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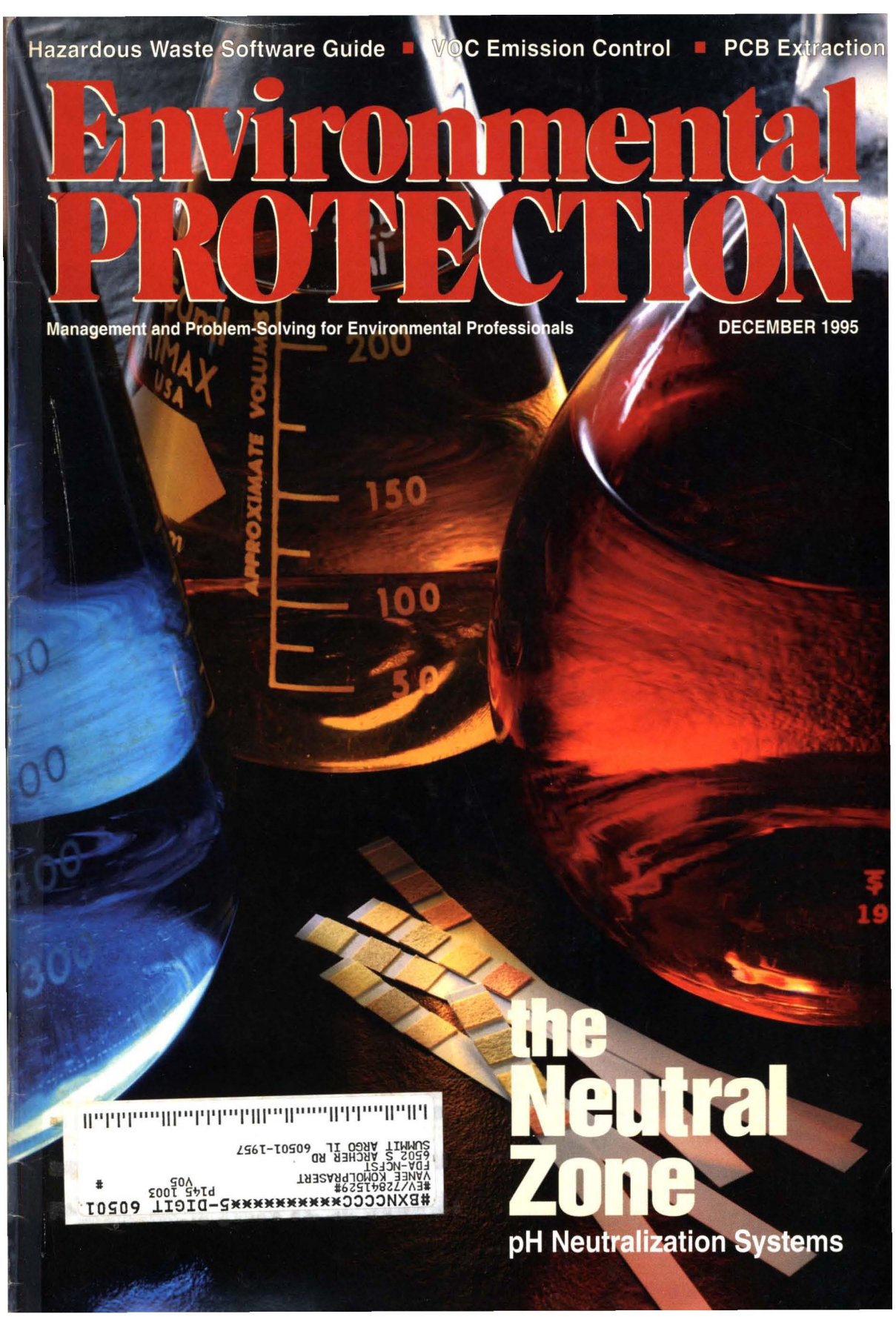
Environmental PROTECTION

Management and Problem-Solving for Environmental Professionals

DECEMBER 1995



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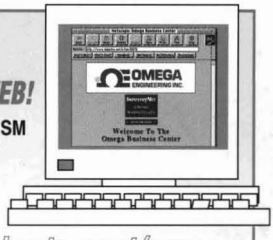

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Cover:
Several new technologies featured in this issue, including packaged treatment systems for the neutralization of corrosive wastes, cut the costs of waste management. *EP's* focus on pH neutralization systems begins on page 16.

Photo: Joe Griffin

Environmental PROTECTION

FEATURES

Page 20

DEPARTMENTS

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New Technologies Pass Financial Litmus Test

In this era of tighter budgets and downsizing, the regulated community is searching for more cost-effective ways of handling waste and cleaning up contaminants. This issue features several articles profiling new technologies designed to meet companies' environmental needs with the least impact on corporate pocketbooks.

As a result of stricter requirements for extremely acidic and alkaline discharges generated from industrial operations, pH neutralization systems have become more and more complex. However, various companies have developed new pre-engineered tank/pump systems for controlled neutralizing of corrosive wastes. These new systems are completely automated and require minimal field hookups. The economic advantages of these new systems are severalfold: lower design and installation costs and reduced maintenance expenses.

With the number of VOC technologies available, the environmental professional may have a difficult task finding the most strategic environmental solution. In his article beginning on page 11, Peter Yewshenko describes different incineration technologies and spells out factors that should be used to choose the best solution to control virtually any type and level of VOC generation that may occur.

As Michael Bonem and Ronald Borah point out in their article, a new chemical-extraction process for the removal of PCBs and other contaminants has been successfully used to decontaminate solid materials such as concrete, brick and steel. The new process offers significant benefits in the reuse of contaminated buildings, equipment, and avoided disposal costs.

And don't forget to check out our Hazardous Waste Software Guide (pages 22 and 23), which lists new software available for the management of hazardous waste. Our guide will help you find the software that best suits your needs, including manifesting, tracking and labeling.

Angela Neville

Angela Neville
Editor-in-Chief

Environmental PROTECTION

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NEWS UPDATE

EPA Proposed Rule Would Delete HAPs from CAAA

Upon receiving petitions from several chemical makers, the Environmental Protection Agency proposed a rule in the Sept. 18 *Federal Register* to delete the hazardous air pollutant caprolactam, which is used to make carpet fibers, nylon and plastics. The agency determined that "emissions, ambient concentrations, bioaccumulation or deposition" of caprolactam "are not reasonably anticipated to cause adverse human health or environmental effects."

Once the rule becomes final, chemical companies won't have to install Maximum Achievable Control Technology (MACT) for source categories using caprolactam. The chemical is regulated in the Clean Air Act Amendments of 1990 under section 112(b)(1), which includes a list of hazardous air pollutants (HAPs) composed of specific chemicals to be used to identify source categories for which EPA promulgates emission standards. Written comments were submitted to EPA last month.

EPA Clarifies Guidelines for Brownfields Pilot Program

EPA will accept proposals for the National Brownfields Economic Redevelopment Pilot Program through March 4, 1996. Also, the agency has clarified application guidelines that it hopes will make the process more competitive.

In July, EPA selected 15 of more than 100 applicants in its first full round of selections for the pilot program, aimed at cleaning up and redeveloping brownfields. The next upcoming deadline for applications is March 4, 1996. Also, applications received earlier in 1995 but not chosen as pilots to date will continue to be considered by EPA in the upcoming rounds. EPA made the announcement in the Sept. 22 *Federal Register.*

EPA seeks to fund 50 two-year demonstration projects with up to $200,000 each for reclaiming brownfields. In all, 18 have been selected so far, including the 15 picked in July. Brownfields are abandoned, idled or underused industrial and commercial facilities where expansion or redevelopment has been complicated by environmental contamination or the perception of it. Cities, counties, states, towns and tribes can apply for the pilot money.

Meanwhile, EPA has clarified the criteria on which it will base evaluations of applications. Proposals need to have a demonstrated commitment of public and private leadership to redevelopment of the brownfield; plans for community involvement; contributions to environmental justice goals; government support and technical, legal and political means to reach the proposal's goals; clearly outlined funding sources; potential for national replication; and a well-defined approach to environmental assessment.

Those applicants who submitted a proposal before the March 1, 1995, and April 17, 1995, deadlines don't need to resubmit it. But they may if they choose, and EPA suggested those applicants review this clarification of guidelines in deciding.

EPA's UWWF Committee Focuses on Effective Rules, Lower Costs

Consistency with the Clean Water Act and improvements to human health and the environment are some of the goals of EPA's Urban Wet Weather Flows Advisory Committee, which held a public meeting in Arlington, Va., Sept. 20.

The meeting is part of a series of discussions to formulate recommendations to EPA for management of stormwater, combined sewer overflows and sanitary sewer overflows (SSOs). Committee members, including officials from industry, environmental groups, and state and local governments, heard reports from two subcommittees and discussed objectives.

Speaking for the SSO subcommittee, Peter Lehner of the Natural Resources Defense Council emphasized the goal of a national "approach" to SSOs, rather than a national policy, saying that the overflow problem may not be significant enough to establish a full policy. "We're still vague on how binding [the recommendations] will be," he said. Currently, there is virtually no guidance on the national level as to what constitutes acceptable overflow, Lehner said, and municipalities tend to rely more on their own judgments. Systems which do not typically suffer from SSOs "should be left alone," he added.

Nevertheless, some committee members expressed concern over the amount of micromanagement that these approaches would entail. Lee Hachigian of the National Association of Manufacturers noted that many municipalities "don't have the resources to handle such large amounts of regulation." Doug Harrison of the American Public Water Works Association noted that, in some cases, an overflow from one locality's system will spill into another's, causing the latter to be in violation of its permit, even though the system is otherwise in full compliance.

Recommendations from the subcommittees will be submitted to the UWWF committee for consolidation. A subcommittee can submit findings to both EPA and the UWWF committee simultaneously, and EPA may use those findings without approval of the committee, but will seek full committee feedback on subcommittee reports.

EPA Rule Limits Emissions from Marine Tank Vessels

EPA is requiring marine bulk-loading facilities to install technology-based systems to limit emissions of air toxics and volatile organic compounds, according to a final rule in the Sept. 19 *Federal Register.*

New and existing marine tank facilities must install Maximum Achievable Control Technology (MACT) or Reasonably Available Control Technology (RACT), depending on the substances they load. MACT and RACT standards are spelled out, respectively, in Sections 112 and 183(f) of the 1990 Clean Air Act.

Marine terminals that load 200 million barrels annually of crude oil or 10 million barrels annually of gasoline are required to reduce VOC emissions by 95 percent using RACT. Overall, VOC emissions, key components in forming ground-level ozone pollution, or smog, will drop by 43,000 tons per year, EPA said.

In addition, marine loading terminals that emit at least 10 tons yearly of hazardous air pollutants (HAPs), or at least 25 tons yearly of a combination of HAPs, must reduce emissions by 97 percent using MACT standards. Emissions from air toxics such as benzene will drop by about 4,500 tons annually, the agency said.

The regulation will affect about 30 marine tank vessel loading operations around the country, said EPA, which expects the national capital cost and the national annual cost to range, respectively, from $270 million to $440 million, and $60 million to $100 million.

For the Valdez Marine Terminal in Valdez, Alaska, the largest oil loading operation in the United States, capital costs will be about $93 million, said Norman Ingram, an environmental official with the Alyeska Pipeline Co., which operates the terminal. Alyeska, an agent for seven petroleum companies, transports about 1.5 million barrels of crude oil daily to the Valdez terminal, where the oil is loaded onto tankers for shipment. Both MACT and RACT standards will be installed on two of the terminal's four loading docks, Ingram said.

"I'm very pleased with the procedure that EPA followed," Ingram said. "It was used to gauge the feelings of all of the stakeholders, particularly those in the Valdez area."

The regulation is effective immediately. Owners or operators of marine vessels loading RACT sources must start constructing vapor-collection systems and air pollution control devices within two years, and have such equipment fully installed by Sept. 19, 1998. RACT sources that begin operating after Sept. 21, 1998, must comply with all requirements upon startup.

Marine bulk-loading MACT sources must install the equipment by Sept. 19, 1999. Owners or operators of MACT-only sources that start operating after Sept. 20, 1999, must comply with all requirements immediately.

EPA Seeks Suggestions on Best Recycled Items for Government

Before EPA decides which additional recycled-content products it should require for federally funded activities, the agency wants information on the availability, quality and waste diversion associated with various candidates. Thus, from Dec. 1, 1995, to Feb. 29, 1996, interested parties can suggest new additions and recommend improvements to the current list of prescribed purchases, the agency announced in the Sept. 20 *Federal Register*.

President Clinton's executive order 12873, which was issued Oct. 23, 1993, asks EPA to designate items for government purchases and recommend content levels in several phases, termed "Recovered Materials Advisory Notices." EPA published its first RMAN May 1, identifying available recovered material ranges for government purchases of 19 items. The items were listed in seven product categories: paper and paper products, vehicular products, construction products, transportation products, park and recreation products, landscaping products and nonpaper office products.

