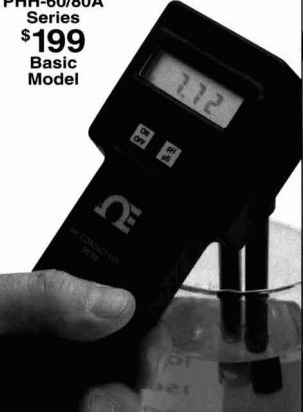




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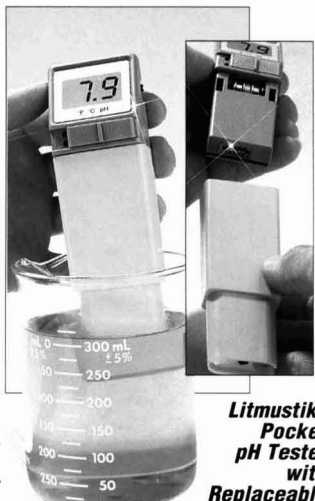
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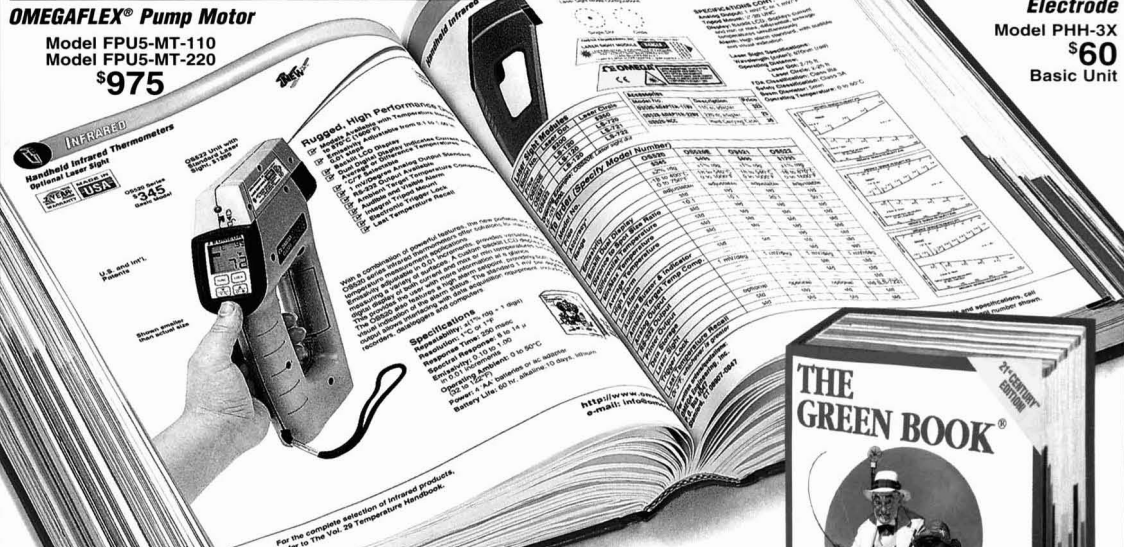
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PT-100-3	0.1	±0.1	0.1	0 to 50	-20 to 60	1.5	1000
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PT-100-5	0.1	±0.1	0.1	0 to 50	-20 to 60	1.5	1000
PT-100-6	0.1	±0.1	0.1	0 to 50	-20 to 60	1.5	1000
PT-100-7	0.1	±0.1	0.1	0 to 50	-20 to 60	1.5	1000
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| 801 <input type="checkbox"/> Stationary Mount Aerators | 804 <input type="checkbox"/> Centrifugal Fans | 807 <input type="checkbox"/> Axial Fans       |
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B. What is your reason for purchasing the selected products/services? (Select one)

- 808  New Construction  
809  Plant Upgrade  
810  Replacement/Maintenance

C. What is your projected budget for the selected products/services? (Select one)

- 811  Over \$200,000  
812  \$100,001-\$200,000  
813  \$50,001-\$100,000  
814  \$10,001-\$50,000  
815  \$5,000-\$10,000  
816  Under \$5,000

D. How immediate is your need for the selected products/services? (Select one)

- 817  0-6 months  
818  7-9 months  
819  10-12 months  
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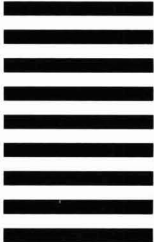
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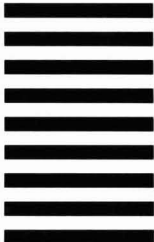
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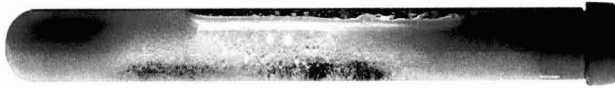
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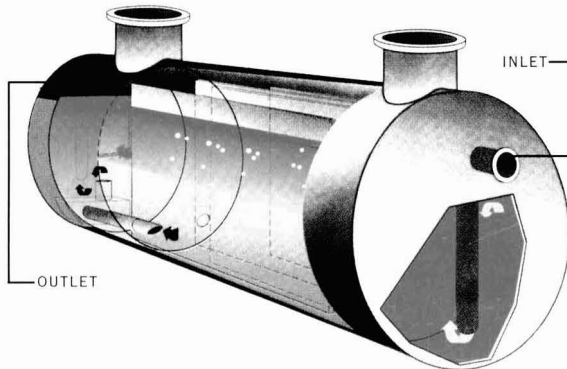


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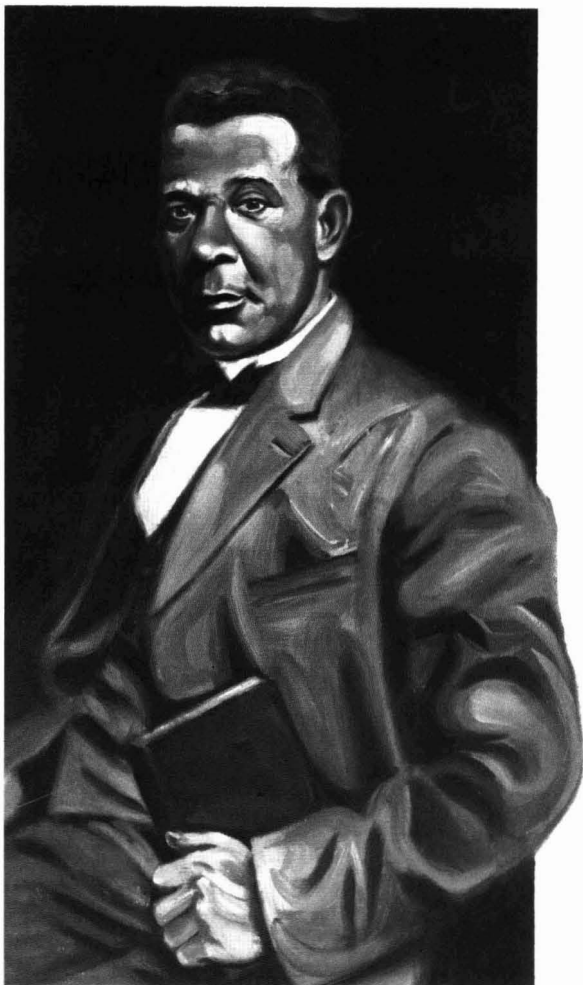
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## ABOUT THE COVER

Conventional treatment of industrial wastewater streams is generally multistep, time consuming and requires extensive equipment and handling. The cover story beginning on page 14 profiles an innovative approach to treating industrial wastewater that eliminates the use of various hazardous treatment chemicals, is easy to implement and operate and generates nonhazardous waste.

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# Wanted: Right brainers

"Imagination is more important than knowledge." Albert Einstein

The U.S. Environmental Protection Agency is looking for a few good innovators. The agency is inviting proposals for pilots under their program Project XL to both industrial facilities and publicly owned treatment works (POTWs). Project XL, which stands for "eXcellence and Leadership," is a national pilot program that is designed to encourage facilities to undertake creative site-specific measures to achieve better environmental results at a lower cost in exchange for exemption from some federal and state environmental requirements.

This is part of EPA's strategy to find better ways of protecting the environment without imposing unnecessary costs and regulatory burdens on society. The regulated community's ongoing criticism of EPA has largely prompted this move toward innovation. The major gripe is that facilities are being forced to comply with unyielding environmental laws that dictate a strict cookbook approach to managing wastewater, air pollutants and hazardous waste. Many environmental professionals feel that they have enough challenges in their jobs without being hamstrung by rigid rules that stifle inventive approaches to pollution control.

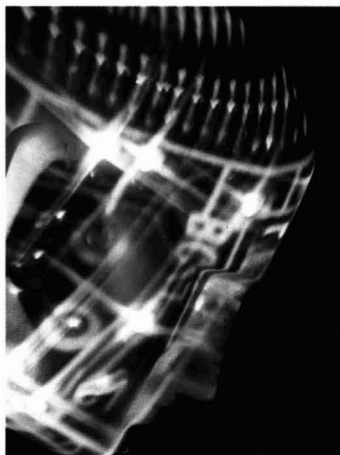
Begun in March 1995 in response to such complaints, Project XL currently has seven pilot programs in operation and another 20 under development. EPA is particularly interested in projects aimed at creating innovative environmental technologies. The agency plans to implement 15 additional projects.

An example of an ongoing Project XL program involves the OSi Specialties Inc. in Sistrville, W.V. The specialty chemical manufacturing plant has agreed to install air pollution controls on a production unit well ahead of when the controls are anticipated to be required by EPA regulations and to reuse methanol and thereby reduce the generation of sludge. The project will result in the destruction of about 98 percent of the organic compounds in the vent streams and the recovery and reuse of 500,000 pounds of methanol that would otherwise have been treated in the facility's wastewater system. This will reduce the sludge from the facility's wastewater treatment system by about 815,000 pounds per year. In exchange for this, EPA and the West Virginia Department of Environmental Protection have deferred new organic air emission regulations applicable to OSi's two hazardous waste surface impoundments.

In addition to industrial facilities, Project XL officials are looking at POTWs. According to EPA, many POTWs have mastered the programmatic aspects of their pretreatment programs and a number of these POTWs feel that their programs should be measured against environmental results rather than strict adherence to procedural and administrative requirements.

For more information on Project XL contact Christopher Knopes, EPA's Office of Reinvention Programs, at (202) 260-5754 or check out EPA's Internet address at [www.epa.gov/ProjectXL](http://www.epa.gov/ProjectXL). If you want information specific to POTWs, call Patrick Bradley, EPA, at (202) 260-6963.

Creative approaches to environmental problems should be encouraged—not punished. The magnitude and complexity of our nation's environmental problems have created an urgent situation that demands imaginative pollution prevention and control techniques.



*Angela Neville*

Angela Neville, JD, REM  
Editor-in-Chief

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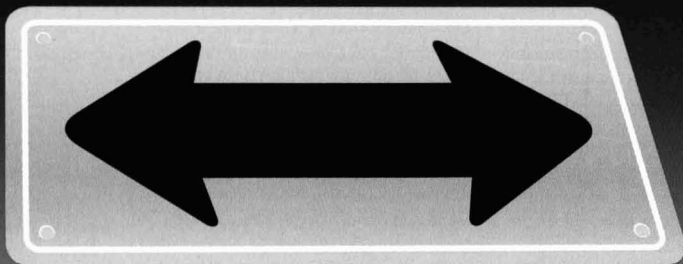
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### Boosting biopesticides' potential

A new technology—microencapsulation—could help useful viruses, bacteria and other environmentally friendly biopesticides compete with traditional chemical pesticides. Agricultural Research Service (ARS) scientists and cooperators in Mexico have produced improved formulations that offer biological control for insect pests.

Encapsulation is the process of mixing microbes with a matrix-forming material, such as cornstarch, that has been partially gelatinized—heated to enable water absorption. When the cornstarch-microbe mixture is added to water and then dried, the microbes become entrapped in protective particles so small they can barely be seen without a microscope.



"Encapsulating microbes in starch or other agricultural materials may help establish alternatives to relying on chemical insecticides or transgenic insect toxins that are now in a few crops," said Peter B. Johnsen, director of the ARS's National Center for Agricultural Utilization Research in Peoria, Ill.

Transgenic insect toxins are proteins produced by plants that have a bioengineered gene from a bacterium such as *Bacillus thuringiensis* (Bt).

Encapsulated bioinsecticides include not only Bt, but also baculoviruses—a group of viruses that cause disease in caterpillars. The viruses begin their infection in the gut of host insects.

With the new formulations, farmers will no longer need to add any ingredients besides water. Additionally, according to ARS entomologist Michael R. McGuire, controlling insects by more than one means may prevent large populations from developing insecticide resistance.

For example, microencapsulated baculoviruses may someday be applied to areas planted with both conventional and transgenic cotton. Cotton pests such as the bollworm and tobacco budworm that may escape death from transgenic toxins can then be killed by the baculoviruses.

For more information, contact Michael R. McGuire at telephone (309) 681-6595, fax (309) 681-6693 or e-mail: mcguirmr@ncaur.usda.gov.

### An intelligent way to control coal emissions

New "intelligent controller" software that uses neural networks and fuzzy logic to help control emissions from coal-burning power plants has been developed by Argonne National Laboratory, near Chicago, and Energy Systems Associates (ESA), Pittsburgh.

The software makes it effective for a power plant to burn natural gas along with coal. The added natural gas returns nitrogen oxide (NO<sub>x</sub>) gases, converting them into nitrogen.

"Since natural gas is more expensive than coal, we're interested in developing a system that will help plant operators use natural gas as economically as possible while maintaining the required NO<sub>x</sub> reductions," said Jacques Reifman, leader of the project at Argonne.

The software is designed to work with ESA's Fuel Lean Gas Reburning technology, a system that injects controlled amounts of natural gas into various regions of a furnace on demand.

The software serves as an advisor, notifying operators of coal-fired power plants when NO<sub>x</sub> emissions are too high and suggesting adjustments to reduce them. "Initial simulation tests on fossil-fueled boilers showed that this combination consistently leads to high average NO<sub>x</sub> reduction and low average rates of natural gas consumption," Reifman said.

The team's approach was to develop an intelligent controller that learns about the plant by using artificial intelligence methods, such as neural networks and fuzzy logic, to analyze plant behavior. Neural networks are computer systems that can learn complex processes by analyzing their performance data.

Argonne and ESA worked with performance data that ESA compiled at one of ComEd's coal-fired power plants near Joliet, Ill.

"The database included the amount and distribution of natural gas and the resulting NO<sub>x</sub> levels," Reifman said. "We provided the database to a neural network and let it discover the relationships between the variables."

For more information, contact Dave Baucac at Argonne at (630) 252-5584 or Roger Glickert at ESA at (412) 429-3576.

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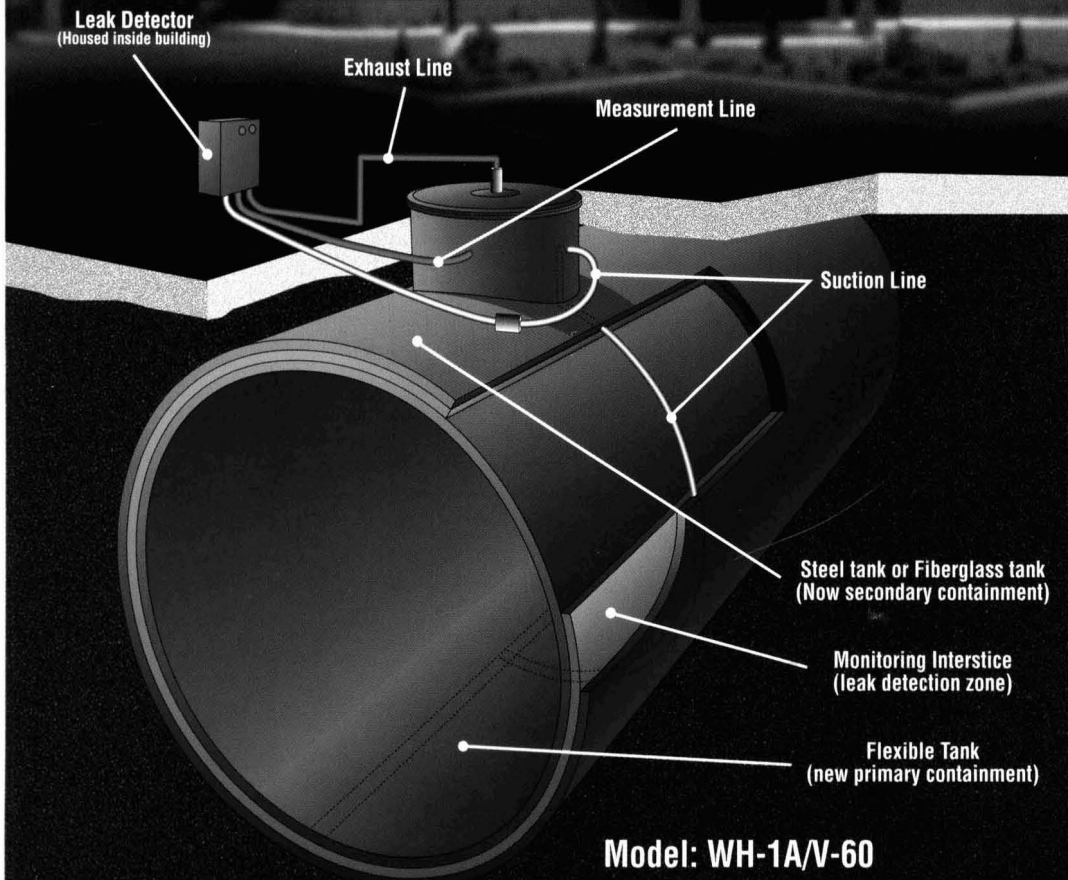






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# News at a glance

Compiled by Kristie L. Guillotte

## Defining parent corporation's Superfund liability

WASHINGTON, D.C.—In June, the U.S. Supreme Court unanimously ruled that a parent corporation cannot be held liable for its subsidiary's violation of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, also known as the Superfund law, simply because the parent company owns or operates the subsidiary.

The decision was reached in the case of *United States vs. Bestfoods*. Action under CERCLA was brought against CPC International Inc., the parent corporation of the defunct Ott Chemical Co., for the costs of cleaning up industrial waste generated by Ott II's chemical plant. Under CERCLA, it has to be proven that the parent company actually operated the facility in question, which was owned by the subsidiary.

The Supreme Court stated, "The question is not whether the parent operates the subsidiary, but rather whether it operates the facility, and that operation is evidenced by participation in the activities of the facility, not the subsidiary. Control of the subsidiary, if extensive enough, gives rise to indirect liability under piercing doctrine, not direct liability under the statutory language."

The court sent the case back to the lower court for the limited purpose of determining whether or not the parent corporation actually operated the facility in question. However, the government's assertion that the officers of the parent corporation were officers of the subsidiary is insufficient to demonstrate that the parent corporation actually operated the facility owned by the subsidiary. The court further stated, "It is entirely appropriate for directors of a parent corporation to serve as directors of its subsidiary, and that fact alone may not serve to expose the parent corporation to liability for its subsidiary's acts."

## MBA's take a new focus

WASHINGTON, D.C.—Eight of the U.S.'s leading graduate business schools received awards in recognition of outstanding curricula and activities focusing on the environment in their Masters of Business Administration (MBA) programs.

The schools were chosen from a survey of MBA programs nationally conducted by the Washington, D.C.-based World Resources

Institute (WRI), an international research organization focusing on issues of the environment and sustainability.

The top eight schools, as surveyed in a WRI report, "Grey Pinstripes with Green Ties: MBA Programs Where the Environment Matters," include George Washington University, New York University, Northwestern University, University of Michigan, University of North Carolina-Chapel Hill, University of Tennessee-Knoxville, University of Virginia and University of Washington.

"Standard business practice is changing; the environment is no longer an afterthought," said Jennifer Finlay, lead author of the report. "Most Fortune 500 companies have moved beyond 'end-of-pipe' fixes focused on preventing pollution and are trying to actively pursue competitive advantage through environmental excellence."

The authors emphasized that the survey is not a general population sample or ranking, but an evaluation based on information provided by the deans. Some significant findings include:

- 86 percent of the schools report offering one elective course, ranging from such courses as "Green Design and Business"

to "Environmental Quality and Economic Advantage;"

- 57 percent report offering more than one elective; and
- 21 percent of schools offer dual degrees with natural resource or forestry programs or environmental management specializations.

## Something fishy in Lake Erie

CLEVELAND—Two artificial reefs placed in Lake Erie last November are proving to be a big catch for the area.

Research conducted by Ohio Sea Grant indicates that the reefs should attract up to 60 times more fish in the surrounding areas and should pay for themselves rather quickly.

Dr. Jeffrey M. Reutter, Ohio Sea Grant director, said, "I like to think of the reefs as environmental endowments—they are completely paid for but they will continue to provide economic benefits and a great deal of enjoyment to anglers for many years. This is also a good example of a major city taking a very bold action to improve both the environment and the economy, showing it is possible to do both."

## Show me the money

NATICK, Mass.—A new survey shows that the environmental consulting industry's revenues are on the rise.

The survey, "Financial Performance Survey of Environmental Consulting Firms," conducted by Zweig White & Associates, found the median annual growth rate of gross revenues in environmental consulting firms to be 6.89 percent last year. This continues an upward trend in growth rates—from 2.69 percent

in 1994 to 1995 and an additional 5.26 percent in 1995 to 1996.

