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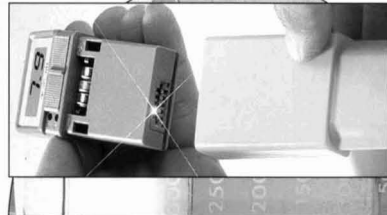
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102	119	136	153	170	187	204	221	238	255	272	289	306	323	340	357	374	391
103	120	137	154	171	188	205	222	239	256	273	290	307	324	341	358	375	392
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113	130	147	164	181	198	215	232	249	266	283	300	317	334	351	368	385	402
114	131	148	165	182	199	216	233	250	267	284	301	318	335	352	369	386	403
115	132	149	166	183	200	217	234	251	268	285	302	319	336	353	370	387	404
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- A Corporate responsibility for Pollution Control
B Manage all Pollution Control Operations at this location
C Supervise sub-group in Pollution Control Operations
D Provide professional consulting service on Pollution Control
E Provide staff environmental service on Pollution Control
Z Other

B. Type of Business (check only one):

- Manufacturing. If manufacturing, please check the appropriate SIC (check only one):
 (20) Food (31) Leather
 (21) Tobacco (32) Stone/Clay/Glass
 (22) Textile (33) Primary Metal
 (23) Apparel (34) Fab. Metal
 (24) Lumber & Wood (35) Mach. except Elect.
 (25) Furniture (36) Elect. & Electron Mach.
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Type of Govt.:
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I State J Federal

- K Transportation
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Z Misc. Services

C. Approximate number of employees at this address (check only one):

- A 0-19 D 100-249 G 1000-1499
B 20-49 E 250-499 H 1500-2499
C 50-99 F 500-999 I 2500 and up

D. In your job function do you recommend, specify or purchase? (check all that apply)

- A Pollution Control Equipment
B Instrumentation
C Chemicals
D Parts & equipment for maintenance operation and control

E. Services/Consulting

F None of the above

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

- A Air F Toxic & hazardous material
B Water G Energy control
C Noise H energy conservation
D Solid Waste disposal
E Industrial hygiene
F None of the above

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

- A Pollution Engineering
B Environment Today
C Environmental Solutions
D Pollution Equipment News
E The National Environmental Journal
F Water Environment & Technology
G None of the above

Environmental PROTECTION

G. Which of the following Respirators and Personal Protective Clothing products (services do you plan to purchase in the next 12 months? (Select all that apply))

- 800 Self-Contained Breathing Apparatus
801 Cartridge Respirators
802 Gloves
803 Hazmat Suits
804 Leak Detectors
805 Hazmat Storage Buildings
806 Handheld Gas Detectors
807 Sorbents
808 Goggles
809 Overpack Drums
810 Storage Enclosures
811 Secondary Containment
812 Waste Bags
813 Bulk Storage Bags
814 Portable Tanks

H. What is your reason for purchasing the selected products/services? (Select one)

- 815 New Construction
816 Plant Upgrade
817 Replacement/Maintenance

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

- 818 Over \$200,000
819 \$100,001-\$200,000
820 \$50,001-\$100,000
821 \$10,001-\$50,000
822 \$5,000-\$10,000
823 Under \$5,000

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

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825 4-6 months
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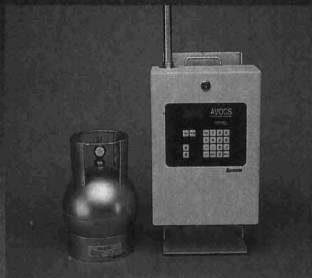


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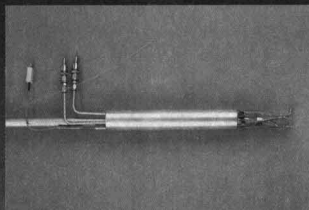
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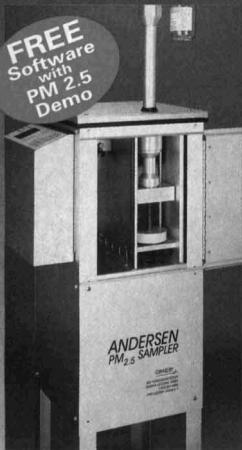
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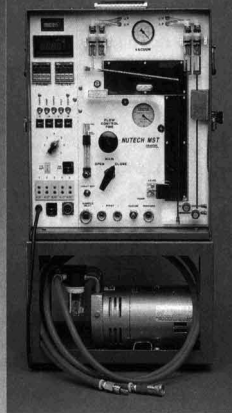
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About the cover:

Caused by activities like construction, traffic on unpaved roads and agriculture, soil-derived fugitive dust is a significant source of air pollution. Beginning on page 12, the article, *From Dirt to Toxic Dust*, gives an overview of how this type of particulate matter impacts human health and what strategies are being used to control it.

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Mark W. Howard, photographer

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Is EPA Too Particular About Particulates?

Once again industry and the U.S. Environmental Protection Agency are at odds with one another. This time many members of the regulated community are unhappy because the EPA announced last December that it intends to tighten the current air quality standards for particulate matter (PM) and ozone.

Particulate matter represents roughly 6 percent of the total human-caused emissions in the United States and is produced at an annual rate of about 7 million metric tons. The size of particulates is highly variable. The largest particles, with a diameter larger than about 10 μm , are generated either by natural causes (windblown dust) or by grinding naturally occurring materials, like coal, sand or lime. In contrast, the finest particles fall in the 0.002 μm to 0.1 μm range. They can be very reactive on their surfaces and serve as sites for the deposition of heavy metals like selenium, arsenic and lead.

Published in 61 *Federal Register* 65780, the proposed rule for fine particles, those 2.5 μm or less, sets up an annual standard of 15 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) and a 24 hour standard of 50 $\mu\text{g}/\text{m}^3$.

The change is meant to give more protection against a wide range of health problems, including premature mortality, increased respiratory symptoms and disease, decreased lung function and alterations in lung tissue and structure.

The impetus for the EPA's action is the recent lawsuit, *American Lung Association vs. Browner*, (DC Arizona, No. 93-643), in which the court ordered the EPA to release by July 19 a final decision on whether it will revise the existing air quality standards for particulate matter and ozone.

As soon as the EPA announced the proposed PM standards, many companies and organizations stated they thought the EPA was being too stringent. They argued their costs will increase out of proportion to any health benefits from the stricter air standards.

For example, Paul Bailey, the American Petroleum Institute director, said the EPA's preliminary cost estimates for the PM rule, roughly \$6 billion a year, are far too low. He estimates the new standards could cost as high as \$19.6 billion for the Midwest and Northeast regions alone.

Other opponents include representatives of small business groups who assert the new PM standards will have a severe economic impact on small businesses and are "pre-mature" at this time.

Additional controversy surrounds the EPA research plan developed for assessing fine PM's health impacts because it's based on the questionable presumption there's a causal relationship between PM_{2.5} μm or less and increased mortality. Most scientists agree that much more research is needed to better understand PM_{2.5} and its effect on human health. The agency needs to find out what types of particulates are impacting what types of people.

With so much inconclusive data, it's difficult to determine if the EPA is being overly exacting with the new PM standards or is taking reasonable action to protect human health. One sure bet is that even if the EPA enacts the proposed standards on July 19, more debate and litigation will certainly follow.

Angela Neville

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

Environmental PROTECTION

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Heat Out Contaminants

NEW YORK—Successful field tests demonstrated that the use of heat with traditional “pump and treat” soil remediation dramatically improves cleanup rates at fuel- or solvent-contaminated sites. Engineers and the Lawrence Livermore National Laboratory (LLNL) and the University of California used six steam injection and electric heating wells to surround the spill. Three additional heating wells were placed near its center to remediate more than 10,000 gallons of gasoline trapped 20 feet below the standing water table. Within a year, approximately 100,000 cubic yards were cleaned, resulting in removal of more than 99 percent of the contaminant.

Radioactive Waste Stabilizer

HOUSTON—Silica gel, the same product packed in new shoes to keep them dry, may stabilize radioactive materials. Silica gel treatment technology to stabilize high-level liquid radioactive waste (HLW) was developed by the Russian Research Institute of Chemical Technology. The gel adsorbs a liquid waste solution to obtain a stable solid product. Although additional studies are needed in the United States before the process will be used to stabilize and recover surplus weapons material, the Russian Institute's initial results are promising.

Brownfields Dispute

WASHINGTON, D.C.—Redevelopment of former industrial areas or brownfields is a disputed topic in the U.S. House of Representatives. According to a House Republican staff member, it should not be reformed separately from the superfund statute. At a Washington Legal Foundation briefing, Nandan Kenkeremath, majority counsel for the House Commerce Committee, harshly criticized recent brownfields bills introduced by House and Senate Democrats. Kenkeremath suggested reforming the superfund program before budgeting money for in fiscal year 1998.

Cleaner Cars

WASHINGTON, D.C.—Eight environmental and public-interest organizations notified the EPA that they plan to sue to open the door to cleaner cars in the 12 northeast states and the District

of Columbia. The action is intended to help the northeast meet its clean air goals and protect public health by opening the region's market to the ultra-clean vehicles now becoming available in California. The organizations sent a formal “notice of intent” to take legal action if the EPA does not act within 60 days. Organizations in the following cities signed the notice: Philadelphia, Penn.; Albany, N.Y.; Washington, D.C.; Boston, Mass.; Augusta, Maine; Trenton, N.J.; San Francisco, Calif.; and Cambridge, Mass. The coalition hopes to counteract pressure on the EPA from oil and auto companies.

Mixed Waste Management

SACRAMENTO, Calif.—The California Environmental Protection Agency's Department of Toxic Substances Control (DTSC) approved a U.S. Department of Energy Site Treatment Plan to manage mixed waste—a combination of hazardous waste and low-level radioactive waste—at Lawrence Livermore National Laboratory in Livermore, Calif. The laboratory will treat some mixed wastes onsite and ship the remaining mixed wastes to authorized out-of-state treatment facilities.

Bioslurping

PATUXENT RIVER, Md.—New technology known as bioslurping is being tested at Patuxent River Naval Air Station to remove and purify contaminated ground water. The site was contaminated at the primary fuel storage location from leaking underground storage tanks and abandoned pipelines. Bioslurping extracts contaminated groundwater, fuel floating on the groundwater surface, air and vapors. By removing vapors and air, oxygen gets pulled into the ground from the atmosphere to naturally break down free-floating petroleum into water and carbon dioxide. It gets its name from the system's ability to enhance the natural breakdown of petroleum products by naturally occurring micro-organisms and the slurping noise it makes. The technology was developed by the Strategic Environmental Research and Development Program (SERDP), a joint Department of Defense, Department of Energy and U.S. Environmental Protection Agency venture.

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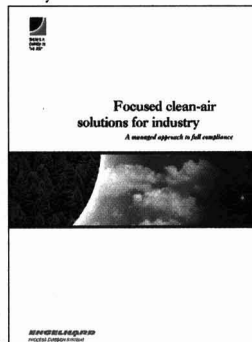
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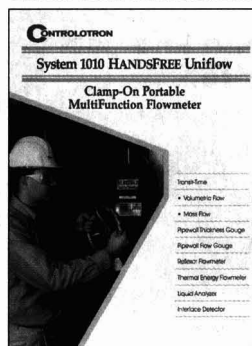
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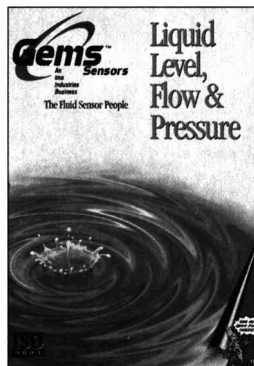


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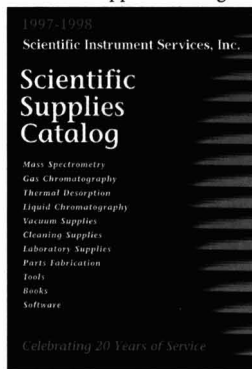
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FROM DIRT TO TOXIC DUST

Outdoor air is a community resource requiring protection from particulate pollution by fine soil-derived fugitive dust.