Now, EPA would like updated information on listed items as well as recommendations for new items. When suggesting an item, respondents should list content levels of recovered materials in the product, indicate whether and how much of the recovered content is post-consumer material, and identify names, addresses, contact names and phone numbers of vendors.

Respondents should include information on whether the item is made from material that represents a significant portion of the solid-waste stream, uses materials that present disposal problems, performs well enough to meet the needs of the procuring agency, is available at a reasonable price considering normal market fluctuations, is purchased in appreciable quantities by the government, is available from an adequate number of sources to ensure competition, and is not restricted to a limited market area. EPA also wants comments on what government specifications, standards or purchasing procedures hamper agency purchases of items containing recovered materials.

The agency does not want further information for items in the "paper and paper products" category, however. EPA is still reviewing comments on a separate draft RMAN for paper products that was issued March 15.

Under the initial RMAN, any agency or contractor using federal funds must procure the product with the highest percentage of recovered materials practicable when purchasing.

Send comments to RCRA Information Center, Office of Solid Waste (5305W), EPA Headquarters, 401 M Street, S.W., Washington, DC 20460. Reference docket number F-95-CPGN-FFFFF. EP

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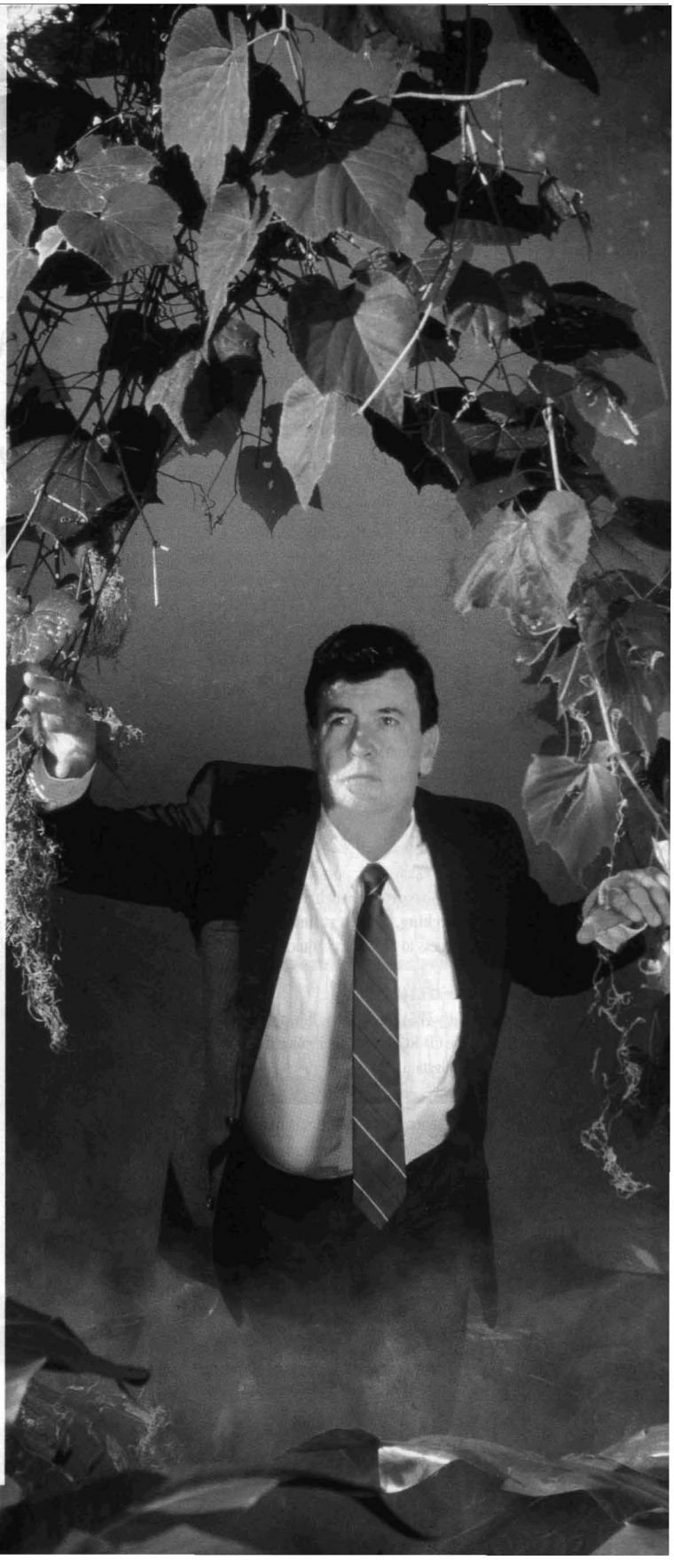

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Hot Stuff Controls for VOC Emissions

Use a broad spectrum of evaluation factors to decide on an incineration system.

By Peter Yewshenko

For close to three decades, American industry has paved the way and led the world in controlling volatile organic compound (VOC) emissions. As more and more systems have been installed, the history of operation for the various types of systems has broadened dramatically, spurring significant technological advances, the traditional technologies and those on the cutting edge of VOC control.

What's Available?

The conventional, traditional or proven methodology for VOC control has been incineration. Incineration technologies include the common afterburner, catalytic oxidizer, recuperative thermal oxidizer and regenerative thermal oxidizer. Incineration has by far been the solution of choice for the majority of all VOC generators.

Other technologies have been used for very specific applications. These include carbon adsorption, condensing and wet scrubbing. These systems also lend themselves to other plant requirements, such as solvent recovery and odor control. New technologies being studied and newly applied existing technologies include biofiltration, where living microorganisms are used to consume VOCs, biofiltration with carbon, and even regenerative with catalyst.

With the number of technologies available, the environmental professional may have a difficult task choosing the most strategic environmental solution. Everyone wants to be state of the art, but no one wants to be the first to try something. Typically, environmental professionals can look at their industry and competition to obtain a timely and important overview of successful and unsuccessful technologies.

In deciding the specific type of incineration system to select, the environmental professional will look at a broad spectrum of evaluation factors. Theses include initial system cost, operational cost, maintenance requirements, reliability factors, and most importantly, the projected success of achieving 99-percent VOC destruction efficiency. As part of the project, the environmental professional tries to minimize (optimize) airflow from the processes through a comprehensive program of capture and recirculation techniques, as well as ensure worker safety and product quality. Part of the selection criteria should also be the possibilities of formulation changes, new products being developed for the company, and the potential need for the VOC-control system to be expanded or for additional units to be purchased.

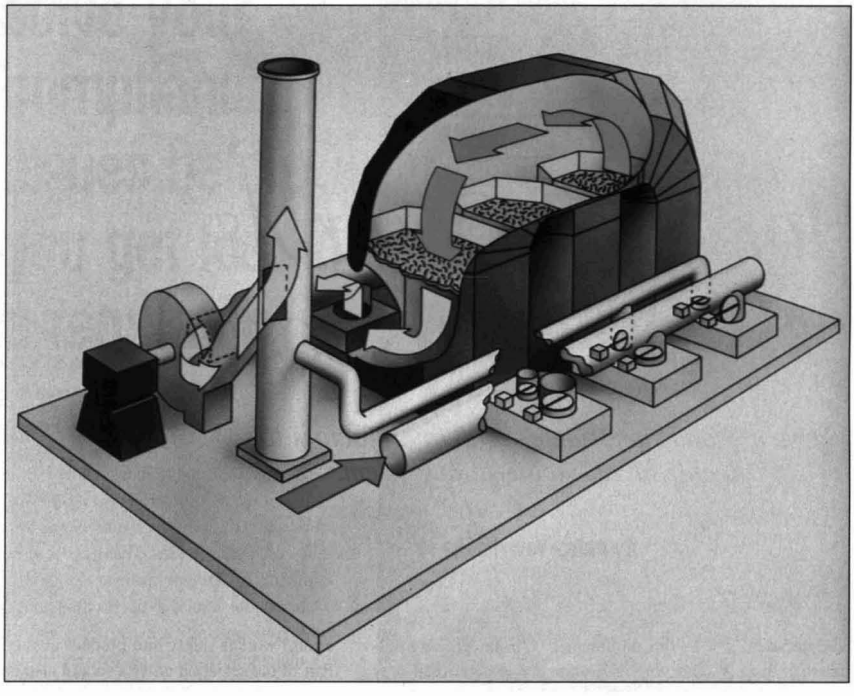
There is a proven means for controlling virtually any type and level of VOC generation

Technical Selection Factors

Once the general summary and evaluation of factors have been completed, the environmental professional will weigh the technical data that will dictate the specific solution respective to system type and design. The technical factors to be considered and analyzed include:

- Process exhaust volume—maximum, minimum and average flows.
- Process exhaust solvent (VOC) composition and concentration—specifically identifying any inorganics.
- Various flowrate-specific VOC concentrations.
- Process operation criteria, flow-rate swings, concentration changes, hours of operation, etc.
- Natural gas (or other auxiliary fuel) and electrical costs.
- Site layout criteria and stack height requirement.
- VOC destruction requirement.

A large percentage of plants will select some form of incineration as their solution



The Ross Air System's regenerative thermal oxidizer, which destroys VOCs in exhaust streams.

to VOC control. Incineration will cause oxidation, the breakdown of airborne solvents and hydrocarbons into primarily water vapor and carbon dioxide. Many types of incineration systems have proven themselves and can do the job if the application is correct.

Incineration Technologies: Which One to Choose?

The following is an overview of the basic differences among technologies. Although there are many variations in system features, the selection process is relatively straightforward.

Common afterburners (no heat recovery) utilize a direct-fired burner(s) into an insulated combustion chamber sustaining a temperature of 1,500 degrees F for at least 0.5 seconds. The chamber will be sized to allow for the given retention time at a certain airflow velocity. This system has the lowest capital cost but is the most expensive to operate. It is suited for extremely low throughput applications of approximately 1,000 standard cubic feet per minute or less. High solvent (VOC) concentrations will help minimize auxiliary fuel consumption.

Catalytic oxidation systems combine a conventional type of heat exchanger with a catalyst. The catalyst, either precious or base metal, will allow oxidation to occur at a fairly low temperature of about 700 degrees F, depending on the particular hydrocarbon constituents in the airstream.

Catalytic oxidation is an excellent approach to VOC control for fairly low throughput applications with a moderate quality of "clean" hydrocarbons. When compounds such as silicone, sulfur, heavy hydrocarbons or particulate are present, they will have a tendency to mask or poison the catalyst's cell structure. When this occurs, the catalyst's ability to react chemically with the hydrocarbon decreases, requiring more fuel to rise to a temperature where proper oxidation will take place. Masking of the catalyst may also cause airflow restrictions whereby more horsepower could be needed to push the air through the system.

Everyone wants to be state of the art, but no one wants to be the first to try something.

The catalytic oxidizer is best suited for well-defined solvent formulations such as clean ink processes. When properly applied, catalyst life should exceed three years and prove the most economically viable over an approximate three- to five-year period.

Recuperative thermal oxidation The heart of this technology is its plate, or tube type, of heat exchanger. The VOC-laden airstream is preheated to a maximum of approximately 80 percent of the 1,500-degree F combustion temperature. This system will be sized based on throughput. The cost will go up in proportion to the efficiency and number of passes being made in the exchanger.

These systems are not sensitive to poisoning like the catalytic systems are. However, care must be taken if any corrosive solvents are present or if any particulates are in the airstream that may adversely affect the system's performance and integrity. Somewhat corrosive solvents can be tolerated with proper selection of materials.

The recuperative-type system is best suited for moderately high solvent concen-

trations and can tolerate a broad mix of constituents. Again, any corrosive solvents should be properly designed for in the system. These systems can handle moderately large volumes of air. But if the design solvent concentration is reduced or if there are swings in solvent concentration, the auxiliary fuel consumption will go up dramatically and cause the overall operation to be inefficient.

Regenerative thermal oxidation Processes that contain a very low concentration of VOCs require a highly thermally efficient control system in order to minimize the need for large quantities of auxiliary fuel. This need becomes increasingly critical as the contaminated air volume rises, due to the enormous amounts of fuel that would be required to sustain a temperature of more than 1,500 degrees F, should higher thermal efficiency not be attainable. For example, at a throughput airflow of 50,000 SCFM, the difference in fuel cost between a 95-percent thermally efficient regenerative system and a 75-percent recuperative system could exceed $200,000 per year in a typical converting application. The regenerative system will require more horsepower, however, because of the additional pressure drop across the system. Yearly savings will be reduced somewhat.