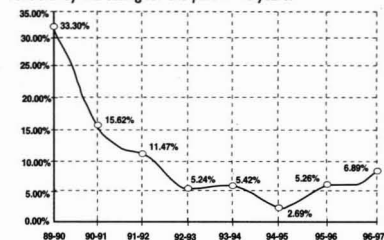
The survey also reveals that many firms are using the increased revenues to pay more bonuses. Bonus costs, based on established plans, have more than doubled in 3 years from 1994 to 1996.

Firms also expressed optimism regarding future revenue growth potential. The median 3-year projected revenue growth is 33 percent. In order to achieve that goal, firms would need to grow by 11 percent each year for the next 3 years.

The financial performance survey provides 26 comparative financial statistics that environmental consulting firms can use to measure their firm's financial performance against industry norms. Also included in the survey is information on finance and accounting staff, personnel costs, lines of credit, professional liability insurance, rent and utility costs and emergency premiums. For more information on the survey, contact Zweig White & Associates at 600 Worcester St. Natick, Mass. 01760, telephone (508) 651-1559 or e-mail [info@zwa.com](mailto:info@zwa.com).

### Trend: Annual growth rates (1989-1997)

Environmental consulting firms' annual growth rates have been consistently increasing for the past three years.



Source: 1998 Financial Performance Survey of Environmental Consulting Firms (Zweig White & Associates, Inc.)

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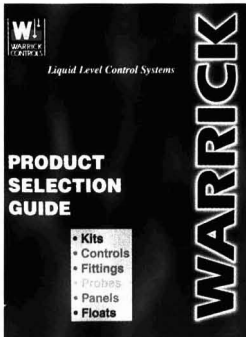
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The GC/MS Application Note Number 61 describes an advanced process for distinguishing individual toxic polychlorophenol isomers in drinking water at parts-per-trillion and lower concentration levels. The GC/MS process uses a Saturn 2000 ion trap system, which provides high signal-to-noise ratios. **Varian Analytical Instruments. Circle 193 on card.**



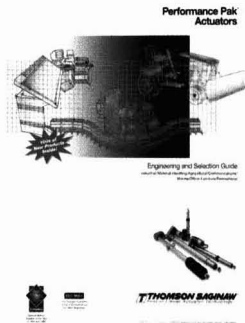
The Transactions in Measurement & Control series is designed to provide access to the information needed to meet measurement and control requirements. It is conceived as a practical thesis and a technical reference series for everyday users of instrumentation and controls. **Omega. Circle 194 on card.**



The Warrick Product Selection Guide is a catalog for liquid level control products, including kits, controls, fittings, probes, electrical panels and float systems. Each product category within the 36-page guide is color coded for fast reference. **Warrick Controls Inc. Circle 195 on card.**



The Series 452 Insertion Mass Flow Element brochure lists specifications, applications and ordering information for the Series 452 heavy-duty industrial, single-point Insertion Mass Flow Element for industrial gases. The Series 452 meets the 1996 CE compliance requirements for EMI emissions and immunity. **Kurz Instruments Inc. Circle 196 on card.**



The 28-page Performance Pak Actuator Engineering and Selection Guide enables designers to match the appropriate electro-mechanical linear ball screw actuators to specific applications. The guide contains specifications on the company's 12-, 36-, 90-, 110- and 220-volt Performance Pak Actuators and more. **Thomson Saginaw Ball Screw Company LLC. Circle 197 on card.**

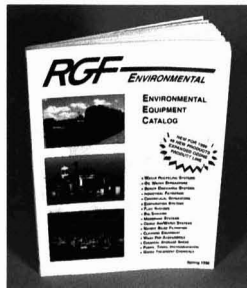
**Whessoe Varec**



The 116-page Digester Gas Safety and Control product catalog from Whessoe Varec features sections on applications, cover equipment, gas control, burners/flares, specifications and technical information. **Whessoe Varec. Circle 198 on card.**

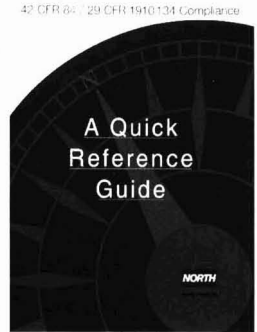


The 1998-99 edition of the Process Safeguarding Engineering Guide features a wide range of trapped key interlocks, trapped key power isolators, integral valve interlocks, lock out and tag out devices, special purpose limit and proximity switches, explosion-proof proximity switches and intrinsic safety barriers. **Scientific Technologies Inc. Circle 199 on card.**



The 150-page Environmental

Equipment Catalog contains design information, engineering data and the company's full line of equipment for water purification, industrial wastewater treatment, recycling and odor control. The catalog contains 48 new product lines and an expanded ozone air and water product line. **RGF. Circle 200 on card.**



The Quick Reference Guide is designed to inform distributors and end-users of respiratory protection devices about the changes incorporated into the new NIOSH standard 42 CFR Part 84 and revised OSHA 29 CFR 1910.134. Background information on the history and intent of both regulations is included. **North Safety Products. Circle 201 on card.**

**High-Performance Valves, Actuators and Accessories**



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Industrial wastewater generally contains contaminants such as suspended solids, dissolved organic matters, heavy metals and cyanides at levels considered hazardous to the environment and that could pose a risk to public health. Such contaminants must be removed or their levels be reduced to legally acceptable levels prior to discharging the wastewater to the environment. Effluents are normally treated by chemical means and the quality of treated effluent must meet discharge standards required by

emulsion breaking, coagulation and scavenging of oil, precipitation of heavy metals as hydroxides or sulfides, flocculation and settling of the solids into a metal-laden floc, separation of floc from treated effluent, and finally discharge. Such techniques are generally multistep, time consuming and require extensive equipment and handling. The entire treatment is carried out sequentially and requires multiple pH adjustments and the addition of hazardous chemical solutions, each with its own feed tank, pump and feed

amount—one percent or higher—of emulsified oil is present in the waste stream, use of an oil-water separator or dissolved air floatation (DAF) equipment becomes necessary for effective removal of oil.

**Simpler is better**

As the collective industrial discharge continues to grow and the CWA regulations governing the discharge of wastewater become more stringent, industrial facilities need new technologies and products that

# Shortcut to success

A new streamlined treatment alternative for industrial wastewater delivers high-quality effluent and generates nonhazardous waste

the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act (CWA).

**Conventional multi-step treatment**

The type of wastewater treatment program put in place by an industry is influenced by factors such as the nature and volume of the waste stream, discharge regulations, available space and the nature of generated waste. The nature and volume of the waste stream and discharge regulations will influence the choice of equipment and treatment chemicals. The overall cost of treatment involves operational costs such as energy, labor, treatment chemicals, sludge processing and disposal and maintenance. The classification of generated waste is very important as disposal of hazardous waste costs an average of three to four times that of nonhazardous waste.

Conventional techniques used in the treatment of industrial waste streams involve

line. Furthermore, both hydroxide and sulfide precipitation methods suffer great limitations in their use in metal removal and both generate hazardous waste that requires further treatment and stabilization at waste treatment plants. In cases where a significant

enhance treatment efficiency and are protective of the environment and public health. A new alternative process for treating industrial wastewater streams is becoming popular as it eliminates the use of the various dangerous treatment chemicals, is

**TABLE 1 • Performance comparison between current and alternative treatments of effluent from an automotive manufacturing operation**

Parameter	Limit, mg/L	Current treatment	Alternative treatment
Oil & grease	50.0	1900	24.5
Suspended solids	NA	35.4	6.5
Total phosphorus	NA	13.2	0.34
COD	NA	991	597
Phenol	0.20	0.19	0.09
Cadmium	0.37	0.005	ND
Chromium	1.47	0.083	ND
Copper	1.80	0.280	ND
Lead	0.37	0.040	ND
Nickel	2.12	0.150	ND
Silver	0.37	0.006	ND
Zinc	1.39	0.180	ND

By Sultan I. Amer, PhD

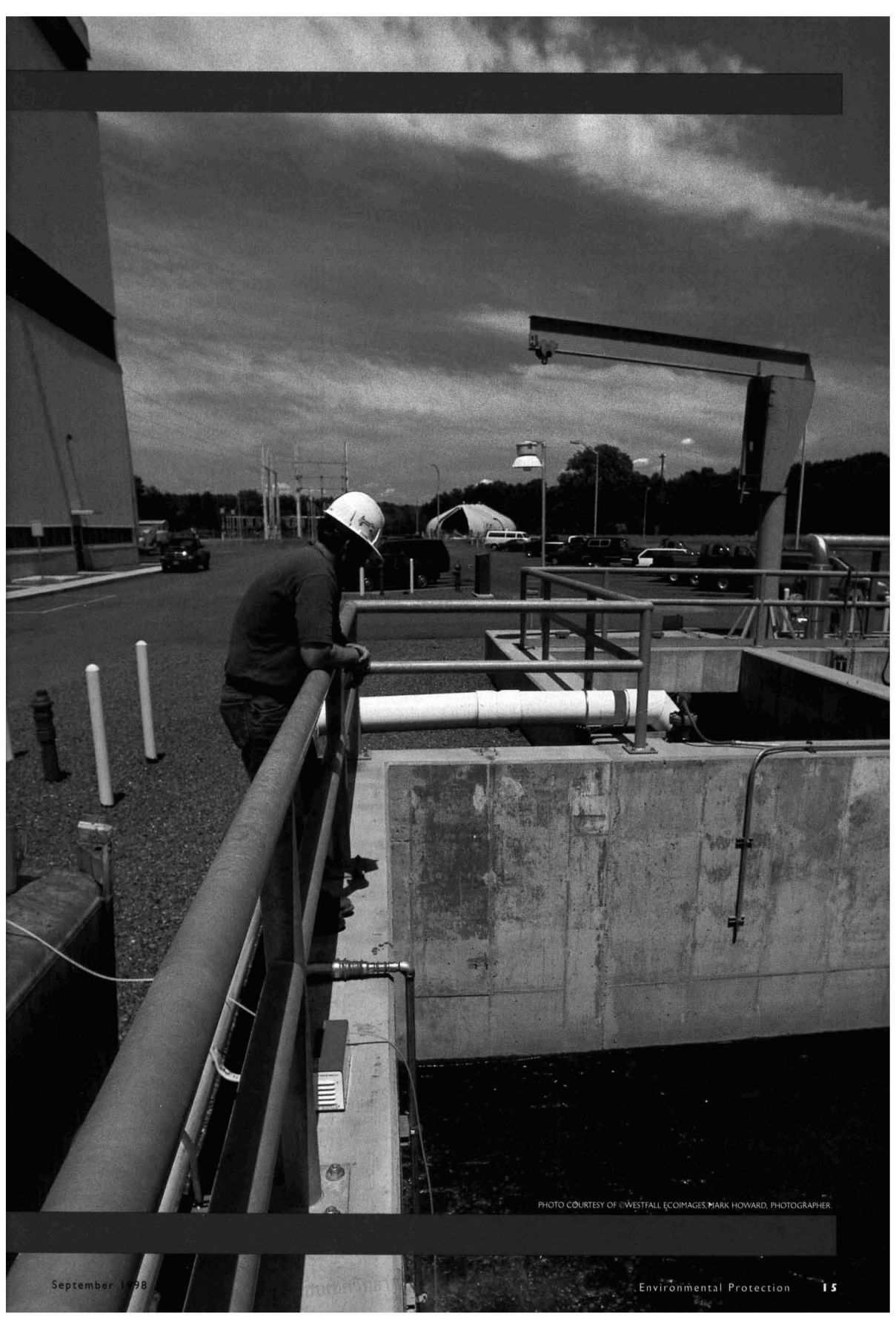


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easy to implement and operate, requires less maintenance and generates nonhazardous waste.

The recently developed AQUASIL® treatment makes use of the concepts of synergy and favorable kinetics to react with the various contaminants simultaneously. This new

technology employs proprietary advanced nonhazardous blend of natural and synthetic minerals that are made to fit the chemistry of the particular waste stream. All products are manufactured from nonhazardous materials and supplied in solid form. They are highly hydrophilic and used in

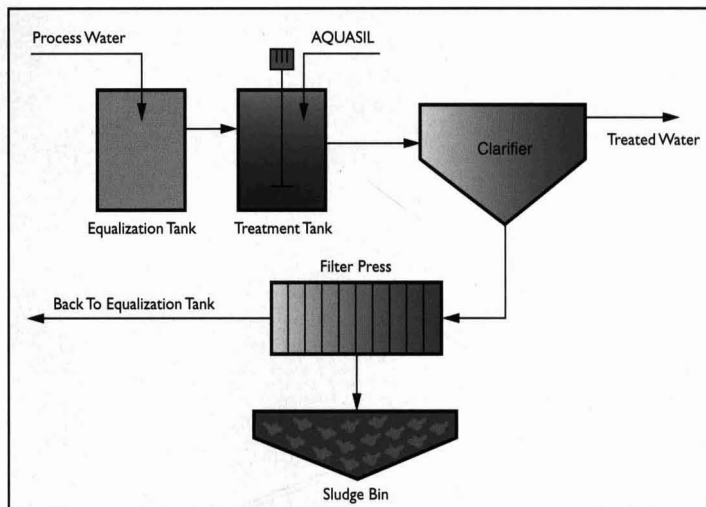
either the batch or continuous processes.

In the new treatment, the particular product is added or metered into the agitated waste stream in a treatment tank. Within a few minutes a dense floc forms, settles quickly and is easily dewatered. Effluents are treated with products at either the low, neutral or moderately high pH. Use of such products eliminates problems inherent in the application of liquid chemicals in the conventional practice. The products have high capacity to take up or remove heavy metals, suspended solids and oil and grease, simultaneously. In addition, they can lower the levels of hexavalent chromium, phenol, arsenic, selenium, phosphorus, fluoride, chemical oxygen demand (COD) and total dissolved solids (TDS). The products also overcome problems associated with hardness and the presence of complexing or chelating agents, surfactants and detergents.

Figure 1 illustrates a conceptual setup of the new treatment; Table 1 shows the performance of the conventional treatment of an automotive manufacturer's wastewater, contrasted with the new method.

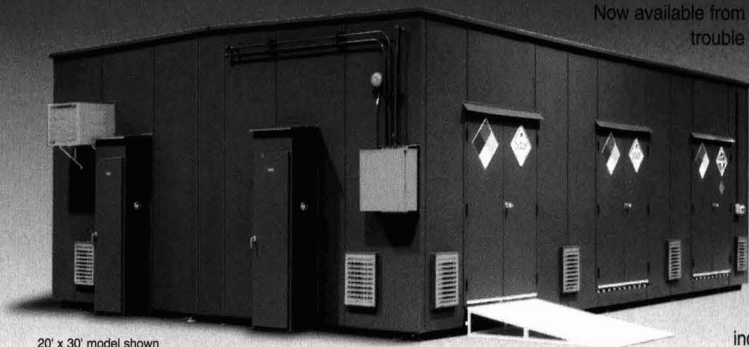
The new treatment is applicable to effluents from a broad spectrum of industries. Applications include operations such as

FIGURE 1 • Conceptual setup for AQUASIL treatment



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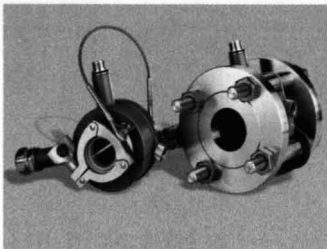
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The benefits of using the new treatment and products become evident if we consider the entire treatment process and its economics. For example, an automotive manufacturing operation has a wastewater treatment system that operates at 600 gallons per minute (gpm) daily. Waste streams from the various operations, which are combined in an equalization tank, are fairly concentrated in suspended solids, oil and dissolved solids. In the conventional treatment, pH is lowered, an emulsion breaker is added and DAF is applied to enhance the separation of oil from water. Oil is skimmed off the surface. Lime slurry is then added to raise the pH and precipitate heavy metals and a flocculant is added to facilitate settling of formed floc in the clarifier. Sludge is withdrawn periodically to a sludge tank and is treated with sludge thickeners prior to dewatering in a filter press. Annual cost of the treatment, excluding labor, maintenance and energy is \$1,630,000.

**TABLE 2 • Analytical results of contaminants in plating waste (filter cake)**

Parameter	Total1 concentration mg/kg	TCLP <sup>2</sup> limit mg/L	RCRA (TCLP <sup>2</sup> ) limits, mg/L
Cadmium	640	<0.005	1
Chromium	240,000	<0.01	5
Copper	3,500	0.04	100
Iron	13,000	<100.00	NA*
Lead	670	0.15	5
Nickel	2,100	0.08	NA*
Zinc	340	0.06	500

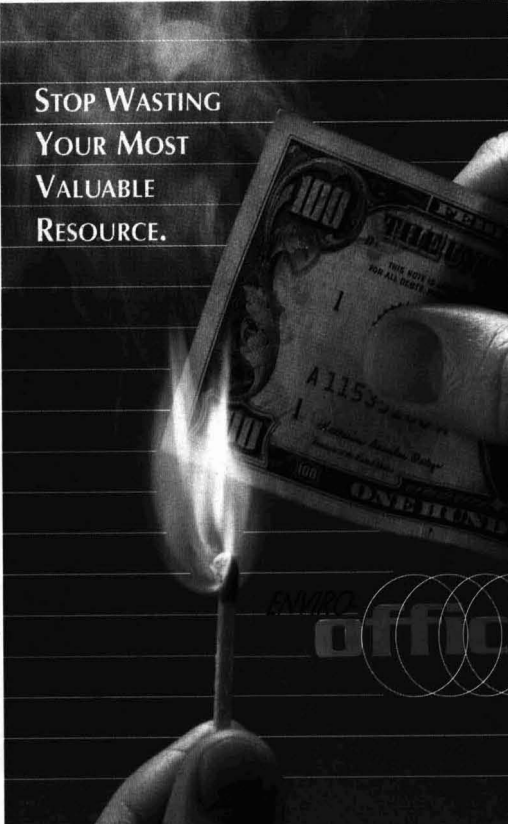
1. Total concentration is obtained by total digestion of waste material in nitric acid and analyzing the digestate for metals.  
 2. A leachate is obtained according to leaching procedure given in reference 4.  
 \* Not Available or Unregulated.

Laboratory tests, conducted over a period of several months, showed that a dose of 350 milligrams per liter (mg/L) of the new product produced much more favorable results (see Table 1). Cost analysis conducted at the automotive manufacturing plant indicates that the new wastewater treatment reduces the cost of waste disposal by 60 percent, sewer surcharges by 70 percent, and the overall cost by 40.4 percent. Furthermore, the DAF operation and all hazardous feed chemicals are eliminated, and the cost of

energy, maintenance and labor is substantially reduced. The high quality of treated effluent, generated by the new treatment, allows for water conservation through recycling.

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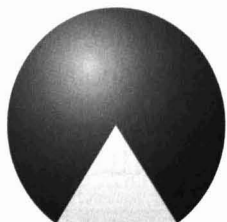
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blesome and the problem is aggravated by the increasing number of wastewater treatment systems. Currently, the waste is transported to treatment plants where it under-

**Table 2** shows TCLP test results for a plating waste generated by the alternative treatment.

The new treatment is easy to implement, employs safe products and provides an eco-


---

**A new alternative process for treating industrial wastewater streams is becoming popular as it eliminates the use of the various dangerous treatment chemicals, is easy to implement and operate, requires less maintenance and generates nonhazardous waste.**

---

goes further treatment to render it suitable for long term disposal. Such a manipulation adds to the overall cost of treatment.

Waste created by of the alternative treatment is already stabilized and does not require any further treatment to render it non-leaching. The waste passes the Toxicity Characteristics Leaching Procedure (TCLP) test and meets the Resource Conservation and Recovery Act (RCRA) requirements and can be landfilled as a nonhazardous material.

nomical alternative to current techniques. It lowers labor, energy and maintenance demands, delivers effluents that meet or exceed discharge and recycling standards and generates nonhazardous waste. 

*Sultan I. Amer is the president and founder of Aquachem Inc., which manufactures Aquasil, in Canton, Michigan.*

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## Corrections

The photographs that appeared on pages 6 and 14 in the July 1998 issue of Environmental Protection were courtesy of © Westfall Ecoimages, Mark Howard, photographer, Woodbridge, Va.