By Richard A. Sullivan, P.E.

Two long-term national epidemiological studies involving over half a million people in 151 cities indicate that more people may be dying from causes attributable to particulate air pollution each year than are killed in automobile accidents. Because of the damaging health effects from airborne particles at concentration levels below the current National Ambient Air Quality Standard (NAAQS) for particulate matter, which is one of the six NAAQS priority pollutants, the U.S. Environmental Protection Agency is under a court-ordered schedule to issue a revised particulate standard by July 19, 1997.

Particulate matter is either emitted directly into the atmosphere (primary particulates) or formed by atmospheric chemical reactions that convert precursor gases into particles (secondary particulates). Primary particulates include soil-derived dust, elemental carbon and soot formed from incomplete combustion of hydrocarbon fuels and solid particles from waste incineration. Primary particles from point source combustion emissions are controllable with filters, electrostatic precipitators and air scrubbers.

Sources of soil-derived fugitive dust are either natural from windblown dust or anthropogenic from construction and demolition, mining and quarrying, traffic over paved and unpaved roads, railroad tracks, waste collection and disposal and agriculture. This primary particulate pollution is significant as evidenced by the EPA's recent estimate that about 70 percent of its $PM_{2.5}$ emissions inventory is comprised of fugitive dust.

Particulate Regulations

In 1971, under the then recently enacted Clean Air Act (CAA), the EPA set the initial NAAQS for total suspended particulates (TSP). It encompassed all forms of airborne particulate matter at $260 \mu\text{g}/\text{m}^3$ 24-hour concentration. By the late 1970 smaller inhalable particles were recog-

Sources of soil-derived fugitive dust are either natural from windblown dust or anthropogenic from construction and demolition, mining and quarrying, traffic over paved and unpaved roads, railroad tracks, waste collection and disposal and agriculture.

nized as being more significant to human health than relatively large particles. In 1987, the EPA replaced the TSP standard for inhalable particles having an aerodynamic diameter of $10 \mu\text{m}$ (PM_{10}) or less at $150 \mu\text{g}/\text{m}^3$ 24-hour concentration. The PM_{10} standard does not specify chemical composition of the particles.

Recent national and international epi-

demiological studies reveal that the most damaging component of inhalable particles to public health is the fine particle fraction. Acting under its court-ordered schedule, the EPA unveiled on November 27, 1996, a proposed new standard for public comment to cover fine particulate matter having an aerodynamic diameter of $2.5 \mu\text{m}$ ($PM_{2.5}$) or less—smaller than one-tenth the diameter of a human hair. The proposed more stringent $PM_{2.5}$ standard is $50 \mu\text{g}/\text{m}^3$ per 24-hour concentration and average $15 \mu\text{g}/\text{m}^3$ annually.

Soil-derived Fugitive Dust

Fugitive dust is derived from either clean soil or soil contaminated by leaks, spills, disposal of hazardous substances, chemical fertilizers and pesticides. The severity of fugitive dust pollution depends greatly on natural or mechanically generated wind speeds and to a lesser extent, the soil type and its moisture content. Wind-blown dust is more prevalent in the drier central and western states where soil moisture is frequently less than 10 percent.

Wind sweeping across unvegetated land rolls fine grains of sand over each other into small piles and also picks up the smaller silt particles and transports them short distances within the ground-based air layer. Clay particles picked up by surface wind will float in the atmosphere, traveling great distances by advection, dispersion and diffusion. Rain and snow reintroduce airborne dust particles into the ground-based air mixing layer.

Human Health

The human respiratory system has an elaborate mechanism to remove particles

from inhaled air. Most particles larger than 10 μm in diameter are trapped by hairs in the nose and by mucous membranes in the nasal cavity. Particles as small as 5 μm are caught in the windpipe (trachea) and bronchial tubes. Particles of 1 to 2 μm are optimal for reaching the air sacs (alveoli) of the lung.

Airborne particles entering the lung irritate the alveoli and can cause inflammation. Particles may also transport toxic substances into the alveoli where soluble ions can travel into the bloodstream. Two well-known forms of physical lung damage are silicosis, from inhaling hard particles and asbestosis, from inhaling air containing fibers of asbestos.

Ranges of soil and dust particle sizes are shown in Figure 1a. The proposed more-stringent $\text{PM}_{2.5}$ regulation will control the fine fraction of soil-derived fugitive dust, namely clay particles, that can elude the human respiratory clearance mechanisms. Clay particles behave as aerosols, which can remain suspended in air for long periods of time. Contrary to popular belief, inhalable clay particles can carry toxic substances into the lung, resulting in adverse health effects. Clay particles can also carry bacteria and viruses into the respiratory system.

Mechanism of Toxic Contamination

Fine fugitive dust derived from geologic materials consists of colloidal clay particles whose physical behavior is controlled by interfacial forces rather than gravitational forces, which govern the behavior of silt particles forming the coarse fraction of fugitive dust. Of more importance is the difference in surface chemical behavior between relatively inert silt particles and colloidal clay particles ranging in diameter from 1 to 0.001 μm .

Colloidal clay particles are formed from the weathering of crystalline rocks. The platy-shaped particles are layer-type aluminosilicates with surfaces having an unbalanced electrical charge resulting from isomorphous substitution within their crystal structure. This charge imbalance is usually negative and compensated by an accumulation of cations and anions to form an adsorbed layer on the mineral clay particle as illustrated in Fig. 1b. The less strongly attached cations and anions near the outer surface of the adsorbed layer can be replaced by other ions. Such ion exchange continues until electrical neutrality is re-established.

Figure 1a Range of Particle Sizes

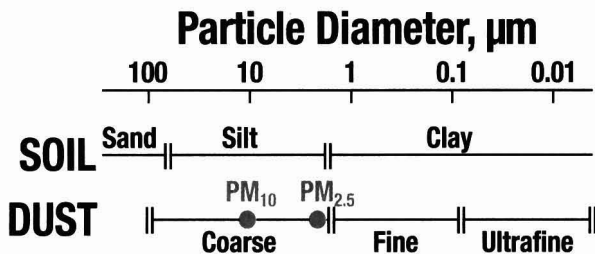
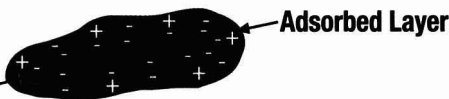


Figure 1b Clay Particle

Particle With Unbalanced Electrical Charge



Polar organic compounds can also bond with cations in the adsorbed layer.

Colloidal clay particles floating in air adsorb water from water vapor in the atmosphere forming an adsorbed layer filled with hydrogen (H) cations and hydroxyl (OH) anions. If these airborne particles impinge gaseous nitrogen oxides or sulfur dioxide emitted from combustion processes, then the particles become coated with nitric or sulfuric acid rather than pristine water. Colloidal clay particles floating in air can also become mobile carriers of other toxic substances through contact with one or more of the 188 regulated hazardous air pollutants (HAPs).

Fugitive Dust Control

More-stringent clean air standards limiting fine particulates ($\text{PM}_{2.5}$) to 50 $\mu\text{g}/\text{m}^3$ per 24-hour will demand more arduous measures to control soil-derived fugitive dust than under the current PM_{10} regulation covering silt and clay particles. California and other western states already require approval of a fugitive dust emissions control plan for human activities capable of generating fugitive dust with exemption of agricultural operations and disturbed surface areas less than one-half acre. On large disturbed surface areas in excess of 100 acres, air quality is monitored using on-site particulate samplers.

Reasonably available control measures (RACMs) such as watering, non-toxic chemical stabilization, wind fencing, grav-

el surfacing, tarpaulin and plastic coverings, vegetation planting and restricting vehicle speeds are used to prevent or reduce PM_{10} fugitive dust emissions from construction and demolition activities. Watering is a common measure for which reclaimed water should be used.

Under CAA requirements for persistent non-attainment areas of PM_{10} fugitive dust pollution, RACMs must be upgraded to best available control measures (BACMs). BACMs include routine street cleaning, prompt removal of soil debris from paved areas, curbs and gutters with storm sewers to expedite drainage, chemical stabilization of soil shoulders along roadways and railroad tracks, paving or chemical stabilization of unpaved roads. The U.S. Department of Agriculture's soil conservation guidelines include planting rows of vegetation and wind fences across the prevailing wind direction, deep plowing rather than disking and no tilling in high winds.

Control of fine soil-derived fugitive dust is likely to be accomplished through improvements to current RACMs and BACMs such as vacuum cleaners, rather than mechanical broom sweepers and leaf blowers to clean city streets and parking areas. **EP**

Richard A. Sullivan, P.E., is a geoenvironmental consultant in Orange County, Calif.

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COMPARING TOXIC AIR POLLUTANT PROGRAMS

Although somewhat similar, state and federal toxic air-pollutant programs have their differences.

By Steven C. Hawkins

From 1970 to 1989, the U.S. Environmental Protection Agency issued nine health-based National Emission Standards for Hazardous Air Pollutants (NESHAPs). Development of these standards was complicated and time-consuming because pollutant-specific risk data had to be collected, reviewed and formulated into emission limitations. Consequently, few standards were promulgated and many known hazardous air pollutants (HAPs) were left unregulated. A 1989 EPA study estimated that major industrial sources released 2.7 billion pounds of air toxic pollutants in 1987 with actual emissions from all sources as high as 13.5 billion pounds per year. Therefore, many states established their own programs for the control of HAPs.

The 1990 Clean Air Act Amendments (CAAA) established significant new air quality programs for the control of 188 hazardous air pollutants. These programs marked a fundamental change in philosophy regarding the regulation of HAPs. In lieu of health-based emission regulations, Section 112(e) of the CAAA created a program for the control of HAPs based on the establishment of control technology standards.

The Federal Air Toxics Program

Section 112(e) of the CAAA establishes Maximum Achievable Control Technology (MACT) standards for source categories emitting major quantities of HAPs. A major source emits 10 tons per year or more of a single HAP or 25 tons per year or more of a combination of HAPs. MACT standards are based on the average control level achieved by the best

performing sources within a specific industrial category. The EPA has identified 174 industrial categories that are major sources of HAP emissions and has proposed 18 MACT standards.

Existing State Regulations

State toxic programs can be classified into two categories: control technology-based and ambient concentration-based. Many states have opted to implement the

State toxic programs can be classified into two categories: control technology-based and ambient concentration-based. Many states have opted to implement the MACT standards, while enforcing their own state air toxics programs.

MACT standards, while enforcing their own state air toxics programs. This, however, can be problematic, because each program may require conflicting levels of control, monitoring and recordkeeping. The similarities and differences between

the federal and state programs can be better understood by examining the air toxic programs of two typical states: New Jersey and New York. These programs are based on control technology requirements and ambient concentration levels, respectively.