Obviously significant, fuel savings have been the primary reason for converters as well as for the majority of all other large-volume and low-concentration generators to utilize regenerative technology for fulfilling their environmental control needs. Additionally, other potential benefits with regenerative technology include better tolerance to thermal shock, tolerance to varying VOC constituents, and the ability to operate close to 2,000 degrees F when necessary in order to achieve 99-percent-plus destruction levels. Recuperative systems cannot operate much over 1,500 degrees F due to heat exchanger limitations, and catalytic systems cannot operate over about 1,100 degrees F due to catalyst limitations.

Regenerative systems preheat the incoming dirty gases to a level of up to 95 percent of the combustion chamber temperature. This is accomplished through the transferring of heat from clean air exiting the system into thousands of saddle-shaped ceramic elements, such as stoneware, within the large regenerative beds. As the dirty air enters the system, it must pass through this stoneware on its way into the combustion chamber, where heat is extracted and recycled via the tremendous ceramic heat sink. The regenerative system, like the other technologies, will offer a plume-free rapid dispersion of simple water vapor, nitrogen and carbon dioxide constituents when properly applied.

Confidence

As today's industrial products and processes continue to advance technically, the environmental professional can feel confident that there is a proven means for controlling virtually any type and level of VOC generation that may result. It's simply a matter of choosing the best solution to meet the plant's particular needs. EP

Peter Yewshenko is vice president, Ross Air Systems, Somerville, N.J.

Extraction Chemistry Goes Deep to Grab PCBs

This successful extraction process uses advanced chemical formulations and engineered applications.

By Michael W. Bonem and Ronald E. Borah

Effective polychlorinated biphenyl decontamination of buildings and equipment is a difficult challenge. Required cleanup levels are typically very low, with the PCB spill policy criteria of 10 micrograms (μg) per 100 cm^2 (40 CFR 761, Subpart G) applied most often. In the best circumstances, this standard is difficult to achieve, but the passage of time complicates the problem.

Over the years, PCBs and other contaminants will migrate deeper into the substrate through the pores in any material. Migration occurs naturally due to gravity and specific gravity differentials, with water from routine cleaning or with pressure. The depth to which this migration will occur depends on many factors, including the porosity of the material, the mobility and solubility of the contaminants, the presence of coatings and the existence of other drivers. Migration of 0.5 inch or more is common and can exceed 4 inches in some cases. Since many current decontamination projects are addressing incidents that occurred 20 or more years ago, deep penetration of PCBs is a widespread concern.

Standard approaches to cleanup projects include physical (destructive) methods and chemical cleaning with surfactants, solvents or acids. Physical mechanisms can be effective if the contamination is not deep and if damage to the surface is allowable. Their primary limitations are the large volume of waste generated, the risk for workers (primarily from airborne contaminants) during the cleanup, the potential need to shut down plant operations and ongoing liability for landfill disposal. Destructive methods can also be very expensive in cases of deep contamination due to the high cost of disposal. Off-the-shelf chemicals address surface contamination but are usually ineffective when subsurface migration has occurred. In addition, many chemicals (strong acids, solvents) pose significant health and safety risks for remediation workers.

Using a crew of four decontamination technicians and a project manager, the project was completed in 10 working days.

A sequential chemical extraction technology process, TechXtract, has been successfully used for the removal of PCBs, other hazardous organic and inorganic substances, and radionuclides from solid materials such as concrete, brick and steel.

The technology uses advanced chemical formulations and engineered applications to achieve significant penetration and removal of these contaminants from below the surface of these materials.

The process chemistry is based on several hypotheses relating to contaminant migration and removal. One hypothesis is that contaminants migrate into the pores and microscopic voids of a material, even for seemingly nonporous media. Mobility of the contaminants, time and secondary forces often drive these contaminants to deeper levels in the substrate. Furthermore, contaminants tend to become chemically or electrostatically bonded to the substrate. In many cases, the time between contamination and decontamination efforts allows the contaminant migration pathways to become partially closed. This system:

- Reopens the pores and capillary pathways to the maximum possible extent.
- Penetrates into the pores as deeply as possible.
- Breaks the substrate and contaminant bonds which may be holding the contaminants in place.
- Binds or encapsulates the contaminants to prevent recontamination.

One recent project in which the technology was employed was the decontamination of an electric utility warehouse where PCB transformers had been stored. As is often the case, the out-of-service transformers had leaked in a number of places. The warehouse was no longer in use, and the utility's objective was to reduce PCB concentrations to less than 10 μg/100 cm^2.

The total area to be decontaminated was 6,300 square feet of concrete floor. Initial wipe samples indicated PCB concentrations ranging from less than 10 μg/100 cm^2

to more than 1,000 $\mu g/100\ cm^2$, with most samples in between. The pattern indicated several "hot spots" where spills had occurred directly onto the concrete. Widely dispersed, low-level PCB contamination (e.g., 10-50 $\mu g/100\ cm^2$) also occurred, spreading from the original hot spots.

Using a crew of four decontamination technicians and a project manager, the project was completed in 10 working days. Seventy sample locations were established using a standard grid layout. All sample locations were reduced to less than 10 $\mu g/100\ cm^2$, with an average final sample result of 3.9 $\mu g/100\ cm^2$.

The first round of post-treatment samples was greater than 10 $\mu g/100\ cm^2$ on 64 percent of the locations. But additional cleaning, with verification sampling, achieved the standard in each case. In many of these locations, the interim post-treatment samples showed increases in PCB levels, verifying the extraction of PCBs from the subsurface of the concrete. Further verification was provided by samples of the waste fluids, which had PCB levels between 37 parts per million and 90 ppm. The total liquid waste volume generated by the decontamination project was about 450 gallons. The total decontamination cost was less than $5 per square foot.

Conclusion

The power of this technology is its ability to penetrate into the substrate through the pores in the material so that PCBs, heavy metals, radionuclides and other contaminants can be pulled into and held in solution and ultimately extracted. It offers significant benefits in reuse of previously contaminated buildings and equipment, waste reduction, and avoided disposal costs. EP

Michael Bonem is president and chief operating officer of EET, Inc., in Bellaire, Texas. EET is a subsidiary of North American Technologies Group. Ronald E. Borah is vice president of EET, and vice president, technology, North American Technologies Group, Inc.

For information on the TechXtract process, circle 46 on card.

PCB Transformer Warehouse Decontamination Project Synopsis

PROJECT CONDITIONS
Area to be decontaminated: **6,300 square feet**
Description: **Concrete floor**
Initial PCB concentration range: **<10 $\mu g/100\ cm^2$ to >1,000 $\mu g/100\ cm^2$**
Source of contamination: **Leaking PCB transformers, subsequent spreading**

RESULTS
Final samples: **70 sample locations; all <10 $\mu g/100\ cm^2$ (average = 3.9 $\mu g/100\ cm^2$)**
Waste fluid: **~450 gallons; 37-90 ppm PCBs**
Crew: **Four technicians, one project manager**
Schedule: **10 working days**
Cost (decontamination): **$4.60 per square foot**

Standardized and Customized pH Neutralization Systems

Self-contained pH neutralization systems are completely automated and require minimal field hookups to operate

By Ed Santos

Despite the threat of budget cutbacks and pressures on national and local environmental groups to reduce costs, the demand to improve, or at least maintain, clean water and clean air standards is still very strong. This is particularly evident in regard to federal and state requirements for the neutralization of acid, alkaline or other contaminated plant discharges, whether they result from process operations, wastewater handling, spills or runoffs from facilities.

Just a few years ago, facility engineers designed and built these neutralization systems with few regulatory guidelines or restrictions. As the requirements tightened, the systems became more detailed and complex. Simultaneously, plant downsizings reduced the available number of personnel to handle the design function. Consultants took up the slack, taking over many of the engineering and purchasing functions. To minimize the detail work at the consulting or facility engineering level and to reduce the problems involved in component purchasing and parts inventory, various companies have developed pre-engineered tank/pump systems for controlled pH neutralizing of corrosive and abrasive waste streams. These packaged systems incorporate all the necessary components—the tank, sump pump, valves, piping, controls and instruments. All components in contact with the fluid are encased in nonmetallic materials inert to the solutions to be pumped.

The choice of pump material and design is critical. Each system is customized for the specific requirements of the application.

Where the application permits, these pre-engineered, completely automated systems require only electrical and auxiliary piping hookup in the field to become operable. Each system is customized for the specific requirements of the application. This involves close coordination among facility operators, consultants and systems engineers. A single source provides all hardware, instruments and controls and this arrangment eliminates time-consuming negotiations with multiple suppliers and subcontractors.

A Typical System

A specification for a typical self-contained pH neutralization system would contain these components:

The Tank. The tank is generally specified in thermoplastic or thermoset material. Polypropylene and polyethylene are commonly used when thermoplastics are required. PVC, CPVC or PVDF tanks are specified if the higher strength of the vinyls or the superior corrosion resistance of the fluropolymer are required. Rectangular or cylindrical tanks, as well as double wall designs, are available in sizes from 50 to 2,500 gallons. Specifications should call for hot gas-welded joint construction to provide continuous seams and avoid recesses or blind areas. If pressurized service is required, carbon or stainless steel tanks are available with appropriate thermoplastic linings or overlays.

The Pumps. Two different pump types are required for these standardized systems:

• Vertical centrifugal (sump) pumps sized and rated for the required flow requirements. The choice of materials depends on the anticipated chemical composition of the waste streams. Polypropylene is most widely used for wetted pump components because it is a relatively low-cost engineered thermoplastic with broad chemical resistance. Pump design should exclude all metal parts from fluid contact. The stainless steel shaft should be entirely sheathed in the appropriate thermoplastic and sealed to avoid metal exposure.

• Two dosing or metering pumps are generally required since pH control requires automatic metering of an acid or caustic solution on demand. These should be self-priming and sealless, with all contact parts covered by nonmetallics inert to the anticipated fluids. Standard systems utilize a flexible liner rotary pump, which operates by means of an oscillating rotor mounted on an eccentric shaft. The motion of the rotor propels the fluid by peristaltic action, squeezing it between the outer surface of the flexible liner and the inner surface of the pump casing. The casings (pump bodies) are available in polypropylene, polyethylene, Teflon and other nonmetallics materials. Available elastomeric liners include pure rubber, neoprene, Hypalon, Buna N, Viton and Nordel.

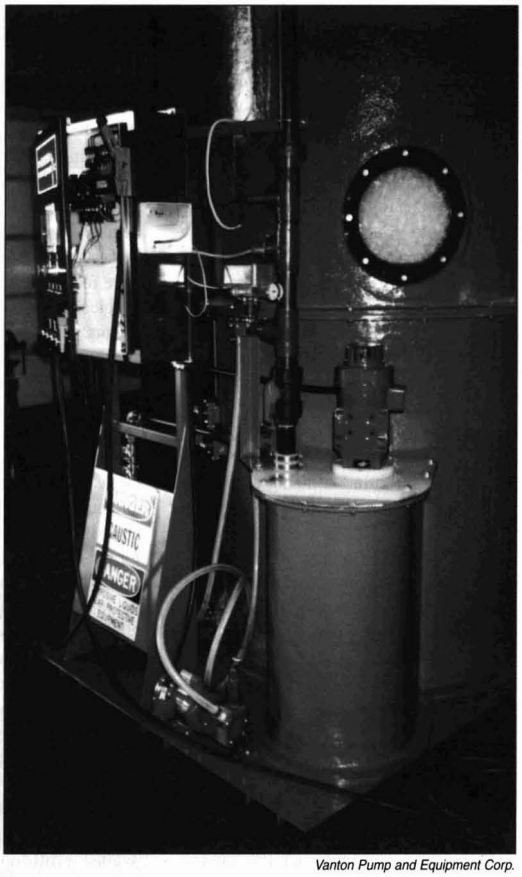
pH Electrode. Electrodes feature a combination design with a measurement-reference and a temperature compensation element in one package. The electrode senses the degree of acidity or alkalinity of the fluid and the pH reading is amplified by a preamplifier.

Preamplifier. It converts pH electrode signals to allow the use of ordinary cable for distant wiring to the pH controller.

pH Controller. The controller accepts the signals from the preamplifier and sends an output signal. You may choose 4 to 20 mA, 0 to 20 mA, 0 to 5 vDC, or 0 to 10 vDC, isolated or nonisolated versions. As the pH level rises or falls beyond the preset acceptable range for discharge, the reagent metering pump provides the appropriate acid or caustic solution to the fluid being treated. The pH electrode continues to monitor the fluid or wastewater contents as they flow into the tank. It automatically shuts down the operating metering pump when the satisfactory pH level is reached. The unit is furnished with a relay output card for high- or low-level pH alarm.

Level Controls. Liquid-level controls made of engineered plastics are set to activate the sump pump when the incoming flow raises the fluid level beyond the preset depth. These controls not only activate the sump pump when the high-level mark is reached and shut it down at the low-level mark, but also provide relays to activate an audible and visible alarm when there is danger of overflow.

pH control of scrubbing system for neutralizing SO_2 with NaOH.



