

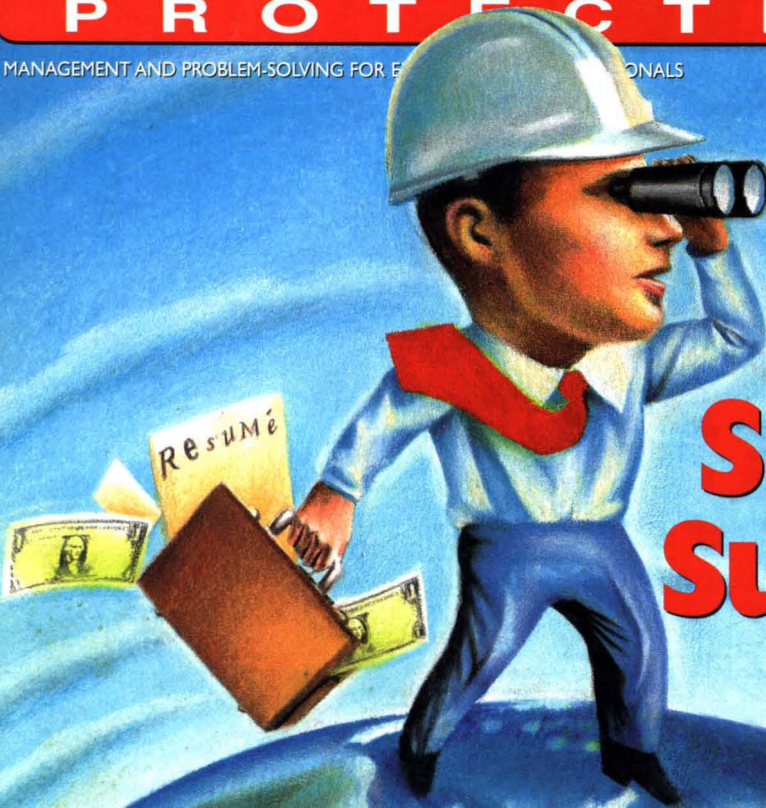
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Environmental

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MANAGEMENT AND PROBLEM-SOLVING FOR ENVIRONMENTAL PROFESSIONALS

AUGUST 1998



1998 Salary Survey

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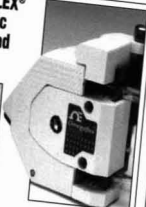
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|--|---|--|--|
| 800 <input type="checkbox"/> Centrifugal Pumps | 811 <input type="checkbox"/> Flow Meters | 825 <input type="checkbox"/> PVC Pipes | (select one) |
| 801 <input type="checkbox"/> Diaphragm Pumps | 812 <input type="checkbox"/> In-Line Filters | 826 <input type="checkbox"/> Stainless Steel Pipes | 833 <input type="checkbox"/> Over \$200,000 |
| 802 <input type="checkbox"/> Sewer Pipes | 813 <input type="checkbox"/> Chemical Metering Pumps | 827 <input type="checkbox"/> Plastic Pipes | 334 <input type="checkbox"/> \$100,001-\$200,000 |
| 803 <input type="checkbox"/> Water Pipes | 814 <input type="checkbox"/> Drum Pumps | 828 <input type="checkbox"/> Pipe Locators | 835 <input type="checkbox"/> \$50,001-\$100,000 |
| 804 <input type="checkbox"/> Airlift Valves | 815 <input type="checkbox"/> Sludge Pumps | 829 <input type="checkbox"/> Steel Pipes | 836 <input type="checkbox"/> \$10,001-\$50,000 |
| 805 <input type="checkbox"/> Plug Valves | 816 <input type="checkbox"/> Progressing Cavity Pumps | | 837 <input type="checkbox"/> \$5,000-\$10,000 |
| 806 <input type="checkbox"/> Pinch Valves | 817 <input type="checkbox"/> Grinder Pumps | | 838 <input type="checkbox"/> Under \$5,000 |
| 807 <input type="checkbox"/> Check Valves | 818 <input type="checkbox"/> Plastic Pumps | 2. What is your reason for purchasing the selected products/services? (select one) | |
| 808 <input type="checkbox"/> Ball Valves | 819 <input type="checkbox"/> Sewage Pumps | 830 <input type="checkbox"/> New Construction | 3. How immediate is your need for the selected products/services? (select one) |
| 809 <input type="checkbox"/> Butterfly Valves | 820 <input type="checkbox"/> Submersible Pumps | 831 <input type="checkbox"/> Plant Upgrade | 839 <input type="checkbox"/> 0-6 months |
| 810 <input type="checkbox"/> Gate Valves | 821 <input type="checkbox"/> Water Pumps | 832 <input type="checkbox"/> Replacement/Maintenance | 840 <input type="checkbox"/> 7-9 months |
| | 822 <input type="checkbox"/> Double Secondary Contained Pipes | | 841 <input type="checkbox"/> 10-12 months |
| | 823 <input type="checkbox"/> Ductile Iron Pipes | 3. What is your projected budget for the selected products/services? (select one) | 842 <input type="checkbox"/> Over 12 months |
| | 824 <input type="checkbox"/> Fiberglass Pipes | | |

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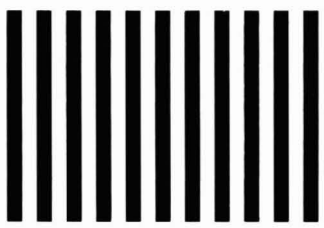
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CITY _____ STATE _____ ZIP _____ ZIP+4 _____

- A. Function which best describes your activity in Pollution Control (check only one):
- | | | | | | |
|---|---|--|---|---|--|
| A <input type="checkbox"/> Corporate responsibility for Pollution Control | B <input type="checkbox"/> Manage all Pollution Control Operations at this location | C <input type="checkbox"/> Supervise sub-group in Pollution Control Operations | D <input type="checkbox"/> Provide professional consulting service on Pollution Control | E <input type="checkbox"/> Provide staff environmental service on Pollution Control | Z <input type="checkbox"/> Other _____ |
|---|---|--|---|---|--|
- B. Type of Business (check only one):
- A Manufacturing. If manufacturing, please check the appropriate SIC (check only one):
- | | |
|--|--|
| <input type="checkbox"/> (20) Food | <input type="checkbox"/> (31) Leather |
| <input type="checkbox"/> (21) Tobacco | <input type="checkbox"/> (32) Stone/Clay/Glass |
| <input type="checkbox"/> (22) Textile | <input type="checkbox"/> (33) Primary Metal |
| <input type="checkbox"/> (23) Apparel | <input type="checkbox"/> (34) Fab. Metal |
| <input type="checkbox"/> (24) Lumber & Wood | <input type="checkbox"/> (35) Mach., except Elect. |
| <input type="checkbox"/> (25) Furniture | <input type="checkbox"/> (36) Elect & Electron |
| <input type="checkbox"/> (26) Paper | <input type="checkbox"/> Mach |
| <input type="checkbox"/> (27) Print/Publish | <input type="checkbox"/> (37) Trans. Equip. |
| <input type="checkbox"/> (28) Chemicals | <input type="checkbox"/> (39) Miscellaneous Mfg. |
| <input type="checkbox"/> (29) Petrol. & Coal | <input type="checkbox"/> (38) Instr./meas./ |
- (30) Rubber/Plastic
- C. Number employed at this location:
- | | | |
|--------------------------------------|--------------------------------------|--|
| A <input type="checkbox"/> 1-19 | B <input type="checkbox"/> 20-49 | C <input type="checkbox"/> 50-99 |
| D <input type="checkbox"/> 100-249 | E <input type="checkbox"/> 250-499 | F <input type="checkbox"/> 500-999 |
| G <input type="checkbox"/> 1000-1499 | H <input type="checkbox"/> 1500-2499 | I <input type="checkbox"/> 2500 and up |
- D. In your job function do you recommend, specify or purchase? (check all that apply)
- | | | |
|--|--|--------------------------------------|
| A <input type="checkbox"/> Pollution Control Equipment | B <input type="checkbox"/> Instrumentation | C <input type="checkbox"/> Chemicals |
| L <input type="checkbox"/> Consulting Contracting | M <input type="checkbox"/> Insurance | |
- E. What types of Pollution Control are you responsible for? (check all that apply)
- | | |
|---|---|
| A <input type="checkbox"/> Air | B <input type="checkbox"/> Water |
| C <input type="checkbox"/> Noise | D <input type="checkbox"/> Solid Waste Disposal |
| E <input type="checkbox"/> Industrial Hygiene | F <input type="checkbox"/> Toxic & Hazardous Material |
| G <input type="checkbox"/> Energy Control/Energy Conservation | H <input type="checkbox"/> None of the above |
- F. Which of the following publications do you receive personally addressed to you? (check all that apply)
- | | |
|---|---|
| A <input type="checkbox"/> Pollution Engineering | B <input type="checkbox"/> Environment Today |
| C <input type="checkbox"/> Environmental Solutions | D <input type="checkbox"/> Pollution Equipment News |
| E <input type="checkbox"/> The National Environmental Journal | F <input type="checkbox"/> Water Environment & Technology |
| G <input type="checkbox"/> None of the above | |



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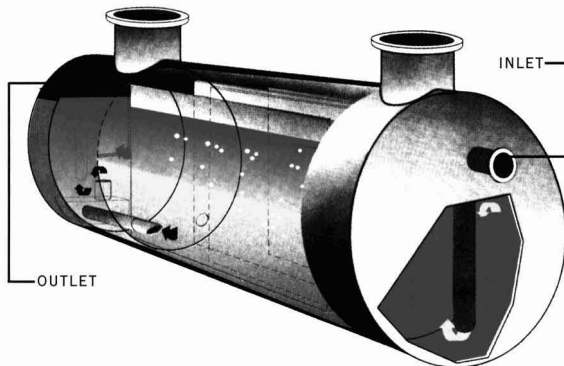


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Environmental professionals looking for employment opportunities must be willing to adapt to today's changing job market. This year's survey that we conducted among our readers gives job seekers an informative glimpse at current salary trends in various segments of the environmental field (see page 18).

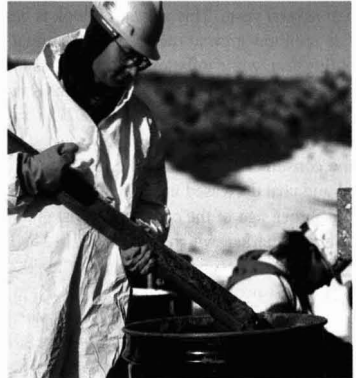
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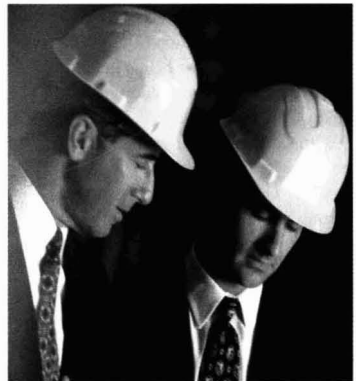
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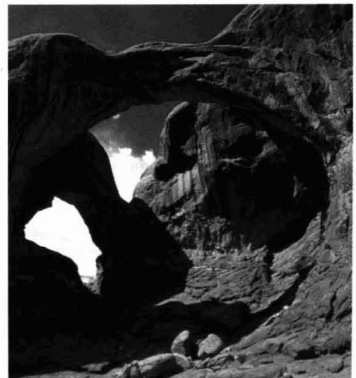
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Rising expectations

In today's Viagra economy, even environmental professionals are finding that things are looking up.

The hope is that the exuberant pace of U.S. business will help reinvigorate the environmental field and lift it out of the financial malaise it has been experiencing during the past several years. This upbeat outlook is based on many positive new developments. The economy grew at the impressive annual rate of 4.2 percent during the first quarter of this year, while inflation dropped to its lowest level since 1964. Consumer spending rose at an annual rate of 5.7 percent in 1998's first quarter, as Americans' confidence soared to almost its highest level in 30 years. Better still, the potent U.S. dollar makes imported goods a bargain and low interest rates make it easy to finance business ventures and consumer durables and homes. As well, the prices of gasoline, oil, natural gas, fuel oil and coal decreased in the first quarter of this year.

Another sign of the country's robust growth is the stock market's strong performance. This bull market, which began back in 1990 at 2,365 points, has been fluctuating recently due to Asia's economic weakness. However, it continues to be resilient and still offers great investment opportunities.