New Jersey Air Toxic Program

The New Jersey air toxic program is an example of a control-based standard. Toxic substances are divided into two categories of 11 and two pollutants. For Group I toxics, the New Jersey Department of Environmental Protection (NJDEP) determines, on a case by case basis, if the source represents "advances in the art of control" for the type of toxic pollutants emitted. For Group II, toxic substances sources are subject to, at a minimum, reasonably available control technology (RACT) requirements.

The obvious similarity between the New Jersey program and the MACT standards is that compliance is demonstrated by the application of a certain type or level of control equipment. However, the New Jersey program differs with the federal program in significant areas. First, it regulates only 13 pollutants instead of the 188 regulated by Section 112(e) of the CAAA. Therefore, MACT will affect many HAP emission sources that previously may have been unregulated by the state program. Second, while both programs are control technology-based, the procedures for establishing the specific control requirements are different. RACT allows for economic considerations while MACT generally does not. Consequently, the control level established by RACT and MACT are usually different. For new



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Comparing Toxic Air Pollutant Programs

sources—those constructed after the promulgation of a specific MACT standard—the differences between the two programs should be minimal. However, problems may occur for existing sources. An example illustrates these differences.

Case Study 1:

In 1994, a rotogravure printing facility installed a printing press. The facility applied for permits with the NJDEP and proposed to control emissions with a carbon adsorption system which would capture at least 80 percent of the total vol-

ume of organic gas emitted and recover at least 90 percent of the collected gas stream. After review and approval from the NJDEP, the facility proceeded with the project as designed. Initial testing of the facility indicated the collection efficiency to be approximately 83 percent with a recovery efficiency of 92 percent.

New Jersey Requirements

The New Jersey rule establishes RACT for surface-coating operations. This regulation requires the use of control equipment that collects at least 75 percent, by

volume, of the source gas emitted from a rotogravure printing operation and prevent it from being discharged into the outdoor atmosphere by at least 90 percent by volume, of the VOC collected.

Federal MACT Requirements

The MACT standard for the Printing and Publication Industry was finalized in May 1996 and is contained in 40 CFR 63, Subpart KK. The rule requires a 95-percent overall control of all HAP emissions from presses at package-product rotogravure facilities.

Program Interaction

The carbon adsorption system installed by the printing facility complies with the requirements of the New Jersey RACT rule. However, the system fails to meet the minimum 95-percent control efficiency of the MACT standard. Consequently, the facility would have to either modify the existing carbon adsorption system to achieve a high overall efficiency, or replace the system with a more effective control technology, such as a thermal oxidizer.

Industrial categories for which a finalized MACT exists will have minimal compliance problems with the New Jersey program. Compliance with the MACT standard should provide an adequate level of control for sources in the state program. However, problems may exist for industrial categories in which the MACT standard has not yet been finalized. For these sources, simply meeting the minimum requirements of the existing state regulation may not be sufficient to prevent costly control equipment retrofitting and re-engineering once the federal MACT standard is promulgated.

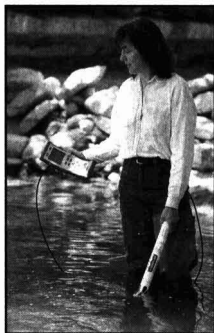
New York Toxics Program

The New York air toxics guidelines evaluate an infinite number of toxic air pollutants and establish acceptable ambient pollutant concentration levels for each substance. The review process requires each pollutant be assigned an initial environmental rating depending on the level of pollutant toxicity. An air quality impact analysis is then performed that uses specific emission and source data to estimate annual- and short-term ambient pollutant concentrations. These concentrations are compared with the acceptable annual guideline concentrations (AGCs) and short term guideline concentrations (SGCs) developed by the New York Department of Environmental Conser-

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vation. The control level required is that needed to meet guideline concentrations.

The New York program is fundamentally different from the New Jersey and the federal air toxic programs. New York evaluates each source for potential environmental impact and requires, on a source specific basis, the amount of control needed. Interaction between the New York program and the federal MACT program is limited because it is impossible to compare control levels. Potential conflicts between the New York and federal program are presented in Case Study 2.

Case Study 2:

Let's assume the publication printing facility described in the previous case study was located in New York. The facility proposes to install a carbon adsorption system capable of meeting the MACT requirements of 95-percent control efficiency.

New York Requirements

The first step is to assign an initial environmental rating to the pollutant. Next, the facility must determine the expected annual- and short-term ambient concentrations for each HAP. This impact analysis considers all sources of HAP at the facility as well as any nearby significant sources. It also includes ambient background concentrations when data is available. In this case, the short-term impact was determined to be 2800 grams per cubic meter (g/m^3) and the annual ambient impact was determined to be $65 \text{ g}/\text{m}^3$. The established SGCs and AGCs for the HAP emissions are $4100 \text{ g}/\text{m}^3$ and $27 \text{ g}/\text{m}^3$, respectively. Because the proposed printing press and carbon adsorption system (95-percent control) fail to meet the AGC of $27 \text{ g}/\text{m}^3$, a higher level would be required for the source. The minimum amount of control needed to meet the AGC was a 99.5-percent total efficiency.

Program Interaction

In this case, the New York program is more stringent. The 99.5-percent level of control required would be adequate to satisfy the 95-percent overall requirements of the MACT standard—however, the source would likely have to use other control technologies, such as thermal oxidation, to meet these higher requirements. The New York program can yield different requirements for similar sources. Consequently, in some cases the state guidelines may be more stringent than the federal requirements, while in others cases

the guidelines are actually less stringent.

Conclusions

The main goal of the federal and state air toxics programs is essentially the same: to protect public health and the environment. However, the procedures and guidelines used to reach these goals are quite different. As numerous MACT standards are finalized over the next five to 10 years, the potential for problems with conflicting requirements will increase. It is important all facilities that are major sources of HAPs evaluate the ap-

plicable state and federal requirements independently of each other when making control technology decisions. Good strategic planning in the initial stages of air toxic source permitting can assure simultaneous compliance with state and federal standards, with a minimal amount of duplicated effort, costly retrofitting and equipment replacement. **EP**

Steven C. Hawkins is project manager with ECKENFELDER Inc. in Greenville, S.C.

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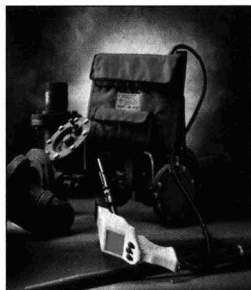
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Instrumentation

provides enhanced speciation of hydrocarbons through $C_{44}H_{90}$ without contaminating the lamp window. **Finnigan Corp./Gas Chromatography Products.** *Circle 161 on card.*

Portable FID

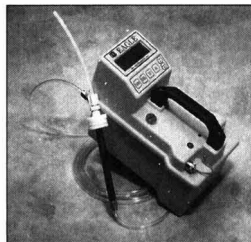
The Model 680 HVM is a fully integrated fugitive emis-



sions monitoring solution. The three-key interface is ideal for fugitive emissions, hazwaste, spill response and industrial hygiene monitoring. It integrates a highly sensitive flame ionization detector, data logger and optional laser bar code scanner. **Thermo Environmental Instruments Inc.** *Circle 162 on card.*

Portable Gas Detector

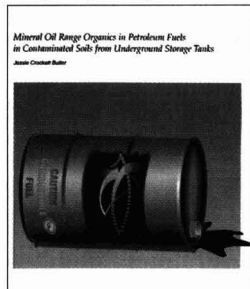
The EAGLE is a versatile, portable gas detector. Stand-



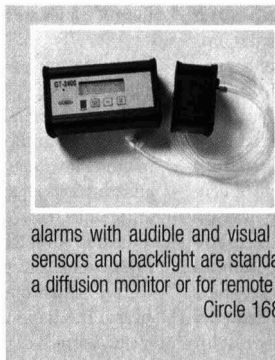
ard features include LEL and ppm combustible ranges, detects up to four diverse combinations of gas, easy auto-calibration, 30 hours of continuous operation, 2-year sensor life, low flow pump shutoff, methane elimination switch and more. **RKI Instruments.** *Circle 163 on card.*

Gas Chromatograph

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tandem Photoionization/Flame Ionization (PID/FID) accurately analyzes gasoline, diesel and mineral oil petroleum fuels in soil. PID/FID

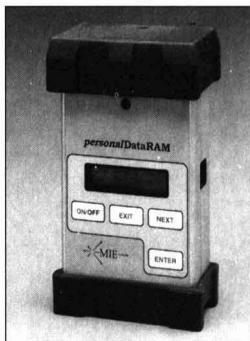


Multi-Gas Monitor

The GT-2400 simultaneously monitors up to four gases for combustible, oxygen and two toxic gases. Dual-level gas concentration alarms with audible and visual indicators, easily replaceable sensors and backlight are standard features. It can be used as a diffusion monitor or for remote sampling. **Gas Tech Inc.** *Circle 168 on card.*

Aerosol Monitoring

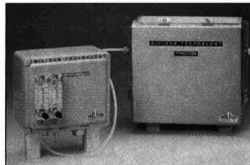
The personalDataRAM™ dust monitor/data logger is a



small, versatile, real-time aerosol monitor. It measures mass concentrations of dust, smoke, mists and fumes and sounds an audible alarm when the user-defined limit is exceeded. Stores up to 10,000 data points including averages, STEL values and real-time/date tagging. Software included. **Monitoring Instruments for the Environment Inc.** *Circle 164 on card.*

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The Pyrolyzer uses chemically selective sensors that do not



react with air, are not sensitive to temperature, humidity or pressure changes and stay awake when gas is absent.

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Gas Detection

GAS Plus simplifies operation and maintenance of a typical



toxic gas detection system. The universal transmitter configures automatically to sensors. Standard features include easily accessible field connections, horizontal conduit entries, corrosion resistant coatings and built-in diagnostics. **EIT.** *Circle 166 on card.*

Portable GC/MS

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RCRA'S NEW ORGANIC WASTE STANDARDS

The EPA introduces new requirements for treatment, storage and disposal facilities, as well as for large-quantity generators.

By Michael King

After many delays and amendments, the U.S. Environmental Protection Agency finally promulgated the new Resource Conservation Recovery Act (RCRA) "Organic Air Emission Standards for Tanks, Surface Impoundments and Containers." The final rule published in the *Federal Register* on November 25, 1996 as (40 Code of Federal Regulations (CFR) Part 265 Subpart CC) is often called simply, "Subpart CC." The final rule amended the requirements for both treatment, storage, and disposal facilities (TSDFs) and for large-quantity generators (LQGs).

Subpart CC mandates that TSDFs and LQGs manage volatile organic hazardous wastes in ways that minimize the escape of volatiles to the atmosphere. Having been promulgated under the Hazardous and Solid Waste Amendments (HSWA) to RCRA, Subpart CC became effective for all TSDFs and LQGs in all 50 states upon publication.

The rule places new responsibilities on TSDFs and generators to control air emissions resulting from accumulation, storage and treatment of volatile organic hazardous wastes. This is the latest phase of the EPA's cross-media pollution control—applying hazardous waste regulations to air emissions.

The new rule also requires that all LQGs comply with 40 CFR Part 265 Subparts AA and BB: "Air Emission Standards for Process Vents" and "Air Emission Standards for Equipment Leaks."

Subpart AA will impact recycling and generator facilities that process organic

wastes containing 10 parts per million weight (ppmw) or greater of organics. Facilities that process wastes using distillation, fractionation, thin-film evaporation, solvent extraction or stripping must now comply. Subpart AA will affect only a few facilities other than the TSDFs to which it already applies.