Vanton Pump and Equipment Corp.

Instrumentation Considerations

Despite the fact that pre-engineered tank/-pump systems take a big load off facility operators, there is such a diversity of facility layouts and needs that for many applications, individual negotiations with consultants and application engineering specialists are still very much in vogue.

There are many fume-scrubbing applications requiring continuous pH control that involve the use of heavy-duty horizontal centrifugal pumps located outside the tank. When engineering these systems, it is equally important to consider complete isolation of all metal components from the corrosive, circulating fluid. The choice of pump material and design is critical. Be sure to provide the manufacturer with all significant operating parameters, including flow, temperature variations, fluid characteristics, etc.

With respect to instrumentation, here are some basic considerations that should provide help to facility engineers or consultants involved with system design.

pH Probe. Since the probe is immersed in the fluid, it must be constructed of a chemically inert material that completely encapsulates the electronics. Its design should permit easy entrance and removal without the use of tools, such as a probe design that has no threads and slips into a CPVC compression fitting. The probe encapsulates a 4 to 20 mA, two-wire transmitter. Accurate measurement of the pH is determined by measuring the difference of the voltage transmitted by the two "batteries" that comprise the probe. One battery is formed by the process electrode and the ground electrode. The voltage is a function of the solution pH. The other battery is formed by the standard electrode, which

Typical pH Neutralization Systems

Here are four case studies of typical pH neutralization systems.

Scrubbing HCL Fumes

A neutralization and ventilation system installed to scrub corrosive, noxious and hazardous fumes from a galvanizing process failed to meet the 99.5 percent removal efficiencies mandated by state and EPA regulations. The company was in danger of losing its operating permit if the problem wasn't solved. An analysis of the cause of the problem revealed that the system was undersized. It required two 40,000 cubic feet per minuite (cfm) scrubbers, each one utilizing a 600 gallons per minuite (gpm) end-suction centrifugal pump. Due to the corrosiveness of the fumes, the pumps were specified with casings and impellers made of solid, molded, homogeneous virgin polypropylene. The wetted end of the large-diameter stainless steel shaft was sheathed in thick-sectioned PVDF (polyvinylidene fluoride). In addition, to avoid any metal coming in contact with the fluid, the mechanical seals were reverse-mounted so that the metal seal was outboard.

System reliability was assured by installing a pH monitoring system so that the recirculating scrubbing fluid would always be at 8 or above. The pH probe was set to energize a self-priming metering pump to deliver the required amount of caustic.

Neutralizing Biotech Wastes

An innovative biotech company specializing in the development and production of various dyestuffs required a pH neutralization system to allow discharge of their facility wastes into the local municipal wastewater treatment system.

The company supplied its own tank. Two vertical centrifugal polypropylene pumps were specified, each with a shaft length of 36 inches and an 18-inch long by 24-inch wide by 1-inch thick polypropylene coverplate sized to the tank dimensions. Fume protection was provided by a special "V" ring seal arrangement in the coverplate. The pumps were driven by 1 hp, 1800 rpm, explosion-proof motors. All wet end components of the pumps were polypropylene, including the impeller, casing, casing cover, support column and shaft sleeve. A water manifold was specified to ensure flushing of the sleeve bearings.

To satisfy the requirement for caustic and acid metering on demand from the pH controls, the specification called for flexible liner pumps with polypropylene bodies and neoprene liners. These pumps were individually mounted on bases and coupled to one-half hp, 1800 rpm, PMDC motors. They were each furnished with an adjustable-speed DC motor controller, designed to accept a 4 to 20 mA external signal.

The specification called for a pH system that would monitor the pH level in both the wastewater neutralizing tank and the effluent line. The pH controller was furnished with two 4 to 20 mA output signals for the neutralization tank and another pH controller with two relay output cards for the high and low pH alarm, and one 4 to 20 mA output signal to the chart recorder for the waste effluent line.

Although the company handled all aspects of the installation, they ordered a completely instrumented control panel in a NEMA 4X thermoset (FRP) enclosure.

Neutralizing Acid Wastes

To handle 50 gpm of acidic wastes against a 30-foot total dynamic head (TDH), the specifications called for a duplex system utilizing two cantilevered, vertical centrifugal polpropylene pumps, with an in-tank shaft length of 22 inches. The pumps were to be driven by 3.5 hp, 1750 rpm, hollow shaft motors. This design involves an integral pump motor shaft. There are no bearings in the fluid being handled, and the immersed shaft is sheathed in polypropylene.

Using multiple switches for the duplex pump operation and a high-level alarm, the system utilized the two pumps on an alternating cycle so that the wear on each pump would be relatively equal. When the inflow into the sump reaches the high-level danger mark, however, both pumps operate simultaneously.

The dimensions of the custom-fabricated, 300-gallon rectangular tank were 62 inches long, 40 inches wide, and 24 inches high. The basic construction consisted of one-half inch wall polypropylene, thermo-welded, with a three-quarter-inch, bolted-on, strut-reinforced cover to support the two sump pumps. An epoxy-painted angle iron that measured 3 inches by 3 inches provided side-wall support.

In conjunction with the polypropylene holding tank, the engineers recommended a polypropylene, horizontal centrifugal 3x2 transfer pump with a keyed polypropylene impeller, a reverse-mounted mechanical seal, and direct water flush lubrication. By reversing the mechanical seal so that the metal seal face is external to the fluid, the initial seal cost is less, maintenance is reduced, and no metal is in contact with the corrosive liquids.

The pH controller, with a two-relay output card and a 4 to 20 mA output signal, energizes the metering pumps as called for by the pH sensors. A two-pen pH chart recorder registers the pH level. A built-in alarm system alerts the operators if trouble exists.

Neutralizing SO_2 with a NaOH

A specialized scrubbing system developed for neutralizing sulfur dioxide gas flowing through a packed tower at 4000 cfm was developed cooperatively by the company's field service engineers and plastic-pump specialists. Prior to the start of the upward flow of the SO_2 gas, the polypropylene packing rings are thoroughly wetted with 50 percent by weight sodium hydroxide. This initial wetting and the continuous wetting required during operation are provided by recirculation of the neutralization solution by a polypropylene cantilevered sump pump set in a cylindrical fiberglass tank. A flow of 155 gpm is maintained against a head of 65 feet.

The pH of the caustic sodium hydroxide solution is maintained about 8.5 through the use of a pH probe that constantly monitors the solution in the tank and energizes a sealless, self-priming, flexible liner metering pump as required. The pump body was specified in PTFE (Teflon) and the flexible liner in chlorosulfonated polyethylene (Hypalon). During operation, a portion of the spent solution is simultaneously discharged and replaced by makeup water. In this way, the scrubber automatically regenerates itself. The compact, skid-mounted pH neutralization system is designed for full operation after the auxiliary piping and electrical connections are completed.

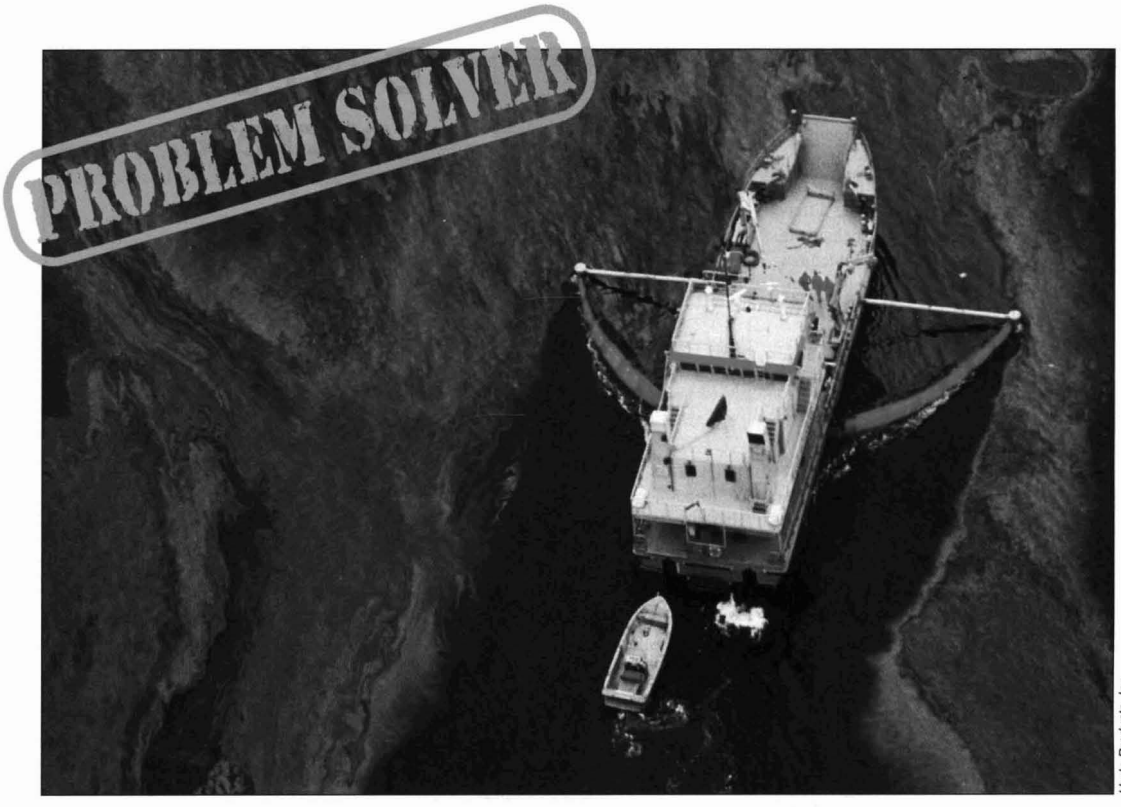
consists of a pH electrode in a chemical standard of fixed pH 7 and the common ground electrode. The analyzer subtracts one voltage from the other, and the differential measurement is the secret behind the accuracy guaranteed by the manufacturer. Construction materials for the wetted components include CPVC, ceramic, glass, Viton and a titanium/platinum alloy.

Microprocessor Analyzer/Controller. The accuracy of the pH measurement depends on the efficiency and performance of the analyzer. The industrial-grade instrument selected should be compatible with the pH probe/sensor and should incorporate a high/low alarm relay and a large LED display easily read under ambient light. It should provide for simple adjustment of the desired pH window.

Float Controls. These devices should be specified to be constructed of the appropriate engineered thermoplastic required for the acids, caustics, salts, waste effluents and other liquids being collected in the sump. The specific design must be determined by the anticipated application, but in general, the control should provide dependable start/stop operation and activation of high-level visual and audible alarms. Rising rod float controls are recommended for depths to 6 feet, and nonrising rod float controls for greater depths or where the overhead clearance is very limited. It is advisable to select designs that permit adjustment of the level control point without removal or disassembly of any component. The electrical switches should be housed in a watertight enclosure mounted above and away from the corrosive liquids. Explosion-proof enclosures should be considered where the application warrants.

Control Panels/Instrumentation. When designing your own pH neutralization system, do not overlook the importance of engineering the control panel and related instrumentation to make your life simple and to provide the recording devices needed for recordkeeping and analysis. Take the time to review the visual and audible signals, switches, analog and digital displays, flow meters and totalizers, in addition to the level and pH monitors and controls. Be sure to incorporate short-circuit protection by using either fusible disconnect or circuit breakers, magnetic motor starters with overload protection, and other safety and control devices. EP

Ed Santos is a systems engineer with Vanton Pump & Equipment Corp., Hillside, N.J.



Hyde Products, Inc.

LORS-5 System installed on Swedish Coast Guard vessel during oil recovery operation off the Swedish coast.

Brushing Up on Oil Recovery

To be prepared for a range of oil spills, emergency response organizations must have an arsenal of powerful and adaptable equipment.

By Jim Mackey

Around the coastal United States, a network of oil spill cooperatives and emergency response organizations stand ready with the technology and the know-how to respond to the first sign of an oil spill. When the telephone rings, they may be required to mop up 200 gallons of oil that leaked off the deck of a ship or to contain and skim 2,000 gallons of oil from a broken hose at a loading terminal. In a few cases each year, they may find themselves responding to a major pollution incident, one that involves hundreds of people and tons of equipment.

A Delaware River Spill

In late July, the Delaware Bay and River Cooperative, a 16-member oil spill cooperative headquartered in Lewes, Del., recovered more than 14,000 gallons of spilled oil. The spill occurred at a New Jersey marine terminal where a vessel was offloading West African Rabi crude oil. Adverse weather conditions forced the tanker away from the discharge platform, thus damaging the facility's loading manifold and spilling oil into the river.