Good news is also found in the current national unemployment rate of 4.3 percent, the lowest since 1970. Additionally, American wage disbursements increased by \$84.7 billion in first quarter of 1998 over the previous quarter.

So far this year, Alan Greenspan and his colleagues at the U.S. Federal Reserve Board have not seen the need to tighten the credit to head off inflation or to strengthen the dollar. For the time being, it appears inflation-free growth will continue unfettered by Fed-imposed interest rate hikes.

With such a strong overall national economy, it's no wonder that many segments of the environmental field are starting to perk up. The growing optimistic attitude stands in welcome contrast to the gloomy mood that has recently dominated this field. Beginning on page 18, our cover story "1998 Salary Survey" spotlights some booming areas like wastewater management, pollution prevention, executive management and brownfield restoration. Not coincidentally, many of these new environmental jobs are being propelled by the free market rather than being compliance-driven as in the early part of the 1990s. Industry's increasing recognition that greener business practices can translate into impressive financial payoffs should promote future employment growth for environmental professionals

Another article "A temporary solution" (page 15) discusses how the environmental field is gradually converting into a profession of contract workers, many of whom prefer the flexibility of project-based work. This is yet another example of how today's workers must learn to deal with market forces that are transforming traditional jobs held by environmental engineers, scientists and managers.

These articles underscore that savvy environmental professionals don't have to settle for being vocational victims of boom and bust cycles. In this dynamic economy, opportunities exist for environmental professionals who are willing to be adaptable and aggressive in their approach to earning a living while cleaning up the environment.



Angela Neville

Angela Neville, JD, REM
Editor-in-Chief

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Compiled by Ingrid Truemper

Vermont wind power plant

Vermont's newest landmark, an arrangement of 11 high-tech windmills placed along a ridgetop near Searsburg, generated enough energy in 1998 to supply the electricity needs of a small town.

The 6-megawatt wind power plant, constructed by Green Mountain Power Corp. (GMP) with financial and technical support from the Electric Power Research Institute (EPRI) and the U.S. Department of Energy (DOE), generated over 1.2 million kilowatt-hours of electricity in the first 2 months of 1998—enough to supply power for about 1,500 homes.

GMP selected the Searsburg site because of its strong and persistent winds and its proximity to existing access roads and transmission lines. The area is away from population centers and has few environmental concerns. Vermont's winter winds will enable the plant to generate more electricity at the time it is most needed.

By reducing the need to burn fossil fuels in other parts of New England, air emissions are expected to be reduced by approximately 22 million pounds a year. The cost per kilowatt-hour of energy generated at Searsburg will be comparable to alternative sources over the 25-year life of the plant.

The Searsburg wind plant is made up of 11 Zond Z-40FS wind turbines, power collection and switching equipment, and a 1.5-mile transmission line that delivers the power to New England Electric Co.'s transmission grid. Each wind turbine consists of a horizontal axis, a three-blade rotor with a diameter of 40 meters, a gearbox transmission, an induction generator and a computer control system.



The EPRI-DOE Wind Turbine Verification Program includes future projects in Iowa, Nebraska, Oklahoma, Texas and New York to evaluate wind generation.

For more information about the program, call EPRI's Chuck McGowin at (802) 660-2445 or e-mail cmcgowin@epri.com.

A new way to see underground

It's one thing to strike oil, another to get it all out of the ground. Reservoirs are often prematurely abandoned because of "oil behind the hole"—pockets of hydrocarbons that wells completely miss.

A new method for making images of the subsurface has been devised by Ki Ha Lee of the DOE's Lawrence Berkeley National Laboratory. Lee and his colleagues in the earth sciences division use data generated with electromagnetic energy (EM) in a novel way that can visualize the subsurface at depths ranging from gas and oil reservoirs thousands of meters deep to plumes of pollutants in shallow soil.

"Electromagnetic energy tends to propagate without loss in free space, but in the ground the story is very different," Lee said. "The ground attenuates the signal severely, especially at the higher frequencies. Instead of propagating like a wave in space, an EM field diffuses into the ground almost like heat does through a solid medium."

Like traditional EM imaging techniques, Lee's method uses low-frequency, diffusive, electromagnetic data sent between boreholes. However, his technique allows better images to be constructed at greater range, reducing drilling costs. He employs a mathematical transformation to convert diffusive EM signals into "wavefields"; the resistivity image is constructed using the transformed wavefield's travel times.

In converting low-frequency EM data to wavefield form, Lee transforms the real-time electromagnetic fields to mathematical equivalents that are easier to manipulate. Thus he can apply familiar methods for using time-dependent data to generate tomograms—maps of two dimensional slices—of the geological structures between the receivers and transmitters.

In addition to recovering oil and gas, the new imaging technique can be used to characterize environmental problems and monitor their remediation. According to Lee, the method can identify large plumes of petroleum-based pollutants in a flooding situation involving massive contamination. To be detectable, the size of the plumes must be at least one tenth of the distance between the receiver and the transmitter.

For more information, call Paul Preuss at (510) 486-6249 or e-mail paup_preuss@lbl.gov.

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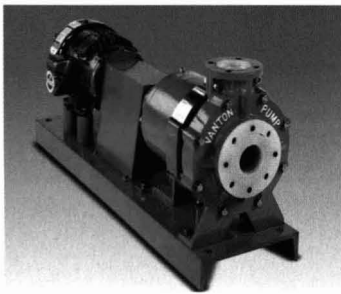
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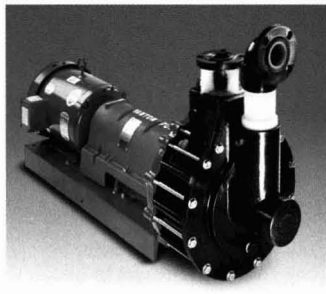
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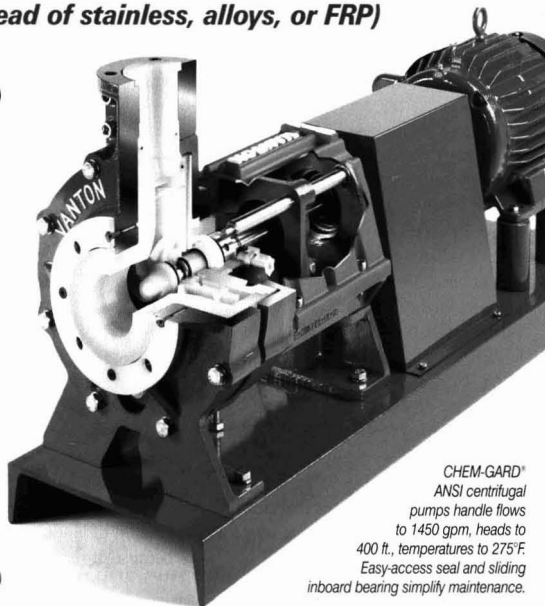
(unlike plastic linings)

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(unlike stainless, alloys, and FRP)

ZERO PRODUCT CONTAMINATION

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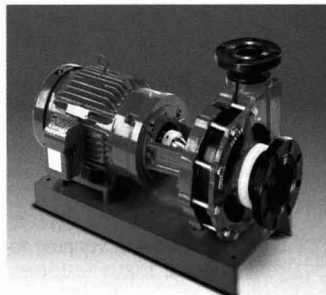
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Circle 112 on card.

News at a glance

Compiled by Kristie L. Guillotte

Teens and baby boomers have similar thoughts on the environment

WASHINGTON, D.C.—The Earth View survey found today's teenagers have similar attitudes about the environment to those who were teenagers at the time of the first Earth Day in 1970.

The survey was conducted by Federick Schneiders Research on behalf of the National 4-H Council and Honda. It found that teenagers and baby boomers agree that government and industry are falling short of their environmental obligations and that time is running out to protect Earth from permanent damage. A majority of both generations also expect world environmental conditions to deteriorate over the next 25 years.

Other findings from the survey include:

- 77 percent of teens and 67 percent of boomers agree that we are running out of time to save the world's environment from permanent damage;
- 71 percent of teens and 67 percent of boomers agree that corporations are not concerned about the environmental impact of their activities or products;
- 86 percent of teens and 71 percent of boomers agree that today's teens will have the greatest impact on the future environment; and
- 81 percent of teens and 76 percent of boomers agree that breakthroughs in technology will help solve environmental problems.

Conservation efforts soaring high

MEMPHIS—Habitat 2000, a fundraising campaign for wetlands and wildlife, reached its official halfway point during the spring of this year.

Officials from Ducks Unlimited (DU) are calling the first 3 years of the 6-year campaign a success. "We're already more than halfway to our overall fundraising goal," said DU president Gene Henry. "The members and volunteers of Ducks Unlimited have really come together under the Habitat 2000 banner to make a genuine difference for the continent's precious wetlands and waterfowl resources."

Habitat 2000 is DU's effort to fund its North American conservation work into the 21st Century. Over the 6 years of the program, DU expects to raise \$600 million to fund conservation efforts on 60 million

acres of wildlife habitat in the United States, Canada and Mexico. Through the campaign, it also plans to increase its membership to 750,000. DU has raised \$359 million towards its goal and counts nearly 670,000 members.

Whipping waste into a permanent place

WASHINGTON, D.C.—Transuranic radioactive waste now has a place for disposal. The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) facility near Carlsbad, N. M. It is the first deep geologic repository for permanent disposal of defense-related transuranic waste in the United States.

Transuranic waste consists primarily of protective clothing, tools, glassware, equipment soils and sludges that have been contaminated with trace amounts of manmade radioactive elements, such as plutonium. Only transuranic waste generated at U.S. nuclear weapons production facilities is being disposed of at the WIPP.

In the next 35 years, a maximum of 6.2 million cubic feet of transuranic waste will be disposed at the WIPP from 23 generator and storage sites throughout the United States. These 23 sites are located in California, Colorado, Idaho, Illinois, Iowa, Kentucky, Missouri, New Mexico, New York, Nevada, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia and Washington. DOE estimates that nearly 38,000 shipments of transuranic waste will travel from these sites to the WIPP.

One-third of U.S. garbage is recycled

EMMAUS, Pa.—A survey found that U.S. residents recycle 30 percent of the solid waste they generate.

BioCycle, the *Journal of Composting and Recycling* conducted its annual "State of Garbage in America" survey, which tracks disposal and recycling trends throughout the United States. The survey found that almost 9,000 curbside recycling programs offer service to an estimated 136 million people.

According to the 1998 survey, 340 million tons of municipal solid waste are generated in the United States—about a 36 percent increase in what was reported 10 years ago. The amount of solid waste that goes to landfills has dropped to 61 percent from 80 percent 10 years ago. The remaining percent of municipal solid waste is incinerated.

Seven states reported recycling rates of 40 percent or more. These include Florida, Maine, Minnesota, New Jersey, South Dakota, Tennessee and Washington.

On a regional basis, New England has the highest recycling rate of 42 percent, followed by the Midwest with 36 percent and the South with 33 percent. The Midwest still landfills 72 percent of its garbage, which is the largest percentage of landfilled waste in the country. The West follows with 68 percent of its garbage being landfilled.

The survey also found that a sufficient amount of landfill space still exists because of recycling.

WASHINGTON, D.C.—Twenty-nine plants and animals are on their way off the endangered species list.

The Fish and Wildlife Service signed a policy, which sets in motion the legal process of either removing the plants and animals from the Endangered Species Act list or including them in the threatened category during the next couple of years.