Subpart BB, on the other hand, will

The rule places new responsibilities on TSDFs and generators to control air emissions resulting from accumulation, storage and treatment of volatile organic hazardous wastes.

affect many facilities including many LQGs. Subpart BB affects most facilities that handle organic wastes (10 percent by weight or greater organics) with pumps, compressors, valves and similar process-control devices. Subpart BB requires facilities to regularly monitor these process-control devices for leaks and, if found, repair them promptly.

The LQG that pumps organic waste out of an accumulation tank or container into a tank truck for transport may

now be required to comply with Subpart BB requirements.

Subpart CC certainly has the largest impact on U.S. industry in general. It impacts most TSDFs and LQGs that handle organic waste with greater than 500 ppmw volatiles. Facilities are responsible for testing their wastes (or using "knowledge of the wastes") to determine if their wastes are regulated. Only those facilities equipped with controls that comply with applicable National Emission Standards for Hazardous Air Pollutants (NESHAP) or New Source Performance Standards (NSPS) regulations under the Clean Air Act are exempt from Subpart CC.

Otherwise, any LQG facilities that handle volatile waste in a tank, surface impoundment or container (other than very small containers) must now comply with Subpart CC.

Tanks

Tanks used to manage volatile organic wastes must now comply with new standards to control emissions to the atmosphere. In practice, the vast majority of hazardous waste storage tanks are above ground.

There are two primary options open to the TSDF and LQG if volatile wastes are managed in tanks—Tank Level 1 and Tank Level 2 controls.

Both levels require that all tanks have "fixed roofs" (though removable roofs can qualify as "fixed").

Tanks must be kept closed unless performing certain normal operations such as filling and discharging. Tank roofs and closure devices must be in-

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RCRA's New Organic Waste Standards

spected initially and then yearly thereafter for defects such as cracks, holes or gaps. Defects noted during inspections must be repaired within 45 days after discovery.

The easier Tank Level 1 controls are allowed under certain combinations of waste vapor pressure and tank size. Under Tank Level 1 controls, tanks must either have closure devices that form a continuous barrier over the waste and seal securely or be vented to a control device. All Level 1 tanks must be inspected both initially and yearly thereafter.

Tank Level 2 controls apply to all other hazardous waste tanks. There are several compliance options under Level 2 controls. They must have one of the following:

- Fixed roof with an internal floating roof;
- External floating roof;
- Vapor collection and control system;
- Satisfy the requirements for a "pressure" tank; and
- Be located inside an enclosure that is vented to a control device.

Vapor collection and control systems

installed on Level 2 tanks must be able to remove at least 95 percent of volatile emissions.

Vapor incinerators, boilers, carbon absorption beds and flares are acceptable control devices. Performance tests demonstrating 95-percent removal must be performed on the vent system and control device and the test results recorded and kept onsite.

Surface Impoundments

All surface impoundments holding volatile hazardous waste must be equipped with a floating membrane cover or a cover vented to a control device. Control device performance testing is similar to that of Tank Level 2 controls. Control devices must be inspected both initially and yearly while waste remains in the impoundment.

If defects are found in the vapor control system or cover, repairs must be completed within 45 days.

Containers

Portable containers larger than 0.1 cubic meters (m³) (26 gallons) capacity that hold volatile hazardous wastes must now comply with Subpart CC. Subpart CC allows several options to the TSDF and LQG, called Container Levels 1, 2 and 3 controls. The applicable control level depends on the volatility of the waste, the size of the container and if stabilization is being performed in the container.

Wastes managed in containers of less than 0.46 m³ (119 gallons) capacity and all low-volatility wastes, regardless of container size, need only comply with Container Level 1 controls. Compliance with Container Level 1 controls can be accomplished in three ways.

The simplest Container Level 1 option is to ensure that containers comply with all applicable U.S. Department of Transportation (DOT) regulations for transportable containers.

This means, for example, that facilities placing volatile wastes in DOT containers such as "1A1" 55-gallon steel drums already comply with Container Level 1 controls.

Facilities that do not or cannot use DOT containers must use containers equipped with covers or closure devices that form either a "continuous" barrier or a "vapor suppressing" barrier.

All containers complying with Container Level 1 controls must be kept closed at all times unless normal opera-



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tions are being performed. All Level 1 containers must be inspected both initially and, if the container remains onsite for very long, yearly thereafter. Any defects found during an inspection, such as cracks or gaps, must be repaired within five days.

Container Level 2 controls apply to more volatile wastes (constituent vapor pressure greater than 0.3 kilo pascals (kPa) {0.044 pounds per square inch (psi)} at 20 degrees Celsius) that are managed in containers larger than 0.46 m³ (119 gallons). Operating requirements like keeping containers closed, regular inspections and prompt repair of defects are similar to Container Level 1 controls.

Also, containers meeting applicable DOT requirements are considered to meet Container Level 2 controls.

However, volatile wastes managed in non-DOT containers must meet the "no detectable organic emissions" under Subpart CC standard or the "vapor-tight" standard. The "vapor-tight" standard must be demonstrated by testing with EPA Method 27 (40 CFR Part 60 Appendix A). Since Method 27 was developed for gasoline tank trailers, it is difficult to apply to most storage containers. Therefore, the "no detectable organic emissions" standard becomes the only real alternative under Container Level 2 controls.

The "no detectable organic emissions" standard relies on EPA Method 21 (40 CFR Part 60 Appendix A) to demonstrate compliance.

If tested by Method 21, an acceptable container should not exceed 500 parts per million volume (ppmv) above background levels. However, there is no requirement under Subpart CC that any containers actually be tested by Method 21. Method 21 is simply the standard by which "no detectable organic emissions" are judged.

Transfer of wastes into all Level 2 containers must follow procedures to minimize exposure of the waste to the atmosphere. Under Container Level 2 standards, filling operations should minimize splashing and foaming. Submerged fill and vapor-balancing systems are acceptable filling methods. Discharging pumpable wastes above a container and letting them fall to the bottom is no longer acceptable.

Level 3 controls only apply when a volatile waste is being stabilized in a con-

tainer. Regardless of size, Level 3 containers must be close-vented to a vapor-control device and all the previously mentioned vapor-control device standards apply.

Conclusion

Subparts CC, along with AA and BB, place a new set of operating requirements on LQGs that generate volatile organic wastes. The new standards were once estimated by the EPA to reduce emissions to the atmosphere by over 73,000 Mega grams per year (Mg/yr).

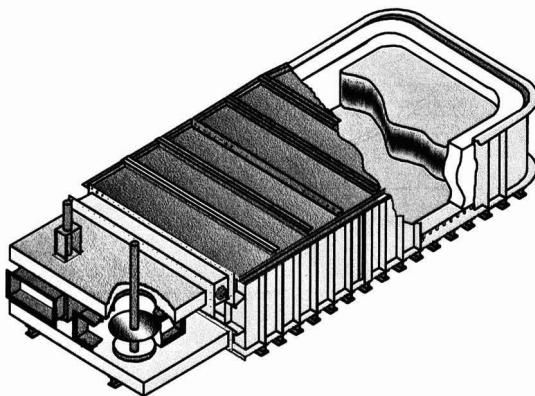
Waste generators will make a substantial contribution to this reduction. Waste management procedures will have to be changed and, in some cases, process modifications installed. Impacted facilities should take credit for these emission reductions in their pollution prevention plans and TRI reports. **EP**

Michael King, CHMM, REA, REP, is a principal and environmental engineer at EXCAL Environmental in Niwot, Colo.

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Natural attenuation processes typically occur at all sites, but to varying degrees of effectiveness, depending on the types of contaminants present and the physical, chemical and biological characteristics of the soil and groundwater.



Deborah Tremblay is an environmental engineer at the EPA's Federal Facilities Restoration and Reuse Office, where she promotes innovative technologies, fosters Agency partnering and coordinates public outreach.

Do federal regulations allow monitored natural attenuation as an option for site remediation?

Monitored natural attenuation is recognized by the EPA as a viable method of remediation for soil and groundwater. However, it should be selected only where it meets all relevant remedy selection criteria, where it fully protects of human health and the environment, and where it meets site remediation objectives within a reasonable time frame. Since there are many methods to achieve site remediation goals, natural attenuation must be evaluated and compared to these other methods during the study phases that lead to remedy selection. Natural attenuation should *not* be considered a default option or a "presumptive remedy."

How is monitored natural attenuation different from a "no action" approach?

Natural attenuation is sometimes mislabeled as a "no action" remedy or a "walk away" approach to site cleanup. However, "no action" sites are sites that pose virtually no risk, allowing the EPA (or other lead agencies) to conclude that no (further) cleanup activities will be necessary. Sites where monitored natural attenuation is being used are doing so because there is

a risk at the site, such as groundwater contaminant concentrations above drinking water standards.

Monitored natural attenuation is not a "walk away" option because adequate site characterization, monitoring and analysis must be conducted to determine its viability as a remedy. Once in place, continued monitoring is needed to verify that contaminant levels are decreasing as anticipated, and the remedy is protecting human health and the environment. Typically, monitored natural attenuation remedies also include "institutional controls" such as groundwater and/or land access restrictions, as well as "contingency" remedies to be employed when natural attenuation processes do not meet remediation goals.

Monitored natural attenuation does not have to be the only remedy component at a site—it is typically combined with other types of remedies (such as source control or soil vapor extraction), or used to complete remediation after other remedy components have cleaned up most of the contamination and are no longer efficiently reducing contaminant levels.

How can you tell if it will work at a site?

You need input from knowledgeable environmental professionals to know if natural attenuation will work at a site. From a regulator's standpoint, you would want solid proof of several things:

- The hydrogeology and the contamination transport and fate issues of the site are well-understood;
- Contamination sources have been identified and have been, or will be, appropriately remediated; and
- The natural attenuation processes at work at the site have been characterized and determined to be capable of achieving the required cleanup levels or objectives in a reasonable time frame.

Simply demonstrating that natural attenuation is occurring is not the only evidence a regulator needs to feel comfortable in selecting it as a remedy or as part of a remedy. More than one line of evidence may be needed to demonstrate that natural attenuation processes are capable of effectively meeting remediation goals. These site-specific lines of evidence may include:

- Historical data indicating a consistent decline in contaminant concentrations over time, and



Peter Feldman is a hydrogeologist in the EPA's Office of Emergency and Remedial Response (also known as the Superfund program), where he is responsible for development of groundwater cleanup policies.

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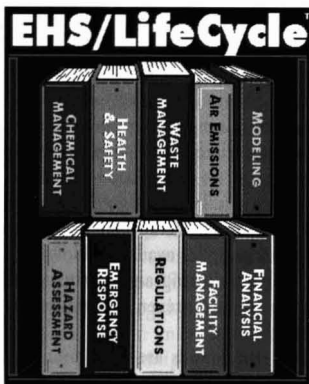
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- a retreating or stable plume;
- Hydrogeologic or chemical data that can indirectly demonstrate the type(s) of natural attenuation processes active at the site, and the rates at which those processes are reducing contamination levels. For example, indicator compounds such as oxygen, nitrate, sulfate iron(II), methane and contaminant daughter products are often used to estimate the potential for contaminants to be attenuated through biodegradation.
- Results of laboratory "microcosm" or field studies to simulate aquifer conditions and demonstrate that native bacteria can biodegrade

contaminants of concern under controlled conditions. Generally, this technique is only recommended when the first two lines of evidence are inconclusive.

What are some potential advantages and disadvantages?

Use of monitored natural attenuation offers several potential advantages, such as less generation of remediation wastes, and fewer and less-intrusive surface facilities. One big advantage is the potential to lower overall remediation costs, particularly at large sites.