Oil spill responders were called out immediately to deploy a containment boom and begin skimming operations. The cooperative used the Lundin Oil Recovery Inc. (LORI) skimming system to separate the oil and water and to lift the oil out of the river. The brush conveyors were deployed over the top of the floating containment boom, allowing the river's current to feed the oil into rotating brushes. The combined efforts of the skimmers recovered more than 14,000 gallons of viscous oil. The skimmers filled 400-gallon tanks on board the workboats in less than 20 minutes, and recovered oil, oily debris and very little water.

The Technology

Most skimming systems work well during

continued on page 27

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COMPANY	PRODUCT	Tracking	Threshold/Parameters	CFR/Haz Database	Labelling	Remediation	Regulation Training	Com. RTK	DOT HM-181	Demo	CD-Rom	Network	TRAINING	SUPPORT	UPDATES	DESCRIPTION
A V Systems (313) 973-3000	MIRS/WASTE Modules	•	•	•	•			•	•	Y	N	Y	Manual, how-to software, on/off site	Phone, Service contract	Yearly	Enables "cradle to grave" tracking of waste streams, containers, manifest, costs. Generates RCRA biennial report. DOS and Windows versions.
Achieve! Technology (800) 446-3427	FastRegs					•		•	•	Y	Y	Y	Manual, how-to software	Phone	Monthly, Quarterly	Comprehensive, up-to-date federal and state regulations with powerful, easy-to-use search/retrieval software
CHEMTOX, Div. of Resource Consultants, Inc. (615) 370-4339	CHEMTOX System	•	•	•	•		•	•	•	Y	Y	Y	On/off site	Phone, on-line, support contract	Quarterly	Comprehensive Windows-based environmental management information system available for managing hazardous waste.
Citation Publishing, Inc. (800) 808-3372	FESA			•						Y	Y	Y	Manual, on/off site	On line, 800 #	Annual, Quarterly, Monthly, Weekly	CFKs, Federal Register and state coverages on CD-ROM.
Clark Boardman Callaghan (212) 890-5558	RODScan									Y	Y	N	Manual	Phone	Three times/year	Complete database of EPA Superfund Records of Decision
	ELR-The Environmental Law Reporter									Y	Y	Y	Manual	Phone	Monthly	A comprehensive source of environmental case law, statutes, federal and state regulations. Updated analysis available.
Corbus (800)524-7096	Waste Trail	•								Y	N	Y	Manual, on/off site	On-line, 800#	As Needed	Completely menu-driven tracking of hazardous waste containers. Generates and prints profiles, manifests. Audits trail of container movement.
	Terms Windows	•						•		Y	Y	Y	On site	Service contract, 800#	As needed	Electronic management of MSDSs, full reporting including Tier II
	Lab Trail	•			•					Y	Y	Y	On site	Service contract, 800#	As needed	Affords laboratories with chemical inventory management and compliance with OSHA's laboratory standards.
	Item	•								Y	N	N	On-site	800#	As needed	Provides complete record keeping for a business training program
Counterpoint Publishing (800) 998-4515	Code of Federal Regulations EH&S Collection	•		•		•	•	•		Y	Y	Y	Manual	Phone	Monthly	Gives compliance specialists one disc to access all EH&S regulatory and legal information issued by state and federal agencies. Counterpoint specializes in compiling state and federal regulatory information for distribution on CD-ROM and the Internet.
EarthInfo, Inc. (303) 938-1788	Environmental Databases					•				Y	Y	N	Manual	Phone	Yearly	Provides fast access to vast amounts of weather, water and soil data.
ERM Information Management Group (610) 524-3854	Enflex EHS Database			•						Y	Y	Y	Software, on/off site phone	800 #	As needed	10 year old environmental database system, modular and interactive by design. User selects one module or several modules for project reporting.
E-Soft, Inc. (800) 844-1400	Generator Associate, Facility Associate, Transporter Associate, Manifest Associate	•	•		•	•			•	Y	N	Y	Manual, on/off site, on-line help, phone.	On-line, contract phone, WWW	Quarterly	Cradle to grave tracking of waste stream profiles, containers, manifest printing, state reporting, MSDS, quotes and work orders. Prices range from $495 to $28,000.
HazMat Control Systems, Inc. (310) 597-7994	Hazwaste 6.0	•								Y	N	Y	Manual, software	Phone, Contract	As needed	Prints manifests and stores, tracks and summarizes data for state and federal regulations. Has a new preloaded database of DOT Hazardous Materials Table 172 and RCRA waste codes.
IHS Regulatory Products (800) 320-4555	Earthlaw	•	•	•			•		•	Y	Y	Y	Manual, software	Phone	Monthly	Comprehensive regulatory information on CD-ROM and on-line. Updated, accurate federal and state data.
LOGICAL Technology, Inc. (309) 689-2900	The Chemical Compliance Monitor		•	•					•	Y	N	N	Manual, on/off site	Phone, service contract	Quarterly	Tool for staying current with regulatory and advisory limits on more than 100 key regulatory and advisory lists. The database is searchable by chemical, root and partial name, synonym and CAS #.
	LogiTrac	•	•	•	•				•	Y	N	N	Manual, on/off site	Service contract	Quarterly	Provides comprehensive environmental tracking. Incorporates flexible materials wastes tracking systems, an air emissions and waste modeling module, a MSDS module and a regulatory chemicals database.
	HAZMIN	•	•	•	•			•	•	Y	N	N	Manual, on/off site	Phone, service contract	Quarterly	Provides comprehensive environmental tracking and hazardous materials training for total hazardous materials management.
Micromedex, Inc. (308) 456-6400	TOMES Plus		•		•	•				Y	Y	Y	Manual, on-line	Phone	Quarterly	Comprehensive chemical reference providing medical and hazard data on thousands of substances.
	LOLI/Transportation		•	•		•				Y	Y	Y	On-line	Phone	Quarterly	Regulated chemicals list of lists. Transportation, DOT Table 101 and TOG Schedule II list II.

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COMPANY	PRODUCT	Tracking	Threshold/Parameters	CFR/Haz Database	Labeling	Remediation	Regulation Training	Com. RTK	DOT HM-181	Demo	CD-Rom	Network	TRAINING	SUPPORT	UPDATES	DESCRIPTION
Micromedex, Inc. (308) 456-6400	Chemmate		•					•	Y	N	Y		Manual, on-line	Phone	As needed	Analyzes physico-chemical properties and writes complete MSDSs.
North American Software (714) 457-9937	HAZARD Waste Mgt. System	•		•	•			•	Y	N	Y		On/off site	Contract	Quarterly	A total disposal management system that prints labels and manifests. Can track waste from receipt to disposal. Bar coding and paperless document storage available.
REGSCAN, Inc. (800) Regscan	RegScan for Windows/DOS/Mac			•				•	Y	Y	Y		Manual, on-line, Phone, on-site	800#	Monthly/weekly	Boolean and phrase search. CFR titles 10, 21, 29, 30, 33, 40, 49. Federal Register, Laws, State Regulations.
	Research Assistant			•		•			Y	Y	Y		Manual, on-line, Phone, on-site	800#	Monthly	Simultaneously searches federal and state regulations and provides a list where the subject can be found.
softshel, inc. (405) 733-2002	Environmental Site Assessment		•						Y	N	N			Phone	As needed	Formats and creates a phase one report. Windows required.
SOLUTIONS Software Corp. (407) 321-7912	Environmental CFR's (CD-ROM)		•	•		•		•	N	Y	Y		How to software	Phone, fax	Quarterly	Complete database of all 50 CFRs, SW486, TSCA, SARA Title III MSDS database with 160,000 plus MSDS innovative environmental technology.
Telecation, Inc. (303) 987-0980	Waste Disposal Tracking Systems	•			•				N	N	Y		Manual	Phone	None	Keeps track of waste drums in the lab. Includes information on Drum ID, waste type, drum location, custodian, date put into use and content description.
WIXEL, Inc. (303) 796-0045	GENTRAX 5.3	•		•	•			•	Y	N	Y		Manual, on/off site	Phone, Service contract	As needed	For single site management of hazardous and non hazardous waste. Generates container labels, state specific manifests, management reports and regulatory reports. Barcoding option is available.
	TSDTrax 2.0	•		•	•			•	N	N	Y		Manual, on/off site	Phone, Service contract	As needed	Provides total facility management for TSDFs. Issues profiles, meets client labeling/manifesting needs, and allows for lab pack management. Quotations, work orders and invoices may also be generated.
	BROKERTrax 4.3	•			•			•	Y	N	Y		Manual, on/off site	Phone, Service contract, on-site	As needed	Enables user to automate requirements for waste acceptance, shipment processing and management reporting. Generates quotes and invoices, incorporates a user-defined grid system to identify generator's pick-up locations and times and generates a variety of management reports.
	SARATrax 2.0	•	•		•		•	•	Y	N	Y		Manual, on/off site	Phone, Service contract	As needed	Monitors information by tracking all chemicals and materials used in daily operations. Monitors incoming materials, tracks process operations and generates regulatory report information and material safety data.
	TransferTrax 4.3	•			•			•	N	N	Y		Manual, on/off site	Phone, Service contract	As needed	Provides a total waste management system for TSDF transfer sites. Issues quotations and client profiles, generates labels and state specific manifests and generates management reports.

A V Systems
4657 Plant Road, Ann Arbor, MI 48108
Circle 105 on card.

Achieve! Technology
P.O. Box 668, Amherst, NH 03031
Circle 106 on card.

Chemtox
P.O. Box 1848, Brentwood, TN 37024
Circle 107 on card.

Citation Publishing, Inc.
7505 East Main Street, Suite 400
Scottsdale, AZ 85251
Circle 108 on card.

Clark Boardman Callaghan
375 Hudson Street, New York, NY 10014
Circle 109 on card.

Corbus
206 Line Road, Kennett Square, PA 19348
Circle 110 on card.

Counterpoint
P. O. Box 928, Cambridge, MA 02140
Circle 111 on card.

EarthInfo, Inc.
5541 Central Avenue, Boulder, CO 80301
Circle 112 on card.

ERM Information Management Group
912 Springdale Drive, Exton, PA 19341
Circle 113 on card.

E-soft, Inc.
6000 Dawson Blvd., Suite E,
Norcross, GA 30093
Circle 114 on card.

Hazmat Control Systems, Inc.
5199 E. Pacific Coast Highway #500
Long Beach, CA 90804
Circle 115 on card.

IHS Regulatory Products
15 Inverness Way East, Englewood, CO 80112
Circle 116 on card.

Logical Technology
5113 N. Executive Drive, Peoria, IL 61614
Circle 117 on card.

Micromedex, Inc.
1446-A MSBG-Cent. Road, Dayton, OH 45459
Circle 118 on card.

North American Software
P.O. Box 1197, Lake Forest, CA 92630
Circle 119 on card.

Regulation Scanning
One Executive Plaza #300, 330 Pine Street
Williamsport, PA 17701
Circle 120 on card.

softshel, inc.
P.O. Box 10813, Oklahoma City, OK 73140
Circle 121 on card.

Solutions Software Corporation
1795 Turtle Hill Road, Enterprise, FL 32725
Circle 122 on card.

Telecation, Inc.
7112 W. Jefferson Avenue, Suite 307
Lakewood, CO 80235
Circle 123 on card.

Wixel, Inc.
7936 E. Arapahoe Court S-3200
Englewood, CO 80112
Circle 124 on card.

Low-Flow Purging Reduces Management of Contaminated Groundwater

With a pumping rate of less than 1 liter per minute, this new approach is proving to be cost-effective.

By Keith E. Schilling

Purging a monitoring well prior to sampling removes stagnant water in the well casing and ensures collection of groundwater samples representative of formation water. Traditionally, a number of well casing volumes are removed (from three to five) and water stabilization parameters are monitored during removal of the casing volumes. Temperature, pH and specific conductance are routinely monitored during purging to determine when a sufficient volume of water has been removed from the well. When these parameters exhibit stabilized readings within a specified range of values (i.e., plus or minus 10 percent over consecutive measurements), the water sample is considered representative of formation water. For deeper wells, purging a well in this manner can generate a large volume of contaminated groundwater, which requires proper handling and disposal. In addition, the amount of time spent purging multiple casing volumes can often be excessive for sites with many wells.

Now there is an alternative to purging multiple well volumes. This new approach focuses on pumping a well from the well screen at a flow rate below the recharge capacity of the formation. The specific rate of pumping is generally aquifer-dependent, but typically does not exceed one liter per minute (or equivalently, 0.26 gallons per minute). By purging at low flow rates, only groundwater that enters through the well screen is purged from the well. Because stagnant water located above the pump intake in the well casing is not drawn down into the pump, the casing volume would not have to be purged from the well prior to sampling.