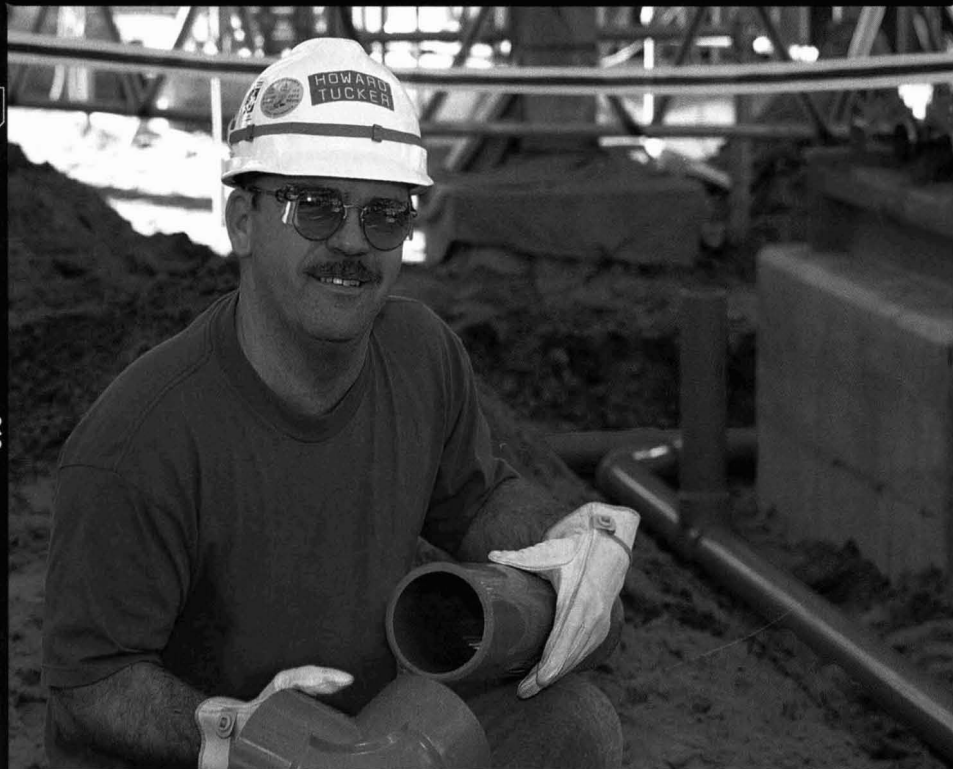
To remove a species from the list, FWS biologists must first determine whether its numbers have returned to a certain level and whether it has adequate habitat for likely survival. Then a proposal is made to delist the species or downgrade it to threatened. After a review period, a final decision is made on the species.

Animals under the proposal to be delisted by the end of this year include the American peregrine falcon, the bald eagle, the Columbian white-tailed deer, the Hawaiian hawk, the brown pelican, the gray wolf, the Virginia northern flying squirrel and the Island night lizard. Fifteen plants are also being considered for delisting.



Species no longer endangered

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Pipes, pumps & valves

Compiled by Ingrid Truemper



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Chlorinators Inc.

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Metering pumps ▼

The ten models of Type F diaphragm metering pumps feature automatic pump output control, which is obtained using a variable speed 1/50-60/115-230 power, 240 to 2,400 rpm motor with a built in controller. The models have different output ranges, with the smallest pumping as low as 0.1 gph and the largest as high as 400 gph.

Madden Manufacturing Inc.

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◀ 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.

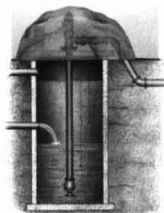
A 10-inch output discharge facilitates the movement of massive amounts of water. Pumpex Inc.

Circle 42 on card.

Pump cover ▶

The Rock is an aesthetically pleasing fiberglass boulder used for blending pump installations into open area locations. It features simple construction and easy installation. The Rock is equipped for entry, lighting and ventilation and has all necessary piping locations and controls.

Circle 40 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 43 on card.



Bladder pump ▶

The Model 407 bladder pump uses a Teflon® bladder, making it ideal for VOC sampling. It meets all U.S. EPA standards for groundwater monitoring and is easily decontaminated without using tools. A PVC bladder pump is also available for suitable projects.

Solinst Canada Ltd.

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◀ Valves

AquaMatic V52 and V53 Series valves are now manufactured with black Noryl and reidentified as K52 and K53 Series.

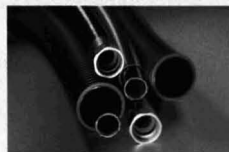
The Noryl valves achieve a 15 to 20 percent increase in body burst

pressure. The black valves are more resistant to fading from ultraviolet radiation in outdoor installations.

Osmonics.

Circle 44 on card.

Underground piping system



PISCES is a completely integrated underground fuel transfer and containment system composed of flexible piping, piping sumps and entry fittings. It is designed for superior dispensing performance, installation efficiency and containment protection for the UST operator.

OPW Fueling Components.

Circle 45 on card.

Wear monitor system

The Kaldetect wear monitor system uses a low voltage

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circuit is interrupted and an alarm is triggered. Kaldetect can be programmed to automatically shut down plant operation.

Abresist Corp.

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Software

Pump-Flo™ version six software includes over 50 pump manufacturers' catalogs on a disk. The program is capable of selecting pumps from the catalogs, then displaying the operating curve, specification document and dimension drawing for the pump.

Engineered Software Inc.

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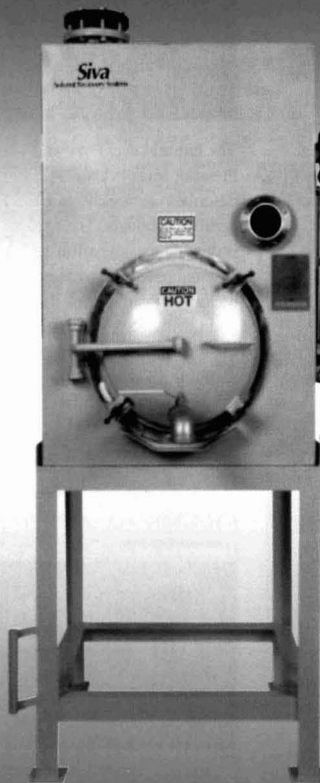
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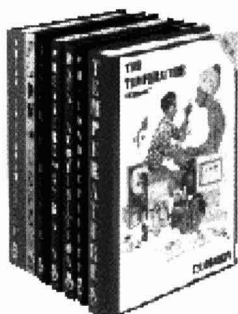
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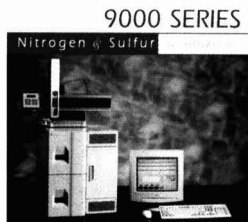
Compiled by Kristie L. Guillotte

Check out some of EP's favorite catalogs, brochures, books and reports available this month.



The Temperature Handbook™ 21st Century™ Preview Edition by Omega has been revised and reorganized for ease of use. It contains up-to-date listings for thermocouple probes, sensors, connectors and wires. Also included are sections covering meters, recorders, trans-

mitters, controllers, instrumentation and data acquisition products. Omega. **Circle 48 on card.**



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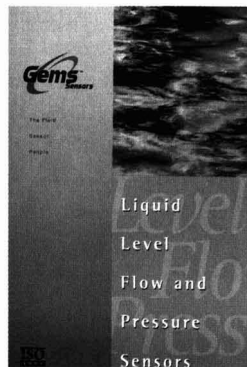
The 9000 Series Brochure by Antek Instruments features nitrogen and sulfur analyzers. Included are horizontal and vertical analyzers, liquid and solid autosamplers and other sample handling accessories. The brochure explains principles of Pyro-Chemiluminescent™ nitrogen analysis and Pyro-fluorescent™ sulfur analy-

sis. Antek Instruments Inc. **Circle 49 on card.**



Safety Storage's Brochure describes their new 2x2 series of prefabricated, relocatable buildings for the storage, handling and dispensing of chemicals and hazardous materials. The brochure also includes information on a wide range of optional environmental controls and safety accessories. Safety Storage Inc. **Circle 50 on card.**

assessing internal and external risks, implementing a Year 2000 Plan (Y2K), incorporating Y2K language in client agreements and minimizing Y2K related liabilities. DPIC Companies. **Circle 52 on card.**

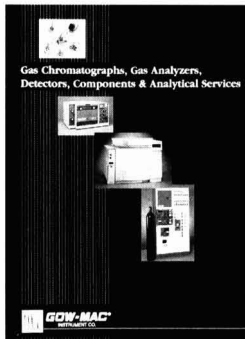


The Liquid Level Flow and Pressure Sensors Catalog describes Gems Sensors CE certified products. The catalog is divided into departments for easy reference. Departments include pressure, level, flow and Qwik Piks™, which lists in-stock products ready for shipping and hints to make the best sensor selection. Gems Sensors Inc. **Circle 53 on card.**

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The Gas Chromatograph, Gas Analyzers, Detectors, Components & Analytical Series Brochure includes Gow-Mac's line of analytical instruments for gas analysis. Brief descriptions are supplied for all of the products. The brochure also describes Gow-Mac's analytical systems group. Gow-Mac Instrument Co. **Circle 51 on card.**

DPIC Companies is offering a free handbook titled "Y2K—Are You Ready for the Year 2000?" This 8-page handbook provides a helpful outline for



Temperature Measurement Solutions is a 20-page color catalog describing a full line of measurement devices for temperature and other environmental conditions. The catalog offers detailed specifications and pricing for all products, both old and new. Telatemp Corp. **Circle 54 on card.**

A temporary solution

Contract work is providing employment for many environmental professionals

By Ingrid Truemper

Michael Barrett, an industrial hygienist and certified safety specialist in Pacifica, Calif., has spent two-thirds of his 10 years of experience in the environmental industry as a contract worker for a job placement agency. Barrett was downsized from his previous job in 1991, just before the beginning of the recession in the environmental job market. "Companies were afraid to commit to long-term employment due to the recession," he said. Barrett is still seeking permanent work but says he enjoys the flexibility of contract work as well.

Barrett's tale is becoming more and more typical. According to the U.S. Bureau of Labor Statistics, in 1950 one percent of the U.S. work force was working on a contract basis. In 1996, that figure had increased to 18 percent. *Fortune* magazine reported that by the year 2000 as much as 40 percent of the U.S. population will be part of the contingent work force.

"Companies are shrinking to a smaller core of full-time employees and then bringing in needed assistance through outsourcing and flexible staffing," said Dr. Barry Goss, president of Pro-2-Serve Professional Project Services Inc. in Oak Ridge, Tenn. Goss, a former senior vice-president of a large company dealing in environmental compliance, left his job specifically to start a business that addressed these changing trends in the work force.

While no official percentages are available, the trend towards contract work in the environmental industry reflects that of the economy as a whole. The numbers may even exceed the national average, since environmental work is typically done on a project

Hard times in the industry

The depressed job market can partly be attributed to the fact that remediation work has slowed down as government clean-up money has shrunk. In 1993, Superfund clean-up funds were at \$1.585 billion. In 1997, that number had

dropped to \$1.394 billion.

Additionally, an explosion of mergers and acquisitions in the private sector has led to duplication of jobs and thus to elimination of staff. Similarly, the military, formerly a large employer of environmental professionals, has downsized. Many environmental professionals are unemployed, and many more are underemployed, working in jobs for which they are overqualified.

Competition forces cost-cutting

Rather than attempting to find a job in a glutted market, many resourceful professionals have opted to go into business for themselves, opening one- or two-person consulting businesses, said Herb Newman, senior staff specialist at Fusion Staffing Services in Walnut Creek, Calif. "These smaller businesses can [offer their services] a lot cheaper than the big guys, so larger companies have to compete by cutting costs." To reduce their overhead, the big firms turn to job elimination.

Instead of relying on permanent staff, larger companies have turned to outsourcing to supply their employment needs. Companies do not have to pay benefits to these employees. Also, since



basis. Additionally, the recession that has prevailed in the national environmental job market for approximately the last 5 years has created a pool of qualified professionals looking for work.

the industry typically works on a project basis, firms can bring in workers for a few months when they need them and then let them go again when business is slow.

A broad spectrum

All types of environmental professionals can be found working on a contract basis, from entry-level employees to very senior project managers. While in the past most of the demand was for lower level employees, according to Goss, companies are beginning to contract out high-end positions on a regular basis. He frequently places executives who have taken early retirement—"people with good skills and

energy who aren't looking to work full-time for a variety of reasons."

Another group has entered the temporary field due to layoffs. Many qualified people who have been downsized do not want to leave the industry, so they turn to contract work while they are waiting for the recession to end. However, Goss believes that the trend away from permanent employment will continue. Some of his employees prefer to work on a projectized basis. "After someone's been laid off a couple of times through no fault of his or her own, he or she begins to understand that full-time, permanent work is going out of existence," said Goss.

According to W. David Keefer, senior professional associate at Pro-2-Serve, in the environmental field most requests

Project-based work
can provide a
fast track to
professional growth
for an individual
willing to sacrifice
job security.

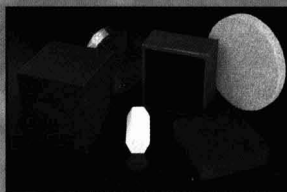
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received are for geologists and senior environmental field technicians. A high demand exists for scientists and engineers who have specialized in a sub-discipline such as engineering safety or radiological control engineering, while the demand is much lower for classical engineering skills.

