. "It's a tremendous benefit for the CEM customers."

The ENDA-E4000T can also be used as a backup CEM system and meets or exceeds EPA requirements for portable and backup CEM systems.

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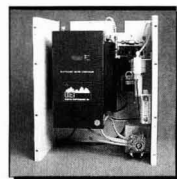
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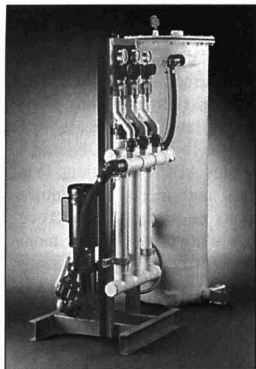
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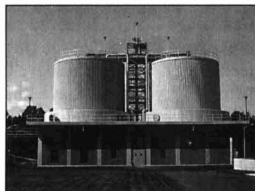


Oh Well

North East Environmental Products introduces its "Econo-Pump," a new multi-well jet pump system. EconoPump is self-adjusting and will maintain a virtually constant water level, resulting in a continuous, predictable cone of depression, with easier free product recovery. The patent-pending system allows the strongest producing

wells to reach peak flow and will not be affected by other wells running slow or even dry, the company says. Models are available that handle from one to five wells per system. **North East Environmental Products.**

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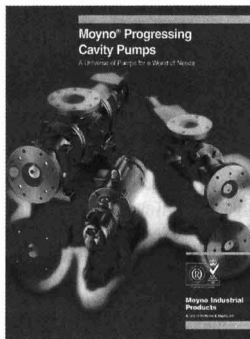


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federal regs. Users are prompted to input data from the manifest necessary to produce a submission-ready report. The program tracks and maintains hazardous and nonhazardous waste quantities at an unlimited number of sites. It also provides monthly status reports for individual waste streams and defines trends in waste generation. Unique state requirement and formats are available. **PARS Environmental Services.**

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In Search of Drier Solids

The "Sharples MaxiMizer DS Centrifuge" has achieved a breakthrough in dewatering technology by exceeding 30 percent dry solids, says the manufacturer. It is a fully automated system that requires minimal operator attention. The MaxiMizer's rugged construction is ideal for high G-force operation. Process-contact elements are manufactured of corrosion-resistant stainless steel. Abrasion-resistant materials add to the unit's long life and low maintenance. **Alfa Laval Separation Inc.**

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Hydrocarbon Analyzer

Control Instruments introduces "View Port," a portable hydrocarbon analyzer for fugitive emissions monitoring. The unit is rated intrinsically safe for use in Class I, Division I, Groups ABCD hazardous locations and meets the requirements of Method 21, a procedure written by EPA for monitoring fugitive emissions. Designed to be a complete monitoring system, ViewPort integrates sampling, datalogging, and report generation in one package. The design features user-friendly Windows-type screens accessed through an intuitive touchscreen and a powerful built-in datalogger that stores up to 10,000 records. **Control Instruments.**

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PRODUCTS & SERVICES

generation of RISC/SPARC-based I/A series products. The new models seamlessly embed Sun Microsystems' advanced technology into the I/A Series' open industrial system architecture with full backward compatibility. **Foxboro Co.**

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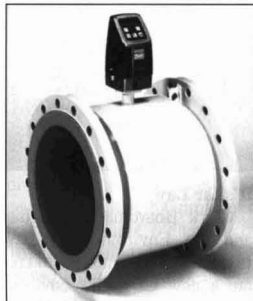


Case on Wheels

The "Zeroller" carrying case on wheels features a pultruded

fiberglass handle and rubber bearing wheels that won't heat upon usage. Available in clear silver anodize or a textured black powder paint finish, Zeroller measures 13" wide, 21" long, and 7.5" deep. **ZERO Enclosures.**

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Magnetic Flowmeter

Danfoss magnetic flowmeters offer reliability, measuring accuracy, easy start-up and servicing,

and a functional design, says the company. With an accuracy of better than .25 percent of rate, the MAG3000 signal converter offers empty pipe cutoff as standard, automatic range change-over, and a rotatable display to optimize readability. The meters feature a unique memory unit, "Sensorprom," which calibrates and programs the meter automatically. ISO9001 approved. **Danfoss/Instrumark.**

Circle 94 on card.

Cured-in-Place Pipeline

FormaPipe Southwest announces the "Cured-in-Place Pipeline" and sewer rehabilitation process.