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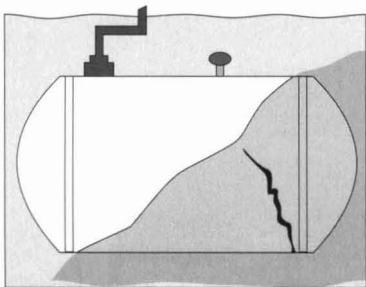
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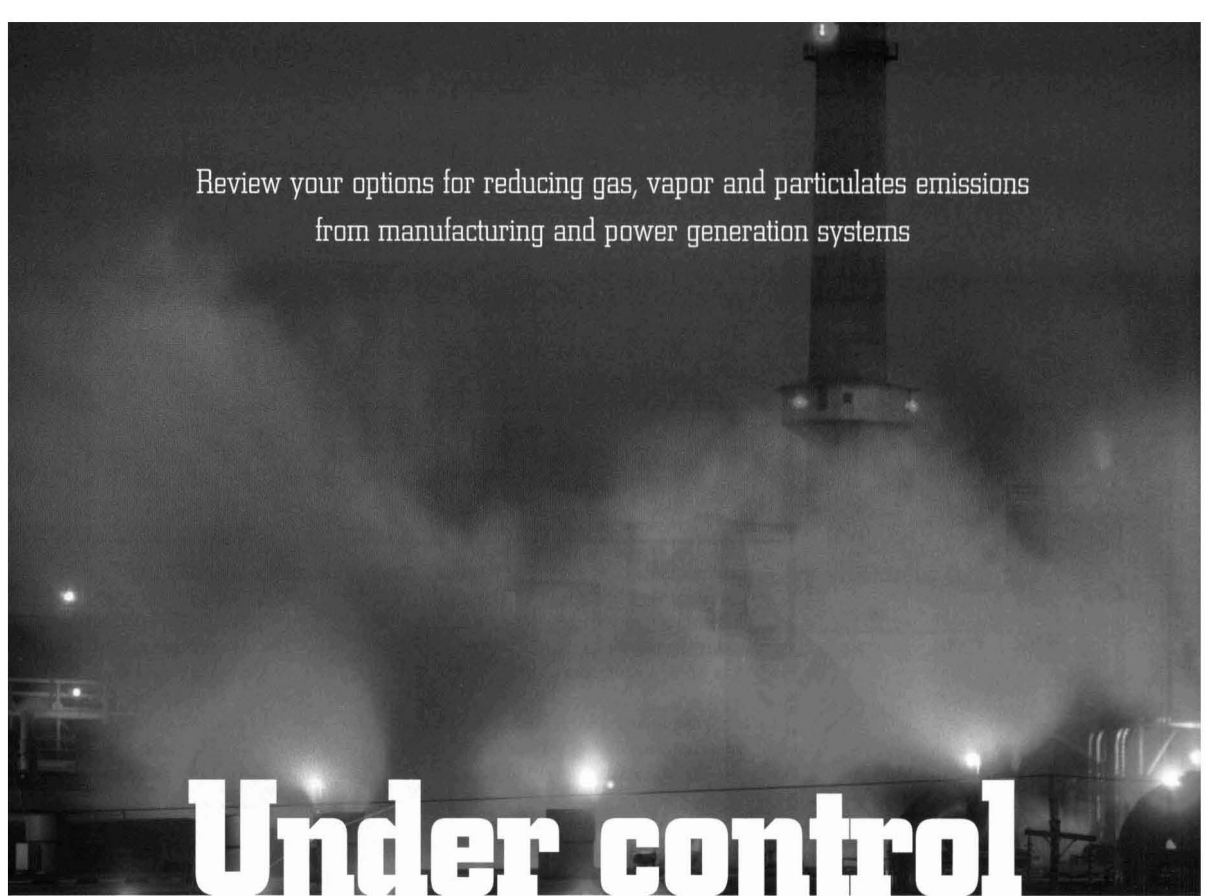
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Review your options for reducing gas, vapor and particulates emissions  
from manufacturing and power generation systems

# Under control

By Paul S. Farber, PE, DEE

**E**missions from manufacturing and power generation systems are regulated by federal, state and local agencies. In some cases, industry will need to install, operate and maintain some form of control equipment to reduce their emissions to permitted levels. Selecting an appropriate control system depends on the hazardous air pollutant being controlled, the characteristics of the process and the degree of control needed to stay in compliance. Decision makers responsible for plant compliance must understand the options available along with their cost factors to properly make these decisions.

To reduce emissions, a suite of tools ranging from pollution prevention and wastes minimization, process modification, to the installation and operation of control systems are available. Some of these options, such as pollution prevention, have the potential not only to reduce emission levels into the environment, but to have the final result of a positive cash flow. Others, including

**Often determining the degree of total emission reduction desired or required is complex and depends upon the size of the facility and the degree of flexibility that is needed for production increases and modifications without further capital investment in control systems and extensive permit changes.**

process modification, will reduce the production and emission of contaminants but may require a capital expenditure and adversely affect production levels at the same time.

In many cases, emissions reduction programs that include pollution prevention and waste minimization may not be able to reduce emissions to the point of regulatory compliance or provide, what management considers to be sufficient allowance for facilities/production expansion. At this point consideration must be given to the selection, installation and operation of control equipment. If the choice of a control system is to be the right one, evaluate the following:

1. What pollutant or combination of pollutants needs to be controlled?
2. What degree of total emission reduction is desired or required?
3. What is the condition of the gas that will be entering the control equipment?
4. Does the gas flow/pollutant concentra-



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- tion vary significantly or is it steady?
5. Is this a new installation or a retro-fit into an existing plant?
  6. What about recovery/disposal of collected pollutants?

**Control what?**

The first, and usually the easiest, question to be answered is, "What emission level is going to be lowered through the installation of the control equipment?" The usual pollutants handled by control equipment are particulates, acid gases or mists, metal emissions—which may be a combination of particulates and vapors—or organic compounds.

Particulate emissions can be reduced by cyclones, fabric filters, electrostatic precipitators and, to some extent, by condensers. Acid mists are usually eliminated by cartridge filters called mist eliminators or by scrubbers, whereas acid gases are controlled by a variety of techniques including wet and dry scrubbing systems, dry adsorption and, in the case of nitrogen oxides, by combustion modification and catalytic and non-catalytic reduction. Metal emissions, which can be both particulate and vapor, have been reduced by combinations of techniques that include filtration, adsorption, condensation and chemical reaction. Finally, organic compound emissions are controlled through a

variety of methods including thermal oxidation, adsorption and wet scrubbing, which is especially useful in reducing odors.

Table 2 on page 27 summarizes the technologies generally used to control emissions of the normal classes of pollutants.

**Determine degree of reduction**

Often determining the degree of total emission reduction desired or required is complex and depends upon the size of the facility and the degree of flexibility that is needed for production increases and modifications without further capital investment in control systems and extensive permit changes. Another factor is whether the facil-

**TABLE 1 • Profiles of air pollution control technologies**

Technology	Operating principles	Advantages	Disadvantages
Cyclones	Centrifugal force separates particles from gas streams.	Low cost, easy to construct and install. Can treat very high temperature gases.	High removal efficiency for small particles requires high pressure drops.
Electrostatic precipitator	Particles are charged and then attracted to grounded plates.	Capable of high removal efficiencies. Can be economical for large gas flows.	Performance depends on particle characteristics. Constant efficiency device—emissions will increase with increasing inlet loading.
Adsorbents	Organic compounds are selectively adsorbed on the surface and pores of the adsorbent.	Almost complete removal of organics from gas stream possible. Recovery of compounds for recycle possible.	Sensitive to gas temperature and humidity. High molecular weight compounds may not desorb completely.
Condensers	Volatile organics are separated from other components in the gas by saturation of the vapor and then a phase change to a liquid.	Can act as primary treatment before adsorbent systems. Organics can be recovered for reuse.	High humidity of gas stream increases energy cost of removal. Entire gas stream must be cooled for effective removal.
Thermal oxidizers	Thermal process oxidizes organic vapors at high temperatures to produce water vapor and carbon dioxide.	Ultimate disposal technique, which destroys pollutants rather than capturing them. Greater than 99 percent destruction of many organics possible.	Arsenic/lead can poison catalytic systems. Changes in residence time of gas will affect destruction.
Wet scrubbers	Droplets collect particles through mechanisms of impaction, interception and diffusion.	Can collect particles, acid gases, metals and organic vapors. Can treat high-temperature gases.	High efficiencies may require high pressure drop. Secondary waste disposal problems from sludges or wet filter cakes.
Semi-dry scrubbers	Evaporation of sorbent droplets cools gas stream while acid gas is neutralized. Particles are collected with fabric filter or ESP.	Can achieve high levels (greater than 90 percent) of acid gas removal and (greater than 99 percent) particulates removal. Dry waste product is easier to dispose of than wet scrubber wastes.	Footprint of spray dryer and particulate control equipment can be large. High humidities from spray dryer could adversely affect particle collection equipment.
Dry injection	Alkali sorbent injected into gas stream reacts with acid gases. Particles are collected with fabric filter or ESP.	Simple sorbent injection system easy to retrofit. Dry waste product easier to dispose of than wet wastes.	Acid gas removals not as high as other systems. High sorbent usage may have adverse economic impact.
Fabric filters	Forces of impaction, interception and diffusion separate particles from the gas stream as it passes through the fabric.	Very high efficiencies for particulates and aerosol removal. Modular construction of large units permits on-line maintenance.	Moisture can plug filters and cause high pressure drops. Fabric degradation results in increased emissions.
Cartridge filters	Gas passes through tightly packed or woven media. Aerosols are separated out and coalesce as liquid stream.	Very efficient for collection of micron-sized aerosols of acid or organics (oils). Small size makes retrofit fairly simple.	Particulates can plug media and cause high pressure drops. Generally not used for high gas flows.



ity is located in an attainment area that is considered to have good air quality as defined in the Clean Air Act or is located in a nonattainment area, which is a geographic location that does not meet the national ambient air quality standards.

The equipment you choose and how that equipment is designed and operated controls how much removal and destruction efficiency is achieved. Additionally, consider how much capture of emissions are possible as in the total degree of reduction. The capture of emissions is not so important a factor for enclosed sources, such as boilers or incinerators, as it is for processes such as coating operations.

#### Incoming gas conditions

To select control equipment, duct work and fans that make up a part of the control system, you must know the condition of the gas entering the control equipment. In particulates control, for example, a fabric filter is extremely efficient—greater than 99.5 percent—in removing particles from a gas stream but is temperature limited depending upon the material used to fabricate the

**The usual pollutants handled by control equipment are particulates, acid gases or mists, metal emissions—which may be a combination of particulates and vapors—or organic compounds.**

filter bags. Filter bags made from polyester or rayon may be inexpensive but can only operate at temperatures below 200 degrees Fahrenheit, whereas fiber glass or Teflon® filter bags have been used successfully up to 450 to 500 degrees Fahrenheit. For extremely high temperature operation, consider using cyclones fabricated from resistant alloys or lined with ceramic—such as those used in some coal-fired boilers—or scrubbers equipped with a quench section.

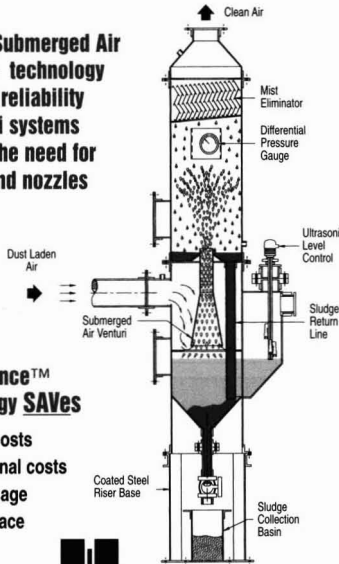
The moisture content of the gas stream will also be a consideration in the selection of a control system for a variety of reasons. Too high a humidity in a gas stream enter-

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ing a control system can lead to cooling and condensation of water from the gas.

Although humidity is not a problem for wet scrubbers, it is for adsorption systems, fabric filters and possibly electrostatic precipitators. Condensation of vapors in fabric filters and adsorption systems can lead to plugging, resulting in high pressure drops and a measurable loss of performance. Additionally, condensation due to high humidities and low temperatures damage and corrode materials unless you take it into account during the design stage. If condensation can occur, then several solutions are available to the system designer. For fabric filters, additional insulation reduces heat loss and an internal

surface coating of a high-temperature epoxy paint prevents surface corrosion. If condensation is a concern with electrostatic precipitators, then you can use a wet electrostatic precipitator constructed to resist chemical attack and sludging systems designed to periodically wash plates clean.

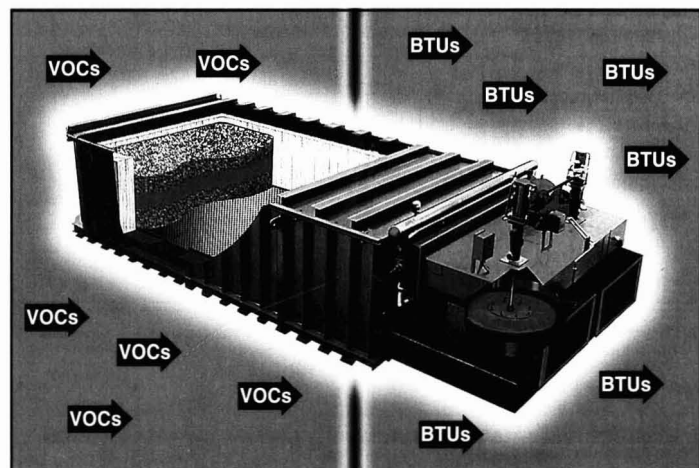
#### Variability of gas flow/pollutant concentration

All pollution control systems are sized, to some extent, based on the volume of gases entering the equipment. If the flowrate entering the equipment is reasonably steady—such as base-loaded—then sizing is simplified. However, if the flow changes due to process or other

variations, then a degree of complexity is introduced into the decision process. If equipment is sized for a maximum gas flowrate that only occurs a fraction of the time, then your company will invest more than necessary in control equipment. Some control equipment, such as fabric filters, are capable of handling increases in gas flowrate without more than a minimal increase in emissions. Others, such as electrostatic precipitators or thermal oxidizers have a direct relationship between gas flowrate, residence time in the system and performance.

#### New or retrofit?

With a new installation, the system designer has a wide variety of choices; retrofitting control equipment into an existing installation creates some limitations. Probably the most critical of these is the available plant area, or the footprint, for the new installation. A less critical but still crucial limita-



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**Selecting an appropriate control system depends on the hazardous air pollutant being controlled, the characteristics of the process and the degree of control needed to stay in compliance.**

tion is the availability of utilities such as steam, electricity and cooling water.


A non-physical limitation on the installation of control equipment in a retrofit situation is the existing permits. Except perhaps for thermal oxidizers, pollutants are not truly destroyed, merely collected intact or in some changed form. Can the existing permits provide for storage of collected pollutants and does your facility have space for such storage? This may be especially important if the collected pollutant could be considered a waste under the Resource Conservation and Recovery Act (RCRA) or present some unusual disposal problems.

## Recovery and disposal of collected pollutants

Because, to a great extent, pollutants are neither created or destroyed but merely changed in form, the net result of the installation and operation of control equipment is to acquire a quantity of material to be handled. What to do with the results of emissions that have been collected and reduced is a problem that the manager or designer of a control system must address. In some cases, you may be able to apply some of the concepts of waste minimization and waste reduction to solve the disposal problem. As an example, fly ash collected from utility electrostatic precipitators or baghouses may be able to be used for manufacturing cement. Certain coals from the western United States produce fly ash that is high in calcium and magnesium salts with pozzolonic properties. When wet, these ashes harden readily and can be integrated into the cement manufacturing process. Likewise, if a stream of organic materials collected by an adsorption system comes from a single process line where only one solvent perhaps is used in manufacturing, then recycling and reusing these organics can be a viable technical and economic option.

If recycling and reusing is not a possibility, then the system planner/designer must make provisions for the manifesting and disposal of these collected pollutants. Under current RCRA regulations, testing and analysis of the collected materials will probably be necessary to properly manifest and dispose of these wastes. In some cases, you may have options for disposing a single waste, such as in a landfill versus waste fuels blending for collected solvents or other liquid organic wastes.

### Decisions, decisions

Installing an emissions control system can be a complex and sometimes forbidding task. Take some time to analyze all of the options that will affect choices and design of the control system before getting too far along the project path (see Table 1 on page 24). Careful consideration of the design and the subsequent operation of the equipment can result in better compliance, emissions reduction and increased efficiency. 

*Paul S. Farber, PE, DEE, is an environmental/regulatory manager at R. A. Kerley Ink Engineers Inc. in Chicago.*

For more information, circle 172 on card.

TABLE 2 • Available control technologies

Technology	Particulate	Acid gases	Metal vapors	Organic vapors
Cyclones		x		
Electrostatic precipitators	x			
Activated carbon			x	x
Condensers			x	x
Thermal oxidizers				x
Wet scrubbers	x	x	x	x
Semi-dry scrubber (spray dryer absorber)		x	x	
Dry injection		x		
Fabric filters	x	x	x	x
Cartridge filters	x	x		x

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# Dustborne infectious diseases

*Airborne particles carry pathogens that can cause life-threatening infectious diseases when inhaled*

By Richard A. Sullivan, PE

The world faces the specter of incurable tuberculosis again, according to a study released last year by the World Health Organization and the Centers for Disease Control and Prevention in Atlanta. The emerging epidemic is from multidrug-resistant strains of pathogenic *Mycobacterium* species. Influenza is a viral infection known for its changing immune characteristics and requires continued development of new vaccines. These public health concerns reveal limitations in antibiotic and antiviral treatments and confirm that clean air is good protection against infectious diseases transmitted through airborne particles.

Indoor air free from pathogenic microorganisms has hygienic precedence in surgical operating rooms and wound treatment rooms of hospitals. In isolation rooms that house patients with contagious diseases, the air is carefully contained and purified to control dispersion of airborne pathogens. Likewise, in buildings where people live, work or gather together, clean air is healthful—albeit to a lower class of particulate cleanliness than in hospitals. Infants, young children and elderly people are especially vulnerable to airborne infectious diseases, partly because they spend much time indoors and partly because their immune systems are not well developed or are weak.

Certain infectious diseases are transmitted by airborne pathogenic bacteria and viruses entering the warm, moist environment in the upper and lower tracts of the respiratory system. Viruses are substantially smaller in size than bacteria and have a parasitic dependence on other life forms. Both bacteria and viruses are readily carried on airborne dust particles and droplet nuclei into the upper respiratory tract, but only some hardy bacterium species can travel without a host carrier.

## Health disorders caused by airborne pathogens

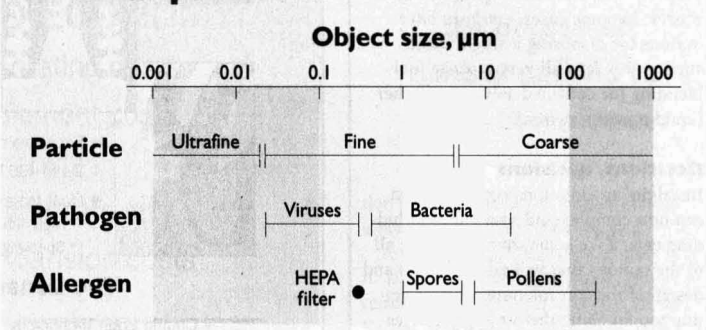
Unlike the innately aseptic organs of the body, the respiratory tracts and lungs are continuously exposed to airborne particles during breathing. Inhaled air passes from the nose through various respiratory passages to millions of balloonlike sacs, the alveoli, in the lungs where oxygen diffuses into the blood and carbon dioxide is removed. The airborne particles may range from mineral dusts and droplet nuclei, to pathogen-carrying dusts, to dust-size allergens that can cause injury, infection or allergic reaction in the upper or lower res-

droplet nuclei can also be contaminated with hazardous chemicals, which can provoke emphysema, bronchitis and lung cancer. Soluble poisonous chemicals can travel from the alveoli into the bloodstream causing disorders elsewhere in the body.

Most respiratory infectious illnesses are caused by viruses or bacteria that are carried by airborne dust particles or small water droplets. Sometimes an illness is the result of a bacterial infection that develops as a complication of a viral infection, such as a common cold. Upper respiratory tract infections include the common cold, influenza, sinusitis, tonsillitis, whooping cough, diphtheria

FIGURE 1.

## Airborne particulate matter



piratory tracts. Upper respiratory tract disorders affect the nose, throat, sinuses and larynx, and lower tract disorders affect the trachea, bronchi, bronchioles and alveoli of the lungs.

Mineral dusts inhaled into the lungs cause injury by accumulating in the alveoli and forming pulmonary fibrosis. Asbestosis and silicosis are the more common forms of this type of lung injury. Dust particles and

and strep throat. Infections of the lower respiratory tract include pneumonias, tracheitis, bronchitis, bronchiolitis, tuberculosis, Legionnaire's disease and Q fever. Bacteria and viruses infecting the upper respiratory tract also can enter the bloodstream, causing diseases such as chickenpox, measles, meningitis, mumps and poliomyelitis.

Airborne pollens, fungal spores and dusts containing fragments of dead house



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mites or animal dander (flakes of dead skin) are common allergens causing hypersensitivity reactions in some people. Hay fever (allergic rhinitis) is inflammation of the nose, and bronchial asthma and allergic alveolitis are lung disorders that cause breathing difficulties.

The ear is another body organ that is exposed to airborne infections through a ventilation passage connecting the back of the nose to the cavity between the eardrum and the inner ear. Inflammation of the middle and inner ears from bacterial or

viral infection can cause earache, vertigo and temporary or permanent deafness. Ear disorders from infection are more common in young children probably because of the shortness of their ventilation tubes into the middle ear.