However, natural attenuation also has potential disadvantages. The main one is

that cleanup time is sometimes significantly longer than active remediation and responsibility must be assumed for long-term monitoring and associated costs. In addition, site characterization may be more complex and costly. Other factors, such as the potential for continued contaminant migration if natural attenuation does not perform as expected, can be addressed in the remedial plan by careful use of institutional controls, monitoring and contingency remedies.

When should it be used as a cleanup approach?

Monitored natural attenuation should be one of many remedy alternatives regulators and consultants should consider. Careful use of this cleanup approach in the right conditions can achieve the desired outcome (e.g., restoration of groundwater to a beneficial use) and save scarce resources for other contamination problems.

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Natural attenuation refers to naturally occurring processes in the environment that reduce the mass, toxicity, mobility, volume or concentration of contaminants in soils and groundwater.

Many questions need to be answered when determining if monitored natural attenuation will be the right remedy for a given site. Is the plume stable or shrinking or still expanding? How close are downgradient receptors? Are alternate water supplies available? How reliable will monitoring and institutional controls be for preventing exposures during cleanup?

Some compounds are more prone to naturally attenuate than others. For instance, many of the regulated components of fuel hydrocarbons (e.g., benzene, toluene, ethylbenzene and xylene (BTEX)) often biodegrade to non-toxic compounds in the subsurface under a variety of environmental conditions. Other compounds, such as certain chlorinated volatile organics (e.g., trichloroethylene), are less

prone to biodegrade than BTEX, but may do so in certain conditions. Other factors to consider are whether natural attenuation will result in the creation of daughter products whose toxicity is greater than the parent, or whether contaminants will be transferred to other media. Where conditions are favorable, natural attenuation may reduce contaminant mass or concentration quickly enough to safely incorporate it as part of the overall site remedy.

Use of monitored natural attenuation should be limited to sites where it will not pose unacceptable risks to human or environmental receptors, and where solid evidence exists that the required cleanup objectives will be achieved in a reasonable time frame.

What is a "reasonable" time frame for achieving cleanup goals?

The EPA encourages carefully estimating remediation time frames for all remedy

Simply demonstrating that natural attenuation is occurring is not the only evidence a regulator needs to feel comfortable in selecting it as a remedy or as part of a remedy.

alternatives undergoing detailed analysis. However, since they are only estimates, the EPA considers them most useful for comparing different cleanup alternatives and less useful for gauging if a particular remediation time frame is "reasonable." No single threshold time frame exists to determine what is reasonable or unreasonable. The determinations must be made on a site-specific basis.

The EPA recognizes monitored natural attenuation may take longer to achieve site cleanup goals than other forms of remediation. Regulators should consider this when evaluating it as a remedy alternative. Other factors for regulators to consider include:

- Size and complexity of the site contamination problem;
- Classification and use of the groundwater, including approved state-wide classification and

valuation systems;

- Current and future demand for the groundwater, including the likely timing of this demand; and
- Regional (e.g., basin-wide) concerns regarding the groundwater's use and impacts from other contamination sources.

The EPA believes that monitored natural attenuation can be a reasonable and protective component of a site's cleanup

strategy at many sites. Decisions to use natural attenuation must be made on a site-specific basis and backed up by sound technical information. However, the EPA still prefers rapid restoration for groundwaters that are currently used or likely to be used in the near future, and active remediation will continue to play an important role in this effort. **EP**

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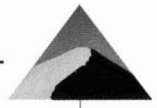
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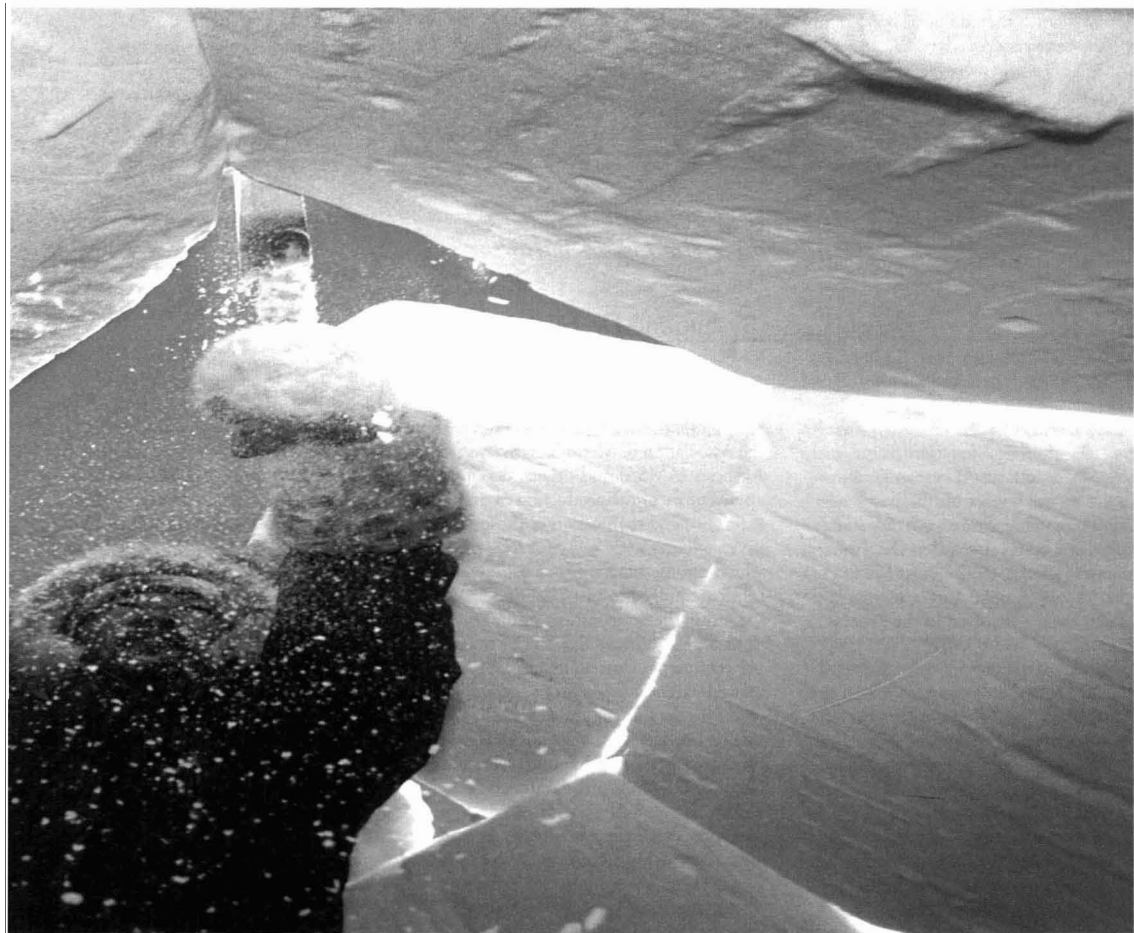


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U.S. BIOSOLIDS OUTLOOK

*Biosolids are gaining popularity as a way to renew crop land
and reduce the loss of valuable resources.*

By Eugene De Michele, PE

After 25 years of steady growth, America's environmental consciousness is here to stay—and the impact on the way we live is immeasurable. Streams, rivers and estuaries are being restored as the primary objective of the 1972 Clean Water Act and its subsequent amendments, and Americans are involved in the process as never before.

Municipal wastewater treatment facilities have played an important role in this turnaround, providing a buffer between the natural environment and concentrated wastewater from urban areas. Citizens have contributed by maintaining pressure to continue federal funding and taking active parts in environmentally related issues. On water quality issues, the Water Environment Federation (WEF) has been the prime advocate for clean water and now finds itself poised to fill the same role in the reuse of a byproduct of environmental improvements.

Background

Biosolids, beneficial organic products of municipal wastewater, are gaining acceptance. The term biosolids was coined in 1991 to replace the commonly used description, sludge, and adopted by the U.S. Environmental Protection Agency in 1996 to better reflect the positive effects of more than 20 years of effort to clean the nation's waters through a massive wastewater treatment program. Biosolids can be used for their organic content as a soil amendment—in some cases as a complete fertilizer, or concurrently with other products, such as chemical fertilizer—to develop a sustainable growth medium.

In 1996, the WEF, in cooperation with the Association of Metropolitan Sewerage Agencies (AMSA) and others, developed an inventory of the production of municipal solids and the portion of those solids in compliance with EPA 503 regulations, which are the basis on which municipal solids are judged to be biosolids.

During the development of the regulations for the use and disposal of municipal treatment plant solids, the EPA reviewed extensive data from around the world on the human health and environmental impacts from biosolids use or disposal. Field trials on biosolids have been conducted in the United States and other countries for at least 40 years. Some biosolids sites have undergone repeated application with monitoring of biosolids for nearly 30 years. Information gathered from these field trials and biosolids sites demonstrates no environmental degradation or human health impacts when used in accordance with federal criteria. The beneficial effects are that plant and animal ecosystems have been significantly improved via increased soil fertility due to biosolids applications. The applications have resulted in macro and micro nutrient additions to the soil, increased organic matter content of the soil and increased moisture delivery to the ecosystem. No documented negative human health impacts have been experienced when biosolids meeting federal regulations have been land applied under good management practices.

Debates on biosolids recycling involves embedded social beliefs, health and environmental concerns, a not-in-my-back-yard attitude in many rural and

suburban communities, and the perception that government is not adequately regulating the product. The basis of this report is information generated in 1995 and gathered in the second half of 1996. It represents data collected from only the largest municipal facilities or from regulators' estimates.

Methods

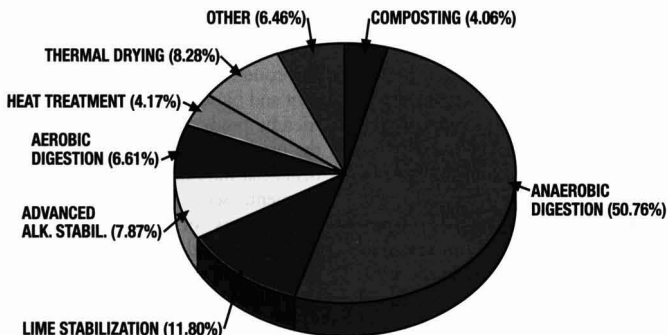
Questionnaires for an overview of the beneficial use of biosolids in the United States were prepared and distributed to the 162 members of the Association of Metropolitan Sewerage Agencies (AMSA) and 57 biosolids regulators. The AMSA membership was selected to receive the survey because of the quality and maintenance of the AMSA list, the working relationship enjoyed by the Federation with AMSA Staff, and the large portion (40 percent to 50 percent) of the United States sewered population served by AMSA members.

Because of the relatively large number of facilities surveyed and the probability that follow-up surveys would enlarge the sampled universe, the software package "Quattro Pro for Windows" was selected for the analysis. The working matrix array contains data from 118 POTWs, 10 regulators (for those states where POTW data was insufficient) and from a U.S. EPA report (Robert Bastian, Office of Water, May 24, 1996).

In the analysis of the collected data, the following assumptions were made:

- The U. S. sewered population is approximately two-thirds the current population of 260 million—a conservative estimate of total biosolids produced.

Figure 1 - Stabilization processes used by publically owned treatment works (POTWs) to produce biosolids.



- In cases where the reporting municipal facilities from a state were responsible for a sewered population greater than two-thirds of the total population, the total biosolids production for the state was left "as reported" on the survey forms.
- In cases where the reporting municipal facilities from a state were responsible for a sewered population less than

two-thirds of the total population, the reported biosolids production for the state was adjusted to estimate total biosolids production.