Goss also places many young college graduates who choose to work on a contract basis and are seeking highly desirable, cutting-edge projects, such as investigations driving toward a no further action determination, to build a diverse portfolio of experiences. Keefer believes that opportunities for career advancement in the environmental field have become limited because of the slowdown in the industry's growth rate. Employees tend to have longer tenures in permanent positions, and projectized work can offer a junior-level employee an effective way to build a résumé through exposure to many different companies and ways of working. Additionally, when an employee is ready to settle down into a permanent position, he or she "can shop around and get a much better feel for what kind of employer somebody would be after having worked for them."

Mid-level employees who sometimes get "pigeonholed" into one job role can also benefit from contract work, says Keefer. Project-based work can provide a fast track to professional growth for an individual willing to sacrifice job security, for a while at least.

"You have to take responsibility for keeping yourself working and marketing your skills. Projectized work is more entrepreneurial—but there's a reward side to go with that," Keefer said.

Benefits to projectized work

"Some of our workers would never take a permanent job—they like the flexibility of contract work. They can work and then

take off a month and go to Europe to ski," said Newman.

Contract jobs can vary from one day to years in length. As more workers turn to contract work as their primary source of income, many temporary placement agencies are offering benefits normally only associated with permanent work. For example, Fusion Staffing Services offers employees who have worked more than 1,000 hours for the agency health care benefits and 401(k)s.

Compensation can be healthy. Many agencies pay slightly higher than the industry average in lieu of benefits. According to Newman, his agency pays in the range of approximately \$20 to \$40 per hour, depending on an individual's background and the nature of the work. Contracts that pay on the higher end of the scale include environmental legal work by licensed attorneys and chemical engineering. Some agencies work on a bidding system, in which candidates are asked what they would accept for the job. A list of candidates together with qualifications and pay requirements is forwarded to the company, which then makes a decision. Other agencies have a standard salary plan based on skills and experience.

Disadvantages

Drawbacks to temporary work exist. Barrett cites periodic shortages of work, depending on the market and due to the seasonal nature of field work. Not all agencies offer benefits, leading to a lower stan-

graphical continuity on the job can be stressful. Boredom and frustration can surface when an employee is forced by economic necessity to work in a field for which he or she is overqualified.

According to Cook, people will often accept an entry-level position just to get a foot in the door. He cites the example of a chemist who accepted an entry-level position at a large firm, at a salary far below what he had been making before he was laid off. The story has a happy ending, however—the chemist was eventually hired permanently, at a much higher wage than what he had been earning as a contract worker.

For better or for worse, temporary work has become a permanent fixture in the environmental job marketplace. Environmental professionals are turning to contract work in ever greater numbers to fill the gap created by the decline in traditional employment opportunities. In a glutted job market, many environmental professionals can discover a viable alternative to a permanent job by exploring the options offered by contract work. **EP**

Ingrid Truemper is an assistant editor of Environmental Protection magazine.

For more information circle 55 on card.

All types of environmental professionals can be found working on a contract basis, from entry-level employees to very senior project managers.

dard of living. Additionally, long commutes can become a fact of life.

Added to the practical discomforts are the psychological ones. "Workers are 'at will' employees, which can be very demoralizing for a highly trained professional," said Mort Cook, president of Environmental Contract Professionals in Los Angeles. A lack of social and geo-

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1998 Salary Survey

From the new types of compensation packages to the hottest job skills, our readers sound off about trends they see impacting today's environmental job market

*By Angela Neville, JD, REM,
and Kristie L. Guillotte*

Our readers have spoken. From down in the trenches throughout the United States, environmental professionals gave us feedback about interesting developments they see happening now in this industry.

Taken as a whole, the comments by our readers about the current state of environmental professionals' salaries send out one clear message. Even though some segments of the environmental market like federally funded remediation projects are continuing to slow down, other areas like ISO 14000-related professional services are booming and offering great possibilities for financial advancement.

To solicit input, we asked the readers of our March issue to complete a one-page questionnaire in which we asked about their workplaces, level of education, years of experience, number of people supervised, geographical locales and gender. More than 190 readers replied and we calculated the numbers to come up with a profile of current salaries for professionals working in the five specific areas of hazardous materials management, solid waste management, air quality management, water and wastewater treatment and health and safety (see Figure 1).

For those of you looking at the survey to compare how your salary stacks up against those of your peers, please note that this should not be considered a statistically valid survey, but rather an

informal representation of *Environmental Protection's* readership.

Expanding job duties

Approximately 50 percent of the respondents stated that they handle job duties in more than one of these five areas and characterize themselves as having multiple environmental job duties. This reflects a

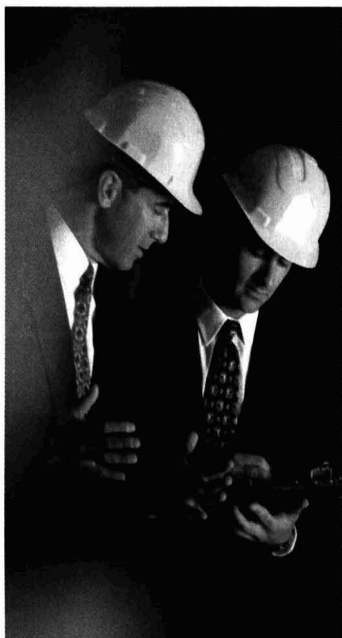
common refrain we heard from our readers who commented that environmental professionals are increasingly asked to perform more broad ranging duties at their jobs.

Other survey participants described their job duties as being other than the five areas listed in the survey questionnaire. Examples of other types of duties listed by our respondents include emergency medical services, industrial engineering, quality assurance of food products, security services, energy production, soil quality analysis, risk communications and petroleum production.

Current employment climate

Several readers commented on how compensation packages are starting to be restructured in the industry. A regulatory compliance specialist for a petroleum pipeline in Tulsa, Okla., commented that "Companies appear to be limiting raises to plus or minus 3 percent across the board. [There is a] move to performance-based pay utilizing bonuses."

Tom Herbert, a project manager at a manufacturing facility in Hyrum, Utah, echoed this sentiment when he stated, "In order to be viewed as a resource or even a partner in our companies, we must find a way to convince management that we add value to the business. We can do this by concentrating on company resource efficiency. Get the most value out of all we buy. Don't waste products."



As far as trends in the most marketable job skills, a project manager for a public utility in Decatur, Ill., stated that "Engineers used to have a stranglehold on the best jobs. That's changing as industry realizes that this is a multi-disciplinary field. The new emphasis on risk assessment and ecological issues will promote the demand for toxicologists and biologists." Matthew Parker, a health and safety consultant in Aiken, S.C., reiterated this outlook in his comment, "The key to more money is cross training."

An environmental consultant in Knoxville, Tenn., summed up the views of

several respondents when he stated that "Environmental management systems, i.e., ISO 14000, are silently catching on at a fast pace." In that same vein, an engineer at a manufacturing facility in Green Bay, Wis., commented that "Through ISO 14000 and environmental management systems, expertise in-house is increasing. The need for specialized consultants will continue to decline."

Like computer specialists and physicians who have to deal with frequent new developments in their fields, environmental professionals also must be willing to be

flexible in order to capitalize on all the continual changes in this challenging industry. These changes include the specific sectors of the industry that are proving to be hot areas in which to find a job.

Charting new waters

We cannot survive anywhere in this world without clean water, so careers in the water and wastewater treatment sector are among the fastest growing in the environmental industry. According to *The Environmental Benchmark & Strategist*, a publication including financial data for the environ-

Figure I Survey Results

WORK PLACE	HAZ MAT	SOLID WASTE	AIR	EH&S	WATER	OTHER	MULTIPLE	TOTAL
Manufacturing	\$50,000	\$63,720	\$65,220	\$55,880	NA	\$66,500	\$59,054	\$59,027
Utility	65,000	32,000	55,500	52,500	40,000	NA	60,333	51,167
Government	40,800	54,831	44,805	29,000	51,371	64,250	53,924	51,508
Academia	NA	NA	NA	33,750	NA	50,000	62,000	44,875
Municipal Landfill	NA	46,000	NA	NA	NA	NA	NA	46,000
Consulting Firm	54,750	42,000	27,750	71,500	68,000	71,125	74,226	65,946
Other	95,000	NA	56,000	66,000	43,000	46,000	62,697	62,138
EDUCATION								
High school	NA	NA	NA	35,000	30,000	51,000	48,500	45,550
Bachelors	50,700	47,140	41,780	47,233	40,820	89,000	63,928	56,335
Masters	50,900	52,152	61,800	62,667	57,416	63,863	60,884	59,914
Doctorate	83,000	50,000	78,500	NA	NA	50,000	69,333	67,071
Other	30,000	NA	29,000	NA	55,000	46,000	60,333	48,714
EXPERIENCE IN YEARS								
0 to 5	35,333	44,666	43,833	32,380	30,375	63,000	44,633	41,628
6 to 10	45,450	49,240	43,476	62,000	NA	52,083	55,839	53,390
11 to 20	70,000	54,205	63,120	72,375	53,125	73,000	66,177	65,456
21 or more	38,667	55,500	50,500	61,250	59,920	74,250	79,312	67,455
PEOPLE SUPERVISED								
Zero	44,413	45,870	53,437	56,880	39,000	NA	59,418	52,824
1 to 5	62,916	55,500	45,996	43,937	45,500	66,875	59,138	56,716
6 to 10	NA	60,000	NA	87,600	57,600	59,000	62,329	64,483
11 to 20	NA	NA	50,000	NA	NA	NA	119,500	99,916
21 to 50	NA	NA	NA	55,000	55,000	55,000	48,500	50,666
51 or more	45,500	52,320	58,000	65,500	65,500	52,000	57,875	55,983
REGION								
Midwest	50,900	39,250	68,600	40,500	52,250	50,000	60,191	56,440
Northeast	30,825	67,000	42,000	59,233	33,000	61,916	55,749	53,565
South	62,000	47,720	44,578	54,233	48,950	74,667	58,567	55,528
West	66,000	65,000	56,928	60,000	NA	52,667	72,476	66,486
GENDER								
Female	69,166	47,860	46,600	28,400	43,700	49,500	61,834	53,886
Male	47,407	51,382	50,528	59,333	56,800	69,125	61,497	58,469
TOTAL	\$51,487	\$50,795	\$49,593	\$55,150	\$48,738	\$64,218	\$61,553	\$57,533

The regions include the following states - Midwest: ND, SD, NE, KS, MN, WI, IA, IL, IN, OH; Northeast: ME, VT, NH, MA, NY, CT, NJ, PA, MD, WV, DE, RI; South: TX, OK, AR, MO, LA, MS, AL, TN, KY, NC, SC, GA, FL, VA, PR; West: CA, NV, AZ, NM, CO, UT, OR, WY, MT, ID, WA, AK, HI

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mental industry, this sector is exploding with new companies, both private and public, and mature companies are revitalizing. The latest market estimate puts the worldwide water and wastewater treatment market at \$500 billion annually.

The U.S. Bureau of Labor Statistics lists water and sanitation careers among the top 10 industries with the fastest employment growth between 1996 and 2006. The bureau predicts a 51 percent increase in the industry.

Walter Frey, a wastewater engineer for Walk Haydel, an engineering firm in New Orleans, has been working in the industry for 35 years. He said that in the 1960s and 1970s, most professionals followed a popular trend to take work at municipal wastewater treatment plants, but today the emphasis has switched to the commercial and industrial sector. "Most of the work in the sanitation area has been done and now it is in the maintenance phase, but there are many jobs available for wastewater treatment in industrial plants," Frey said.

William Reilly, president and chief executive officer of Aqua International Partners, San Francisco, and former chief administrator of the U.S. Environmental Protection Agency, expects to see the water and wastewater industry grow significantly in the next couple of years. "This industry is becoming more of a priority internationally," said Reilly. "The strongest competitors for international water and wastewater projects are not from the United States, but we are working to change that and hoping in the next couple of years to provide U.S. companies and environmental professionals with more opportunities."

Brownfields create opportunities

Another job sector that is growing in the environmental industry is brownfield restoration. "No one is waiting around anymore for Superfund, so great attention is being given to brownfields," Reilly said. "Brownfields is one of the more creative areas in the environmental industry because most are located in areas near existing infrastructures and by restoring them employment grows in the area."