#### Indoor air quality

Indoor air quality is affected much by the indoor environment; nevertheless, in homes without air conditioning about 65 percent of the concentration of dust particles having an aerodynamic diameter of 10

micrometers ( $\mu\text{m}$ ), also known as particulate matter (PM-10), originates outdoors, and fine particle concentration approaches 75 percent. The concentration of outdoor PM-10 fugitive soil-derived dust has been regulated by the U.S. Environmental Protection Agency for 10 years. Recognizing that fine fugitive dust is more damaging to public health, last year EPA promulgated a new, more stringent standard for fine dust with an aerodynamic diameter of 2.5  $\mu\text{m}$  (PM-2.5). Fine fugitive dust consists of colloidal clay particles that can carry poisonous chemical substances, as explained in an article "From Dirt to Toxic Dust" in the May 1997 issue of *Environmental Protection*.

Indoor airborne particulate matter can vary from mineral dusts, to liquid droplets, to particles derived from biological sources. "Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones," prepared by the Institute of Environmental Sciences and Technology (IEST) and referred to as Federal Standard 209E, is used in the control of airborne contamination in healthcare facilities as well as in manufacturing facilities of pharmaceuticals, medical devices, food processing, microelectronics and aerospace. Standard 209E defines airborne particles as objects of solid or liquid composition ranging between 0.001  $\mu\text{m}$  and 1000  $\mu\text{m}$  in size. Ranges in sizes of airborne particles, pathogens and allergens are shown in Figure 1.

Indoor air pollution is deceiving because particles finer than about 60  $\mu\text{m}$ , the diameter of a human hair, cannot be seen by the naked human eye unless viewed in a ray of bright light, where airborne particles larger than 10  $\mu\text{m}$  may be seen. Inhaled airborne dust particles carrying viruses or bacteria are too small to be seen by the human eye.

#### Transmission of dustborne infections

Airborne infectious diseases are spread by small droplets of saliva or mucus expelled into the air from an infected person coughing or sneezing. The largest of such pathogen-containing droplets settle under gravity onto surfaces, while droplets less than 100  $\mu\text{m}$  evaporate and form stable airborne droplet nuclei 1 to 4  $\mu\text{m}$  in diameter. Droplets resting on surfaces also evaporate and contaminate dust particles that can later become resuspended in air. Droplet nuclei are similar to outdoor condensation nuclei that are formed when water vapor cools and condenses on floating dust particles to become fog droplets 10 to 15  $\mu\text{m}$  in diameter.

Transmission of airborne infections depends primarily on the concentration of pathogen-carrying particles in the air and

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on the duration of exposure. Droplet nuclei are the principal carrier of *Mycobacterium tuberculosis*. Because of their parasitic dependence, airborne viruses must travel attached to dust particles or droplet nuclei in spreading infectious disease. Thus, dustborne viruses become effectively larger airborne particles than the size of a virus shown in Figure 1. Naked viruses, as well as bacterial spores, can survive for several months on airborne dust particles.

The human respiratory system has an elaborate clearance mechanism to remove particles from inhaled air. Most inhaled particles larger than 10  $\mu\text{m}$  in diameter are trapped by hairs in the nose and by mucous membranes in the nasal cavity, and the trapped particles are expelled by sneezing. Oral breathing bypasses the nasal passages, resulting in greater particle deposition in the lower respiratory tract. Most particles larger than 5  $\mu\text{m}$  are caught

**The airborne particles may range from mineral dusts and droplet nuclei, to pathogen-carrying dusts, to dust-size allergens that can cause injury, infection or allergic reaction in the upper or lower respiratory tracts.**

in the trachea, bronchi and bronchioles, and are expelled by coughing and sneezing. Particles smaller than 5  $\mu\text{m}$  are more likely to be deposited in the alveoli, where insoluble particles may be ingested by macrophages and expelled by coughing or sneezing. Deepest infectious penetration into the respiratory system results from inhaling fine pathogen-carrying particles.

#### **Control of indoor dust particles**

Air conditioning of a building or room controls the purity, humidity and temperature of indoor air, and is essential for those buildings housing cleanrooms or clean zones. Both filtration and ventilation improve the particulate cleanliness of indoor air. Ventilation with clean

fresh air dilutes the concentration of airborne pathogen-carrying particles in a room, whereas filtration removes dust particles not only from air drawn in from outside to replace stale air but also from the indoor circulating air. If air must be sterilized, then the air is irradiated with ultraviolet rays that kill microorganisms by denaturing their deoxyribonucleic acid (DNA).

Three types of air filters are shown in Figure 2. Many air conditioning systems use fiber filters composed of closely

packed fiberglass wool that can trap coarse dust particles and pollens. The cleaned air may then pass through a carbon filter of granulated activated carbon to absorb odors. A high-efficiency particulate air (HEPA) filter rated for 99.97 percent filtration efficiency at 0.3  $\mu\text{m}$  is needed to remove fine dusts, pathogens and spores from indoor air. HEPA filters composed of folded fiberglass paper were developed by the U.S. Department of Energy to trap fine radioactive dusts in atomic plants. With the development of

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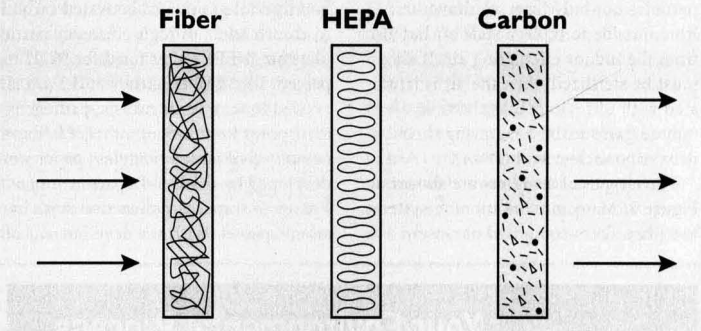
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FIGURE 2.

## Types of air filters




more robust material media, HEPA filters are now used to remove other types of fine airborne particulate matter.

HEPA filters certified for 99.97 percent filtration efficiency at 0.3  $\mu\text{m}$  are expensive as they actually trap most penetrating particles in the range of 0.07 to 0.3  $\mu\text{m}$ . So to extend the effective life of a HEPA filter beyond a couple of years, contaminated air is commonly drawn initially through a fiber filter,

**A high-efficiency particulate air (HEPA) filter rated for 99.97 percent filtration efficiency at 0.3  $\mu\text{m}$  is needed to remove fine dusts, pathogens and spores from indoor air.**

which is much cheaper to replace, in order to remove the coarse particles larger than 10  $\mu\text{m}$ . Recent development of cleanable HEPA filters made from more durable filter media has further increased effective filter life to more than 20 years. Cleanable HEPA filters are usually cleaned in place whenever the need arises using a mobile vacuum system to remove and contain particulate matter.

Various simple approaches are helpful to reduce the concentration of pathogen-carrying particles in rooms with no air conditioning, and some of the techniques are also applicable to air conditioned buildings. Dilution ventilation of a room can be accomplished by opening a window and turning on a fan, recognizing the outdoor air may not be free of pathogens and allergens. When outdoor air is too cold or too hot to comfortably open windows, a portable air cleaner can be used to move stagnant air around in a room and to remove airborne dust particles through a HEPA filter. House cleaning causes resuspension of dust particles that can be minimized by using a vacuum cleaner with a HEPA filter, in addition to the collection bag or dust bin, to control particle emissions. Also, dusting cloths and floor mops can be sprayed with a dust-holding aerosol to enhance their dust collection. 

*Richard A. Sullivan, PE, is a geoenvironmental consultant in Orange County, Calif.*

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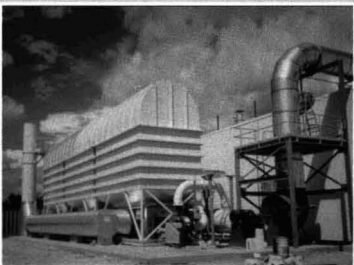
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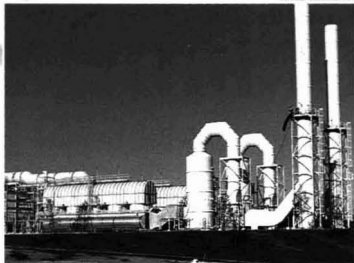
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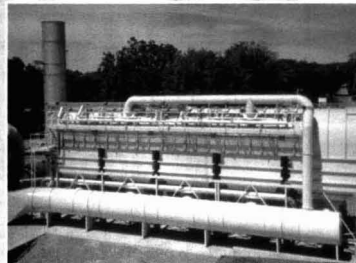
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# CLEARING UP PROBLEMS



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*Proper turbidity readings are the key to treatment efficiency and pollution control in water and wastewater treatment*

## WITH TURBIDITY TESTING

*By Ann Foster, Michael Sadar, David Gustafson and Julie Schlegel*

**T**urbidity measurement—a qualitative measure of the clarity of water or a liquid—is one of the best indicators of water quality available to any environmental laboratory or industrial testing bench. It is a significant tool for processes taking in water, such as drinking water treatment facilities; food and beverage operations; and the chemicals, manufacturing and power industries requiring high quality process water. Accurate turbidity readings help define the extent of treatment and filtration required and help control final product quality. Local or federal regulations require turbidity monitoring of wastewater treatment facilities and industrial processes discharging water to the environment, to evidence proper treatment and to limit pollution. Achieving accurate and consistent turbidity readings at very low levels requires proper instrument calibration and good testing technique.

### **What is turbidity?**

The popular analytical reference, Standard Methods for the Examination of Water and Wastewater, jointly published by the American Public Health Association (APHA), the American Water Works Association (AWWA) and the Water Environment Federation (WEF), defines turbidity as an “expression of optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample.” Turbidity does not directly quantify the suspended particles in your water; instead, it measures the scattering effects particles like microbial organisms and non-microbials, such as silt, clay, organic matter and colloids have on light.

Light scattering and the resulting turbidity measurement are affected not only by the amount of particles present but also by their size, shape and makeup. For example, light

scattering increases as particle size increases and as the difference in refractive index between the particle and the water increases. At a certain particle concentration, light scattering multiplies, and absorbance by those particles begins to occur. Although these relative dynamics may be more than you care to know about particles and light scattering in water, you will understand why certain guidelines apply to the turbidity test.

### **The measuring system**

Modern turbidity measurement methods use the nephelometer, a turbidimeter measuring scattered light with a photodetector 90 degrees to the incident light. Readings are expressed as nephelometric turbidity units (NTUs). Alternative procedures may use a colorimeter or spectrophotometer, which measures light transmitted through a sample with a detector 180 degrees to the

incident beam. The value in this case is expressed as formazin attenuation units (FAU). The different optical methods—reflectance in a nephelometer and light attenuation or absorbance in a photometer—can result in different readings, depending on the size, shape, color and refractive properties of particles in the sample. The photometer also is limited in measuring transmitted light at high or low tur-

sized from 0.01 to 10 microns, a profile that best represents the variety of natural particulates in your sample and most closely mimics the light scatter of your sample. Non-formazin alternative standards, even if accepted by EPA, do not provide this particle profile, so it is reasonable to expect a discrepancy in values when comparing their light-scattering effect to that of formazin.

Further, varying lots of formazin pro-

tering—and the resulting turbidity measurement—is linear from approximately 0.012 NTU to 40 NTU, so an accurate calibration standard used anywhere in that range will yield an accurate calibration even at levels less than 0.5 NTU. The key is to use an accurate calibration standard. The effects of instrument stray light, dilution water, volumetric transfer and contamination will likely contribute at least 0.2 NTU error when preparing a fresh formazin standard solution, even in the best of situations. Table 1 illustrates how this error increases as the targeted standard solution value decreases.

So even if you are measuring samples at 0.5 NTU or less, use a 20-NTU formazin solution to calibrate your instrument, or the standard value cited in the instrument manual. Prepared, stabilized formazin, with a 1-year stability, eliminates the need for standard preparation and likely calibration error. Recently, a method using stabilized formazin as a primary standard for turbidity measurement of water and wastewater was accepted by EPA.

Validate your 20-NTU calibration, using stabilized formazin verification standards quality-controlled to values of 0.30, 0.50 or 1.0 NTU. These verification standards are used to check your calibration but are not

## Read the nephelometer operator's manual to avoid the handling and sampling errors and the higher NTU readings that result.

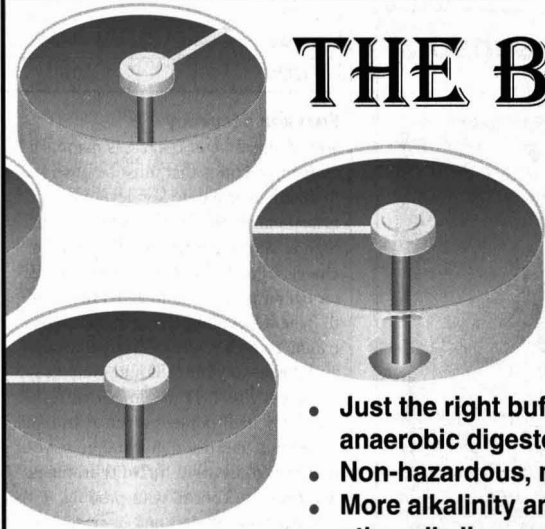
bidity levels and is not recommended for samples with less than 20 NTU.

Instruments are calibrated using standards of formazin polymer, stabilized formazin or styrene divinylbenzene copolymer beads. Most manufacturers base their nephelometer software algorithms on formazin calibration, accepted by the U. S. Environmental Protection Agency for compliance testing for more than 20 years. The formazin polymer contains a highly reproducible range of irregularly shaped particles

duce statistically reproducible nephelometric, (90-degree) scatter of white light, regardless of the make or model of nephelometer. Therefore, portable, laboratory or process nephelometers properly calibrated with formazin or stabilized formazin can provide the comparable readings you may need in the field, quality control lab or process building.

### Calibrate correctly

The relationship between particle light scat-




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used to actually calibrate the instrument. Use them often to check instrument stability, repeatability and possible lamp degradation.

Targeted calibration standard value (NTU)	Actual calibration standard value (NTU), considering a 0.2-NTU (best-case) error
20.0	20.2
2.0	2.2
1.0	1.2
0.5	0.7
0.2	0.4
Percent error	How the instrument reads a 0.3-NTU sample (NTU)
1.0%	0.303
10%	0.33
20%	0.36
40%	0.42
100%	0.6

**Further accuracy**

Your nephelometer operator's manual contains instructions that must be observed to obtain an accurate low-level turbidity measurement. Short cuts can cause falsely high readings that fall outside your discharge regulations. Read the nephelometer operator's manual to avoid the handling and sampling errors that can contribute scratches, dust, fingerprints and air bubbles to your cells and samples—and the higher NTU readings that result. Once you incorporate proper instrument calibration and testing technique in your program, those valid turbidity readings will help you control your product, improve your process and be ready for compliance when your pollution control regulator calls. **EP**

*Ann Foster is the director of Strategic Information Services, Michael Sadar is the application scientist, David Gustafson is the coordinator of regulatory affairs, and Julie Schlegel is the marketing technical writer of Hach Co. in Loveland, Colo.*

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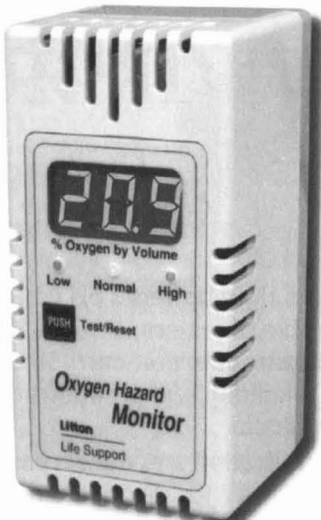


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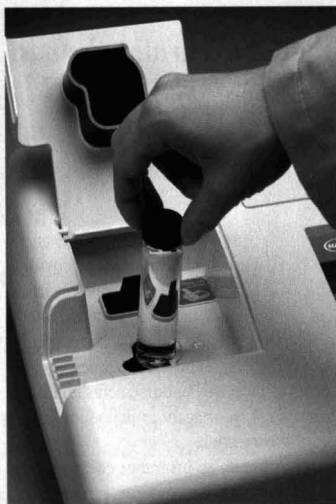
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## Safety of formazin products in turbidity measurement

Some laboratory professionals have questioned the safety of using formazin in turbidity test calibration because one of its ingredients—hydrazine sulfate—is defined as a hazardous substance by some state health agencies. However, while one of the raw materials of formazin is a suspected toxic substance, the residual of this material in final formazin and stabilized formazin products is well below pre-synthesis concentration. Further, newly available quantitative analysis and toxicity information about the final products support the fact that no shipping, handling or disposal regulations have been applied to formazin during more than 20 years' use as a primary turbidity standard. The information described here supports the fact that formazin and stabilized formazin are safe to use as primary turbidity standards. Popular analytical references, such as Standard Methods, U.S. Environmental Protection Agency Method 180.1 and American Society of Testing Materials (ASTM) Annual Book, detail the procedure for preparing stock 4,000-NTU formazin standard. Hydrazine sulfate is the limiting reagent in this well-defined synthesis reaction and, theoretically, will react completely during synthesis. Only very low residual concentrations—low parts per million (ppm)—should exist after polymer formation. Stabilized formazin products are prepared by diluting this stock formazin standard with a slightly different diluent formulation (U.S. patent number 5777011). However, quantitative analysis of hydrazine in final formazin or stabilized formazin standards, using traditional colorimetric methodology, is very difficult. Investigators with the U.S. Army Corps of Engineers detailed in a research publication released to the public in 1996 that hydrazine can be detected in water matrices ranging from distilled water to heavily contaminated wastewaters and in soil extracts using ion chromatography coupled with electrochemical detection. This methodology, applied to formazin stock solution and its dilutions by an independent investigating laboratory, shows less than 3.5 ppm exists

in finished formazin and stabilized formazin standards. The head space of formazin and stabilized formazin product bottles was evaluated using a method recommended by National Institute for Occupational Safety & Health (NIOSH) as a standard method for detecting a test article in air. Range of detection tubes was 0.2 ppm to 10 ppm hydrazine. Testing showed no positive response, indicating that hydrazine was too low to detect or



not present. Single oral dose toxicity investigation by M. B. Research Laboratory in Spinnerstown, Penn., revealed the LD50—the dose shown to be lethal to at least half of the laboratory rats given the test article—to be greater than 5,000 milligrams per kilogram of body weight. The U.S. Occupational Safety and Health Administration and Canada's Workplace Hazardous Materials Information System (WHMIS) both regulate for toxicity those chemicals with LD50 values up to 500 mg/kg. The more-stringent European Union's Classification and Packaging of Dangerous Substances regulates chemicals with LD50 values up to 2000 mg/kg. With an LD50 value greater than 5,000 mg/kg, formazin and stabilized formazin are not toxic according to OSHA, WHMIS and European Union dangerous substances regulations. These products not only provide the most accurate turbidity calibration for water analysis but also are safe to use. As with any chemical, common chemical handling practices and good laboratory procedures should be observed.

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# Premium

By Keith Cannon, ARM

# protection

*Part two in a two-part series on learning the basics about environmental insurance so you can ensure that your company receives the best coverage at the lowest price*

In our July issue, part one of this article explained the differences between surplus lines versus admitted policies, claims made versus occurrence policies, payroll versus receipts and auditable versus flat premiums.

## Minimum annual and earned premiums

These two terms are often confused. The minimum annual premium is the smallest premium insurers will charge for issuing a policy. In Exhibit 1, the quoted premium, based on projected revenues of \$3 million dollars, was \$7,500. Because the minimum annual premium was also \$7,500, there would be no return premium even if annual receipts fell below the projected \$3 million. Auditable policies often have a minimum premium equal to the quoted premium, eliminating the possibility of any return.

The minimum earned or retained premium only becomes an issue when a policy is canceled midterm. It simply is the minimum amount the insurance company will retain, regardless of how quickly an insured cancels their policy after coverage is bound. Minimum earned premiums generally range between 25 to 35 percent, and may sometimes run as high as 50 percent of the minimum annual premium. In few cases, coverage may be quoted with a 100 percent minimum earned premium when dealing with risks presenting significant short term exposures. When considering premium financing, it is important to understand the insurer's guidelines concerning midterm cancellation, as they determine the down payment amount, interest rate and available payments.

## The pollution endorsement

Insurance companies offer varying degrees

of coverage for environmental incidents. However, the extent of protection provided varies significantly. When a proposal states that pollution is included, you must determine exactly what coverage is being provided and for what exposures. Request sample copies of proposed endorsements and policies and ask your agent to define the coverage and protection.

For example, an insurance company specializing in coverage for petroleum marketers offers pollution coverage under their general liability, but only for bodily injury (BI) and third party property damage (PD). The policy excludes coverage for all remediation and excludes BI&PD for commercial

exposures, offering it only for their residential fuel oil customers. In contrast, other companies offer full pollution coverage for both commercial and residential customers. This difference could mean the difference between an insured party remaining in business or filing bankruptcy.