Summary

Results of a survey of the nation's largest municipal wastewater treatment plants responsible for a sewered population of ap-

proximately 65 million people indicates a 1995 national municipal solids production of approximately 6 million dry tons. The portion of solids complying with 40 Code of Federal Regulations (CFR) Section 503 is estimated by the POTWs to be 5.3 million dry tons, or 87.5 percent.

Biosolids beneficial uses include land application (54.35 percent), incineration and other uses such as landfill cover, compost and fertilizer. Biosolids disposal selections include surface disposal, landfill and incineration.

The processes used to stabilize the biosolids include anaerobic digestion (50.7 percent), some form of heat or thermal treatment (12.5 percent), lime stabilization (11.8 percent), advanced alkaline stabilization (7.9 percent), aerobic digestion (6.6 percent), composting (4.1 percent) and other processes such as incineration, air drying and lagooning (Figure 1). Approximately 12 percent of the produced biosolids are shipped out of state.

More than 80 percent of the states surveyed have biosolids regulatory programs. Two-thirds of the POTW respondents

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were aware of active biosolids regulatory oversight and enforcement programs in their state. Biosolids regulatory authority is imbedded within state water programs (72 percent) and solid waste programs (22 percent). These programs are staffed by 1 to 2 people per million population. Only 25 percent to 28 percent of the POTWs and regulator programs have citizens' education or outreach programs for biosolids. Only 10 of 25 responding regulators indicated that their state had adopted the 40 CFR 503 rule.

POTWs and regulators were consistent in strongly endorsing the prospects for beneficial use of biosolids. However, both groups felt the views expressed by the agricultural community and the engineers/scientists/university professionals for biosolids recycling were not as positive. Respondents were optimistic about the likelihood of their state's delegating regulations; 75 percent to 80 percent thought the prospect was likely or very likely.

More than 80 percent of all POTWs receive what they perceive to be a minor number of complaints stemming from

biosolids production or transportation. The primary complaint is odor (62 percent), with transportation (14.7 percent) and health (11.63 percent) also prominent. The regulators also view biosolids complaints to be minor, but more frequent. Odor (41 percent), health (22 percent) and nuisance (17 percent) are the most commonly received complaints.

In addition to citizen complaints, resistance to beneficial use from specific groups is a reality for 30 percent to 40 percent of the respondents. Farm organizations, the food processing industry, local, county and state ordinances and elected individuals, universities and the press all have been factors in the effort to resist biosolids recycling.

To help assess the influence of active local or state biosolids organizations on the occurrence of resistance, survey respondents were asked to indicate if they were aware of the existence of such biosolids organizations. Forty-four percent of the POTWs and regulators were aware of active local or state biosolids organizations. However, there appeared to

be no relationship between the presence of a biosolids organization and the occurrence of complaints or reported resistance.

Conclusions

Environmental quality is a societal concern and biosolids is an environmentally friendly product. Treating and applying the product to land or using it in other beneficial ways simply makes good environmental sense.

Awareness of diminishing landfill space, the need to recycle valuable resources, and the many positive things that have happened due to the Clean Water Act have resulted in the very best of choices—the chance to renew and revitalize crop land and cover, while simultaneously and dramatically reducing the loss of valuable resources. **EP**

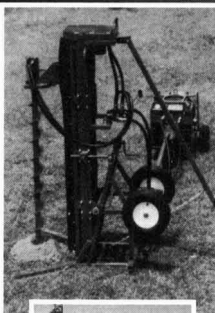
Eugene De Michele is a professional engineer and an association manager. He is currently responsible for the Water Environment Federation's biosolids program.

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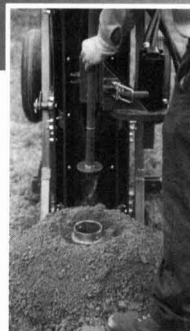
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Part one of a two-part series about how environmental management systems (EMS) enhance pollution prevention efforts.

Many books and articles have been published recently dealing with the environmental management standards of the International Organization for Standardization (ISO) 14000. They have focused on topics such as a guide to what the standards mean, how to develop an environmental management system (EMS) to conform to ISO 14001, how to audit and what to look for in a company's EMS, what to look for in an auditor or EMS course provider and how to choose a Registrar for EMS certification. But what facility managers want to know is how the standards help prevent pollution onsite and help increase cost savings along the way.

ISO 14000 at a Glance

The first ISO 14000 standards were passed in September 1996—14001; 14004, which focused on the EMS; 14010, 14011 and 14012, which focused on environmental auditing. Organizations have since taken another look at their specific environmental programs and EMSs, and how they may benefit from being in some type of conformance or completely conforming to ISO 14001. The standard delineates the main elements of an EMS and what organizations should have in place to be in conformance. Taking a closer look at ISO 14001 and the key elements of the ancillary standards, EMS auditing, environmental performance evaluation (EPE) and life-cycle assessment (LCA), you should remember that the standards are management tools to improve an organization's environmental performance. Organizations can benefit from such improvements in many ways. The EMS standards define the components that should be in place to attain an organization's environmental achievement goals, and more importantly, the necessary steps to achieve the goals. The three audit-

ing standards define the methodology of planning and executing an EMS audit, and more importantly, identifying how to improve the existing EMS. The auditing standards also define the necessary qualifications for an EMS auditor. The EPE draft standard is designed to allow organizations to measure progress against objectives to performance goals. Finally, the LCA draft standard takes a macroscopic view of the impacts of products, processes and services during their life cycle.

Identifying P2 Opportunities

As a broad overview, the elements of ISO 14001 point to opportunities for pollution prevention (P2) and financial incentives through the management review cycle, which allow changes or improvements to occur where appropriate. This concept may mean something different for each facility. Improvements may also occur as a result of identifying opportunities for enhancing a particular set of duties, or in providing a consistency to perform these duties. ISO 14001 guidelines allow increased adherence to regulatory requirements, provide for efficient products and services, and one of the key drivers—provide opportunities to do more with less in materials used or subsequent wastes generated.

Cases will vary at each site, but delving into such situations on a micro level can identify site-specific situations that can lead to one or more P2 and cost saving opportunities within a particular facility.

The specific elements of ISO 14001, which focuses on environmental management systems, consist of: (1) environmental policy, (2) planning, (3) implementation and operation, (4) checking and corrective action, and (5) management review. From these elements, ex-

amples are provided where you may find pollu-

BY GABRIELE CROGNALE, P.E.

P2

Special Report

tion prevention opportunities. Additional examples will be provided in part two of this article in an upcoming issue of *Environmental Protection*.

Environmental Policy

The cornerstone of the standard sets the tone within an organization as to what the main environmental objectives and targets will be with respect to its activities, products and services. It also addresses how these mesh with the organization's commitment to continual improvement and pollution prevention.

The driving force within the policy is to ensure that the organization's commitment rests with the organization's environmental objectives and targets and asks the question, "What does the organization really want to achieve in environmental performance, and are pollution prevention and cost savings among these priorities?" Of key importance is how the policy is developed—namely, whether by management or by environmental staff—and that it has top management's approval.

Planning

Within the objectives and targets further delineated within planning, pollution prevention objectives can be measured on a quantifiable basis, such as tracking Toxic Release Inventory (TRI) emission levels, or measuring the volume of wastewater generated per unit of production. Such examples allow the pollution prevention objectives and targets identified to take a recognizable shape. For these opportunities to occur, the framework needs to be part of an organization's environmental policy, which is the first step to begin planting the seed for pollution prevention opportunities at a facility.

Implementation and Operation

The structure and responsibility defined within implementation and operation adds another dimension—the individuals who perform the functions and the managers who oversee them to ensure that EMS requirements are established, implemented and maintained. As in any working system, someone needs to be responsible for carrying out the organization's

"marching orders," while another manages the individuals to ensure top management's intent is carried out. In close concert with structure and responsibility is training, awareness and competence. Within this sub-element of implementation and operation lies many opportunities. If not acted upon, they become missed opportunities for pollution prevention and cost savings within a regulated organization. Without adequate and appropriate training to increase awareness and competence levels about environmental considerations, unnecessary spills or releases, possibly with potentially disastrous or costly results, may occur. Adequate and appropriate employee training programs greatly increase a facility's compliance level and decrease situations that may cause mishaps.

Communication is also important. Without adequate and appropriate communication between managers and workers, especially in situations that may adversely affect employees' safety and health or the environment, gaps may evolve in a facility's EMS. If left



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Pollution Prevention

unchecked they may lead to unnecessary waste management issues. Identifying and shoring up any such gaps also provides opportunities for pollution prevention and related cost savings. The litmus paper test is to ensure that the lines of communication between top management and line workers are kept open.

Checking and Corrective Action

Although employees have good intentions to adhere to policies, it is hard unless the organization has in place two important ISO 14001 elements—checking and corrective action and management review.

Corrective action is an internal documentation system established to allow trained individuals to monitor and measure key characteristics of internal activities that may adversely affect the environment. These include properly maintaining equipment and processes to ensure they are functioning at peak efficiency, ensuring the facility is in compliance with all environmental regulations and rules, keeping related permits up-to-date, and seeing that required documents are prop-

erly and timely filed. In situations where nonconformance is noted and corrective action is necessary, management should ensure that systems exist that allow the appropriate individuals to execute corrective actions to the facility's EMS. Without such systems, good intentions to eliminate pollution at the source could be dismissed over time due to a lack of follow-up or managerial oversight. With such systems previous workplace situations that allowed National Pollutant Discharge Elimination System (NPDES) permit or other wastewater excursions; unpermitted air emissions or clogged filters causing excess particulates to be released; mixing hazardous and non-hazardous wastes increasing both waste and waste handling costs; and other worker-related items can be eliminated and internal controls and checks can find and correct such workplace excursions.

Management Review

Like other management-driven incentives or company functions, the ultimate responsibility for the EMS's effectiveness in

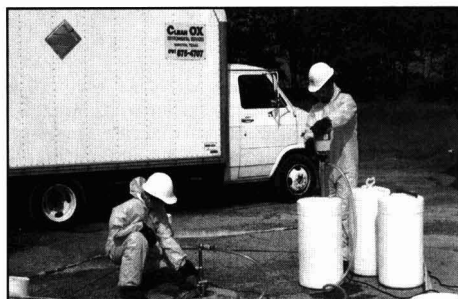
achieving P2 goals and cost savings rests with top management. To be effective, management's review of the EMS needs to focus on the improvements that should occur as a result of the facility's EMS audit findings, which is part of checking and corrective action, and ensure that improvements are executed and incorporated into the ISO EMS standards.

Tracking and measuring improvements at a facility using similar techniques and placing dollar values to the improvements may help to develop a direct relationship to cost savings by eliminating unnecessary pollution or waste handling. Compiling this data into a tabular or report format could be valuable to top management, providing them tangible proof that efforts to implement EMS improvements are also pollution prevention opportunities, which create real cost savings. **EP**

Gabriele Crognale, P.E., is the principal of MCG Associates in Needham Heights, Mass.

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Air & Waste Management Association Showcase

AWMA's '97 Exhibition

This Toronto conference and exhibition will focus on how the air, waste and environmental management fields are becoming more international.



Photo courtesy of Tourism Toronto

THIS SUMMER ENVIRONMENTAL professionals are going to beat the heat by heading up north to Toronto, Ontario, to the Air & Waste Management Association's 90th annual meeting and exhibition, which will be held in the Metro Toronto Convention Centre during June 8-13.