Water samples are generally collected during low-flow purging as soon as formation water is determined to be flowing from the well. Therefore, it is important to recognize the difference between formation water and stagnant casing water during the low-flow purging process. Water stabilization parameters are monitored in-line from the wellhead by sampling discharge to recognize quickly when formation water is present. In this manner, the amount of water purged from a well is dependent solely on formation water stabilization rather than predetermined well volumes. Measuring turbidity, reduction/oxidation potential (redox) and dissolved oxygen during purging is recommended to gauge the degree of water stabilization.

The low-flow purging approach can effectively reduce the volume of contaminated water generated during purging and the time spent performing the task. The following example illustrates how the low-flow purging approach is reducing costs associated with long-term monitoring at a contaminated groundwater site.

Purging Equipment and Procedures

Dedicated bladder pumps were installed in monitoring wells at the site to perform quarterly groundwater sampling of 15 bedrock wells ranging in depth from 60 to 350 feet. At each well, a bladder pump was installed at a depth approximately 20 feet below the static water level surface. In addition, a drop tube from the pump to the well screen was used to purge and sample groundwater from the midpoint of the well screen. The cost to install the dedicated pumps and tubing in the wells averaged about $1,000 per well. A generator and controller unit to operate the pumps in all of the wells at the site cost an additional $4,000.

A multiprobe water analyzer was used to measure water stabilization parameters in-line from the pump to discharge. Purge water was directed through a flow cell containing measurement probes for temperature, pH, specific conductance, dissolved oxygen, redox and turbidity. The parameter data were visually displayed and recorded on a portable computer at a rate of one set of readings every 20 seconds. This interval was selected to coincide with the approximate pulse pumping associated with the bladder pumps. Purging generally continued at the site until the parameters stabilized to within 10 percent over two consecutive minutes of pumping.

Discharge from the flow cell unit was typically directed to a graduated bucket where the flow rate and total volume of purge water removed from the well could be measured. The contaminated water was subsequently placed in 55-gallon drums or equivalent containers for disposal.

The cost of the multiparameter flow cell

Figure 1

Water stabilization measurements collected during purging of a 60-foot deep monitoring well. Parameter readings include: temperature (C), pH, dissolved oxygen (% saturation), specific conductance divided by 10 (millimhos/cm), turbidity (NTU) and redox divided by 10 (oxidation-reduction potential in millivolts).

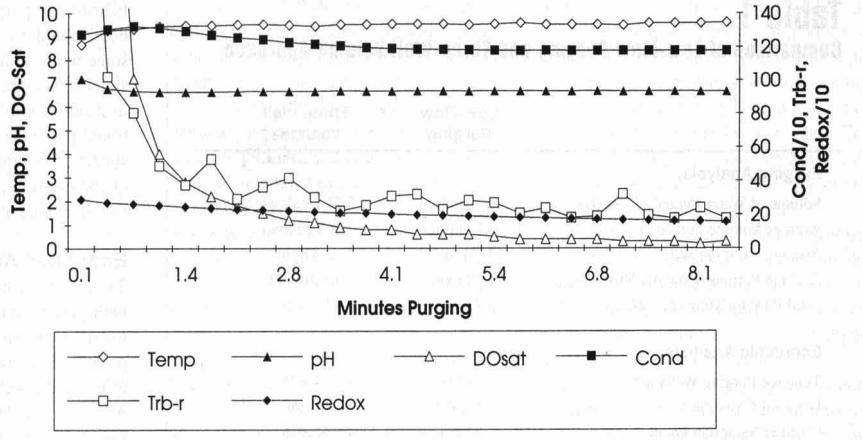
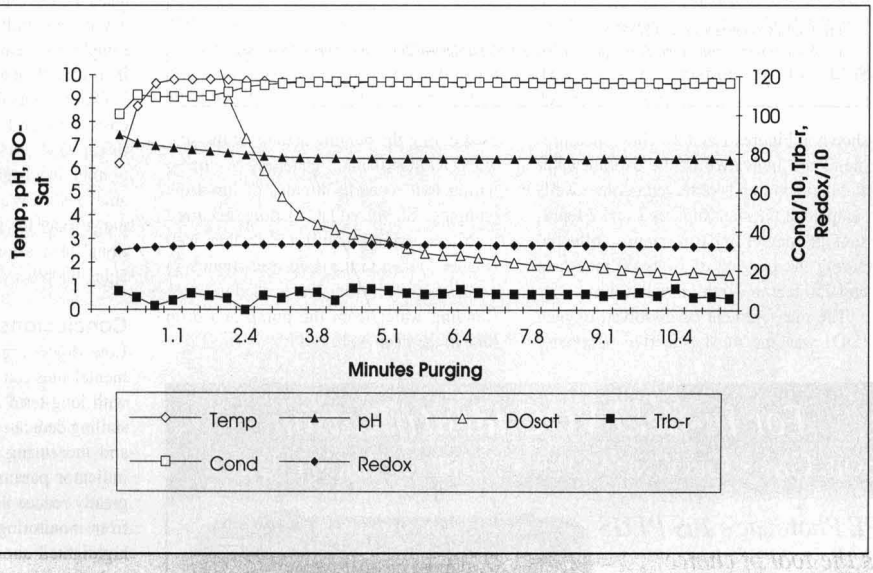


Figure 2.

Water stabilization measurements collected during purging of a 250-foot deep monitoring well (parameter units same as Figure 1).



was about $5,000. The unit can be operated with any MS-DOS portable computer equipped with communications software.

Purge Volumes

Low-flow purging with the dedicated bladder pumps has greatly reduced the volume of water generated during purging of monitoring wells. The average volume of contaminated water generated per well (4.1 gallons) was significantly less than the traditional three-volume approach (49.5 gallons). A summary of the purge volume and purge time for the low-flow approach and a comparison with the traditional three-volumes approach is presented in Table 1.

Each well was purged at an average rate of 0.31 gallons per minute (gpm) for an average duration of 13 minutes. Based on records from previous sampling activities at the site, an average of 50 minutes per well was needed to purge three casing volumes from each well. The total time required to purge three volumes in this manner (12.5 hours) is nearly four times greater than the time needed for low-flow purging (3.25 hours). Based upon an estimated consulting fee for a two-person sampling crew at $150 per hour, the cost difference in sampling time between the two methods is nearly $1,400 per sampling event.

Stabilization Parameters

Stabilization data were visually displayed and recorded by a portable computer in the field, which was used for viewing, archiving and plotting purposes. Typical stabilization measurements recorded during purging at two well locations are

Table 1.
Comparison of Low-Flow Purging and Three-Well Volume Approach

	Low-Flow Purging	Three Well Volumes
Purging Analysis:		
Volume of Water Purged (*15 wells*)	61.2 gallons	743.1 gallons
Average Volume Purged	4.1 gallons	49.5 gallons
Average Pumping Rate	0.31 gpm	2-5 gpm
Average Purging Time per Well	13 minutes	50 minutes
Total Purging Time (*15 wells*)	3.25 hours	12.5 hours
Economic Analysis:		
Time for Purging Wells (*a*)	$500	$1,875
Disposal Costs (*b*)	$1,300	$3,750
Cost per Sampling Event	$1,800	$5,625
Sampling Costs for Year (*quarterly*)	$7,200	$22,500
Sampling Costs for 30 Years	$216,000	$675,000

(a) Assumes two-person crew at $150/hour.
(b) Assumes cost to dispose one drum equals $1,000; $300 for additional drums (one drum = 55 gallons).

shown in Figures 1 and 2. These measurements are indicative of the overall water stabilization trends observed in other wells sampled at the site. Figures 1 and 2 represent parameter measurements collected during the purging of wells 60 feet deep and 250 feet in depth, respectively.

The measurement of dissolved oxygen (DO) was the most sensitive parameter used during the purging activity at the site, with DO stabilization generally occurring within four to eight minutes of low-flow pumping. Stabilized DO readings occurred with less purging time in the shallow well (Figure 1) than in the deep well (Figure 2) because of additional time needed to purge standing water from the pump and drop tube in the deep well.

Testing turbidity (Figure 1) and redox also has proven useful in judging the stabilization of purged water. Turbidity has been noted to fluctuate on occasion in some wells, although this parameter occasionally is compromised by ambient light infiltration into the flow cell. The traditional parameters of pH, temperature and specific conductance stabilized very quickly during purging and have not been useful as indicator parameters.

Economic Analysis

Table 1 also compares the costs associated with purging three volumes from wells vs. low-flow purging over a 30-year life of the project. Considering only the time needed to purge the wells and the costs associated with disposal of the contaminated water, the low-flow purging approach will reduce sampling costs at the study site by approximately two-thirds compared with traditional methods of purging wells. Based on this analysis, the capital costs of about $20,000 associated with installing the dedicated sampling system for 15 wells can be saved in as little time as six quarters of sampling.

Other factors that increase the disparity in costs between low-flow purging and traditional methods include: costs for transporting and staging purge water at the site, analytical costs associated with sampling the purge water for disposal purposes, and additional professional time needed for managing the process.

Conclusions

Low-flow purging of wells at environmental sites can lessen the costs associated with long-term monitoring programs. Installing dedicated low-flow pumps in wells and measuring DO, turbidity and redox indicator parameters during purging can greatly reduce the volume of water purged from monitoring wells. In the case study highlighted above, low-flow purging procedures reduced the volume of contaminated water generated by more than 90 percent compared with the traditional method of purging three well volumes, and reduced the costs associated with the management and disposal of contaminated groundwater by two-thirds. Over 30 years of groundwater monitoring at a site, the potential savings offered by using a dedicated low-flow purging system can be very attractive. EP

Keith E. Schilling is a senior hydrogeologist at Montgomery Watson, in Des Moines, Iowa.

continued from page 20

the first few hours of a cleanup operation, and only when the oil is effectively trapped by a containment boom to build a thick layer around the device. Recovery technologies, by their very nature, have a specific range of effective application. In other words, most of them perform best in calm conditions and relatively fresh and clean oil. Their performance degrades rapidly as oil begins to weather and mix with floating debris, or if wind and seas increase. Very few skimmers function satisfactorily during the later days of a cleanup or as weather conditions worsen.

An effective skimming system must be able to be mobilized quickly. The system should be able to sweep through large areas to reach as much oil as possible even when spread in a thin layer on the water surface. The system should continue to function in difficult wind and sea conditions. Most importantly, it should recover all types of product, including viscous oil, tar balls and debris.

Why is oil so difficult to pick up? Crude oil released into water begins to change its characteristics almost immediately. "Light ends" of the crude oil are lost through evaporation and dissipate into the atmosphere. What is left after only a day or two is a much more viscous and persistent pollutant.

To make matters worse, most crude oils begin to form a stable water-in-oil emulsification within hours after a spill, increasing the total volume of product to be recovered. Depending on the particular crude oil, available wind and wave energy, a thick "chocolate mousse," with as much as 75 percent water, can be formed in two to three days. Residual tar balls are formed that can remain in the water for weeks or months.

The LORI skimming technology is based on sound principles of fluid management—using the natural movement of water instead of trying to fight against it. A natural feeding mechanism delivers oily water through the separation process, and a simple mechanical separation and recovery device—a brush conveyor—removes the pollutants from the water.

The system separates collect oil from water, independent of the type of oil or the mixture. The rotating brush conveyor is fitted with a stiff polypropylene brush mounted on drive chains. The brushes are designed so that medium- and low-viscosity oils are captured between and on the surface of the brush bristles. Viscous oil, emulsion and tar balls pile on and are carried on the tips of the brush bristles. The brush conveyor lifts debris such as rubbish, sticks and seaweed and removes it out of the way of the recovery process.

Oil and debris are combed and squeezed from the brush bristles at the top of the conveyor. Recovered product falls into the collection chamber, where it flows by gravity into holding tanks or is pumped into temporary storage bladders.

The stiff brush recovery system is normally incorporated into the hull of a workboat or attached to the boat's side or bow. This turns the entire vessel into an effective advancing recovery device. EP

Jim Mackey is marine department manager at Hyde Products, Inc., Cleveland, Ohio.

For more information on the LORI system, circle 47.

CHEM SHOW 1995

TAKE A GLIMPSE AT THE FUTURE

The following innovative products are just a sample of things to come. They are being featured at Chem Show 1995 in New York City, December 4-6.