The FormaPipe process involves impregnating custom-manufactured polyester-fiber tubing with thermosetting resin to create a smooth, corrosion-resistant structural lining within an existing pipe. FormaPipe utilizes manhole access and robot-



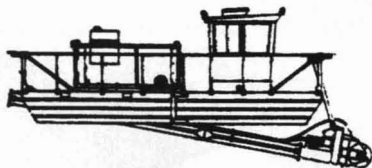
ic lateral reinstatement equipment, thereby eliminating the need to excavate. **FormaPipe Southwest.**

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Water Sampling System

HF Scientific announces the "PSW 2000 Water Sampling System" for collection of wastewater samples at municipal and industrial wastewater plants. In

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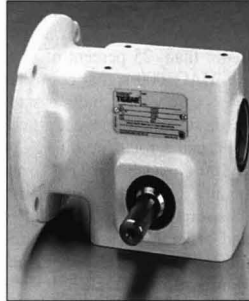
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PRODUCTS & SERVICES



In addition to the standard reusable bottles, the PSW 2000 offers disposable polyethylene lined paper cartons similar to those used by the milk industry. The cartons are ideal for long-term storage of samples. The PSW 2000 will take up to 25 separate samples in a 24-hour period. An optional cooling/heating unit is available for maintaining temperature control during the sample cycle. **HF Scientific.**

Circle 96 on card.



Right-Angle Speed Reducer

Dodge's new "E-Z Kleen Tigear Right Angle Speed Reducer" is coated with abrasion-resistant white nylon to survive corrosive chemicals and frequent washdowns. It is engineered specifically for wastewater treatment applications. Features include factory-filled USDA Class H2 approved synthesized lubricant, stainless steel hardware, rubber-coated seals, and electroless nickel-plated output shafts to provide

longer life in harsh environments. **Dodge.**

Circle 97 on card.



It's the Law

Clark Boardman Callaghan and the Environmental Law Institute have teamed up to create a new CD-ROM environmental law research tool. The "Environmental Law Reporter" includes coverage of CFRs and applicable state regs considered critical to the practice of envi-

ronmental law and compliance. **Clark Boardman Callaghan.**

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Wide Angle Switches

A wide-angle (90-100 degree) float switch from Conery is designed to eliminate the need for two level controls to get desired amount of pump down or the need for automation of a manual pump. Made for use with permanent split capacitor, shaded pole, and capacitor star motors of up to .5 hp at 115 volts. The

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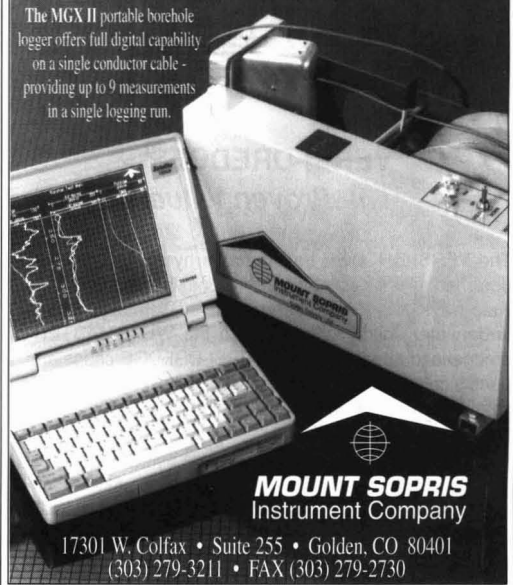
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MGX II

The MGX II portable borehole logger offers full digital capability on a single conductor cable - providing up to 9 measurements in a single logging run.



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PRODUCTS & SERVICES

all-steel, 20-amp, hermetically sealed mercury switch will withstand up to a maximum of 43 amps starting current, with a 12 to 15 amp run current, the company says. **Conery.**

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High-Speed Crusher

TeeMark's CanDoo model PCCI crushes containers and oil

filters of up to one gallon in size and prepares them for recycling at the rate of 300 per hour. With a crushing force of 38,000 lbs., a one-gallon liquid container is reduced to 7/16 inches with less than one percent residuals. The unit can be used for processing flammable containers, as it is powered by shop air of an explosion-proof electric motor. Can be used to compact hazardous waste inside drums. **TeeMark Corp.**