The conference's theme will be "Science

and Technology: the International Language," and will include forums on international environmental agreements and global urban infrastructure and a workshop presenting an international exchange on how regulatory agencies deal with innovative technology.

The meeting is filled with seminars on topics such as indoor air quality, pollution prevention and site remediation and closure. Attendees may choose sessions in six main categories: air issues, environmental management, waste issues, business risk management, education and international issues.

AWMA expects over 1,000 technical papers and 450 exhibitors of environmental services and equipment. Professional

development events include continuing education courses, a job fair and a number of technical tours to nearby facilities.

In keeping with the conference's international theme, Toronto is a culturally diverse city that has more than 70 ethnic groups speaking more than 100 languages. The host city has shed its Victorian image and is now the home of First Canadian Place, the 72 story tower, and the SkyDome, a sports complex with a hotel, restaurants and entertainment centers.

The AWMA conference offers environmental professionals the chance to visit Canada's most popular tourist destination while increasing their knowledge of the latest advances in the environmental field.

Hydrogen Sulfide Analyzer

The Jerome 631-X Hydrogen Sulfide Analyzer is an easy-

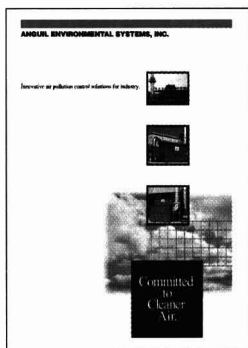


to-use, hand-held portable analyzer capable of accurately measuring low levels of H₂S concentrations from 1 ppb to 50 ppm in seconds. Ideal for gathering quantitative data or reduced sulfur concentration in ambient air. **Booth 1811. Arizona Instrument.**

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Brochure

Anguil Environmental Systems released an 8-page brochure covering its successes from design to installation. It describes the engineering process that goes into every unit manufactured. **Booths 1614/**



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VOC Analysis

HAPSITE™ is a portable GC/MS for easy and depend-



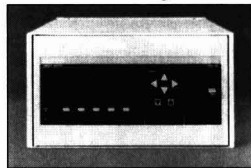
able on-site analysis of VOCs. Battery-powered, lightweight and weatherproof, it can speciate and quantify VOCs in min-

utes. Ideal for stationary source testing, hazardous-waste site investigations and emergency response. **Booth 1939. Inficon.**

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Ambient Air Monitors

AP-360 series of ambient air monitors were designated Ref-



erence or Equivalent Methods in accordance with 40 CFR 50-53. The AP-360 series includes CO monitor, NO-NO₂-NO_x monitor, SO₂ monitor, O₃ monitor and CH₄-NMHC-THC monitor. **Booth 1917. Horiba Instruments Inc.**

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Economical RTO

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high temperatures to oxidize VOC emissions. Ceramic grid blocks recover heat from the cleaned flue gas to preheat entering gas. **Booth 1124. United McGill Corp.**

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Stack Emission Monitor

The new portable stack emission monitor Testo 360



with RATA accuracy surpasses CEMS equipment in usability, portability and affordability. It

consists of four components, all operated by a notebook computer incorporated into the instrument. Booths 1804/1806. Testo Inc.

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VOC Abatement System

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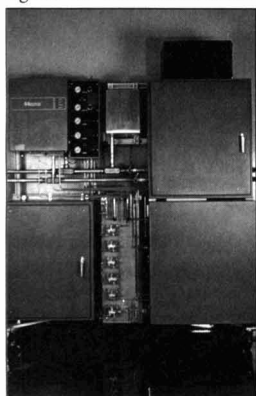


creased maintenance. Get effective destruction of gaseous emissions and eliminate heat exchanger fouling. Booth 525. Alzeta Corp.

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Continuous Gas Analyzer

The Enviro-FTIR is designed for continuous moni-



toring of stack emissions and provides simultaneous measurement of gases. The heated extractive gas-handling system maintains sampling integrity necessary for monitoring highly-water soluble components. Booths 809/811. Applied Automation.

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ISO 14001 requirements, and add value to your business. ANSI-RAB Accredited Advanced EMS Auditor Course available. Booth 2017. Excel Partnership Inc.

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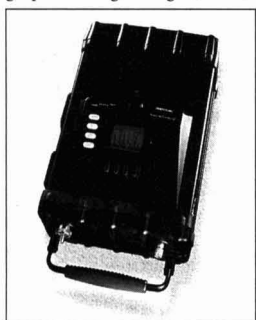


analyzer capable of five simultaneous gas measurements and a dynamic range. Ideal for industrial hygiene applications, HAPS compliance and VOCs monitoring. Booth 1012. California Analytical Instruments.

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The Voyager gas chromatograph is a lightweight, hand-



held instrument with analytical ability to chart subsurface contamination. It combines rapid sampling techniques with field-generated analysis for an accelerated site characterization plan. Booth 1010. PE Photovac.

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Air & Waste Management Association Showcase

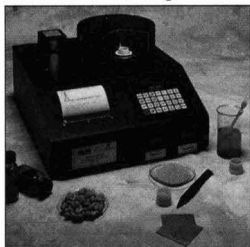


sion efficiency and 95-percent heat recovery. Stack, fans and sound-reduction equipment available. It is self-sustaining with the process heat contribution. Booth 1218. ABB Air Preheater Inc.

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Bench-Top Analyzers

Bench-top/at-line instruments for measuring elements

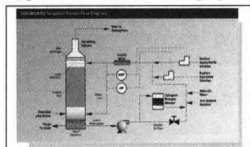


from ASOMA Instruments use Energy Dispersive X-Ray Fluorescence (EDXRF) technology, which is rapid, non-destructive, non-coating and requires little or no sampling preparation. Booths 836/838. ASOMA Instruments Inc.

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Eliminate Odors

Odorguard, an enhanced hypochlorite scrubbing pro-



cess, eliminates odors and low-level VOCs in gas streams with a 99.9-percent guaranteed removal rate and 40-percent less operating costs than traditional scrubbers. It is fouling resistant and can be used in a variety of industries. Booth 1225. Monsanto Enviro-Chem.

Circle 238 on card.

Compliance Database

PlantWare® Audit determines and maintains regulatory compliance for both Title V

preparation and compliance assessments. View pertaining regulations, create an inventory of facility equipment and establish emission units. Booth 617.

EnviroMetrics Software Inc.
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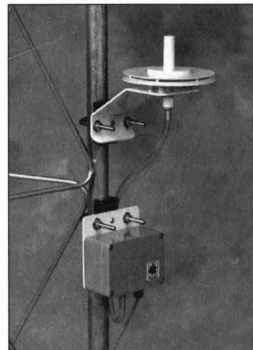
Flow Meter

The Model 100 Micro Gas Flo-Sensor is designed as a low-cost alternative to glass tube and ball flow meters. It uses a Pelton-type turbine wheel to determine the flow rate of the gas capable of measuring extremely low flow rates over 13 ranges. Booth 1810. McMillan Co.

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Pressure Sensor

The Young Model 61201 Barometric Pressure Sensor is



an analog output electronic barometer in broad temperature ranges for meteorological and utility applications where continuous power is available. The Model 61002 Gill Pressure Port minimizes dynamic pressure errors due to wind. Booths 1518/1520. R.M. Young Co.

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Hydrocarbon Analyzer

The Model 55C is an automated continuous measure-

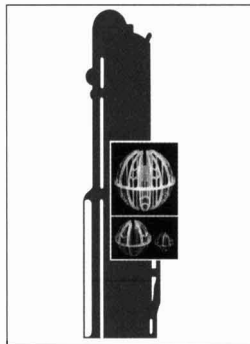


ment of methane and non-methane hydrocarbons in air. It achieves detection limits of 50 ppb or less with a sensitive flame ionization detector and proprietary column design. Total analysis time is less than 70 seconds. Booth 1505. Thermo Environmental Instruments Inc.

Circle 242 on card.

Superior Design

Jaeger Tri-Packs® are ideal for use in air stripping and



odor scrubbing applications. Other technologies include products for use in all mass transfer applications, which includes a full line of ceramic and metal random packings, and a variety of column internals. Booths 1928/1930. Jaeger Products Inc.

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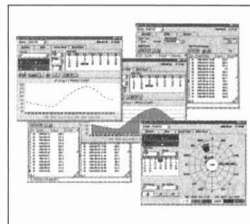
Catalog

Response Rentals' catalog features rental instrumentation for continuous emissions monitoring (CEM), including EPA reference analyzers for ozone, carbon monoxide, sulfur dioxide, NO_x and VOCs; heated sample lines, sample conditioners and dilution probes; dataloggers; calibration gases; and more. Booth 1738. Response Rentals.

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Data Logger Software

MicroMet™ Plus Software is environmental data collection and reporting software including Wind Rose, color charting and graphic features. Designed

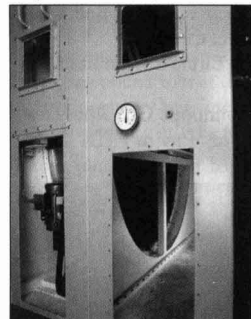


specifically for use with MicroMet and CR-10 Data Loggers, it operates single or network of local or remote recording sites with an Auto-Polling-Reporting system. Booth 1605. Met One.

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VOC Emission Control

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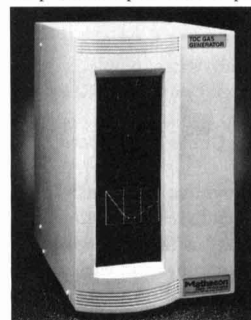


VOCs with energy savings and lower operating costs. It is suited for high-gas volume and low-VOC concentration applications in the automotive, pharmaceutical, semiconductor, printing and chemical processing industries. Booth 612. Engelhard Corp.

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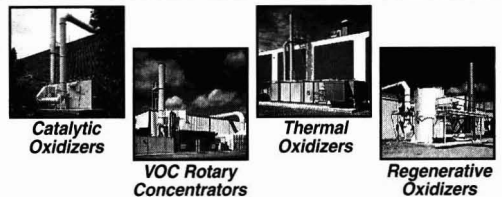
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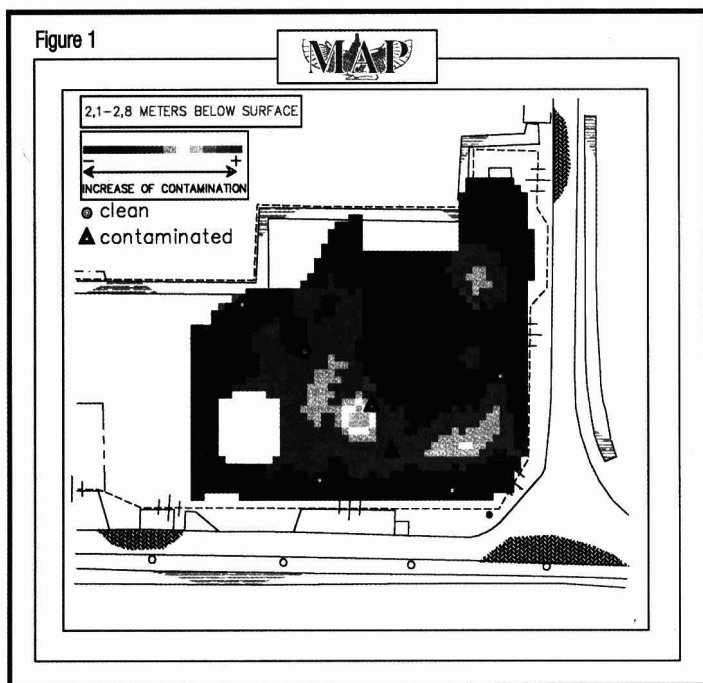
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ZEROING IN ON HYDROCARBONS

Ground penetrating radar technology locates and defines hydrocarbon contamination.