A pollution exclusion is a common coverage deficiency in environmental professional liability policies. While such a gap would seem obvious, it is found with surprising frequency. Many small consultants, interested only in premium savings, merely want to obtain a certificate of insurance to comply with contract bid requirements. A company would be better advised to invest

## Exhibit 1

**Insured:** ABC Environmental Services  
**Operations:** Storage tank removal and installation; remediation services  
**Receipts:** \$ 300,000 (Projected)  
\$ 300,000 (Audited)  
\$ 50,000 (Additional)

	<b>Insurance company A</b> (Surplus lines)	<b>Insurance company B</b> (Admitted)
<b>Quoted premium (rate)</b>	\$ 7,500.00 (2.5%)	\$ 7,500.00 (Flat)
<b>Policy fee</b>	\$ 150.00	\$ 0.00
<b>SL taxes (3%)</b>	\$ 229.50	\$ 0.00
	\$ 7,879.50	\$ 7,500.00
<b>Add. (Audit) premium (2.5%)</b>	\$ 1,250.00	\$ 0.00 (Flat)
<b>SL taxes Add. premium</b>	\$ 31.25	\$ 0.00 (Admitted)
<b>Final premium</b>	\$ 9,160.75	\$ 7,500.00
<b>Charge for additional insureds (2)</b>	\$ 300.00	\$ 0.00 (Blanket add. ins.)
<b>Total cost of insurance</b>	\$ 9,460.75	\$ 7,500.00
<b>Minimum annual premium</b>	\$ 7,500.00 (Auditable)	\$ 7,500.00 (Flat)
<b>Minimum earned (25%)</b>	\$ 1,875.00	\$ 1,875.00
<b>Additional insureds (each)</b>	\$ 150.00	\$ 0.00 (Blanket)

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a little more for complete protection, than to waste the premium buying a certificate for a policy providing no coverage. Some

by or on behalf of the consultant. Consultants and contractors should avoid such restrictive forms.

**A company would be better advised to invest a little more for complete protection than to waste the premium buying a certificate of insurance for a policy providing no coverage.**

professional liability policies exclude any liability from contracting work performed

### Your insurance representative

Selection of your insurance agent must focus on his or her experience in the environmental insurance market. If you already have a firm relationship with a general agent, ask him or her to seek the assistance of an environmental specialty broker. Do not assume that a representative at a bigger insurance firm is better than one at a smaller firm. An agency that advertises that it specializes in this, that and everything else, is really saying "we don't specialize in anything." Choosing an agent who writes insurance for all business puts you back to square one—dealing with a generalist.

Keith Cannon, ARM, is vice president of Morgan-Marlow Environmental Insurance, a wholesale broker located in Virginia Beach, Va., specializing in all lines of coverage and specialty programs for environmentally related business.

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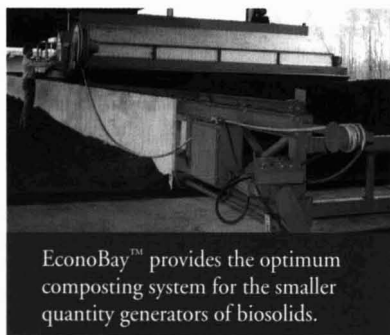
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# The next step in environmental investigations

*Computer forensics takes the investigation of environmental violations high-tech with the latest in electronic information recovery techniques*

Earl E. Devaney, Johnny Lee and Martin D. Topper, PhD

In the predawn hours, cars and trucks begin assembling in a deserted parking lot behind a fire station. The team leader gathers federal, state and local law enforcement officers together. Assignments, building diagrams and entry plans are issued to a variety of personnel wearing jackets emblazoned with the names and insignia of their agencies. Last minute checks are made of protective clothing that guards against exposure to hazardous substances. Everyone is ready to go, including the seized computer evidence recovery specialists (SCERS). The involvement of computer evidence recovery specialists is a clear signal that the investigation of environmental violations has gone high-tech.

Given the world's increasing reliance on computers to store and process data, The U.S. Environmental Protection Agency's Office of Criminal Enforcement, Forensics and Training (OCEFT) anticipated that investigations conducted by its staff would uncover altered computer records used to hide evidence of environmental violations. Therefore, OCEFT's National Enforcement Investigations Center (NEIC), located in Denver, Colo., created a team of highly skilled computer specialists trained in forensic data analysis, computer seizure and data recovery. In addition, NEIC has begun developing new tools for gathering electronic evidence of environmental violations, so that NEIC can provide state-of-the-art forensic services into the 21st century.

NEIC's Computer Forensics Team (CFT)

uses the latest information recovery techniques combined with expert knowledge of pollution control technologies to gather evidence of civil and criminal violations of environmental laws and regulations such as illegal or unpermitted discharges, falsification of continuous emission monitoring

**Using software specifically developed for law enforcement, the mirror image is run through a series of programs that produce reports that verify that the data seized was not altered during restoration and examination.**

reports and failure to perform required environmental measurements. The CFT is composed of four members who intimately understand IBM and Macintosh operating

systems, are experts in laboratory automation, and are skilled in computer network administration. The team includes computer specialists and a certified financial analyst. Some CFT members have computer experience that dates from the 1960s, and all CFTs can collect and analyze evidence from both obsolete and cutting-edge information systems. In addition, all team members have completed training courses at the Federal Law Enforcement Training Center (FLETC) and are FLETC-certified seized computer evidence recovery experts.

## **Evidence**

Obtaining evidence of environmental violations from computers can pose complex problems. These problems can be more difficult to solve than those presented by data seizures from personal computers used in typical white-collar crimes like false billing. The increased complexity arises from the fact that computers at industrial facilities, like metal plating shops, petroleum refineries or electrical power plants, are frequently integral parts of larger information systems.

These industrial computer systems can include any combination of mainframes, minicomputers and personal computers, each of which may run a variety of operating systems. In addition, they can have extremely complex control systems. Evidence of a violation may be secreted in mislabeled, deleted or otherwise hidden files stored in any component of the computer

system, including the company's computer network, the individual workstations of its employees, the interfaces between these systems or the automated systems that control industrial processes. In addition, the pollution control devices, discharge monitoring networks, laboratory instruments and the business records of the enterprise may also contain important information about criminal activity. When this is combined with the fact that many violators are skilled computer operators who are experts at manipulating data, the search for evidence can quickly become very difficult.

#### Search warrants

The key process in executing a search warrant for computer evidence involves making "mirror" images of hard drives. A mirror image is not a routine backup. It is a bit-by-bit copy that is an exact duplicate of the hard drive that contains any hidden and deleted files. Once created, the mirror image is then "streamed" onto disk drives that contain removable one gigabyte cartridges. This process is relevant to all computer data, including memory systems that support e-mail, local area networks and other network operations.

During the execution of the warrant, CFT members document the seizure process. The presence of the computers at the scene must be recorded to establish the relationship of seized data to the computers and to their operators. Such documentation includes the computer brand and model, configuration, special markings and serial number. Diagrams are created that show the locations of the seized computers and names of the users. Photographic evidence can also be useful to establish the presence of seized computers at the scene where the warrant was served. Computer users, information systems personnel and network administrators are interviewed regarding passwords, the design and use of the network operating system, the type of e-mail system and any other information that can reveal how data is stored and retrieved in the suspect's computer system.

#### Laboratory analysis

Once the mirror image of the data from the company's hard disks has arrived in the computer forensics lab, it can be restored to a clean hard drive. Using software specifically developed for law enforcement, the mirror image is run through a series of programs that produce reports that verify that the data seized was not altered during restoration and examination. Software utilities are then used to restore all recoverable deleted or erased files and to examine all areas of the disk for evidence.

When all the seized data files have been identified and recovered, the data is written to a write-once, read-many CD-ROM. The data can then be examined using a variety of software packages. Commercially available software tools enable CFTs to view and print virtually any file with full formatting intact, regardless of the application that created the file. A highly advanced search utility uses state-of-the-art techniques to quickly and accurately search any IBM-compatible PC, floppy disk or hard drive for evidence. For example, an entire hard drive can be searched, including deleted files and other hidden areas, for a specific sample number or key word.

Once the data has been transferred in the lab, a variety of techniques is available to analyze it. NEIC used "reverse engineering" in a recent case, which helps determine if recovered data is the result of an illegal simulation. For example, suppose the CFT learns that the suspect company allegedly manipulated data reports to a regulatory agency in order to create the appearance that they have remained in compliance. Upon further investigation it is discovered that the company is using a computerized system to automatically gather, analyze and report the information directly to the regu-

*Continued on page 59*

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# Putting hazardous materials in their place

Understand the options available for storing hazardous waste and feedstock chemicals

By Kristie L. Guillotte

**W**hether you deal with hazardous feedstock chemicals or hazardous waste, the storage of these materials could be disastrous if proper procedures are not followed. Numerous containers and buildings exist to accommodate storage of these materials. Before a company can decide how to store the materials, its personnel must first know and understand the laws that govern the process.

The storage of hazardous chemicals is something that almost all manufacturers face because so many raw materials are hazardous. One set of rules related to the storage of these materials is covered under the Emergency Planning and Community Right to Know Act of 1986 (EPCRA). EPCRA requires states to establish a process for developing local chemical emergency preparedness pro-

grams and to receive and disseminate information on hazardous chemicals present at facilities within local communities.

The storage of hazardous waste is regulated by the U.S. Environmental Protection Agency under the Resource and Conserva-

tion Act (RCA). Containers, such as 55-gallon drums, must be labeled with the words "hazardous waste" and include the date the waste was generated. A container made of or lined with a material that is compatible with the hazardous waste to be stored should be used.

The containers holding hazardous waste should be closed during storage, except when adding or removing waste. Do not open, handle or stack containers in a way that might rupture them, cause them to leak or otherwise fail. Inspect areas where containers are stored at least

once a week. Look for leaks and deterioration caused by corrosion or other factors.

Maintain the containers in good condition. If a container leaks, put the hazardous waste in another container. Do not mix incompatible wastes or materials unless precautions are taken to prevent

**The storage of hazardous chemicals is something that almost all manufacturers face because so many raw materials are hazardous.**

tion Recovery Act (RCRA), which is set out in 40 *Code of Federal Regulations (CFR)* parts 260 through 299.

#### **Storing waste**

EPA requires hazardous waste to be stored according to specific guidelines. Contain-

certain hazards, such as reactivity that leads to explosions or auto-ignition.

Aboveground storage tanks (ASTs) must also be labeled with the words "hazardous waste." Use ASTs to store waste that will not cause a tank or its inner liner to rupture, leak, corrode or fail. Tanks that have an automatic waste feed should have a waste feed cutoff system or a bypass system for use in the event of a leak or overflow. Discharge control and monitoring equipment and the level of waste in uncovered tanks must be inspected at least once a day. Inspections for

ignitable or reactive wastes, use the National Fire Protection Association's (NFPA) buffer zone requirements. These requirements specify distances considered to be safe buffer zones for various ignitable or reactive wastes and can be found on the Internet at [www.nfpa.org](http://www.nfpa.org). Two feet of freeboard—space at the top of each tank—in uncovered tanks should be provided, unless the tank is equipped with a containment structure, a

drainage control system or a stand-by tank with adequate capacity.

### Locking up chemicals

Containment, fire protection and segregation are the most important aspects of a sound hazardous chemicals management program, according to Mark G. Roer, sales manager of Haz-Stor®, a division of Justrite Mfg. Co. These factors help in the selection of the appropriate

locker for storing, accumulating or dispensing such chemicals.

"Choosing a hazardous materials storage locker depends on four primary factors,"



Roer said. The first is the volume of the chemical involved. Lockers usually have the capacity to hold two to six 55-gallon drums or can be custom designed to hold more. The size of the containment sump depends upon the volume of the chemical stored. For example, two drums with 55-gallon capacity have a 60-gallon sump capacity and exceed EPA requirements. The second factor to consider is the type of chemicals being used and whether they are flammable, combustible, corrosive or toxic. The characteristics of the chemical determine the spe-

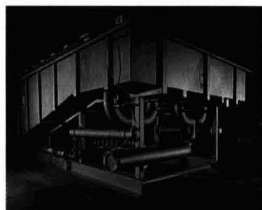


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leaks and other problems should be done weekly. For covered tanks containing

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cific construction features required in the lockers. The chemical application is another issue to consider. For generators of hazardous waste, lockers assist in a compliance program while the waste is on site. When storing virgin materials, specific construction features are required for the more dangerous situation of dispensing certain chemicals. The final factor to consider is the specific outdoor location of the hazardous materials storage locker. Local codes dictate where to place a locker depending on the type of construction. States usually follow one of two codes—NFPA Code 30 or the Uniform Fire Code (UFC) article 79, 80.

When flammable and combustible liquids are stored, minimum distances are required for locating the locker in relationship to other structures. Both NFPA and UFC have established standards to mandate minimum distance needed from a property line, public way or building on the same property. NFPA also specifies through Standard 30 that lockers should not exceed 1,500 square feet in gross floor area and include a spill containment system to prevent the flow of liquids from the structure under emergency conditions. The containment system should have sufficient capacity to contain 10 percent of the volume of containers allowed or

the volume of the largest container, whichever is greater.

#### Constructing buildings

No two manufacturers will design the same kind of hazardous storage building, but there

buildings are gaining in popularity. These buildings should be designed for the storage of Class I, II and III flammable and combustible materials and have a 2-hour bidirectional fire-rated structure that complies with UL Classification U425. Some other fea-

**The containment system should have sufficient capacity to contain 10 percent of the volume of containers allowed or the volume of the largest container, whichever is greater.**

are certain structural components that should be found on all hazardous materials storage buildings. These features include 10-, 12- and 14-gauge steel construction, secondary spill containment sump, steel or aluminum grate flooring, three-point keyed latch, exterior static ground, interior surfaces coated with chemical-resistant epoxy and seismic tie-down pads.

Fire-rated hazardous materials storage

tures to look for in a fire-rated building that makes storage safer include 1-hour fire-rated doors, which are UL classified and have UL listed frame and hardware, gravity ventilation system with UL classified fire dampers and hazard labeling—U.S. Department of Transportation placards or NFPA 704 rating signs.

Safety Storage manufactures a building designed for the storage and handling of compressed gas cylinders. The Model

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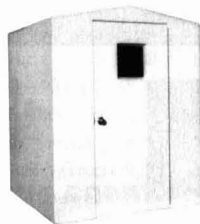
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Climate-controlled hazardous storage materials are also proving to be beneficial in climates that are excessively hot or cold. These buildings are more diverse and require a custom design, according to Ken Wilkins, Safety Storage vice president of sales.

"There really isn't one package in climate controlled buildings to suit all users' needs," Wilkins said. "It depends on many factors, such as the hazardous material to be stored, the outdoor temperature and climate in the area where the building will be located and the size of the building."

Wilkins also said the trend among most manufacturers is to use air conditioners and fan-forced or convection heaters with a built-in thermostat. Many also have outdoor thermostats. This helps them regulate the building's temperature, so it is at the proper level to coincide with its environment. In extremely cold climates, the ceiling, floor,

walls and door of the building is usually insulated to help maintain the proper temperature for the material being stored.

Many accessories that are available for hazardous materials storage buildings make the process of storing raw chemicals or waste easier. The containment shelves designed by Shields Environmental contain a sump to catch any leaks that might occur, a continuous 2-inch lip to prevent articles from falling and a drain with a cap to allow drainage from shelves. Ideal Environmental Products and Services manufactures platforms that hold anywhere from one to 48 drums. The platforms are constructed using 10-gauge HRS and painted with chemical-resistant epoxy paint. These platforms can be used inside the storage building. Most manufacturers offer these types of accessories with the same features.

The range of hazardous storage materials is vast. Shopping for a hazardous storage container, tank or building has become easy because the market has grown and the options are available. Educating yourself about the laws governing hazardous storage and being knowledgeable about the features storage products contain is the best place to start when putting hazardous materials in their place. **EP**

Kristie L. Guillotte is an assistant editor for Environmental Protection magazine.

## Information and help lines

If you deal with the storage of hazardous materials, keep these phone numbers handy. Information and help are available by calling these numbers.

- RCRA 800-424-9346
- Superfund and EPCRA 800-535-0202
- National Response Center 800-858-7378
- Chemical Transportation Emergency Center (CHEMTREC) 800-424-9300
- Hazardous Waste Ombudsman 800-262-7937
- Office of Hazardous Materials and Transportation 202-366-4488
- U.S. EPA Headquarters Library, Hazardous Waste Collection Database 202-260-1355
- Occupational Safety and Health Administration 800-321-6742
- U.S. Consumer Product Safety Commission 800-638-2772

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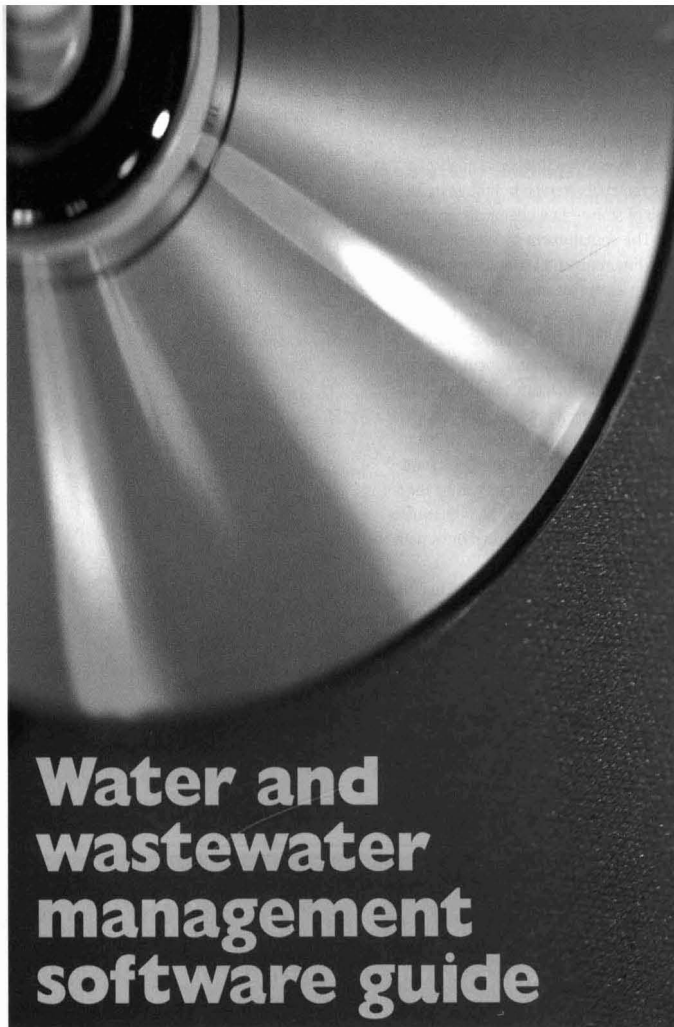
- ◆ Cited as a primary calibration standard in Hach Method 8195, an acceptable version of EPA Method 180.1
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# Water and wastewater management software guide



**A V Systems Inc.**  
4657 Platt Rd.  
Ann Arbor, MI 48108  
(734) 973-3000

**Product name:** MIRS™

**Features:** Stormwater management, groundwater management, drinking water, wastewater, water quality, parameters, permit tracking, reporting and demo.

**Description:** Manages outfalls, permit parameters, parameter limits and test data for pretreatment, industrial water, wastewater or stormwater permits. Tracks analytical sample results for discharge calculation. Generates daily, monthly and annual discharge monitoring reports, trend analysis and many other reports. Produces annual release summary to water for Form R.

**Circle 176 on card.**

**Bureau of National Affairs Inc.**  
1231 25th St. NW  
Washington, DC 20037  
(800) 372-1033

**Product name:** BNA's CSCD

**Features:** Wastewater, permit tracking, monitoring and reporting

**Cost:** Between \$500 and \$1,000

**Description:** Provides practical discussions and step-by-step guidance in plain English for federal and state regulations covering air, water and waste.

**Circle 177 on card.**

**Computational Mechanics Inc.**  
25 Bridge St.  
Billerica, MA 01821  
(978) 667-5841

**Product name:** Hydrotrack

**Features:** Modeling and demo.

**Cost:** \$1,490 for full version and \$375 for starter pack

**Description:** Produces water current and pollutant transport models.

**Product name:** Oiltrack

**Features:** Modeling and demo.

**Cost:** \$1,490 for full version and \$375 for starter pack.

**Description:** Oil spill trajectory simulation software.

**Product name:** Transport Analysis

**Cost:** \$506

**Description:** Solves transport equations using the boundary element method.

**Product name:** PRISE

**Features:** Parameters and modeling.

**Cost:** \$690

**Description:** Calculates air or waterborne effluent dispersion.

**Circle 178 on card.**

**Dakota**  
Decision Support Software

**Dakota Software Corp.**  
7 Tobey Village Office Park  
Pittsford, NY 14534  
(716) 381-8710

**Product name:** Dakota Auditor

**Features:** Stormwater management, groundwater management, drinking water, combined sewer, overflow, wastewater, water quality, demo, regulation updates and auditing.

**Cost:** \$995

**Description:** Dakota Auditor is an expert system combining a powerful auditing tool with a comprehensive regularly updated information resource. Using Decision Tree Logic, it builds a regulatory profile of a facility and produces targeted checklists that are specifically applicable to individual facilities. It captures and tracks comments, findings and corrective actions, prints customized reports and trains personnel. The program covers federal and state requirements with regular updates and conforms to ISO 14000.

**Circle 179 on card.**

**EcoAnalysis Inc.**  
221 E. Matilija St. Ste. A  
Ojai, CA 93023  
(800) 646-1461

**Product name:** EcoDB

**Features:** Stormwater management, groundwater management, parameters, permit tracking, monitoring and reporting.

**Description:** EcoDB is an environmental data warehouse system that handles diverse data types. Features include data entry and loading routines, queries, QA/QC, graphics, links to third party software systems, metadata and more, tailored to specific needs.