The lucrative return on investment that can result from cleaning brownfields has caused both private and public companies to become interested. Randall L. Airst, senior attorney for American Land Recycling Corp., Exton, Pa., said that environmental consulting and engineering firms with a more traditional management structure and the combination of financial management, real estate knowledge and

environmental expertise are the ones that will provide job opportunities with brown-field restoration. "As far as the cleanup itself goes, companies that can provide innovative cleanup technology at the lowest cost will benefit the most," said Airst.

Cleaning the planet

In October 1997, *U.S. News & World Report* included pollution prevention specialists among its choice of top 20 careers. According to the magazine, "The Environmental Careers Organization expects the \$1 billion pollution prevention industry to grow by 10 percent in 1998." In the private sector, companies that can expect to see this growth are those specializing in defense contractors and metal refinishing. The government is expected to hire specialists.

According to the *U.S. News & World Report* study, "An engineer who can show industry an environmentally acceptable way to paint planes or process raw materials will find a warm welcome."

William Anderson, executive director of the American Academy of Environmental Engineers in Annapolis, Md., reported to the Bureau of Labor Statistics in 1994 that "The focus on environmental policy generally has moved in 10-year cycles—water supply in the 1960s, solid waste management in the 1970s, hazardous waste management in the 1980s and air quality in this decade. In each case, new policies lead to job growth for certain occupations."

Help wanted: Need well-rounded person

Although the Bureau of Labor Statistics reported that engineers and scientists in general can expect 45-percent growth between 1996 and 2006, opportunities for business professionals in the environmental industry are also growing. Companies need professionals who can market their goods and services.

Adam Kohn, senior vice president and principal at the executive search firm of Christian & Timbers in Cleveland, said, "Environmental consulting companies are searching for more seasoned executive management at the top because they need someone who can bring in big projects."

Kohn sees the trend moving towards professionals with a technical background, mostly by trade, and marketing-oriented skills. He stated that within the environmental field, there is a need for more chief executive officers, executive vice presidents, regional vice presidents and marketing directors.

L. Barry Goss, PhD, president and CEO

of Pro-2-Serve Professional Project Services Inc. in Oak Ridge, Tenn., believes the field needs more technical business professionals who can provide peer-level interaction without fitting into the category of a classic salesperson.

"The generalist is gone. In the environmental industry, you need the combination of a good technical background with a business head," said Goss.

Bouncing back

Environmental Business International Inc., San Diego, counted over 1 million jobs in more than a dozen environmental industry sectors in 1993, or roughly one worker out of every 12 for the economy as a whole.

Herb Newman, an environmental staffing specialist for Fusion Staffing Services in Walnut Creek, Calif., does not believe the environmental industry as a whole is bouncing back from the slump it experienced. He said, "There are some new areas that are shaping up, such as environmental, health and safety auditing, environmental compliance and ISO 14001, but the progress these sectors are making seems to be creeping along."

"The environmental industry is leveling and changing its nature," stated Goss. He believes that the consolidation of large companies and downsizing has made many firms cautious about rehiring a full staff. Newman and Goss both agree that the trend is moving toward providing workers on a project or temporary basis.

"Companies keep the core staff, which are workers they can justify employment for over the long haul, but they turn to companies like Pro-2-Serve to find flexible staffing or individuals with the skills they need to accomplish the task at hand," said Goss. (*EP* discusses this issue in-depth in "A temporary solution," p.15).

The environmental industry has experienced its ups and downs. At this time, the industry seems to be somewhere in the middle with more of a positive outlook than just a couple of years ago. Jobs exist for environmental professionals who have expanded their knowledge to sectors beyond the ones of their specialization. The keys to having a long and well-paid career in this ever-changing industry are education about emerging fields and keeping abreast of federal and state environmental regulations. **EP**

Angela Neville, JD, REM is editor-in-chief and Kristie L. Guillotte is an assistant editor of Environmental Protection magazine.

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Stepping

Don't start pounding the pavement without our salary survey and these practical job hunting tips

OUT

By Ashley E. Blyth

If you are hunting for a job because of downsizing, rightsizing or just plain old corporate meanness, all the tools you need to maximize your search are at your fingertips. The old adage, "Availability is more important than ability" may not seem true in your particular technical field, but there is a lot to be said for being in the right place at the right time. Before you even have to drain the 2 months' salary you've saved to fund your job hunt, consider these basic tips.

The first step

Update your resume and curriculum vitae every time you start a new job, get a promotion or transfer, gain new responsibilities or get a raise. Include project names on which you have worked and the responsibilities you had. If you do not have a computer at home, it may be easier to pay someone to create a resume for you. If you do use such a service, be sure to get a copy of your resume and matching letterhead on a disk. Then you can update your resume on a computer in your local library or at an office and copy center.

Always keep one copy of your resume on plain white paper to fax. Heavy bond paper usually has cotton fibers or a pattern to it that does not transmit well via facsimile. If your resume has color on it, make your faxable copy in grayscale. Once the decision maker contacts you for an interview after receiving your easy-to-read faxed resume, you can present your color version on heavy paper in person.

Get moving

Developing a resume is easy. Finding the place to send it is another challenge.

Your next step depends on two things: how badly you need a job and how competitive the job market is. If you are employed and not totally uncomfortable with your current job, start by compiling your resources and contacts. Organize all the professional contacts you have made by looking through business cards and old correspondence. If you have kept neither of these, this is a good time to start. From every conference, seminar and tradeshow you attend you collect business cards, notes

and brochures. Instead of filing them away, either in a drawer or in the trash can, make a note on each one where you got it and why. When you get a business card from someone, ask for his or her e-mail address; it is a cheap and easy way to keep in touch. Following through is the difference between meeting a stranger and

making a contact.

If you have already received notice that you are being laid off or you plan to relocate in the near future, step up the pace and start networking. An easy way to start is to commit half of your lunch break 3 days a week to calling the professionals with whom you have maintained contact. After a couple of weeks, adjust the time you spend based on the fruits of your labor.

Walking through the Web

According to a 1997 survey conducted by JWT Specialized Communications, 66 percent of human resource professionals are using the Internet for recruitment-related activity, and over 62 percent of potential employers expect to use the Internet to recruit in the coming 12 months.

The Internet is an excellent source of information for general trends, resume tips and salary information, but is still a passive way to actually job hunt. Richard Nelson Bolles, career guidance guru and author of *What Color is Your Parachute?*, writes on his Web site that there are five ways in which the Internet can be helpful to job hunters or career changers:

1. To search for job listings;
2. To post your resume;
3. To obtain job-hunting help or career counseling;
4. To make contacts with people who can help you find a job; and
5. To research fields, occupations, companies and cities.

Of the salary survey respondents interviewed, all said that they have used the Internet during their job searches. None, however, had actually received job offers as a result of research and resume posts on environmental and safety-related job bank



Web sites. One respondent, Wes Kolar of Athens, Ga., said, "[The Internet] is the only place I look anymore. I can find 20 safety-related jobs at any given moment.

**Following through
is the difference
between meeting
a stranger and
making a contact.**

The papers are useless." He learned of his current position through a contact already working for his current employer.

Bruce Nocita was not as enthusiastic about the Internet's real job lead potential. Although he has researched two job-related Web sites, "so far nothing appropriate has turned up."

Footnotes

One job-hunting resource to peruse

is Bolles' popular best-selling book, *What Color Is Your Parachute?* Updated yearly, the book includes aptitude tests, budget plans, relocation advice and alternative career suggestions. His accompanying Web site, www.washingtonpost.com/wp-adv/classifieds/careerpost/parachute, provides links to and his evaluations of several job-related Web sites.

Make general job hunt advice applicable to the environmental job market. After determining how urgent your job need is, polish up your list of accomplishments and start networking. Keep a copy of *Environmental Protection's* 1998 salary survey handy and glean some ideas from our salary survey article by Editor Angela Neville and Assistant Editor Kristie Guillotte about employment trends. If you do not meet success searching for traditional employment, study Assistant Editor Ingrid Truemper's nod to non-traditional jobs. **EP**

Ashley Blyth is managing editor of Environmental Protection magazine.

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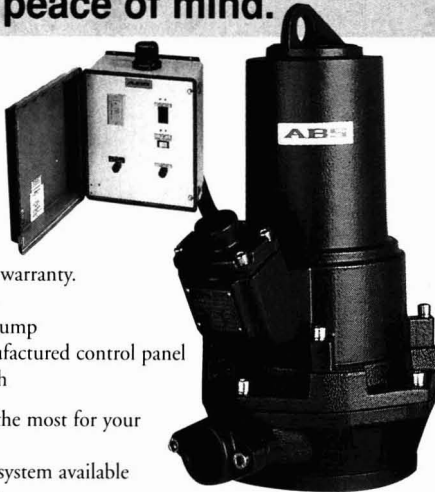
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Seeing the light

By George Tchobanoglous, PE, PhD, Robert Emerick, PhD,
Frank Loge, PhD, and Jeannie Darby, PE, PhD

*A better understanding of particles' impact
on ultraviolet disinfection can lead to more
efficient wastewater treatment*

Radiation emitted from ultraviolet (UV) light sources has been used since the beginning of this century to disinfect water supplies. When applied in proper doses, UV light has been proven to kill effectively the bacteria and viruses found in wastewater without contributing to the formation of toxic compounds.

In applying ultraviolet UV radiation for the disinfection of wastewater, factors that must be considered include: contact time, UV light intensity, number and physical state of organisms, types of organisms and the characteristics of wastewater. Of these factors, the characteristics of the wastewater, and more specifically, the degree of association between the target organism to be disinfected and the particles that are present, will generally have the greatest impact on the UV disinfection process.

Modeling the disinfection process

In 1908, Harriet Chick proposed a simplified first-order model to describe the decrease of organisms with time, for a given concentration of disinfectant, assuming the individual organisms are discrete entities within the fluid. The model is expressed as:

$$N = N_0 e^{-kt} \quad (1)$$

Where N = number of organisms remaining after disinfection

N_0 = number of organisms present before disinfection

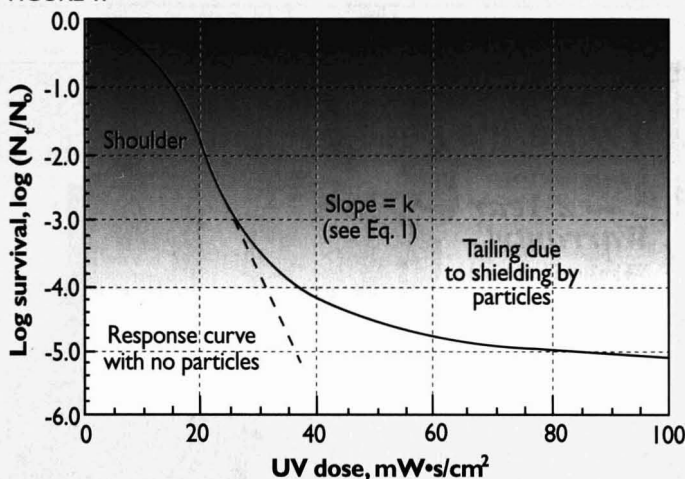
k = decay constant which reflects the impact of the factors affecting the action of the disinfectant
 t = time

However, in treated wastewater, which

contains total suspended solids (TSS), this relationship does not apply, especially where stringent effluent microorganism standards must be met. The effect of effluent TSS on disinfection performance is

taken into account by the water quality factors. Water quality factors that must be considered include size, size distribution and concentration of the particles that comprise the TSS; the nature and number

FIGURE 1.



illustrated in Figure 1. It should be noted that Equation 1 applies to the straight line portion of the curve given in Figure 1.

The effectiveness of UV disinfection of wastewater treatment can be modeled with a relationship of the following general form:

$$N = \phi(N_0, W_f, D) \quad (2)$$

Where N = number of organisms remaining after disinfection

W_f = water quality factors

D = UV dose

The characteristics of the wastewater are

of target organisms and their physical state within the liquid, such as free swimming or particle associated; and the presence of chemical compounds that can absorb UV radiation. The dose of disinfectant for a physical agent can be defined as follows

$$D = I \times t \quad (3)$$

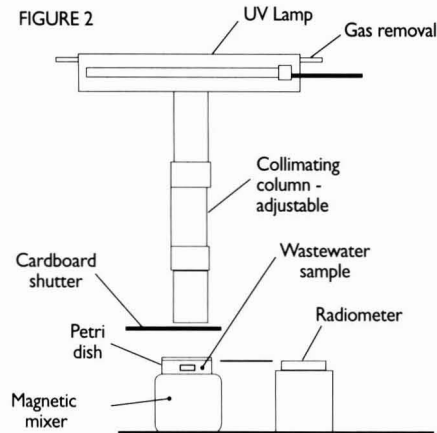
Where D = UV dose, milliwatt seconds per centimeter squared ($\text{mW}\cdot\text{s}/\text{cm}^2$),

I = intensity of physical agent, that is UV radiation

t = contact time

Germicidal effectiveness of UV radiation

Ultraviolet light is a physical disinfecting agent as opposed to a chemical one. Radiation with a wavelength of around 254 nanometers (nm), characteristic of low-pressure UV disinfection systems,



penetrates the cell wall of the micro-organism and is absorbed by cellular materials including DNA and RNA, which either prevents replication or causes death of the cell. The required UV dose is determined based on collimated beam studies or from pilot-scale studies to account for the site specific factors influencing water quality.