Water Valve

George Fischer's Type 660 Water Valve is designed for both residential and industrial applications. Available in 1/2" through 2" sizes, the low-torque valve requires no adjustments and ensures a reliable shutoff. **George Fischer, Inc.** *Circle 61 on card.*

World Pump

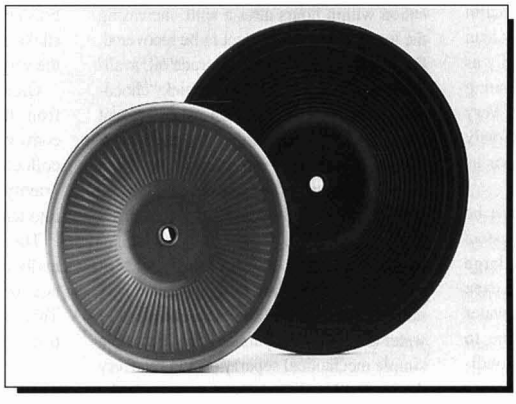
This international technical magazine for pump users provides news and technical articles on all major issues affecting fluid handling systems. Provides information regarding purchasing, operating and troubleshooting pumping equipment. **World Pumps.** *Circle 62 on card.*

Monomer Recovery System

The VaporSep Monomer Recovery System relies on organic-selective membranes to separate monomers from inert gas, recovering both for reuse. Benefits to polyolefin producers include conserving nitrogen for recycle and saving natural gas. **Membrane Technology and Research, Inc.** *Circle 63 on card.*

Single Piece Diaphragms

The One-Up single piece Teflon diaphragm consists of a new advanced form of PTFE and neoprene with a nylon reinforcement, eliminating the need for the conventional two-piece system consisting of a Teflon overlay and an elastomer backup diaphragm. **Versa-Matic Pump.** *Circle 64 on card.*



Versa-Matic Pump

Wafer Liquid Turbine Meters

ITT Barton, a unit of the ITT Fluid Technology Corporation, introduces the 8600 Series, featuring the wafer design and the capability of metering almost any type of liquid. Its symmetrical design allows it to be calibrated to measure flow in either direction and is equally accurate whether mounted vertically or horizontally. Designed for easy service and maintenance, the internal parts are interchangeable within each size. **ITT Barton.** *Circle 65 on card.*

New Process Reduces Sludge

Advanced Fluidized Composting (AFC) is a new biological treatment process that reduces organic sludge by converting organic wastes to carbon dioxide and water. Operating at twice the temperature of traditional systems, the process is able to reduce costs due to the unique integration of various chemical treatment procedures. The patented process is a combination of thermophilic biological treatment with a chemical treatment step. **Environmental Resources Management (ERM) Group.** *Circle 66 on card.*

Through-Shaft Cooling

The new Viking Mag Pump utilizes an improved magnetic coupling design and allows operation at higher speeds on higher liquid viscosities. Featuring "through-shaft" cooling, the pump eliminates mechanical shaft seals and potential liquid leaks. **Viking Pump, Inc.** *Circle 67 on card.*

New Book on Adsorption Processes

Novel Adsorbents and their Environmental Applications, a new book from the American Institute of Chemical Engineers (AIChE), focuses on technical advances in the development of inorganic and polymeric resins for environmental applications. **American Institute of Chemical Engineers.** *Circle 68 on card.*

New System Measures Tank Level and Pressure

ITT Barton, a unit of the ITT Fluid Technology Corporation, has designed a new system for measuring and transmitting level, pressure and other data from cyrogenic tanks and non-cyrongenic systems. Features an 8-bit FLASH memory. **ITT Barton.** *Circle 69 on card.*

Brochure on Piping Systems

George Fischer has a new brochure highlighting polypropylene (PP) industrial piping systems ranging in sizes from 3/8" to 12". Ideal for transport of liquid wastes, acids, solvents, solvents and potable water. Three fusion methods are available. **George Fischer, Inc.** *Circle 70 on card.*

Paper Processing

Advances in Pulping & Papermaking, a new volume from the American Institute of Chemical Engineers (AIChE), covers advances in pulping, bleaching, papermaking, and fuel and sludge handling. The 16 papers incorporate both fundamental studies and current industry practices. **AIChE.** *Circle 71 on card.*

Plastic Series of Pumps

The Versa-Matic Company has expanded its Elima-Matic line of pumps to include two new 2" plastic models available in Kynar and Polypropylene. The pumps offer anti-stalling, non-icing, lubrication free air valve systems and feature a new bolted manifold design that offers leak-free construction with ANSI flange porting. **Versa-Matic Pump.** *Circle 72 on card.*

PRODUCTS & SERVICES

Enclosed-Type Pinch Valves

The Flex-Valve 2100 Series enclosed-type pinch valves, from Flexible Valve Corporation, are designed for harsh operating conditions found in wastewater, water treatment plants, or other environmental applications where corrosive and abrasive flows are processed. The Flex-Valve 2100 Series handles a variety of materials such as dry powder, abrasive slurries, corrosive fluids, and sludge. The Flex-Valve 2100 Series valves are interchangeable with gate, plug and ball valves, and feature the shortest length of all flanged Flex-Valves.

Flexible Valve Corp.

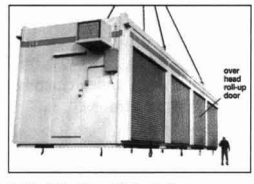
Circle 73 on card.

Flame Ionization Technology

According to an independent study conducted for the Florida Department of Environmental Protection, the PetroSense PHA-100 has been found to be 100 times more sensitive than existing Flame Ionization (FID) technology in the measurement and detection of petroleum hydrocarbons. The PetroSense PHA-100, a portable instrument manufactured by FCI Environmental, Inc., uses fiber optic chemical sensor technology with digital electronics and an advanced microprocessor.

FCI Environmental, Inc.

Circle 74 on card.



Liftable Steel Modules

Haz-Safe Buildings offers liftable steel modules for mixing, dispensing, testing, and other dedicated activities, such as enclosing manufacturing areas utilizing hazardous materials. Buildings can be constructed to a height of 16 feet, with dimensions as large as 14 feet wide by 70 feet long.

Haz-Safe Buildings by Design

Circle 75 on card.

IBC Washing System

Recycle Inc. will be adding a new, automated intermediate bulk container (IBC) washing system. The system will increase the efficiency of its IBC/Tote cleaning operation, minimize wastewater generation, and reduce turnaround times for dedicated IBC reuse customers. The new computerized washer will be available in 1996 to customers in the Gulf Coast region.

Recycle Inc.

Circle 76 on card.

Solids Level Monitor

Monitoring sludge blanket levels with the SLM-3000

PRODUCT & SERVICES

Solids Level Monitor provides a solids concentration profile of the blanket. Designed for greater accuracy, sensitivity and reliability in a variety of applications, including water and wastewater treatment clarifiers, waste sludge and high rate thickeners, mud and solids washers, and fluidized bed reactors. This unit works by automatically sensing the solids level interface set up by the user at the critical concentration.
BTG

Circle 77 on card.

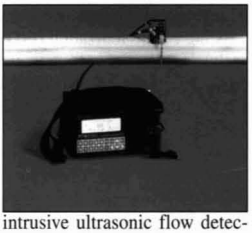
Wind and Air Temperature Remote Sensing

Climatronics announced the availability of the new Remtech RASS (Radio Acoustic Sounding System) for remote sensing of wind and air temperature. Applying a simple principle of physics, the RASS measures the temperature profile of the atmosphere. Applications include inversion detection, airport fog forecasting, pollution dispersion, radio wave propagation, etc. The RASS can replace tethered balloons and radiosondes, and when combined with a SODAR, can be used instead of multi-level tall towers.
Climatronics Corp.

Circle 78 on card.

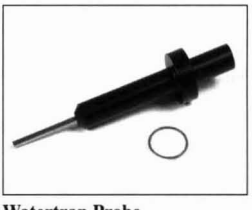
Ultrasonic Flow Detection

Controlotron's field programmable 190P Spectra Fourier Flowmeter offers precision, non-



intrusive ultrasonic flow detection, featuring state-of-the-art Fast Fourier Transform (FFT) signal processing technology. FFT achieves accuracy of up to 1% of flow rate, can be operated on pipes ranging from 3/8 inch to 225 inches in diameter, and constantly maintains optimal operation, even under changing application conditions.
Controlotron

Circle 79 on card.



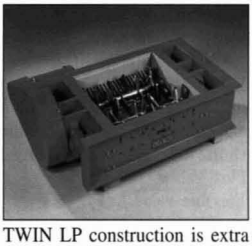
Watertrap Probe

Foxboro offers the new Watertrap Probe for CENTURY OVA and TVA analyzers. The Watertrap fits directly onto the hand-held unit of both the OVA and TVA in place of the standard close area sampler. Sampling with Watertrap prevents ingestion of liquid water into the analyzer sample system, which can cause sample line contamination and potential damage to the analyzer. The Watertrap Probe will not affect readings, but will help prevent expensive repairs and costly downtime.
Foxboro Co.

Circle 80 on card.

Material Reduction Processor

The DELUMPER TWIN LP is a material reduction processor that incorporates new design features and quality construction. From Franklin Miller, the processor features the proprietary "LP" cutters that are stacked on two heavy counter-rotating parallel shafts in a staggered pattern to assure smooth continuous separation, reduced power consumption, and optimal feeding. The DELUMPER



TWIN LP construction is extra heavy duty, and the cutters are available in special alloys as well as with the FMI hardfacing option.
Franklin Miller Inc.

Circle 81 on card.

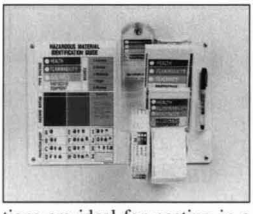
Portable Infrared CO_2 Analyzer

Geotechnical Instruments has a new portable CO_2 analyzer, Anagas CD 95, designed for use in a wide range of industrial and environmental applications. Anagas CD 95 is a digitally-calibrated, microprocessor-controlled, dual-wavelength infrared analyzer designed for easy, dependable operation. It provides automatic compensation for changes in barometric pressure and temperature to ensure CO_2 measurement accuracy and long-term stability. The Anagas CD 95 range comprises nine basic models capable of reading from parts per million to 100% gas levels.
Geotechnical Instruments, Inc.

Circle 82 on card.

Hazardous Materials Identification

Lab Safety Supply's Hazardous Materials Identification Guide Label Stations help you organize chemical labels to make them more accessible and to make it more convenient to use these important safety tools. Each station holds label sheets and rolls of several sizes. Sta-



tions are ideal for posting in a shared work area to make labels readily available where chemicals are stored or dispensed.
Lab Safety Supply Inc.

Circle 83 on card.

Sampling Monitors

The McNeill Series 2800 Dual Channel Sampling Monitor monitors a wide range of gases from any location. Install the Series 2800 Monitor in a safe location for easy access by supervisory personnel, yet draw gas from any area (hazardous or safe). The Series 2800 instrument also monitors air flow to ensure the sample pathway is clear and the pump is generating sufficient flow.
McNeill International

Circle 84 on card.

Air Sampler

G.O. Environmental has a new generation of air sampler that uses clean internal components to ensure sample integrity. The system's features include the ability to evaluate sample cans before taking samples; continuous monitoring of system pressure; and programmed or remote control operation over telephone lines. The air sampler can monitor or measure up to 16 optional meteorological or chemical sensors for adaptive sampling.
G.O. Environmental, Inc.

Circle 85 on card.

HAZCO Catalog

HAZCO Services has released its 1995-1996 catalog, which features instrumentation, confined space and sampling equipment, safety supplies, and mobile facilities for the environmental industry. The 324-page catalog offers the latest technology on the market today, including 100 new items.

HAZCO Services, Inc.

Circle 86 on card.

Liquid-Liquid Separator

The CINC Model V-20 delivers up to 200 GPM with more than 99% separation efficiency. A simple rotating device, it employs centrifugal force to separate liquids of different specific gravities. The CINC line includes smaller and portable models.

CINC.

Circle 87 on card.

Scrub Unit

The TSU-1000 Radial removes organic contaminants to non-detectable levels and carries a 1000 lb. carbon capacity. The shallow bed allows for the processing of high flows with a low pressure drop.

Cameron-Yakima, Inc.

Circle 88 on card.

Wastewater Pumps

Pumpex has a new self-contained, dry mounted, fully submersible wastewater pump. The unique configuration features a recirculating closed loop cooling design that permits safe operation in both wet and dry environments. The sealed Pumpex system circulates a clean glycol mixture for optimal cooling and virtually no risk of clogging.

Pumpex, Inc.

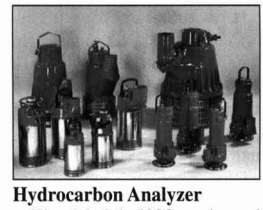
Circle 89 on card.

PRODUCTS

Environmental Equipment Rental Program

Graseby presents an entire line of air sampling instruments, systems and accessories for the rental market. Featured in the new Graseby catalog, the inventory includes stack sampling systems, source emission sampling systems, ambient sampling systems, ambient and stack impactors, and analytical equipment.
Graseby

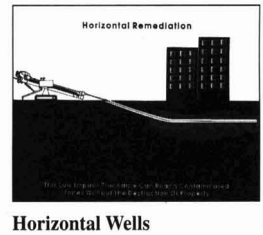
Circle 90 on card.