**Product name:** LabTRAQ

**Features:** Stormwater management, groundwater management, drinking water, combined sewer, wastewater, water quality, parameters, permit tracking, monitoring and reporting.

**Description:** LabTRAQ is a full-featured laboratory information management system. It automates data handling, such as sample, work assignment analysis, QA/QC, instrument and reporting, for water, wastewater and environmental laboratories.

**Product name:** Pretreatment Information Management System (PIMS)

**Features:** Stormwater management, drinking water, overflow, combined sewer, wastewater, parameters, permit tracking, monitoring and reporting.

**Description:** PIMS automates industrial pretreatment program operations such as monitoring, permitting, compliance and reporting.

Circle 180 on card.



**Essential Technologies Inc.**  
1401 Rockville Pike Ste. 500  
Rockville, MD 20895  
(800) 999-5009

**Product name:** PlantWare 32 Water

**Features:** Stormwater management, groundwater management, drinking water, combined sewer, overflow, wastewater, water quality, parameters, permit tracking, monitoring, modeling, reporting and demo.

**Cost:** Varies

**Description:** PlantWare 32 water is an integrated system that combines sample tracking, calculations and permit requirements with the ability to generate regulatory and corporate reports.

Circle 181 on card.

**Fourth Dimension Interactive,**  
a Dames & Moore Group Co.

221 Main St. Ste. 600  
San Francisco, CA 94105  
(415) 896-5858

**Product name:** EMIS 2.0

**Features:** Storm water management, groundwater management, drinking water, combined sewer, overflow, wastewater, water quality, parameters, monitoring, modeling, reporting and demo

**Description:** EMIS 2.0 runs against a back-end Oracle or SQL server database and is entirely Web-based. It incorporates features that allow Internet and intranet access to corporate-wide environmental data.

Circle 182 on card.

**Hyprotech**  
2000 Oxford Dr. Ste. 610  
Bethel Park, PA 15102  
(412)833-4820

**Product name:** EpSelson

**Features:** Wastewater, modeling and demo

**Cost:** Starts at \$6,500

**Description:** EpSelson provides conceptual design, equipment selection and troubleshooting of wastewater treatment systems. Access search routines and live equations are featured, as well as an expert system and costing module designed to provide information to solve wastewater treatment problems.

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**J.J. Keller & Associates Inc.**  
**3003 W. Breezewood Lane**  
**Neenah, WI 54957-0368**  
**(800) 327-6868**

**Product name:** Keller-Soft EHS Advisor

**Features:** Reporting and demo  
**Cost:** \$279

**Description:** Encyclopedia approach to regulatory and non-regulatory EHS concepts.

**Circle 184 on card.**



**KNEX Inc.**  
**5570 Sterrett Pl. Ste. 208**  
**Columbia, MD 21044**  
**(410) 964-9900**

**Product name:** iKNEX

**Features:** Stormwater management, groundwater management, drinking water, wastewater, water quality, parameters, permit tracking, monitoring, reporting and demo.

**Cost:** Less than \$1,000

**Description:** iKNEX is a net-based auditing, self-assessment and issues tracking software that includes audit protocols and regulatory references.

**Circle 185 on card.**

**Knorr Associates Inc.**  
**10 Park Place**  
**P.O. Box 400**  
**Butler, NJ 07405**  
**(973) 492-8500**

**Product name:** DataPipe™

**Features:** Groundwater management, drinking water, wastewater, water quality, parameters, permit tracking, monitoring, modeling, reporting and demo.

**Cost:** Varies by model and users

**Description:** DataPipe is a comprehensive, modular, multi-user Windows-based program for collecting and managing environmental, safety and occupational health information. Depending on the modules a customer chooses, a DataPipe system can perform one recordkeeping and reporting function or many different tasks. Additional modules can easily integrate with existing DataPipe systems as requirements grow. DataPipe can store images as well as conventional data. Major environmental modules include MSDS, NPDES, storage tanks, waste manifests, emissions, chemical inventory, permits, incidents and IH samples. The system can be connected to supported instruments for direct data transfer.

**Circle 186 on card.**



**LFR Technologies**  
**225 S. Cabrillo Hwy. Ste. 102-D**  
**Half Moon Bay, CA 94019**  
**(650) 712-7470**

**Product name:** GreenSuite

**Features:** Stormwater management, groundwater management, drinking water, combined sewer, overflow, wastewater, water quality, parameters, permit tracking, monitoring, modeling, reporting and demo.

**Cost:** Varies

**Description:** The 100-percent Web-based system integrates environmental management, safety, industrial hygiene and occupational medicine into a single enterprise business solution that addresses the extended supply chain. GreenSuite is Year 2000 compliant.

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- dissolved oxygen
- sp. conductance
- conductivity
- turbidity
- salinity
- resistivity
- TDS
- redox
- ammonium
- ammonia
- depth
- vented level
- total dissolved gas
- nitrate
- chloride
- ambient light (PAR)
- transmissivity
- chlorophyll A
- barometric pressure
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**Modern Technologies Corp.**

33 W. First St. Ste. 300  
Dayton, OH 45402  
(937) 226-7724

**Product name:** Enviro-Office<sup>®</sup>

**Features:** Stormwater management, waste water, parameters, permit tracking, monitoring, reporting and demo.

**Cost:** More than \$1,000

**Circle 188 on card.**

**Pacific Environmental Services Inc.**

5001 S. Miami Blvd. Ste. 300  
P.O. Box 12077  
Research Triangle Park, NC  
27709-2077

(919) 941-0333

**Product name:** i-STEPS

**Features:** Stormwater management, groundwater management, wastewater management, parameters, permit tracking, monitoring, modeling, reporting and demo.

**Cost:** \$2,000, varies by user type

**Description:** i-STEPS infinity is a Windows software application that manages environmental data for facilities that produce wastewater effluent loadings and solid and hazardous waste. The i-STEPS design assists users with waste management according to the RCRA and wastewater tracking under the NPDES regulations. Additional i-STEPS features include periodic tracking, estimation, placement and control of these media, standard and user-specific calculations, and many standard forms to meet regulatory requirements.

**Circle 189 on card.**

**RegScan**

One Executive Plaza  
330 Pine St. Ste. 300  
Williamsport, PA 17701-6215  
(717) 323-1010

**Product name:** RegScan

**Features:** Demo

**Cost:** \$500 to \$1,000

**Description:** State and federal EHS regulations.

**Product name:** RegScan Live!

**Features:** Demo

**Cost:** \$100 to \$500

**Description:** State and federal EHS regulations on the Internet.

**Circle 190 on card.**

**Serac Technology**

2817 West End Ave. Ste. 127-107  
Nashville, TN 37203  
(888) 343-6355

**Product name:** Introduction to Industrial Wastewater Management 1.0.

**Features:** Wastewater, water quality, parameters and monitoring.

**Cost:** \$224

**Product name:** The Design and Operation of the Activated Sludge Process for Industrial Wastewater.

**Features:** Wastewater, water quality and demo.

**Cost:** \$259

**Circle 191 on card.**

**SOLUTIONS Software Corp.**

1795 Turtle Hill Rd.  
Enterprise, FL 32725  
(407) 321-7912

**Product name:** 50-Title

**Features:** Demo

**Cost:** \$62.50

**Description:** 50-Title is a CD-ROM set that includes CFR Titles 1 through 24 at 1998 revision levels and the rest of the CFR Titles at 1997 revision levels. Adobe Acrobat 3.01 Reader+Search software for instant search and retrieval is included on the Windows, Mac and UNIX versions.

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# Juicing up compliance audits

*At Ocean Spray, computerized audits systematize compliance and encourage the participation of facility personnel*

By Arlene Davidson

**“W**e’re all in this together.” That’s how Herb Hohn, manager of regulatory affairs of Ocean Spray Cranberries Inc. describes his department’s philosophy. Managing risk and identifying gaps are challenges and responsibilities shared by staff at all facilities. That was not the case when Hohn arrived at Ocean Spray in 1989. While audits had been performed, they were not systematized. Audit protocols did not match every compliance area at Ocean Spray and were inconsistently applied from one location to another. Hohn knew the audit program was in need of modification.

Hohn oversees environmental, health and safety (EHS) regulatory compliance at all cranberry receiving stations and processing plants in eight states plus British Columbia. With over \$1.4 billion in revenues, Ocean Spray grapples with more than just washing cranberries and pressing them into juice. Wastewater treatment, Clean Air Act impacts, Emergency Planning and Community Right-to-Know (EPCRA) reporting and major Occupational Safety and Health Administration compliance are part of the broad range of Ocean Spray’s EHS issues.

## **Getting started with audit software**

As part of implementing a more rigorous

compliance program, Hohn felt that computerizing Ocean Spray’s audits would transfer a systematized technology across the entire EHS network in addition to enhancing the sense of teamwork critical to maintaining EHS standards. With strong support from the vice president of manufacturing, Hohn entered into an outsourc-

and observations via conference calls. By the end of the year, all staff integral to the program were exposed to a real-life audit implementation of the system. Including non-EHS staff in Dakota Auditor training and orientation was key to integrating EHS ownership into Ocean Spray’s production process. The software was fully in place in



PHOTO COURTESY OF OCEAN SPRAY CRANBERRIES INC.

**Ocean Spray grapples with wastewater treatment, Clean Air Act impacts, and Emergency Planning and Community Right-to-Know reporting.**

ing agreement with Dakota Software and implemented Dakota Auditor at each one of the plants in early 1996. Initially, each location practiced conducting an actual audit of the same subject, like EPCRA or Hazard Communication, sharing comments

1997 and provides in-depth checklists for essentially every federal EHS issue affecting Ocean Spray’s interests. The questions on the screen look just like printed checklists, which facilitates training. Additional questions can be added to the checklist or exist-

ing ones can be annotated.

The software's reference library, linked to each checklist question from the audit and covering federal and state regulations, is written in easy to understand language. Hohn considers the reference library as an "electronic coach" that accompanies his team throughout the audit process. The program's environmental modules cover all aspects of waste management, air emissions, water discharges, hazardous materials transportation, Toxic Substances Control Act, EPCRA and other pertinent issues. The industrial hygiene and safety modules cover the OSHA general industry standards, including exposures to hazardous substances, radiation and noise; the physical protection of workers; equipment safe-

to look only at questions that are pertinent to the issue.

### Benefits of systemization

Currently, every manufacturing plant has agreed to perform a certain number and sequence of self-audits and submit those reports to the assistant general counsel at the corporate office. The positive acceptance of the self-audit program has enabled constant moni-

rate visits that occur just every 2 years. Plant personnel know that the corporate staff, who help them manage risk, receive

supportive, continuous feedback and positive interaction. When preparing for a corporate audit, as a courtesy to those involved and so that

everyone understands in advance what the questions and issues are, Hohn sends a

custom checklist from his corporate office to the facilities. By sending it ahead of the audit, the staff develops a more in-depth understanding of the regulatory issues and why they are integral to business operations.

Generally, sending ahead the checklist also avoids surprises and a confrontational

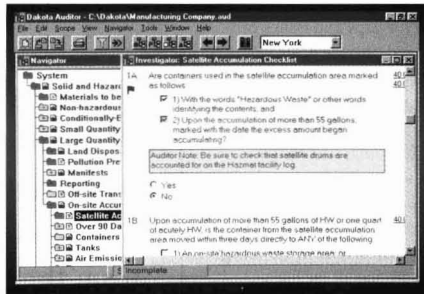


PHOTO COURTESY OF DAKOTA SOFTWARE CORP.

**Use of a common audit software tool between corporate and facility personnel has enabled more continuous monitoring of problem areas and effective communication without constant reliance on corporate visits and input.**

guards; medical records; and emergency response plans. The system enables the user

toring of program areas and EHS subjects year round without total reliance on corpo-

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atmosphere. At the plant, data is entered into the program to be analyzed. Hohn stresses that the audit teams look as hard for innovative, praiseworthy EHS developments as they do for gaps and issues of non-compliance and provide positive feedback to the facilities at every opportunity. Activities like well-organized centralized EHS filing systems, innovative examples of machine guarding, successful replacement of a solvent with a non-hazardous alternative to reduce the plant's hazardous waste stream and examples of strong employee involvement are recognized and shared among all facilities. Using the same software tool on all audits throughout the company systematizes and standardizes the process. It is also an effective learning and training tool and communication improves among the people actually doing the work—electricians and maintenance employees. Effective teamwork, an expanded knowledge base, better trained in-house managers and increased awareness of plant responsibilities have given managers greater confidence and autonomy. In fact, some career changes have occurred as a result of integrating the software, as some production staff have become EHS specialists.

With the software program in place at the plant level, the corporate team is able to focus more on management systems throughout the company. Use of a common

**The software's reference library, linked to each checklist question from the audit and covering federal and state regulations, is written in easy to understand language.**

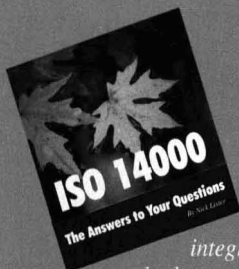
audit software tool between corporate and facility personnel has enabled more continuous monitoring of problem areas and effective communication without constant reliance on corporate visits and input.

Hohn credits Dakota Auditor and its effective use by plant EHS leadership for non-EHS employees' expanded awareness and ownership behavior. As a result, Ocean Spray has moved toward greater reliance on self-audits and has found that they have reduced external audit compliance fears as well as EHS risk. The systematic approach among EHS teams supported by the software and the sharing of positive innovations that have led to compliance improvements have allowed the corporate group to move away from managing regulatory details to focus on systems rather than symptoms. Reviewing corrective action plans guides Ocean Spray to identify why a deficiency may be occurring, rather than just fixing it. Ocean Spray's auditors have enhanced their efficiency and added value to the audit process by encouraging the participation of facility personnel. By computerizing its audit system, Ocean Spray increased the strong employee involvement critical to maintaining EHS compliance and reducing risk. **EP**

*Arlene Davidson is marketing director at Dakota Software Corp., Pittsford, N.Y.*

**For more information circle 89 on card.**

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ORLANDO



# WEFTEC '98 heads to Orlando

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*Compiled by Kristie L. Guillotte and Ingrid Truemper*

Sunny Orlando will play host to the 71st Annual Water Environment Federation Conference & Exposition October 3 through 7. The WEFTEC '98 Expo, one of the world's largest assemblies of wastewater and water quality products and services, will showcase the latest developments of more than 700 companies. Due to popular request, the Expo will open on Sunday, October 4, for a special Expo preview. Opening hours will be later than last year, extending to 5 p.m. each day.

When planning your schedule for Orlando, allow ample time to take advantage of the opportunity for one-on-one exchange with the many knowledgeable industry manufacturers, consultants and contractors who will be in attendance. Located in halls A1 to B3 of the Orange County Convention Center, the Expo is near the technical sessions and committee meetings.

By using your WEFTEC '98 Expocard, you can pinpoint those exposition companies that match your interests. Insert your Expocard into any reader located in the registration area at the WEF Message Center and enter the product categories that you want to see to receive a printout of those companies and their locations. Your Expocard can also be used to place your name on a manufacturer's mailing list or to place an order.

Special events at WEFTEC '98 open to all participants include a luncheon with David Brinkley, WEFTEC for Families activities,

WEF Night at Universal Studios Florida, AAEE/AIDIS/WEF Breakfast, Operations Challenge, 4th Annual WEFTEC for Teachers, the U.S. EPA Wastewater Management Excellence Awards Ceremony, the WEFTEC '98 Golf Tournament and the AEEP/WEF Scientists' Luncheon. Capping the end of WEFTEC is the annual dinner dance.

An extensive technical program is offered to participants, who can also choose from nine of the Orlando area's facility tours designed to complement WEF technical sessions. Twenty-four conference workshops will be held on Saturday and Sunday, October 3 and 4. The Water Environment Research Foundation (WERF) is also sponsoring several workshops on October 3 and 4. International programs include an international workshop, international technical sessions, an international buyer program and the WEFTEC '98 Global Business Center.

To help you take advantage of Orlando's many tourist attractions, the Local Arrangements Committee has a booth located in Exhibit Hall B1 near registration. Additionally, WEFTEC '98 offers the Lifestyle Program for guests of attendees, which features discounted tickets to Walt Disney World, a tour of the Kennedy Space Center and more.

For more information about WEFTEC '98, call (800) 666-0206, e-mail [expoinfo@wef.org](mailto:expoinfo@wef.org) or visit the conference's Web site at [www.wef.org/docs/weftec98.html](http://www.wef.org/docs/weftec98.html).

## Spectrophotometer



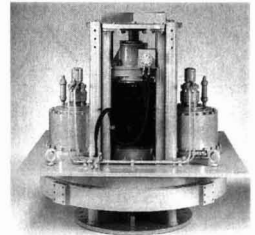
The Hach DR/4000 UV-VIS Spectrophotometer enables repetitive testing. Software improvements include: storage for customized instrument setups; selectable dilution factor for use with any program; erasable data points; text or tabular print format selection; and more. **Hach Co.**  
**Circle 157 on card.**

## Pumps



Vanton Pump & Equipment Corp. is offering close-coupled, compact centrifugal pumps with all fluid contact parts of chemically inert thermoplastics. The design can be furnished in unpigmented polypropylene or polyvinylidene fluoride. The pumps are rated for flows to 550 gpm at heads to 220 feet. **Vanton Pump & Equipment Corp.**  
**Circle 158 on card.**

## Drive unit

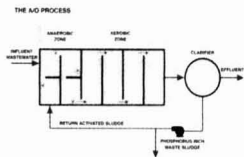


The Model DHL-60-20-2 drive unit includes a high-capacity, precision-bearing integral with a forged alloy steel gear enclosed in a durable fabricated steel housing. All reducers that make up the drive unit are directly coupled. The primary reducer is hydraulically driven to ensure load balancing between the pinion drive gearboxes. **DBS Mfg.**  
**Circle 159 on card.**

## Aerators

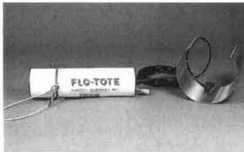
ChannelAire™ Systems are submersible units with the power to achieve oxygen transfer requirements in an area of influence up to 525 feet in diameter without remote-blower systems. Direct-drive stainless steel turbine impeller and macerating blades mix turbulently. Features include low noise, low energy use and moisture detection system. **ABS/Framco Environmental Technologies.**  
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## Nutrient removal



Krüger's A/O® Process is a wastewater treatment process that uses an anaerobic selector to cultivate a selective biomass naturally recurring in biological treatment plants. The biomass stores BOD anaerobically and assimilates phosphorus in a subsequent aerobic phase. **Krüger Inc.**  
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## Flowmeter



The Flo-Tote™ II Portable Electro-

magnetic Open Channel Flowmeter features a robust, non-fouling sensor; Auto-Cal™ to eliminate the need for site calibration in most cases; a Q-Stick™ band-sensor insertion tool for no-manhole-entry installations; and an ATC Level™ to compensate for variations in temperature. **Marsh-McBirney Inc.**  
**Circle 162 on card.**

## Suspended solids analyzer



The Model 7011 turbidity/suspended solids continuous monitoring instrument with full sensor line, and the Model 711 portable MLSS/MLA analyzer system are certified to completely

fulfill European Community (CE) certifications standards for electro magnetic compatibility. **Royce Instruments Corp.**  
**Circle 163 on card.**

## Drainage pump



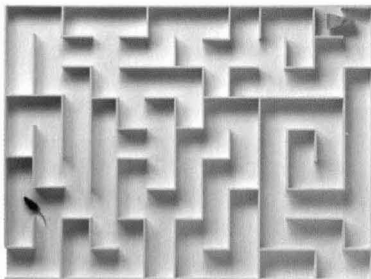
The PX30N drainage pump is capable of handling 10,000 gpm, 24 hours a day. It also offers easy on-site installation. Thermal overload and leakage protection monitors assure problem-free pumping. A 10-inch output discharge facilitates the movement of massive

amounts of water. **Pumpex Inc.**  
**Circle 164 on card.**

## Chlorine sensors



The GT Series of chlorine sensors can detect up to four gases. The liquid inhibiting probe attachment prevents damage to the sample system by automatically shutting the pump off and sounding a low flow alarm if liquid or water is aspirated. **GasTech Inc.**  
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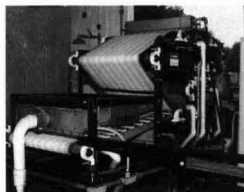
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### Vertical centrifuge

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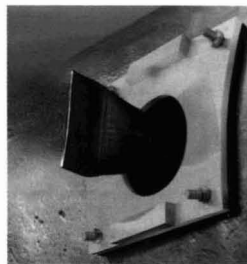
vertical centrifuge is suited for applications requiring containment of a process from the atmosphere including flammable, toxic, carcinogenic or pyrophoric materials. Operates at temperatures up to 700 degrees Fahrenheit and pressures from vacuum to 150 psi. **Alfa Laval Separation Inc.**  
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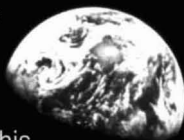
nents, standard machines and custom equipment originate. **Osmonics.**  
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Continued from page 43

latory agency through the Internet.

How could the company manipulate the data if the reporting is directly through the computer system without human intervention? The computer system could be running a simulation. Reverse engineering can uncover a simulation by dissecting the computer code to analyze the process the computer is performing and the mathematical calculations performed by the code. Reverse engineering can also help determine which processes and calculations the computer code is not executing.