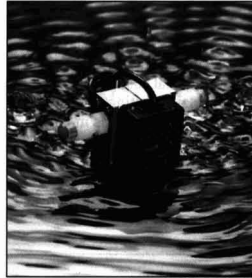
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TOC Analyzer

Fluid Data's new micro-processor-based on-line TOC analyzer TOCOR 200 provides a fast and reliable indication of Total Organic Carbon/Dissolved Organic Carbon, including organic substances that are volatile at ambient temperatures. Depending on the instrument configuration, the TOCOR 200 can successfully measure TOC

concentrations in the range of 0-3 mg/liter carbon up to 0-10 grams/liter. **Fluid Data Inc.**

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Corrosive Gas Measurement

McMillan Company's Series 105X Teflon Flo-Sensor is designed to measure small, precision flow rates of corrosive gases. It measures corrosive gases such as chlorine, bromine (and many others) with gas flows of 0.3 pounds/day. Series 105X Flo-Sensor is capable of

measuring flow rates from 25 milliliters/minute to 5 liters/minute, with six flow ranges. It features standard output signals: 0-5 VDC linearized Analog and Filtered output, and pulse output. **McMillan Company.**

Circle 102 on card.

Submersible Pressure Transmitter

Viatran Corp.'s Model 516 submersible pressure transmitter uses hydrostatic head pressure to measure liquid level and provide accurate measurements down to 1,200 feet. It measures less than 1 inch in diameter and includes features such as corrosion resistance, stainless steel construction, and ranges up to 500 psi. The 516 has a 4-20 mA output signal and a silicon piezoresistive sensor for increased accuracy and stability. **Viatran Corp.**

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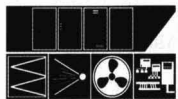
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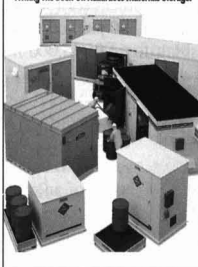
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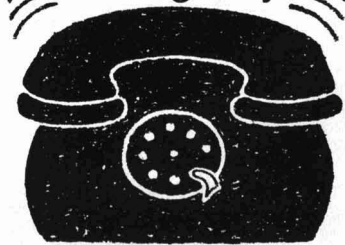
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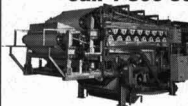
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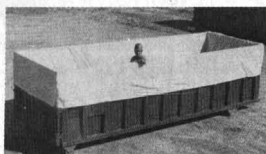
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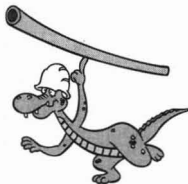
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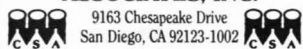
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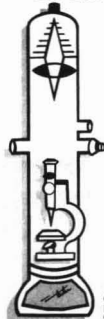
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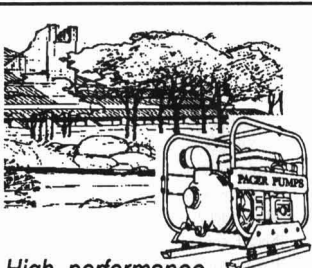
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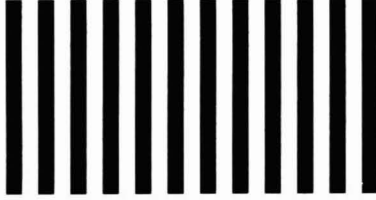
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- A Corporate responsibility for Pollution Control
- B Manage all Pollution Control Operations at this location
- C Supervise sub-group in Pollution Control Operations
- D Provide professional consulting service on Pollution Control
- E Provide staff environmental service on Pollution Control
- Z Other (please specify) _____

2. Type of Business (check only one):

A **Manufacturing. If manufacturing, please check the appropriate SIC (check only one):**

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- B 20-49 F 500-999 I 2500 and up
- C 50-99 G 1000-1499
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4. 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 and control
- E Services/Consulting
- F None of the above _____ (please specify)

5. What types of Pollution Control are you responsible for? (check all that apply):

- A Air F Toxic & hazardous material
- B Water G Energy control/energy conservation
- C Noise H None of the above
- D Solid waste disposal
- E Industrial hygiene _____ (please specify)

6. Which of the following publications do you receive personally addressed to you? (check all that apply):

- A Pollution Engineering
- B Environment Today
- C Hazmat World
- D Pollution Equipment News
- E The National Environmental Journal
- F Water Environment & Technology
- G None of the above _____ (please specify)

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