Hydrocarbon Analyzer

The Model 5000, a heated total hydrocarbon analyzer, offers high reliability, accuracy, sensitivity, and overall stability in a compact, self-contained package. Utilizing a hydrogen Flame Ionization Detector within a heated oven to prevent loss of high-molecular-weight hydrocarbons, it analyzes trace-level contaminants in air, high-purity gases, and all other gases.
PACE Environmental Products, Inc.

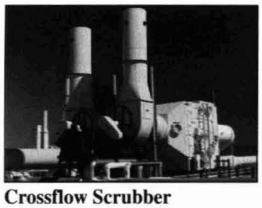
Circle 91 on card.



Horizontal Wells

Southern Diversified Technologies offers horizontal well installation for soil and groundwater remediation. For use with several types of remediation, installation minimizes impact on the surrounding work area, offering the option to guide a drilling head under paved surfaces. Routine traffic and business activities are not disrupted.
Southern Diversified Technologies, Inc.

Circle 92 on card.



Crossflow Scrubber

The Tri-Mer Crossflow is engineered to scrub inorganic compounds while maintaining stack emissions below 80 ppb for all input concentrations. It offers dual-stage, high-speed liquid recirculation, which produces intense contact between the contaminant and scrubbing liquid, and produces low stack emissions.

Tri-Mer Corporation

Circle 93 on card.

Weather Network Leasing

WNI Weather Network now offers leasing options on individual meteorological sensors and systems. A full service

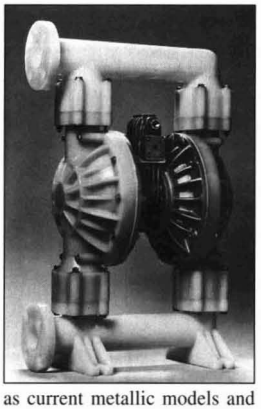
weather company, WNI also has weather forecasting and meteorological consulting services.

WeatherNews, Inc.

Circle 94 on card.

Diaphragm Pumps

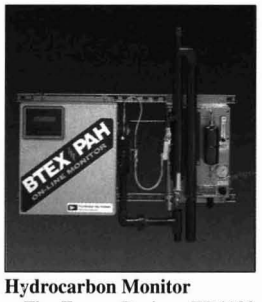
Versa-Matic Pump Company has expanded its Elima-Matic line of pumps to include two new 2-inch plastic models available in Kynar and Polypropylene. These pumps offer the same exclusive antistalling, non-icing, lubrication-free air valve system



as current metallic models and its bolted manifold design offers leak-free construction with ANSI flange porting. The Elima-Matic air valve operating mechanism minimizes or prevents stalling due to mechanical centering and freezing or icing of the entire air valve system.

Versa-Matic Pump

Circle 95 on card.



Hydrocarbon Monitor

The Turner Designs TD4100 detects BTEX, gasoline, jet fuel and oil in water. It is a continuous, on-line process control monitor that provides hydrocarbon detection. The TD4100 has detection limits for fuel down to 1 ppb and Benzene detection down to 100 ppb for clean water applications. Also monitors treated and untreated wastewater, groundwater, process water and storm water run-off.

Turner Designs

Circle 96 on card.

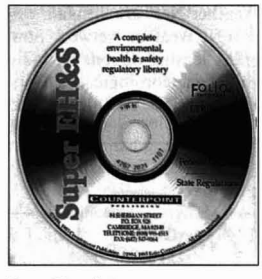
PRODUCTS

Site-Assessment Software

MacNeill Software introduces version 3.88 of Site-Assessment Software, a new method of quickly assembling ASTM-style environmental site-assessment phase I narrative reports. This software reduces the time it takes to write reports and is easy to use. It includes a start guide, tutorial, manual and on-line help.

MacNeill Software

Circle 97 on card.



Four Regulatory Publications on One CD-ROM

Counterpoint Publishing has a monthly SuperEH&S CD-ROM disk, giving access to Environmental, Health & Safety (EH&S) regulatory and legal information issued by state and federal agencies. The single disk eliminates interruptions and lost time while researchers sort and swap multiple CD-ROMS. Allows full access to updated CFR titles and daily *Federal Registers.*

Counterpoint Publishing

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Stop Wasting Water!

The Controlstik system reduces the amount of water used in continuous flow rinse tanks. Featuring three easy-to-install parts, it saves on water bills, sewer use charges and waste treatment expenses while maintaining water purity.

Myron L Company

Circle 99 on card.

PRODUCT LITERATURE

Airborne Ground Penetrating Radar

This brochure highlights the benefits and applications of Airborne Ground Penetrating Radar, which can detect subsurface objects and map plumes of refined hydrocarbons. This system is truly an underground vision that provides an economical alternative to conducting site assessments.

AES International Corp
Texas A&M University
1500 Research Pkwy.
Suite 220
College Station, TX 77845
(800) 331-0960
Fax (409) 775-0928

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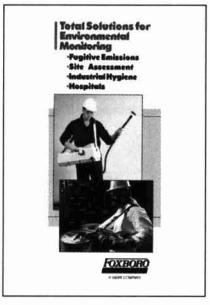

Air Monitoring Guide

The Foxboro Company offers a buyers guide entitled "Total Solutions for Environmental Monitoring." The pamphlet discusses long term monitoring solutions for the following applications - Fugitive Emissions, Hazardous Waste Site Assessment, Hospital Monitoring and Ambient Air Monitoring for Industrial Hygiene. The Foxboro analyzers best suited for each application are briefly described.

The Foxboro Company
33 Commercial Street
Foxboro, MA 02035

Circle 55 on card.

Haz-Safe Buildings by Design

Factory Mutual (FM) approved liftable steel modules for mixing, dispensing, testing, and other dedicated activities such as enclosing manufacturing areas utilizing hazardous materials. Brochure contains 24 full color photographs, 11 suggested floor plans for drum storage and three structural construction graphics detailing buildings up to 14' wide x 70' long x 16' high with patented modular expansion capabilities up to 1,500 square feet.

Haz-Safe Buildings by Design
P.O. Box 606
Leechburg, PA 15656-0606

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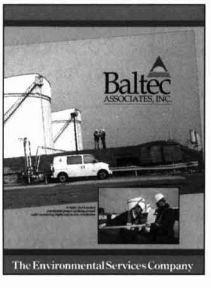

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460 Old Post Road
Bedford, NY 10506
(914) 234-9580

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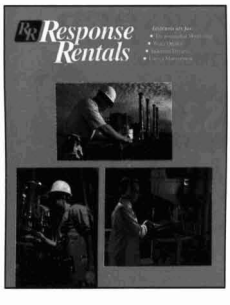
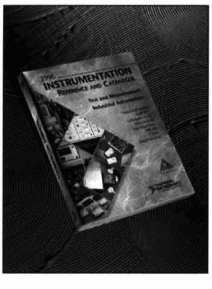


Environmental Monitoring Instrument

Response Rentals' new 48-page catalog features an expanded line of rental instruments for environmental monitoring. It includes analyzers and monitors for hazardous waste investigators, remedial assessment surveys, continuous emissions monitoring (CEM), groundwater sampling and perimeter monitoring. Portable instruments for field testing as well as continuous analyzers are available. Response Rentals offers applications assistance, nationwide overnight delivery, and instrument calibration and repair.

Response Rentals
1057 E. Henrietta Rd.
(716) 424-2140, (800) 242-3910
Fax (716) 424-2166

Circle 53 on card.



FREE *Catalogue*

The National Instruments 1996 catalogue features new versions of LabVIEW®, Lab Windows®/CVI, and HiQ®. Other new software products includes Measure™, a new spreadsheet add in for direct data acquisition and control and VirtualBench™, a family of Windows based turnkey virtual instruments. New hardware products include GPIB, DAQ, and VXI interfaces for PCI-based computers; PCMCIA interfaces; MXI-2 interfaces; and serial interfaces for industrial communications applications.

National Instruments
(800) 433-3488 (US and Canada)
Fax: (512) 794-8411

Circle 57 on card.

Earthprobe 200

This self-contained all hydraulic rig meets the growing demand for direct push/probing technology for taking soil, water or vapor samples. The Earthprobe 200 is ruggedly built and can be mounted in any suitably sized pickup truck. Advanced hydraulics allow precise control over the feed and hammering functions. The mast tilts for angle probing. The optional rotary head provides limited auger drilling capability.

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The International Joint Commission (IJC), a bi-national organization established by the Boundary Waters Treaty of 1909 to help prevent and resolve disputes along the boundary between Canada and the United States, is accepting applications for the position of Secretary of the U.S. Section of the Commission. The incumbent serves as the senior civil servant and principal administrator of the U.S. Section, with responsibility for both the day-to-day management and direction of the organization as well as long-term planning, environmental policy development, and treaty and agreement implementation. Salary range for the position is $97,900 to $107,700. Some travel is required.

Applicants must possess and demonstrate extensive experience in all phases of organizational and program management, as well as substantive knowledge and expertise in environmental policy issues, legislative processes, and public policy development and implementation. Additional requirements include experience and skill in integrating with boards, commissions, or authorities, and the ability to collaborate and communicate with widely diverse organizations, groups and individuals.

Prospective applicants should write to or call the IJC at 1250 23rd Street, NW Suite 100, Washington, D.C., 20440, (202) 736-9000, to request a copy of the position vacancy announcement and application forms. Applications must be postmarked by January 12, 1996. The International Joint Commission is an Equal Opportunity Employer.

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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):**

❑ (20)	Food	❑ (30)	Rubber/Plastic
❑ (21)	Tobacco	❑ (31)	Leather
❑ (22)	Textile	❑ (32)	Stone/Clay/Glass
❑ (23)	Apparel	❑ (33)	Primary Metal
❑ (24)	Lumber & Wood	❑ (34)	Fab. Metal
❑ (25)	Furniture	❑ (35)	Mach., except Elect.
❑ (26)	Paper	❑ (36)	Elect. & Electron. Mach.
❑ (27)	Print/Puvlish	❑ (37)	Trans. Equip.
❑ (28)	Chemicals	❑ (38)	Instru/meas/analyz/controlling
❑ (29)	Petrol. & Coal	❑ (39)	Miscellaneous Mfg.

B ❑ Mining
C ❑ Agriculture
D ❑ Engineering & Contracting
L ❑ Consulting
M ❑ Insurance
E ❑ Utilities, public, private & cooperative
F ❑ Govt. including municipal or district sanitary water or wastewater trmnt. sys. or plants

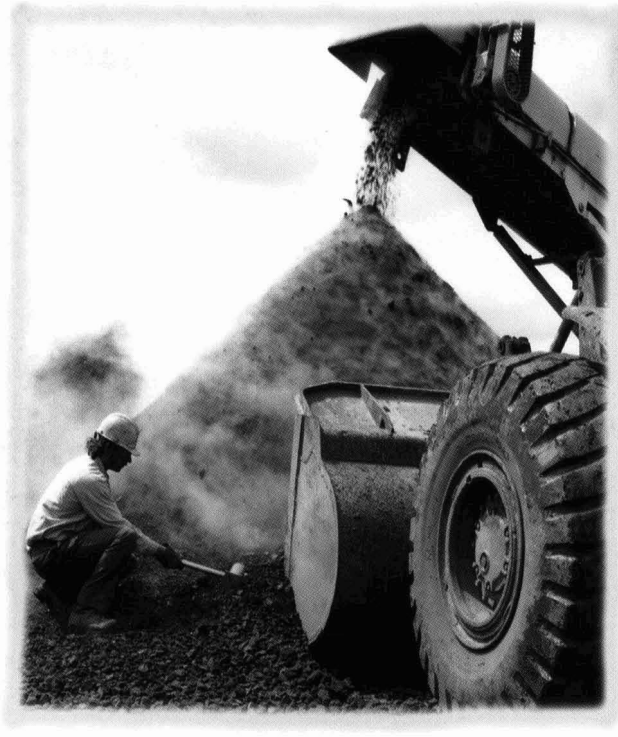
Type of Govt:
G ❑ City H ❑ County
I ❑ State J ❑ Federal
K ❑ Transportation
N ❑ Labs O ❑ Training P ❑ Real Estate
Z ❑ Misc. Services_____ (please specify)

3. Approximate number of employees at this address (check only one):
A ❑ 1-19 E ❑ 250-499 H ❑ 1500-2499
B ❑ 20-49 F ❑ 500-999 I ❑ 2500 and up
C ❑ 50-99 G ❑ 1000-1499 D ❑ 100-249

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 materials
B ❑ Water G ❑ Energy control/energy conservation
C ❑ Noies H ❑ None of the above_____ (please specify)
D ❑ Solid waste disposal
E ❑ Industrial hygiene

6. Which of the following publications do you receive personally addressed to you? (check all that apply):
A ❑ Pollution Engineering
B ❑ Environment Today
C ❑ Environmental Solutions
D ❑ Pollution Equipment News
E ❑ The National Environmental Journal
F ❑ Water Environment & Technology
G ❑ None of the above_____ (please specify)



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