#### Future challenges

The problem of determining data integrity grows daily as computer systems become larger and more complex. The continuous emissions monitoring (CEM) operation and reporting program under the Clean Air Act is an example. CEM data is tracked and electronically reported to EPA by the regulated facility using a variety of commercial software programs. NEIC is working to develop methods that will verify the validity of CEM data, as well as verify whether the computer is properly monitoring operating conditions at the facility.

Detecting breaches of security is another

concern. For example, the team investigating an alleged accidental spill at a chemical plant suspects that the spill was intentionally caused by a disgruntled employee who sabotaged a critical process control valve.

### NEIC used "reverse engineering" in a recent case, which helps determine if recovered data is the result of an illegal simulation

Further investigation determines that the plant is highly automated and the valve is completely controlled by the company's computer system. To find out if the computer's security has been breached, the investigator will need to access the computer system logs. NEIC is developing methods to

search the logs to determine if the spill was accidental, the result of a system malfunction, caused by a disgruntled employee or the act of a computer hacker who gained unauthorized access.

The increasing importance of automated information systems has created the opportunity for environmental and other violators to use new and more complex methods for hiding the evidence of illegal activities. Forensic experts at EPA's NEIC are working together with others in law enforcement to develop techniques for gathering and analyzing electronic evidence that will ensure that violators will not succeed in hiding evidence of their transgressions in the darkest recesses of cyberspace. **EP**

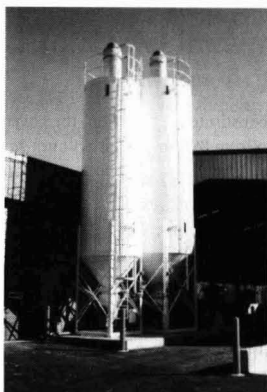
*Earl E. Devaney is the director of EPA OCEFT. Before coming to EPA he developed the computer forensics program at the U.S. Secret Service. Johnny Lee is a computer specialist and computer forensic analyst who is the leader of the NEIC computer forensics team. Martin D. Topper, PhD, is an environmental protection specialist on the staff of EPA's office of criminal enforcement, forensics and training.*

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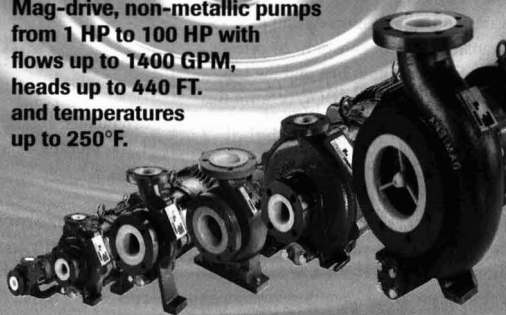
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# Avoiding the jailhouse blues

*Individual employees are now being targeted for criminal prosecution as federal environmental enforcement increases*

By James E. Meason, JD

**T**he U.S. Environmental Protection Agency's latest statistics reveal two startling trends in environmental enforcement: an increased resort to criminal prosecutions, and the specific targeting of individual company employees, rather than the company itself, for environmental crime prosecutions.

In fiscal year 1996, criminal cases accounted for 10 percent of all federal environmental cases. Over the past 5 years, the federal government's criminal enforcement efforts have almost completely shifted to target company employees instead of companies. About 75 percent of criminal pleas or guilty verdicts in 1995 and 1996 came against individual company employees as compared with roughly only 20 percent in 1991. Sources within EPA and the U.S. Department of Justice (DOJ) confirm that the 1995 and 1996 statistics are not flukes.

## **Fiscal year 1996 criminal enforcement statistics**

In all respects, 1996 appears to have been another profitable year for criminal environmental enforcement—the federal government assessed \$77 million in criminal penalties. EPA initiated 548 cases and referred 262 cases to DOJ; the previous

high referral marks were 256 in 1995 and 220 in 1994. Of these 262 cases, 221 corporate and individual defendants were indicted; 107 individuals plead guilty or were convicted, as were 33 corporate

criminal indictment, trial, conviction and the possibility of a hefty fine and jail time, forces individuals to pay greater heed to environmental laws and regulations. Given the stigma attached to a criminal conviction,

**The change in enforcement emphasis is directly attributable to the government's belief that the threat of a criminal indictment, trial, conviction and the possibility of a hefty fine and jail time, forces individuals to pay greater heed to environmental laws and regulations.**

defendants; and sentencing constituted 1,160 months of jail time, up from 890 in 1995.

## **The government's rationale behind criminal enforcement**

Conversations with EPA and DOJ representatives reveal that the change in enforcement emphasis is directly attributable to the government's belief that the threat of a

conviction, the government hopes that individuals will not simply shrug off a regulatory violation as only the company's potential liability.

EPA cites the 1990 enactment of the Pollution Prosecution Act as the muscle behind this enforcement trend. The law effected many changes in the agency's criminal enforcement program, including increasing the ranks of criminal inspectors to 200 by

**EPA criminal enforcement FY 1982 through FY 1996**

Action	Fiscal Year														
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Referrals to DOJ	20	26	31	40	41	41	59	60	65	81	107	140	220	256	262
Defendants charged	14	34	36	40	98	66	97	95	100	104	150	161	250	245	221
Months sentenced	0	0	6	78	279	456	278	325	745	963	1,135	892	1,188	888	1,116



October 1, 1995. As recently as 1991, there were only 62 agents. As of November of 1996, the agency employed 170 agents and planned to hire 20 more in 1997. In spite of this bulking up of enforcement personnel, there actually has been a net loss of two attorneys with EPA's Criminal Investigation Division since the passage of the Pollution Prosecution Act, thereby impeding, to some extent, the growth in criminal enforcement efforts.

### Protect yourself - know the law

While the overwhelming majority of environmental cases are civil or administrative in nature, the threat of criminal enforcement actions, which in 1996 accounted for 10 percent of all federal cases, is significant. Therefore, anyone associated with a company's operations and management activities should understand how the law views personal criminal liability.

Generally speaking, in the event that civil litigation arises over any particular business activity, a company officer or employee who acted within the scope of his or her company authority will not be personally liable for that business activity—any liability will attach to the company itself. Moreover, a company will be responsible for the criminal acts of its officers and employees who act within the scope of their employment. For example, a paper manufacturing company employs a loading dock supervisor to manage its outbound customer shipments. The supervisor's purposeful placement of a bomb in a shipment to a company customer most likely will not subject the employer to criminal sanctions, because placing bombs in shipments of paper is not within the scope of the supervisor's employment. Instead, the supervisor will probably face criminal prosecution.

The courts have established theories under which company officers and employees can be held criminally responsible for their actions. In the 1943 U.S. Supreme Court case of *U.S. vs. Dotterweich*, the court published what has become known as the "responsible relation" theory of criminal responsibility. The small company repackaged and relabeled drugs to sell through mail orders. The government charged the drugs were misbranded and adulterated.

Although the government neither alleged nor proved that the company president himself knew the facts or participated in the distribution of the drugs, the court held criminal responsibility attached to the president, who could at least have gained information about the condition of the products. The court placed the burden on an "otherwise innocent" person who stood in a "responsible relation" to a public danger.

After *Dotterweich*, some legal observers stated that, because of the small size of the company, the law was unclear as to whether the responsible relation theory would apply to larger organizations, especially those with well-developed management structures. That question finally was answered by the U.S. Supreme Court 30 years later in *U.S. vs. Park*, a case involving the president of a large company being tried for causing the sale of unsanitary food. That opinion enunciated what has come to be known as the "responsible corporate agent" doctrine. While acknowledging that, as the company's chief executive officer, "he was responsible for any result which occurs in [the] company," Park's defense was that the company had an organizational structure that placed various management responsibilities in several dependable company departments.

In rejecting the company president's defense, the court observed that Park was

**Anyone associated with a company's operations and management activities should understand how the law views personal criminal liability.**

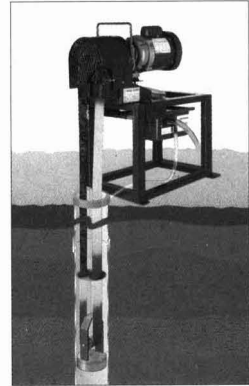
criminally liable when he "had, by reason of his position in the corporation, responsibility and authority either to prevent in the first instance, or promptly to correct, the violation complained of, and that he failed to do so." The court "focused on the issue of his authority with respect to the conditions that formed the basis of the alleged violations."

Although these cases involved high-level company officials, there is nothing in the "responsible relation" or "responsible corporate agent" doctrines that limits their application to company presidents or other officers and directors. In fact, anyone meeting the applicable criteria can be found criminally liable.

### Criminal case selection criteria

After gaining a basic understanding of the law, it is also instructive to know how EPA and DOJ decide, at least in theory, to "go criminal" in any particular case. Broad standards on this issue are laid out in a

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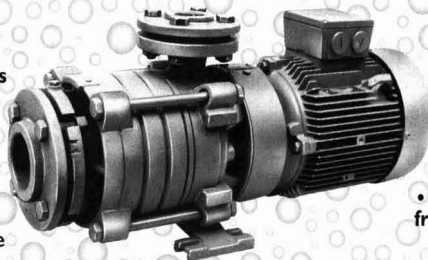
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January 12, 1994, memorandum from the director of EPA's Office of Criminal Enforcement regarding "The Exercise of Investigative Discretion." Those standards are significant environmental harm and culpable conduct or intent.

The environmental harm can be actual or threatened. Examples of actual harm are illegal discharges, releases or emissions that have an identifiable and significantly harmful impact on human health or the environment. Threatened harm is less concrete and is very subjective. It can be demonstrated by actual or threatened discharges, releases or emissions. Additional factors include the failure to report such releases, and whether a non-compliant trend or attitude held by the regulated community may benefit from the deterrent effect of a criminal investigation.

Culpability is based on any history of repeat violations, deliberate misconduct resulting in a violation, the concealment of misconduct or falsification of required records, tampering with monitoring or control equipment and conducting pollution-related activities without a permit, license, manifest or other required documentation.

### Examples of recent criminal prosecutions

In 1996, a Wisconsin businessman who owned an underground storage tank business was sentenced to serve 41 months in prison without the possibility of parole for illegally dumping hazardous waste. He had directed employees to transport 55-gallon drums containing hazardous waste to a junkyard.

A former vice president/general manager and a plant engineer for a South Dakota meat packing company were sentenced in 1996 to prison sentences totaling 30 months, 6 months home confinement and ordered to pay \$15,600 in fines and restitution for Clean Water Act violations. The pair had falsified discharge reports and illegally discharged hazardous waste.

In another Clean Water Act case, a California Corrections Department employee was indicted in 1996 for discharging partially treated sewage and chlorine wastes from a prison in violation of the facility's discharge permit, and for failing to report the discharges.

In January 1997, an Illinois company that manufactures grain wagons and farm equipment plead guilty to unlawfully burying hazardous paint and solvent wastes on company property and to making a false statement to a federal agency. The company agreed to pay a \$100,000 fine, be placed on probation for 5 years, reimburse the state \$97,000 for cleanup costs, complete cleaning up the contamination at its own cost,

place a newspaper advertisement apologizing for the violations, and implement an environmental compliance training program. In a related case, the company's vice president was fined \$4,000 and sentenced to a 7-month prison term and 7 months of work-release for his role in the activity.

These prosecutions did not spare any level of employee or differentiate between the public and private sectors of the economy. These four cases demonstrate that a company, company owner, company officer, company employee and state employee can all be criminally prosecuted.

### Clinton's tough environmental crime bill

During a Michigan campaign stop in August 1996, President Clinton pledged to offer new environmental crimes legislation. Although it was introduced in the Senate shortly thereafter, it saw no action for the remainder of the session. The bill was reintroduced during the 105th Congress.

The proposed legislation would:

- Allow federal prosecution of environmental crimes even when crimes are stopped before pollution occurs, thereby penalizing "attempted" environmental crimes primarily prosecuted through sting

operations;

- Permit prejudgment seizure of polluters' assets similar to the tactics employed against drug traffickers;

- Reimburse state and local law enforcement agencies for their costs in assisting federal environmental prosecutions;

- Increase the maximum prison sentence for environmental crimes from 15 to 20 years; and

- Extend the statute of limitations from 5 to 8 years for many laws. A similar measure, the Environmental Crimes and Enforcement Act, was introduced in the House on January 7, 1997.

### Outlook

Since environmental law and regulation has existed only approximately 15 years, it is subject to growing pains. In light of executive and legislative branch initiatives, it appears that increased criminal enforcement is the wave of the future. **EP**

*James E. Meason, JD, is an attorney in Rockton, Ill., who specializes in environmental and administrative law. He was previously a federal law enforcement attorney in Washington, D.C.*

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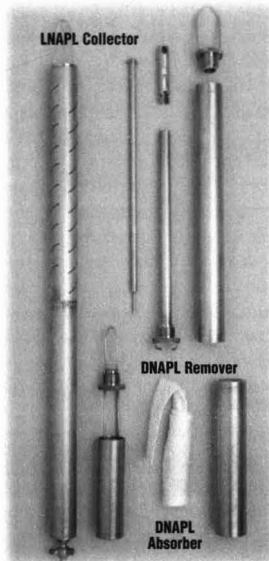
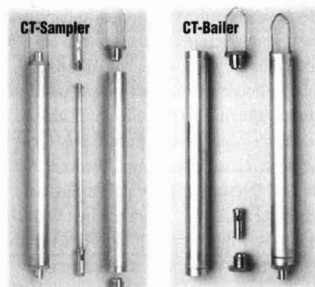


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# Universal waste rule: Mercury rising

*While most waste batteries are handled under this regulation, the debate is heating up as to whether the rule also should apply to fluorescent lamps*

By Charles B. Lewis

The technical complexity of hazardous waste regulations confounds both experts and non-experts. This complexity creates special problems when common hazardous wastes are generated by users who have little familiarity with waste regulations. Of course, household wastes are excluded from the strict regimen generally applicable to hazardous waste under Subchapter C of the Resource Conservation and Recovery Act (RCRA). However, many non-industrial businesses may not be acquainted with the rules governing common hazardous wastes. Ideally, these generators should transfer their waste to more experienced handlers for recycling or safe treatment. This is the basic idea behind the U.S. Environmental Protection Agency's universal waste regulation (40 *Code of Federal Regulations*, Part 273), which was adopted in May 1995.

The universal waste regulation streamlines rules for batteries, pesticide wastes that are recalled or collected as part of a collection program and thermostats containing mercury. In addition, EPA and authorized states may include additional wastes through the petition process. For example, a number of states have added fluorescent lamps to the list of universal wastes. On the other hand, authorized states cannot be forced to adopt the universal waste rule—with the exception of the Mercury-Containing and Rechargeable Battery Management Act (Battery Act), which took effect in 1996. The universal waste rule was a relaxation of existing federal standards.

Industrial and non-industrial businesses need to be aware of the basic requirements and advantages of the universal waste designation. In particular, it is important for these facilities to become familiar with the specifics applicable to two items of current interest, batteries and fluorescent bulbs. Rechargeable batteries, the subject of the recently enacted Battery Act, help power many of our modern technological marvels, including cellular and cordless phones, laptop computers and video cameras. Fluorescent lamps or bulbs are present in virtually

every American workplace. They are currently the subject of a heated debate over whether they should be treated as universal waste or granted a conditional exemption from any hazardous waste regulation.

## What is a universal waste handler?

To be subject to the universal waste rule, one must be a universal waste handler. Basically, this includes two groups: (1) those who generate or create the waste, and (2) those who receive the waste from other generators, collect it, and send it elsewhere for recycling, treatment or disposal.

## Advantages of universal waste designation

A universal waste designation generally offers several potential advantages to handlers of the waste:

- Generator status: Some states exclude universal waste in determining generator status. By designating hazardous waste as universal waste, a large quantity generator may qualify as a small quantity generator and avoid more onerous regulations.
- Longer storage times: Universal waste can be accumulated for up to 1 year, which is longer than the 180 or 270 days normally allowed for large quantity and small quantity generators.
- Less labeling: Universal waste generally needs less labeling than other waste.
- No manifest: A hazardous waste manifest is not required to ship universal waste.

## Universal waste requirements and prohibitions

Despite potential advantages to the universal waste designation, all handlers of universal waste are also subject to a number of requirements and prohibitions:

- Disposal by handlers is prohibited. The waste must be recycled or disposed of at a hazardous waste facility.
- Treatment or dilution by handlers is prohibited, except for mandatory responses

to releases and certain optional actions with batteries.

- Transportation is allowed only to another universal waste handler, a destination facility or a foreign facility.

In addition, several rules differ depending on whether the universal waste handler qualifies as a small quantity (SQ) or large quantity (LQ) handler. An SQ handler accumulates less than 5,000 kilograms (kg), approximately 11,000 pounds, of universal waste of any type—batteries, pesticides or thermostats—at any time. An LQ handler accumulates more than 5,000 kg of any type of universal waste at any time.

## Differences for small and quantity handlers

The notification, tracking and training requirements differ for small and large quantity handlers of waste. Small quantity handlers need not notify EPA of universal waste activities and need not keep records of shipments of universal waste. Record retention is recommended, however, to show how long universal waste has been stored. In addition, SQ handlers need only inform employees who manage individual waste of the proper procedures for the type of universal waste at the facility.

Large quantity handlers must send written notification of universal waste management to the regional administrator and receive an EPA identification number before reaching the 5,000 kg storage limit. In addition, LQ handlers must keep a record, log, invoice, bill of lading or other shipping document for at least 3 years after each universal waste shipment received at the facility or sent from the facility. Finally, LQ handlers must ensure that all employees are thoroughly familiar with proper waste handling procedures for universal waste during normal facility operations and emergencies.

## Accumulating universal waste

Generally speaking, both large and small quantity universal waste handlers may accu-

multate universal waste for no longer than 1 year from the date when the waste was generated or from when the waste was received from another handler. Collection is allowed beyond 1 year if necessary solely to accumulate enough waste for proper recovery, treatment or disposal. A universal waste handler must identify how long universal waste has been accumulated by identifying the earliest date that something becomes waste or is received as waste. This can be done by:

- Labeling a universal waste container or individual waste item;
- Using an on-site inventory system;
- Placing it in a specific area; or
- Using another method that clearly identifies the period of accumulation.

### Universal waste batteries

Most waste batteries are covered by the Battery Act of 1996. The Act covers nickel-cadmium batteries (Ni-Cd), certain small sealed lead-acid (SSLA) batteries, other rechargeable batteries and certain mercury-containing batteries. EPA is expected to promulgate a codification rule that will specify the exact batteries covered by the act. By creating a national universal waste rule for the collection, storage and transportation of covered batteries, the Battery Act seeks to facilitate their recycling and proper treatment.

The Battery Act specifically states that it does not apply to lead acid batteries managed under 40 CFR Part 266, Subpart G. This regulation was adopted to manage recyclable spent-lead acid batteries before adoption of the universal waste rule. Handlers can choose to manage spent lead-acid batteries under Part 266 or Part 273, which is the universal waste rule. The vast majority of the nation's automotive lead-acid batteries are recycled under the Part 266 standards that predate adoption of the universal waste rule.

### Handling waste batteries

Batteries that are handled under the universal waste regulations must be treated as follows before being shipped for recycling or disposal:

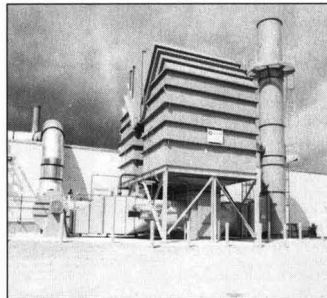
- Clearly mark each battery as "Universal Waste Battery(ies)," "Waste Battery(ies)," or "Used Battery(ies)."
- Place any leaking or damaged battery in a closed, structurally sound container.
- If the battery casing is intact and in good condition, you may remove electrolyte if cells are immediately closed after removal, sort the batteries by type, mix battery types in one container, discharge batteries, regenerate used batteries, disassemble batteries or packs into individual batteries or cells or remove batteries from consumer products.

*Continued on page 75*

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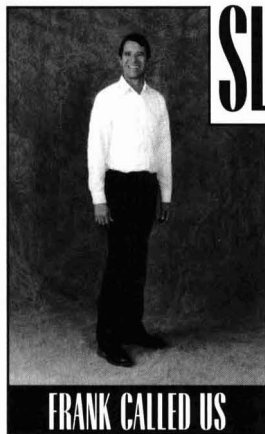
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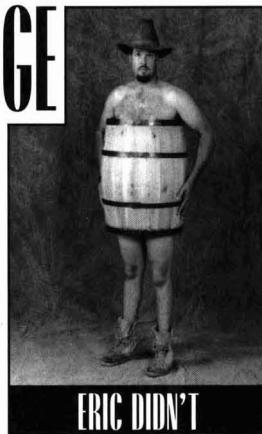
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Compiled by Kristie L. Guillotte and Ingrid Truemper

**Respirator**



Survivair's 2000 series of low maintenance half masks has a new yoke suspension system. The upgraded system allows for easier donning and doffing. It has a push and pull adjustment to provide a snug fit. Survivair.

Circle 91 on card.