In collimated beam studies (see Figure 2), the UV dose is controlled by maintaining a constant UV intensity—a function of tube length and the number of lamps used for light application—and varying the exposure time. Because the geometry of the collimated beam is fixed, the depth-averaged UV intensity within the Petri dish sample volume can be computed using Beer's law, which states that the absorbance of a solution of a given chemical species at a fixed wavelength is proportional to the thickness of the solution, or the light pathlength, and the concentration of the absorbing species. Therefore, by knowing the exposure time, the UV dose can be determined. The UV dose is then correlated to the microorganism inactivation results, typically measured using the multiple tube fermentation (MTF) test. The results are reported in the form of a dose-response curve (see Figure 3).

Impact of particles in wastewater

The UV dose required to achieve a 5 to 6 log reduction in the number of dispersed

coliform organisms (total coliform/100 milliliter) is the range from 10 to 40 $mW \cdot s/cm^2$. Unfortunately, in wastewater, a number of coliform organisms are either clumped or particle associated. As a result, the UV dose required for organisms that are in clumps or are particle associated

will depend on the size and number of particles and the degree of association with the target organisms. The impact of treatment plant specific water quality factors on the effectiveness of UV disinfection is illustrated in Figure 3. As shown, although bulk measurements made on effluents from different plants can be similar, like TSS and transmittance values, specific factors such as the degree of particle associated coliforms that are not measured routinely can impact disinfection performance significantly. It is important to note that increasing the

UV dose in the tailing region, which is the right hand side of graph, will result in limited, if any, improvement in the effectiveness of UV disinfection.

Increasing the UV intensity tenfold will also have little effect on the inactivation of

The effectiveness of UV disinfection will vary with each treatment plant, depending on the number of organisms that are either clumped or particle associated and the distribution of particle sizes in the effluent.

particle associated coliforms. The reason that there is little or no effect is that the adsorption of UV radiation by wastewater particles is 10,000 times or more greater than the bulk liquid medium. Thus, particles larger than some critical size, typically 10 to 20 micrometers (μm), will effectively

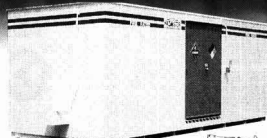
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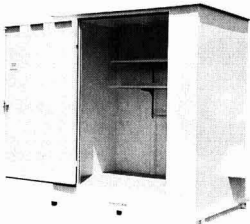


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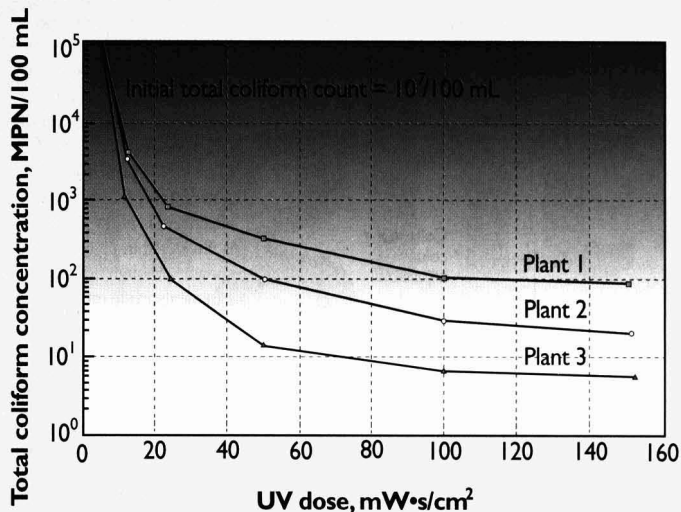
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shield some embedded microorganisms. The effectiveness of UV disinfection is governed primarily by the number of par-

on the number of organisms that are either clumped or particle associated and the distribution of particle sizes

FIGURE 3.



ticle associated coliform. Therefore, to improve the performance of a UV disinfection system, either the number of particles

in the effluent. Because the adsorptive properties of wastewater particles are composed of biological material, increasing the UV intensity will not cause a significant improvement in the performance of the UV system. Thus, it is not possible to predict a priori whether a specific degree of inactivation can be achieved with secondary effluent containing particles. To overcome the effects of particle shielding either the particle size distribution must be modified by making appropriate modifications in the design and operation of the upstream treatment processes to produce an effluent with particles that can be disinfected more effectively or the particles must be removed by some means—granular medium or membrane filtration. To meet the stringent coliform requirements for unrestricted wastewater reuse applications, coliform count equal to less than 2.2 most probable number (MPN)/100 milliliter (mL), effluent filtration will be required. **EP**

Either the number of particles with associated coliform must be reduced by modifying the operation of the upstream process, or the particles themselves must be removed by improved clarifier design or filtration.

with associated coliform must be reduced by modifying the operation of the upstream process, or the particles themselves must be removed by improved clarifier design or filtration.

Summary

The effectiveness of UV disinfection will vary with each treatment plant depending

George Tchobanoglous, PE, PhD, and Jeannie Darby, PE, PhD, are professors in the Department of Civil and Environmental Engineering at University of California at Davis; Robert Emerick, PhD, and Frank Loge, PhD, received their degrees from the Department of Civil and Environmental Engineering University of California at Davis with thesis work on UV disinfection.

For more information, circle 58 on card.

MACT attack

EPA picks up the pace in developing new maximum achievable control technology air quality standards for industry

Ted Sears, MS, JD

The Clean Air Act (CAA) amendments of 1990 require that U.S. Environmental Protection Agency establish standards for major sources of 189 (now 188) listed hazardous air pollutants believed to cause adverse health or environmental effects. EPA published a list of 173 major source categories that emit one or more of these listed pollutants and is in the process of developing maximum achievable control technology (MACT) standards for each listed source category.

The CAA amendments established a 10-year schedule for MACT standard promulgation. Under this schedule, EPA is to promulgate certain MACT standards in the first 2 years of the program, about 25 percent in the first 4 years, an additional 25 percent not later than the seventh year and the remaining 50 percent not later than the tenth year of the program.

Report to Congress

Pursuant to CAA Section 112(s), EPA filed a report with Congress in December 1997 entitled Second Report to Congress on the Status of the Hazardous Air Pollutant Program under the Clean Air Act. The triennial report addresses EPA's air toxics control programs and the performance-based approach EPA has taken to setting MACT standards.

According to the report, EPA has been productive in fulfilling the 2- and 4-year group MACT standard requirements, which account for approximately 25 percent of the 173 source categories listed under this program. The Agency has promulgated all of the air toxics standards slated for completion within 4 years of the 1990 amendments. At the time of the report, EPA had set standards for 47 categories of industrial sources, and the first substantive compliance date for the MACT standards already promulgated under the CAA amendments has passed for about 10 source categories. In addition, the agency has built the necessary infrastructure for implementing the MACT standards. EPA considers this initial effort the starting point for its air toxics management program as it continues

through proposal and promulgation of the 7- and 10-year standards.

EPA is in the process of developing many of the remaining MACT standards it is required to promulgate. Under EPA's initial schedule, many of these standards were due to be completed in 1997, while remaining ones are due in 2000. According to other EPA documents, the agency has promulgated three of 29 standards originally due in 1997. It expects to promulgate the lion's

If EPA fails to promulgate these standards by the required date, CAA Section 112(j) requires that EPA undertake case-by-case MACT determinations, which would then be incorporated into individual Title V permits.

share of standards in 1998 that were originally due in 1997, in many cases being only months behind schedule.

The agency is also behind schedule on other Section 112 requirements. For example, EPA is continuing to work on a report to Congress addressing residual risk issues, which will address whether sources regulated by MACT standards present any remaining risks to the public once those standards are in place. The report was due to Congress by November 15, 1996. Also, under Sections 112(c)(3) and 112(k), EPA

was to have developed an urban area air toxics strategy by November 15, 1995. EPA is actively engaged in the urban strategy development and expects to propose the strategy in mid-1998.

The agency's progress on MACT standards is in no small measure a direct result of its acknowledgment of the work it faces in setting these standards. It generally takes EPA 4 years to complete a MACT standard. Using traditional approaches, EPA uses vast resources to gather and analyze data to establish the standard. As a result, the agency's commitment of resources to the standards due for completion in 1994 has directly affected its ability to address the 1997 and 2000 MACT deadlines. Thus, despite the noted progress, EPA acknowledges that it is behind schedule, even announcing in March 1995 that it was behind schedule on several MACT standards and potentially behind schedule on a large number of MACT standards due in 1997 and 2000.

Falling behind in the MACT standard context has significant ramifications, both for the agency and the regulated community. If EPA fails to promulgate these standards by the required date, CAA Section 112(j) requires that EPA undertake case-by-case MACT determinations, which would then be incorporated into individual Title V permits. A case-by-case MACT is expected to be based on what the federal MACT standard probably would have been, but in reality will likely be overprotective.

A program for partnerships

To avert undertaking case-by-case MACT determinations in the future, EPA has implemented a streamlined MACT standard development procedure called the MACT Partnerships Program. The program is designed to ease the burden of establishing MACT standards for all source categories and help the agency meet its schedule for promulgating the standards. To date, the program has helped to the extent that EPA will continue to rely on it. Thus, facilities in those source categories that have not yet had a MACT standard established can expect EPA to rely on this

approach in the future, which is good news, since it avoids the case-by-case MACT determination, and bad news because the streamlined MACT process is potentially loaded with uncertainty and may open individual MACT standards to challenge.

The MACT Partnerships Program operates in two phases. First, EPA develops a presumptive MACT for the source category based on data it has gathered. In a presumptive MACT meeting, EPA and local agencies evaluate existing emission rate and limit data. They study the information to ascertain a proper MACT standard, grounding their decision only on the reviewed material. From EPA's perspective, the process avoids time-consuming stack tests, information requests and analysis. The result is a draft presumptive MACT, which must be approved in consultation at an open meeting with the directors of the Emission Standards Division, the State and Territorial Air Pollution Program administrators and the Association of Local Air Pollution Control officials. EPA and local agencies then determine a final presumptive MACT and address how they will develop a final MACT standard.

Although not legally binding, the pre-

sumptive MACT is meant to be "complete" to expedite final MACT standard development or, if necessary, a case-by-case MACT determination. The first phase streamlines the accumulation and interpretation of emissions data for the source category and takes 3 to 6 months. The streamlined process, however, ignores factors typically considered in MACT standard development, such as the MACT floor, control costs and economic cost-benefit impacts.

The second phase of the MACT Partnerships Program involves final-standard development for the source category. EPA uses one of three approaches to transform the presumptive MACT into a final MACT standard:

- The Adopt-a-MACT program;
- The Share-a-MACT program; and
- The streamlined traditional program.

The Adopt-a-MACT program is generally used when the source category contains few sources. A state accepts primary responsibility for collecting and analyzing data and prepares the documentation necessary to promulgate a final MACT standard. Facilities and consultants may contribute technical data, public meetings are held and EPA proposes and subsequently finalizes an

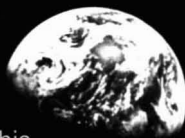
enforceable MACT standard. The Adopt-a-MACT program takes about 2 years.

In the Share-a-MACT program, EPA directs the development of a final MACT, assigning responsibilities to MACT planners from state and local agencies and environmental and industry groups. The latter participants have a limited role, providing information on emissions data and the proper subdivision of the MACT by class, size and type of source. EPA facilitates the process, counting mostly on the partners' expertise to provide the data on which the MACT standard is based.

The streamlined, traditional program is a reduced MACT development process devised to abbreviate the time needed to develop standards. EPA incorporates a presumptive MACT in the process to cut the time needed.