**Piston pump**



The Anchor Piston Pump 103E is an electrically powered positive displacement pump designed for shallow or deep well recovery. Powered by a top head drive motor, the unit can lift liquid from depths of up to 100 feet in wells with diameters as small as 4 inches. **Blackhawk Environmental Co.**

Circle 92 on card.

**Analyzer**

The Seta Autocloud Analyzer is



fully automatic and does not require an external cooler. Cooling is achieved using integral electronic peltier cells and air cooling that allows tests down to negative 20 degrees Celsius.

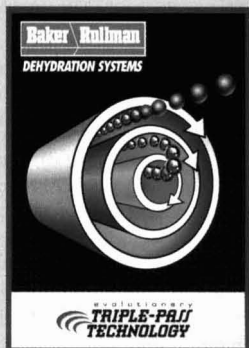
highlight

**Dehydration systems guide**

Baker/Rullman offers an introductory guide to triple-pass rotary dehydration systems designed for safe and efficient drying of municipal sludge and other organic byproducts. The eight-page, four-color guide demonstrates how the triple-pass design evaporates large volumes of material with varied densities, producing a uniform end product.

**Baker/Rullman Mfg. Inc.**

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Circle 56 on card.

September 1998

This test method can determine the cloud point with a resolution of 0.1 degrees Celsius on up to 20 samples without operator intervention. **Petroleum Systems Services Corp.**  
**Circle 94 on card.**

#### Storage station



The HazMat station comes with an internal sump and a fiberglass lid that enables outdoor storage. The lightweight lid lifts easily and gives full access to the drums or smaller containers stored. The lid is lockable to prevent trespassers and keeps out precipitation.

**P&D Solutions Corp.**  
**Circle 95 on card.**

#### Audit

SGS International Certification Services is now authorized to audit apparel, sportswear, cosmetics and other businesses' efforts to develop safe and decent workplaces worldwide. The new certification standard, Social Accountability 8000, represents a consensus of recommendations from the international business community, non-governmental organizations and labor organizations. **SGS International Certification Services Inc.**  
**Circle 96 on card.**

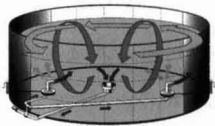
#### Microwave analyzer



The Millenniumwave-2000

Moisture/Solids Microwave Analyzer is designed for rapid single or dual moisture analysis. It detects variations between samples for an accurate product control adjustment. With the exception of the cooling fans, the unit has no moving parts. **Microwave Designs Inc.**  
**Circle 97 on card.**

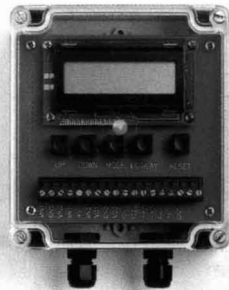
#### Mixing system



The JetMix™ Vortex Mixing System is engineered to take advantage of a tank's natural hydraulic characteristics in order to achieve optimum mixing of solids. The flow pattern created by the system's simple nozzle and pump placement eliminates dead spots, reduces energy requirements and virtually

eliminates solids settling. **Liquid Dynamics Corp.**  
**Circle 98 on card.**

#### Analyzer



The RHDP-3 moisture analyzer is a microprocessor-based transmitter that will accept all RH and temperature transmitters with milliamp and voltage outputs and will then output various moisture parameters in metric and non-metric form. The outputs are selectable as milliamp or voltage signals. **Omega.**  
**Circle 99 on card.**

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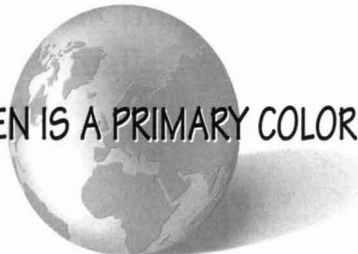
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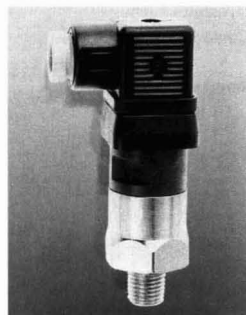
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**Pressure switch**

The PS-E, PS-EH and PS-EV Series of miniature low-, high- and vacuum-pressure switches measure 2.4 inches long by 1 inch wide and weigh 0.3 pounds. Applications include hydraulic system pressure monitoring, steam-lined flow, coolant flow and test equipment. **Gems Sensors Inc.**

**Circle 100 on card.**

**Software**

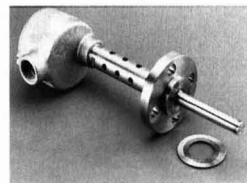
MSDSFinder™ is advanced MSDS management and environmental reporting software. It



offers a sophisticated environmental reporting module, an Intranet module and an optional scanning device. It is designed for corporate-wide, division-wide and site-wide use.

**ImageWave Corp.**

**Circle 101 on card.**

**Transducer system**

The Bundle Waveguide Technol-

ogy™ system gives drift-free, obstructionless, flow measurement in difficult liquids and gases. The system uses ultrasonic transducers to measure the flow of high temperature gases and liquids with high viscosity and high molecular weights. **Panometrics.**

**Circle 102 on card.**

**Monitoring system**

The Waterloo System allows multilevel monitoring with fewer drilled holes and low purge volumes. Samples and pressure readings take less time, as the system uses dedicated equipment at discrete zones.

Sample integrity is achieved using packers or bentonite seals avoiding cross-contamination.

**Solinst Canada Ltd.**

**Circle 103 on card.**

**Reporting software**

The Web-based Incident Tracking System for Safety/Health automates the workplace illness and injury reporting and data-management tasks required by federal and state regulatory authorities. The software package version 2.02 incorporates input from the system's early adopters in manufacturing, insurance and other industries. **GZA Information Systems Division.**

**Circle 104 on card.**

**Air dryer**

The Balston® SMD Membrane air dryer dries compressed air to dew points as low as 35 degrees Fahrenheit at flow rates of up to 200 scfm. Dry air is achieved by returning a small portion of the dry product air to sweep out moisture, which

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## NEW PRODUCTS



preferentially passes through the membranes. **Whatman Inc.**

Circle 105 on card.

### Membrane



The Silver Series membrane for disc diffusers has proven in field tests to substantially outlast conventional EPDM membranes, while still maintaining resistance to physical deforma-

tion and the ability to maintain high oxygen transfer efficiency. **SANITAIRE.**

Circle 106 on card.

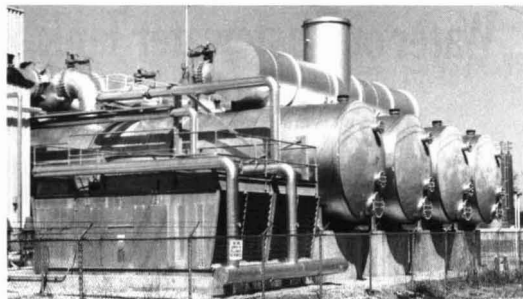
### Oil mist eliminator



The Oil Mist Eliminator offers a low cost way to remove oil and water aerosols from a compressed air system. Units remove 99.98 percent of particles 0.1 micron and larger, and reduce liquid content to 0.5 ppm by weight. Pressure drop is between 0.5 and 1 psi and average cartridge life is between 8 and 15 years. **Kaeser Compressors.**

Circle 107 on card.

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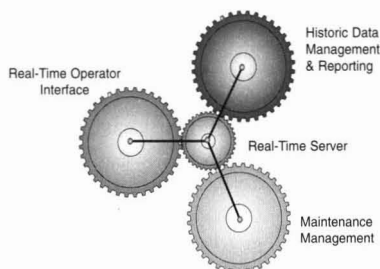
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**Water level logger**

The WL14 water level logger now incorporates an optional mouse-shaped probe for sewer and stormwater flow monitoring. The probe protects the sensor from debris and velocity effects. The WL14 is programmable, records 6,000 readings and runs for 1 year on a 9-volt DC battery.

**Global Water.**  
Circle 108 on card.

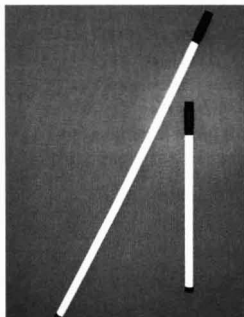
**Pumps**

The MPH Series high-temperature pumps are designed for low-flow, high-head, high-temperature applications. These close-coupled, sealless, magnetically driven pumps provide fluid handling at temperatures up to 536 degrees Fahrenheit with no cooling water required.

**Magnetex Pumps Inc.**  
Circle 109 on card.

**Extraction technology**

SCHUMAProbe™ uses the same microporous, homogeneous structure found in SCHUMASOIL® well screen, and provides soil vapor extraction and air sparging capabilities. It is capped and threaded with a 3/4-inch NPT male



end for simple installation and features an average pore size of 20 µm. U.S. Filter / Schumacher Filters America Inc.

Circle 110 on card.

**CO tester**

The ECOM-EM CO tester is a small, handheld unit designed to

meet the MSHA regulation requiring testing of CO emissions from diesel engines used in underground coal mines. Features include CO measurement to 4,000 ppm, exhaust and vacuum pressure testing, internal pump, backlit LCD display and more. ECOM America Ltd.

Circle 111 on card.

**Pumps**

The controllerless leachate AutoPump passes particles as large as 1/8 inch in diameter and handles temperatures as high as

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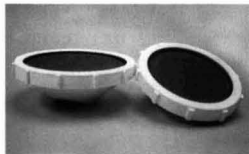
## NEW PRODUCTS

212 degrees Fahrenheit and pH levels from 1 to 12. The pump can reach depths of 500 feet and are available as both top- and bottom-loaders, in long and short versions.

Clean Environmental Equipment.

Circle 112 on card.

### Disc diffusers



Ceramic Fine Bubble Disc Diffusers have been proven to conserve energy and reduce wastewater treatment plant power by 50 percent or more. The threaded retainer ring/holder concept ensures an airtight seal between the diffuser and top-mounted O-ring gasket, eliminating potential leaks. SANITAIRE.

Circle 113 on card.

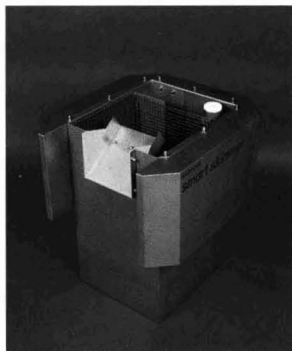
### Thermo oxidizer



Models TO-120 and TO-240 have been designed to thermally oxidize up to 120 and 240 gallons of wastewater per hour at up to 1,600 degrees Fahrenheit utilizing natural gas, LPG or diesel fuel. Additional savings can be achieved by adding the optional waste oil burner. RGF Environmental Systems Inc. Circle 114 on card.

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Justrite's new mixing tank facilitates compliance with EPA and OSHA regulations by meeting the criteria as both a closed and covered container. The gasketed lid, which locks in place for security, may be completely removed for fast filling and dispensing. A bail handle is provided for carrying. Justrite Mfg. Co.

**Circle 115 on card.**

**Piping systems**

The +GF+ PPRO-Seal natural

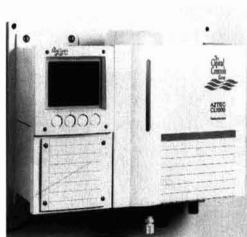


polypropylene piping system is manufactured from a pure polypropylene polymer with no plasticizers, pigments or any other contaminants that could affect the fluid medium. The system handles corrosive fluids up to 212 degrees Fahrenheit. **George Fischer Inc.**

**Circle 116 on card.**

**Residual analyzer**

The Aztec® CL1000 residual analyzer includes advanced micro-processor-based electronics and a



three-electrode measuring cell arrangement. This arrangement provides the analyzer with the capability of measuring in the parts per billion residual range, as well as high residual ranges to 60 mg/l. **Capital Controls Co. Inc.**

**Circle 117 on card.**

**Continuous emissions monitor**

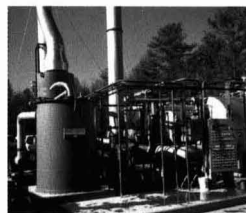
The MicroCem continuous emissions monitor is designed for gas- and oil-fired combustion units, package boilers, gas turbines, diesel generators, PEMS model profiling, hot water and steam generation plants and more. It is micro-processor controlled with



diagnostics and over-board auto-calibration and blowback. **Anarad.**

**Circle 118 on card.**

**Adsorption system**



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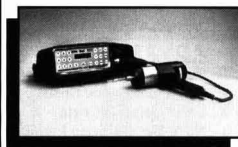
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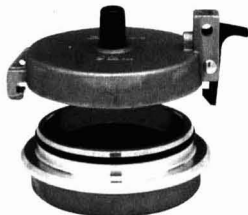
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## NEW PRODUCTS

designed to solve VOC emission problems. The contaminated air stream is passed across the carbon bed. The carbon extracts the VOCs from the airstream and adsorbs them, holding them on its surface and in its pores. The VOC-free air is exhausted into the atmosphere. **Croll-Reynolds Clean Air Technologies.**

Circle 119 on card.

### Monitor cap



The 62M Monitor Cap/Adaptor provides easy access to monitor equipment, while providing security in a liquid tight environment. Both the monitor cap and the adaptor are made from cast aluminum. The adaptor

secures to the riser using a female 4-inch NPT pipe thread.

**OPW Fueling Components.**

Circle 120 on card.

### Lead detection

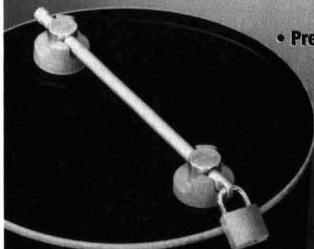


The portable SA-5000 Scanning Analyzer™ is based on the anodic stripping voltammetry analysis technique. Results of up to 300 tests can be stored in memory with time, date, job code and sample number data for later recall on the display, downloaded to a PC or printer output. **Palintest USA.**

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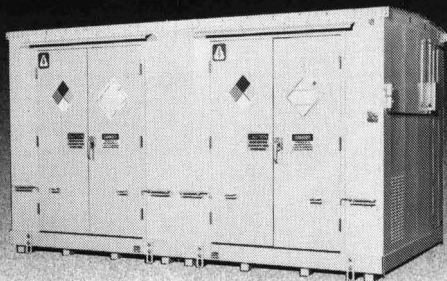
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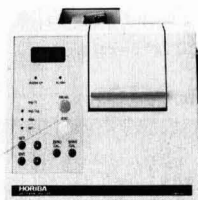
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September 1998

Continued from page 75

### Fluorescent lamps

In a 1994 proposal, EPA suggested two possible ways to handle mercury-containing fluorescent lamps: (1) cover them under the universal waste rule, or (2) grant the lamps a conditional exemption. A majority of states have either received approval from EPA to apply the universal waste rule to fluorescent bulbs or plan to do so. Proponents of using the universal waste rule argue that it would prevent increased mercury contamination from landfills while also helping to facilitate recycling of the bulbs. Proponents of the conditional exemption argue that fluorescent lamps benefit the environment by greatly reducing mercury emissions, as well as carbon dioxide and other greenhouse gases, from coal-powered plants. By allowing the lamps to be landfilled, a conditional exclusion would maximize consumer convenience and use of the bulbs. This argument assumes that recycling bulbs is not really necessary, since the additional mercury contamination would be negligible. Opponents of the proposed exemption argue that no amount of landfilling would be insignificant, given mercury's extreme toxicity.

### Handling fluorescent lamps

Most states that regulate fluorescent lamps as universal waste either require or recommend the following practices before the lamps are shipped for recycling or disposal:

- Label the lamp or storage containers "Universal Waste Electric Lamp(s)," "Waste Electric Lamp(s)" or "Used Electric Lamp(s)."
- Package lamps to minimize breakage and to prevent release of lamp fragments if breakage occurs.
- Crush lamps only as part of a recycling process; do not exceed applicable exposure limits for mercury.

Contact your state agency to see what state-specific rules are currently applicable to fluorescent lamps.

### User-friendly regulations

Both the universal waste rule and conditional exemption approaches to fluorescent lamps assume that less environmental regulation can sometimes lead to more environmental protection. Those who argue for applying the universal waste rule believe that we can reduce energy use while also minimizing mercury contamination through streamlined regulations that encourage recycling. Those who argue for a conditional exemption

believe the risk from mercury is so insignificant, at least compared to the benefits of the fluorescent bulbs, that they should not even be classified as hazardous waste. Whichever approach EPA adopts, including possibly allowing the states to choose the universal waste rule or conditional exemption for themselves, the debate itself illustrates an important development in environmental law: the acknowledgment that regulations, while essential to the protection of the environment, can themselves have environmental costs and disadvantages. This realization suggests that use of the universal waste rule will expand in the future. The universal waste rule represents a balanced approach that recognizes both the dangers of common hazardous wastes and the need to make regulations user friendly to encourage the waste's safe collection and disposal. **EP**

*Charles B. Lewis is an editor with Summers Press Inc., Ft. Worth, Texas. He is the author of Workers' Compensation Guide for Employers and editor of the following books published by Summers Press Inc.: EPA Compliance Guide for Hazardous Waste and OSHA Compliance Guide.*

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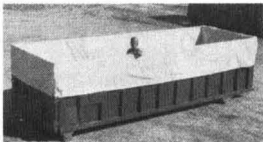
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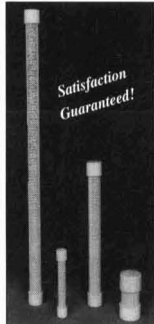
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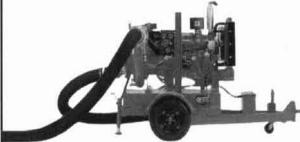
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| 801 <input type="checkbox"/> Stationary Mount Aerators | 804 <input type="checkbox"/> Centrifugal Fans | 807 <input type="checkbox"/> Axial Fans       |
| 802 <input type="checkbox"/> Submerged Aerators        | 805 <input type="checkbox"/> Aeration Blowers |   |

B. What is your reason for purchasing the selected product(s)/services? (Select one)

- 808  New Construction  
809  Plant Upgrade  
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C. What is your projected budget for the selected product(s)/services? (Select one)

- 811  Over \$200,000  
812  \$100,001-\$200,000  
813  \$50,001-\$100,000  
814  \$10,001-\$50,000  
815  \$5,000-\$10,000  
816  Under \$5,000

D. How immediate is your need for the selected product(s)/services? (Select one)

- 817  0-6 months  
818  7-9 months  
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| 3  | 39 | 75  | 111 | 147 | 183 | 219 | 255 | 291 | 327 | 363 | 399 | 435 | 471 | 507 | 543 | 580 |
| 4  | 40 | 76  | 112 | 148 | 184 | 220 | 256 | 292 | 328 | 364 | 400 | 436 | 472 | 508 | 544 | 581 |
| 5  | 41 | 77  | 113 | 149 | 185 | 221 | 257 | 293 | 329 | 365 | 401 | 437 | 473 | 509 | 545 | 582 |
| 6  | 42 | 78  | 114 | 150 | 186 | 222 | 258 | 294 | 330 | 366 | 402 | 438 | 474 | 510 | 546 | 583 |
| 7  | 43 | 79  | 115 | 151 | 187 | 223 | 259 | 295 | 331 | 367 | 403 | 439 | 475 | 511 | 547 | 584 |
| 8  | 44 | 80  | 116 | 152 | 188 | 224 | 260 | 296 | 332 | 368 | 404 | 440 | 476 | 512 | 548 | 585 |
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| 12 | 48 | 84  | 120 | 156 | 192 | 228 | 264 | 300 | 336 | 372 | 408 | 444 | 480 | 516 | 552 | 589 |
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| 22 | 58 | 94  | 130 | 166 | 202 | 238 | 274 | 310 | 346 | 382 | 418 | 454 | 490 | 526 | 563 | 599 |
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| 9  | 45 | 81 | 117 | 153 | 189 | 225 | 261 | 297 | 333 | 369 | 405 | 441 | 477 | 513 | 549 | 586 |
| 10 | 46 | 82 | 118 | 154 | 190 | 226 | 262 | 298 | 334 | 370 | 406 | 442 | 478 | 514 | 550 | 587 |
| 11 | 47 | 83 | 119 | 155 | 191 | 227 | 263 | 299 | 335 | 371 | 407 | 443 | 479 | 515 | 551 | 588 |
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| 13 | 49 | 85 | 121 | 157 | 193 | 229 | 265 | 301 | 337 | 373 | 409 | 445 | 481 | 517 | 553 | 590 |
| 14 | 50 | 86 | 122 | 158 | 194 | 230 | 266 | 302 | 338 | 374 | 410 | 446 | 482 | 518 | 554 | 591 |
| 15 | 51 | 87 | 123 | 159 | 195 | 231 | 267 | 303 | 339 | 375 | 411 | 447 | 483 | 519 | 556 | 592 |
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| 20 | 56 | 92 | 128 | 164 | 200 | 236 | 272 | 308 | 344 | 380 | 416 | 452 | 488 | 524 | 561 | 597 |
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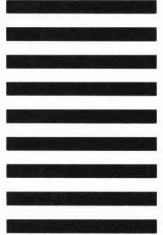
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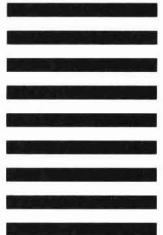
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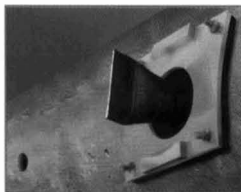


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