To the extent the MACT Partnerships Program helps the agency avert having to prepare Section 112(j) case-by-case, source specific MACT standards, the regulated community will almost always come out with a better result than with a source-specific MACT standard. Indeed, despite the possible appearance of being arbitrary and capricious, the use of streamlined administrative process does not necessarily result

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in an arbitrary and capricious final MACT standard. Industry involvement and data that reflects real emission reduction from specific sources may result in MACT standards that are as accurate as possible. For this reason alone, the MACT Partnerships Program is a positive approach to MACT standard development.

On the other hand, it is conceivable that

considerations such as the MACT floor, control cost and economic impacts and benefits will not be available. This could lead to inaccurate final standards and even uncertainty because it may leave the standard subject to judicial challenge.

For this reason, regulated sources should ensure that their MACT standard process be supplemented if a MACT Part-

nerships Program approach is used. This could be done by having EPA include a definite, separate procedural step for deliberating these elements, or that the agency include their consideration in the proposed rule. The agency could readily accommodate their consideration during

Conclusion

EPA is under legislative pressure to regulate air toxics. The agency has been unable to meet its own aggressive schedule and in response has developed the MACT Partnerships Program to expedite the process. In its attempt to do too much too quickly, EPA has created a program that could leave the standards open to challenge. The problem can be readily fixed to benefit both the Agency and the regulated community by incorporating the necessary considerations into the process to avoid having to undertake Section 112(j) case-by-case MACT determinations. **EP**

Ted Sears, MS, JD, is a senior consultant who specializes in air and hazardous waste matters for the Technical Group, LLC, in Washington, D.C.

For more information circle 91 on card.

To avert undertaking case-by-case MACT determinations in the future, EPA has implemented a streamlined MACT standard development procedure called the MACT Partnerships Program.

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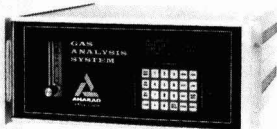
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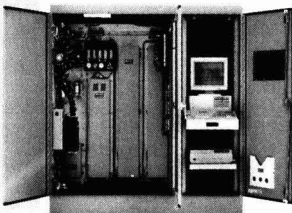
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Hazmat storage

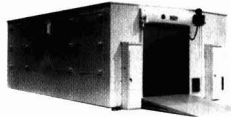
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◀ Structures

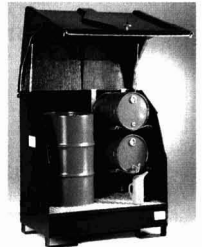
Big Top Structures are designed for protecting equipment or containing hazardous materials and toxic waste. The structures are engineered for extreme climates and can withstand 110 mph winds and heavy snow. Custom and standard designs are available. They are made of a galvanized steel frame with a heavy-duty reinforced vinyl membrane. *Big Top Mfg.*
Circle 59 on card.

Storage building ▼ Hazmat ▶ station



The jumbo size modular 2- or 4-hour fire-rated portable buildings in sizes up to 1,400 square feet stores solvents, corrosives, flammables and other toxic chemicals. Each welded steel unit includes a containment sump to collect spillage or leakage for proper disposal. Options include lighting, insulation, HVAC, explosion release doors, overhead entry door and a variety of alarm and fire suppression systems. *Precision Quincy Corp.*
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The hazmat station offers a variety of storage combinations. It is capable of safely storing hazardous materials over an internal 66-gallon spill containment sump. The station contains a lockable, fiberglass lid that is supported by gas cylinders, which opens high enough to offer full access to all drums. *P&D Solutions Corp.*
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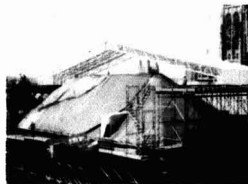


◀ Storage tank



The 550-gallon Megatainer is specifically engineered for the transportation of both hazardous and non-hazardous materials. It is constructed of durable 1/2-inch polyethylene for a high level of impact strength and corrosion resistance. The Megatainer weighs 570 pounds and has top-lifting lugs that enable it to be easily loaded and unloaded using a crane and hoist equipment. *Snyder Industries.*
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Building system ▼



The temporary roof and building system consists of a rigid aluminum framework clad with a fire retardant, high-strength reinforced polyethylene laminate. The system is capable of withstanding winds of 120 mph, static loads to 50 pounds per square foot and clear spans to 200 feet. *American Containment Systems.*
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Drum locator ▶ systems

Underground storage tanks, buried drums, burial trenches and other subsurface sources of pollution are located by environmental engineers and geoscientists without excavation using Subsurface Interface Radar (SIR) systems and the GEM-300 EM electro-magnetic profiler. The SIR-2 is a portable, field-rugged ground-penetrating radar system often used in environmental site assessments. The GEM-300 EM Profiler collects data at 16 frequencies simultaneously. *Geophysical Survey Systems Inc.*
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Compiled by Kristie L. Guillotte
and Ingrid Truemper

Flow controllers



The FMA5400/5500 series electronic gas mass flow controllers provide for controlling the flow of a wide variety of gases from 0 to 10 sccm up to 100 slm. They are available in aluminum and brass construction for typical gas flows and a 316 stainless steel construction for applications requiring more corrosion resistance. Omega.
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Chain



The SAV709 stainless steel chain weighs 2.2 pounds per foot and is designed to run on

720S style non-metallic sprockets. It has a longer wear than either non-metallic or cast chains and has less parts than non-metallic chains.
Hitachi Maxco Ltd.
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Stain detector tube

A new length of stain detector tube monitors for airborne levels of chlorine in the sub TLV range. Tube number 8LL has a total measuring range of 0.025



to 2 ppm and can monitor at TLV levels with one pump stroke in about 1 minute. The system includes a piston-type precision pump with lifetime warranty. Sensidyne Inc.
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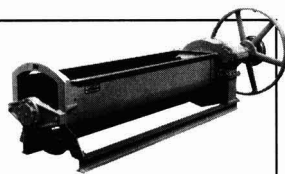
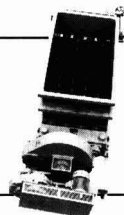
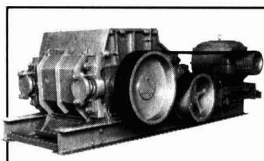
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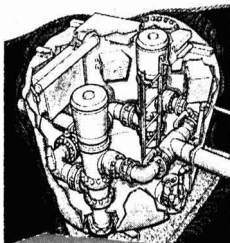
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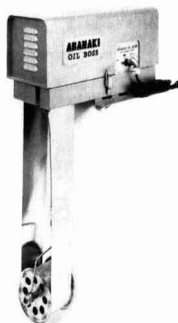
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Anarad Inc.
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Oil skimmer



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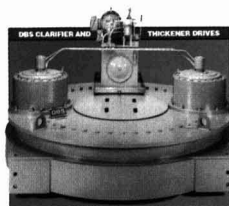
ISO 9001 certification received

Osmonics' Minnetonka, Minn., operation has received ISO 9001 certification. The location is the company's largest manufacturing location and worldwide headquarters, where the majority of its components, standard

machines and custom equipment originate. Osmonics.

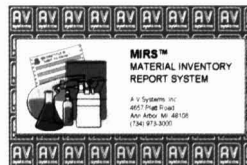
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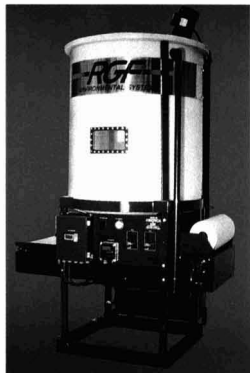
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Treatment system



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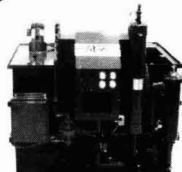
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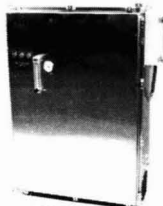
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Leak detection system



LeakLoc® Continuous Rapid Response Systems detect and locate leaks in cross-country pipelines within 3 minutes of occurrence and make the data simultaneously available to centralized data acquisition systems. Signal processing and acoustical monitoring locate leaks by analyzing pressure waves. Tracer Research Corp.

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The Advanced Tensiometer indicates changes in water content by measuring soil water potential and can be used to monitor relative changes in soil moisture. It consists of a porous ceramic water reservoir that connects to a pressure transducer and data logger. It permits installation up to 60 meters deep. In-Situ Inc.

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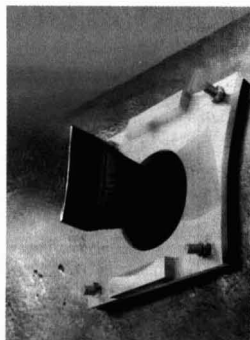


A demonstration remediation project at the former Mare Island Naval Shipyard in the San Francisco Bay area destroyed PCB soil contaminants. After applying in situ thermal desorption technology to the soils adjacent to a former electrical shop, the project produced non-detect readings in the remediation of PCBs.

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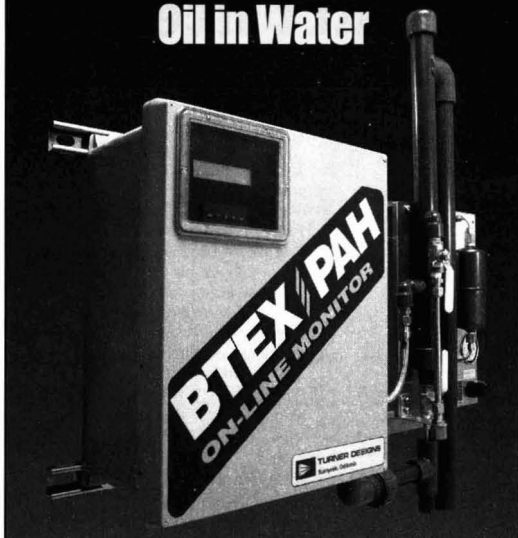
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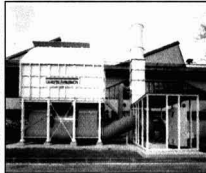


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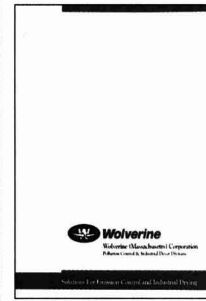


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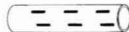
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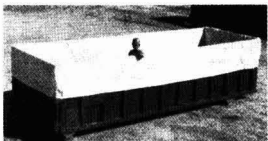
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Referral directory

Air dispersion modeling software

Bee-Line Software – P O Box 7348, Asheville, NC 28802. (704) 258-1895, FAX: (704) 258-1821.
E-Mail: beest@beeline-software.com,
Internet Address: www.beeline-software.com.

Leaders in air dispersion modeling software and training.

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Asbestos analysis

Precision Analysis Inc. – 22 Avieto Court, Florissant, MO 63031, PH/FAX: (314) 838-5052.

Bailers – Single use

Enviroline Inc. – 2235 Nursery Road, Suite C, Clearwater, FL 34624. (800) 554-0123, FAX: (888) 554-0123.

Manufacturers of economical disposable bailers, coliwassas, drum thieves and filters.

Barrels – Container products

Youngstown Barrel & Drum Co. – 1042 Marble Street, Youngstown, OH 44501.
(800) 359-3786, fax: (330) 746-3288. Internet Address: www.thomasregister.com/ybd.

Bioremediation

Medina Agriculture Products Co. Inc. – PO Box 309, Hondo, TX 78861. (210) 426-2288.

Full line of products for bioremediation and Environmental cleanup.

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Consultants

Leggette, Brashears & Graham Inc. – 126 Monrow Turnpike, Trumbull, CT 06611. (203) 452-3100, FAX: (203) 452-3122.

Professional groundwater and environmental engineering services.

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Handex Environmental – 106 Thompson Prk Dr, Cranberry Township, PA 16066.
(800) 989-8321, FAX: (412) 772-9733,
Internet: www.Handex.com.

Full service environment consulting & contracting.

SSG Incorporated – 14K World's Fair Drive, Somerset, NJ 08873.
(732) 356-0560, FAX: (732) 356-6440.
E-Mail: pstrauss@ssgcorp.com

Cost-effective solutions to environmental problems.
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Excel Partnership Inc. – 75 Glen Road, Sandy Hook, CT 06482. (800) 374-3818, FAX: (203) 426-7811.
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Dames & Moore Group – 911 Wilshire Blvd., Suite 700, Los Angeles, CA 90034.
(213) 683-1560, FAX: (213) 628-0015.
E-Mail: LAXHK@DAMES.com.

Engineering, environmental, construction management, litigation support services.

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International Asbestos Testing Laboratories (IATL) – 16000 Horizon Way, Unit 100, Mt. Laurel, NJ 08054.
(609) 231-9449, FAX: (609) 231-9818.

Asbestos and lead analytical services. NVLAP, AIHA, and NY-ELAP accredited.

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Liners – Truck

Packaging Research & Design – P O Box 678, Madison, MS 39130.
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Disposable bag liners for roll-offs, dump trailers & railroad gondola's.

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Rental equipment

ASC Professionals – 15075 E. Eleven Mile Rd., Roseville, MI 48066. (800) 372-4260, FAX: (810) 771-0098.

Safety equipment rental & repair.

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Environmental & Safety Services Inc. – PO Box 3394, Wilmington, NC, 28406
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Sludge dewatering services

J.D. Meagher/Allwaste Inc. – PO Box 752, Westborough, MA 01581. (508) 366-6606, FAX: (508) 366-6662.

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Training manuals – Wholesale

Network Environmental Systems Inc. – 10933 Trade Center Drive #108, Rancho Cordova, CA 95870. (800) 837-2384, FAX: (818) 853-8626.
Internet Address: www.nos.hazmat.com.

OSHA - EPA - DOT training manuals for sale.

Water monitoring

Scientific Instruments Inc. – 518 W. Cherry St. Milwaukee, WI 53212. (414) 263-1600, FAX: (414) 263-5506, E-Mail: sii518@aol.com.

Stream gauging/water monitoring.

See our ad in Classifieds

Protection perspectives

Arches National Park in Moab, Utah, contains one of the largest concentrations of natural sandstone arches in the world. In addition to the arches, the park features other geologic wonders such as spires, pinnacles, pedestals and balanced rocks. Despite a possible temperature range of 50 degrees within a 24-hour period, the contrasting colors, landforms and textures attracted 858,525 visitors in 1997. The park is 73,379 acres in size.

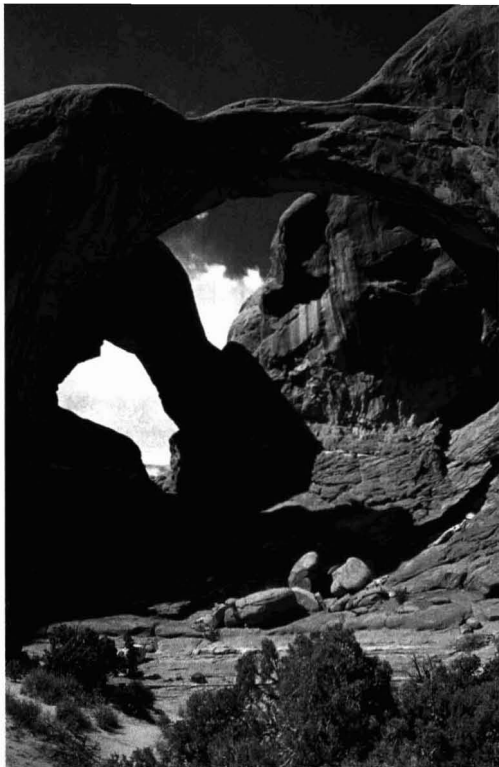


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Contact Mark Howard via e-mail at markwh727@aol.com

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Environmental PROTECTION

August 1998
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Reader Service Card
N9808F

FREE INFORMATION

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PLEASE SEND ME FREE INFORMATION ON THE FOLLOWING ITEMS:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
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101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
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161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
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201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
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261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300

Follow these simple steps:

1

Answer all questions completely, sign and date your card.

2

Circle the number(s) on the attached card that correspond to the advertisement & items mentioned in this issue that you would like FREE information on.

3

Detach and mail your postage-paid card today! For faster service, fax your card to:

(312) 922-3165

IT'S THAT EASY!

8/98 BUYING PLANS SURVEY PUMPS, PIPING & VALVES PRODUCTS/SERVICES

1. Which of the following PUMPS, PIPING & VALVES products/services do you plan to purchase in the next 12 months? (select all that apply)
- | | | | |
|--|---|--|--|
| 800 <input type="checkbox"/> Centrifugal Pumps | 811 <input type="checkbox"/> Flow Meters | 825 <input type="checkbox"/> PVC Pipes | (select one) |
| 801 <input type="checkbox"/> Diaphragm Pumps | 812 <input type="checkbox"/> In-Line Filters | 826 <input type="checkbox"/> Stainless Steel Pipes | 833 <input type="checkbox"/> Over \$200,000 |
| 802 <input type="checkbox"/> Sewer Pipes | 813 <input type="checkbox"/> Chemical Metering Pumps | 827 <input type="checkbox"/> Plastic Pipes | 334 <input type="checkbox"/> \$100,001-\$200,000 |
| 803 <input type="checkbox"/> Water Pipes | 814 <input type="checkbox"/> Drum Pumps | 828 <input type="checkbox"/> Pipe Locators | 835 <input type="checkbox"/> \$50,001-\$100,000 |
| 804 <input type="checkbox"/> Airlock Valves | 815 <input type="checkbox"/> Sludge Pumps | 829 <input type="checkbox"/> Steel Pipes | 836 <input type="checkbox"/> \$10,001-\$50,000 |
| 805 <input type="checkbox"/> Plug Valves | 816 <input type="checkbox"/> Progressing Cavity Pumps | | 837 <input type="checkbox"/> \$5,000-\$10,000 |
| 806 <input type="checkbox"/> Pinch Valves | 817 <input type="checkbox"/> Grinder Pumps | 2. What is your reason for purchasing the selected products/services? (select one) | 838 <input type="checkbox"/> Under \$5,000 |
| 807 <input type="checkbox"/> Check Valves | 818 <input type="checkbox"/> Plastic Pumps | 830 <input type="checkbox"/> New Construction | |
| 808 <input type="checkbox"/> Ball Valves | 819 <input type="checkbox"/> Sewage Pumps | 831 <input type="checkbox"/> Plant Upgrade | 3. How immediate is your need for the selected products/services? (select one) |
| 809 <input type="checkbox"/> Butterfly Valves | 820 <input type="checkbox"/> Submersible Pumps | 832 <input type="checkbox"/> Replacement/Maintenance | 839 <input type="checkbox"/> 0-6 months |
| 810 <input type="checkbox"/> Gate Valves | 821 <input type="checkbox"/> Water Pumps | | 840 <input type="checkbox"/> 7-9 months |
| | 822 <input type="checkbox"/> Double Secondary Contained Pipes | 3. What is your projected budget for the selected products/services? | 841 <input type="checkbox"/> 10-12 months |
| | 823 <input type="checkbox"/> Ductile Iron Pipes | | 842 <input type="checkbox"/> Over 12 months |
| | 824 <input type="checkbox"/> Fiberglass Pipes | | |

SUBSCRIPTION INFORMATION

YES, I would like to receive/continue to receive *Environmental Protection*. No.

Signature _____ Date _____

Title _____

Business Phone (____) _____ FAX No. (____) _____

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COMPANY _____

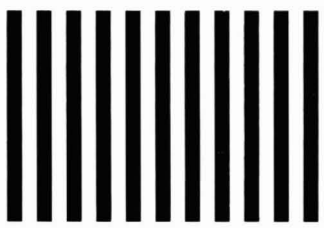
ADDRESS _____ Home Bus.

CITY _____ STATE _____ ZIP _____ ZIP+4 _____

- A. Function which best describes your activity in Pollution Control (check only one):
- | | | | | | |
|---|---|--|---|---|--|
| A <input type="checkbox"/> Corporate responsibility for Pollution Control | B <input type="checkbox"/> Manage all Pollution Control Operations at this location | C <input type="checkbox"/> Supervise sub-group in Pollution Control Operations | D <input type="checkbox"/> Provide professional consulting service on Pollution Control | E <input type="checkbox"/> Provide staff environmental service on Pollution Control | Z <input type="checkbox"/> Other _____ |
|---|---|--|---|---|--|
- B. Type of Business (check only one):
- A Manufacturing. If manufacturing, please check the appropriate SIC (check only one):
- | | | | | | | | | | | | |
|------------------------------------|---------------------------------------|--|---|--|--|--|---|---|--|--|---|
| <input type="checkbox"/> (20) Food | <input type="checkbox"/> (31) Leather | <input type="checkbox"/> (32) Stone/Clay/Glass | <input type="checkbox"/> (33) Primary Metal | <input type="checkbox"/> (34) Fab. Metal | <input type="checkbox"/> (35) Mach., except Elect. | <input type="checkbox"/> (36) Elect. & Electron Mach | <input type="checkbox"/> (37) Trans. Equip. | <input type="checkbox"/> (38) Instr./meas./ | <input type="checkbox"/> (29) Petrol. & Coal | <input type="checkbox"/> (39) Miscellaneous Mfg. | <input type="checkbox"/> (38) Instr./meas./ |
|------------------------------------|---------------------------------------|--|---|--|--|--|---|---|--|--|---|
- C. Number employed at this location:
- | | | |
|--------------------------------------|--------------------------------------|--|
| A <input type="checkbox"/> 1-19 | B <input type="checkbox"/> 20-49 | C <input type="checkbox"/> 50-99 |
| D <input type="checkbox"/> 100-249 | E <input type="checkbox"/> 250-499 | F <input type="checkbox"/> 500-999 |
| G <input type="checkbox"/> 1000-1499 | H <input type="checkbox"/> 1500-2499 | I <input type="checkbox"/> 2500 and up |
- D. In your job function do you recommend, specify or purchase? (check all that apply)
- | | | | | | |
|--|--|--------------------------------------|--|--|--|
| A <input type="checkbox"/> Pollution Control Equipment | B <input type="checkbox"/> Instrumentation | C <input type="checkbox"/> Chemicals | D <input type="checkbox"/> Parts & equipment for maintenance operation & control | E <input type="checkbox"/> Services/Consulting | F <input type="checkbox"/> None of the above _____ |
|--|--|--------------------------------------|--|--|--|
- E. What types of Pollution Control are you responsible for? (check all that apply)
- | | |
|---|---|
| A <input type="checkbox"/> Air | B <input type="checkbox"/> Water |
| C <input type="checkbox"/> Noise | D <input type="checkbox"/> Solid Waste Disposal |
| E <input type="checkbox"/> Industrial Hygiene | F <input type="checkbox"/> Toxic & Hazardous Material |
| G <input type="checkbox"/> Energy Control/Energy Conservation | H <input type="checkbox"/> None of the above _____ |
- F. Which of the following publications do you receive personally addressed to you? (check all that apply)
- | | | | | | | |
|--|--|--|---|---|---|--|
| A <input type="checkbox"/> Pollution Engineering | B <input type="checkbox"/> Environment Today | C <input type="checkbox"/> Environmental Solutions | D <input type="checkbox"/> Pollution Equipment News | E <input type="checkbox"/> The National Environmental Journal | F <input type="checkbox"/> Water Environment & Technology | G <input type="checkbox"/> None of the above _____ |
|--|--|--|---|---|---|--|



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The equipment must continuously concentrate complex chemicals under harsh, ever-changing conditions. This demands uncompromising attention to:

- Equipment design
- Materials of construction
- Components selection
- Process/safety control logic

Engineered to Perform Day-in, Day-out

Facility Planning

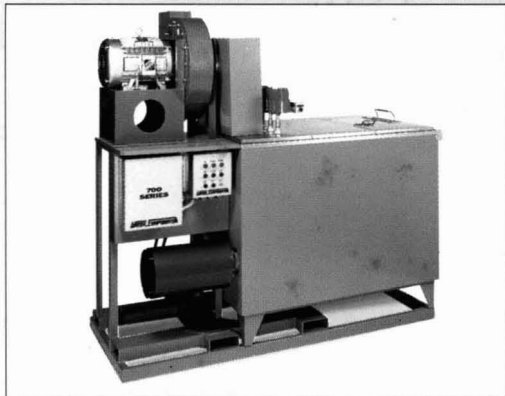
Start to finish, SAMSCO will help integrate the evaporation system into your plant's daily operations. Complete system design of your wastewater handling and specification of ancillary equipment is provided, yielding flexibility, low operating cost and minimal routine maintenance.

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SAMSCO systems are not waste stream specific and can process several complex chemistries simultaneously. As production needs change, SAMSCO provides free waste analysis throughout the operating life of the evaporator.

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