By Ing P.B. van der Roest, Drs. D.J.S. Brassers, A.P.J. Wagebaert and P.H. Stam



The increasing costs of remediating contaminated sites has stimulated research for cost-reducing techniques in soil investigation and cleanup techniques. Under the traditional approach, soil borings and groundwater wells are used to investigate contaminated soil. Although useful tools to determine the amount and characteristics of the contamination, they are inefficient and costly in providing information on the location and extent of contamination,

as they only give information on one point. This often leads to uncertainty in estimating cleanup costs or, even worse, to unsuccessful cleanups. MAP Environmental Research has developed a technology using ground penetrating radar (GPR) in combination with in-house-developed software to locate and define the extent of hydrocarbon contamination. With this technology, the quality of site investigation is increased and costs are reduced. Since 1994 MAP has improved its

technology and applied it to more than 100 projects, predominantly for the petrochemical industry. All projects were later checked by conventional drilling. Two years' experience has continuously increased the quality and broadened the applications of the method.

Background

The theoretical background of detecting hydrocarbon contamination has been analyzed and studied by several well-known scientists at several U.S. and European research institutes. Practical applications, however, have been sparse until recent years. In 1994 MAP discovered that by applying certain processing techniques, radar data could be analyzed to generate useful information on contamination. The technique is based on the principle that the chemical and physical characteristics of the soil and groundwater is altered by contamination. This results in a variation in radar reflection and of the radar signal's amplitude.

Fieldwork and Processing

To execute the method, a systematic GPR survey in a dense grid is conducted to collect the necessary data, using a survey wheel to determine the x and y coordinate. The data are analyzed with the in-house developed software. Depth values are obtained through secondary field measurements. Knowing the x, y z coordinates and the contamination value, a three-dimension computer image of the contamination in relative values can be generated. The comprehensive information forms the basis for a targeted and effective drilling plan. The outcome of



Ground penetrating radar (GPR) locates and defines the extent of hydrocarbon contamination.

chemical analyses delivers information on absolute values and the type of contamination. The information can be applied to the relative radar model after a correlation between the radar and lab-analyzed data is made. The combination of the two data sets generates an overall picture.

Method Characteristics

By using the GPR technique, a significant and comprehensive data set is collected. For example, at a site of approximately 1,000 m², around 15,000 reference points are collected versus 20 to 30 reference points by the conventional method of drilling and sampling. This shows the particular strength of the method—localizing the contamination in magnitude as well as in intensity. Soil conditions are normally very heterogeneous, so a limited number of drillings often leads to an inadequate insight in the contamination, which may again lead to bad estimations of remediation cost, or worse, cost-ineffective cleanups. Averaged depths of a GPR investigation in the sandy and clayey subsoil of the Netherlands are around 20

to 40 feet. Experience shows that minimum detection levels go down, depending on local circumstances, to the range of 200 to 500 milligrams per kilogram of dry matter (kg/dm) parts per million (ppm) in soil and 50 micrograms per liter parts per billion (ppb) in groundwater.

A Project Example

Carried out by MAP Environmental Research in 1995, the site is a former oil exploration site initially investigated in the conventional way. Contamination consisted of mineral oil and aromatics. Maximum values of mineral oil of 1000 microgram (mg/kg/dm) (ppm) were present in the soil and groundwater maximum values of 500 mg/l (ppb) were observed. The site has an area of approximately 2000 square meters. The soil consists of fine sand to 7 meters below surface, and surface sandy loam is found between 3 and 6 meters. The groundwater level during investigation was around 1.5 meters below surface.

Based on the conventional information a remediation plan was made. When ex-

"The technique is based on the principle that the chemical and physical characteristics of the soil and groundwater is altered as result of contamination."

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Zeroing in on Hydrocarbons

cavation started, the actual size of the contamination turned out to be far different. The remediation was stopped and MAP was asked to do a secondary investigation of the area. The GPR investigation was done using a GSSI Sir 10A (upgraded version) ground-penetrating radar unit with a 100 megahertz (MHz) antenna. To get integral information on the entire area, the investigation was executed in a 2-meter by 2-meter grid. Along these lines, radar data was continuously collected and x and y coordinates were determined using a survey wheel. The depth of

the measurements was around 7 meters below surface.

The collected radar data was then processed by MAP's specially designed software. Vertically, the survey was divided into layers with a thickness of 0.7 meter. For each layer a map was made showing the relative contamination level as found with GPR (Figure 1). The results were presented within one week.

To verify results of the GPR investigation, a few more drillings were installed. Using these drilling results, a comparison was made between the radar data and the

absolute values of the contamination. Since the correlation was high, an accurate "absolute" model of the contamination could be delivered. Based on the new information, an alternative plan was made and remediation work progressed.

In the accompanying figure (Figure 1) the relative contamination situation is shown in the layer from 2.1 to 2.8 meters below surface. The various colors of the squares (size: 1 meter by 1 meter) represent the relative level of the contamination; from dark blue (less contaminated) to green, yellow and red (most contaminated). All values represent the cumulated contamination. To compare the results of the GPR survey to the results of drilling, the drilling locations are presented in the map. The triangles represent contaminated drillings, while the circles represent (almost) clean drillings.

Conclusion

In its short existence MAP has already built up relations with many international clients, like Shell (over 35 projects), the Dutch Gasunion and Akzo Nobel. With larger sites (over 1.000m²), the GPR survey may already have earned back on the investigation itself.

MAP has already received interest in the United States. In 1995, MAP filed with the U.S. Environmental Protection Agency Database for Innovative Site Investigation Technologies. In 1996, the company applied for the Consortium for Innovative Site Characterization, a program run by the EPA and sponsored by the U.S. Department of Defense and the U.S. Department of Energy that is intended to spur new investigative technologies. The EPA is still evaluating GPR.

GPR is also being used in projects conducted by the Bureau de Recherche de Geologie et des Mines, which is both the French geological survey and a commercial mineral exploration organization, and the Finnish Geological Survey. The agencies are using GPR in commercial operations involving environmental audits because GPR-based investigation increases the quality of site-investigation since more complete information is provided. **EP**

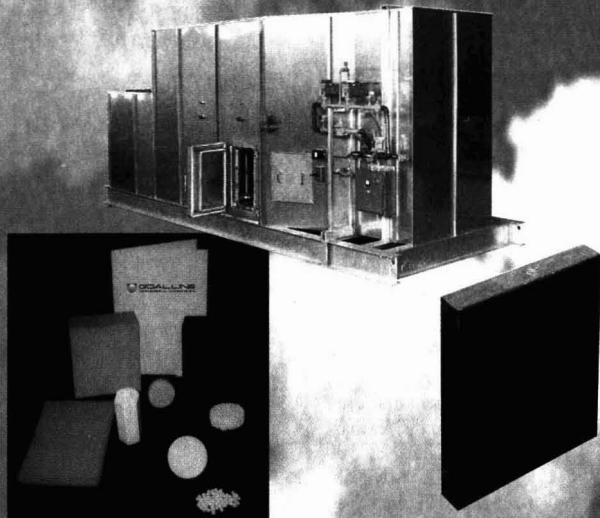
Ing P.B. van der Roest, Drs. D.J.S. Brasser, A.P.J. Wagebaert and P.H. Stam are members of MAP Environmental Research BV, in Arnhem, The Netherlands (+31-26-3778730).

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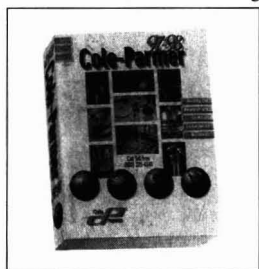


mercury with the Hach DR/2010 Portable Datalogging Spectrophotometer. Stores up to 1,000 data points and records sample readings with group number, sample number and date/time stamp. Readouts available in Portuguese and Japanese languages. Hach Co.

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Instruments Catalog

The new 1997-98 Cole-Parmer instruments catalog



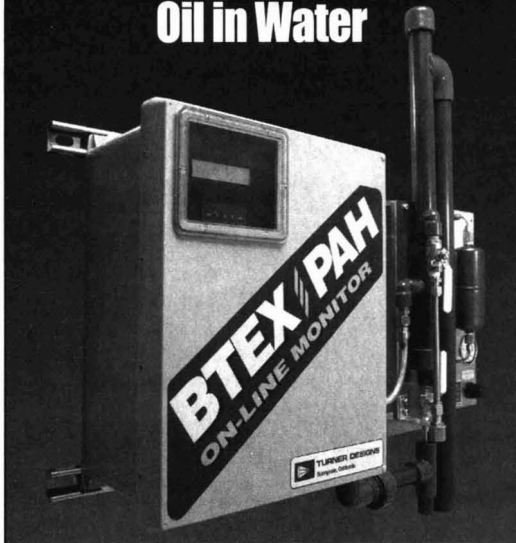
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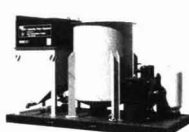
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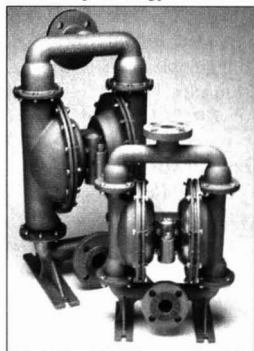


Therm module handles gas flows of 500 to 10,000 SCFM with VOC concentrations as low as 1/2 percent. It has no flow control valves or dampers with start up under 15 minutes. Roof mounting next to existing stack is available. ARTCO Marketing.

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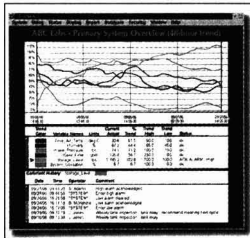
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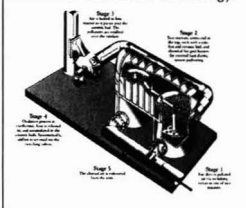
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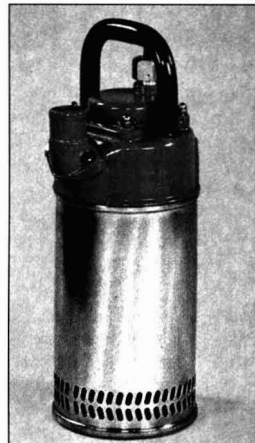


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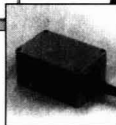
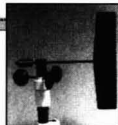
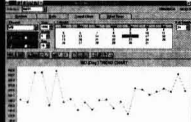
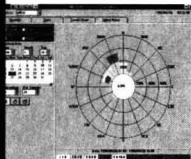


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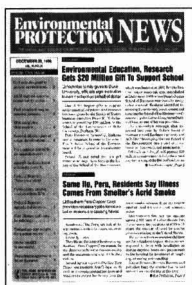
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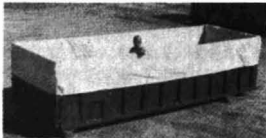
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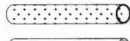
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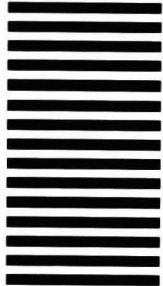
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100	117	134	151	168	185	202	219	236	253	270	287	304	321	338	355	372	389
101	118	135	152	169	186	203	220	237	254	271	288	305	322	339	356	373	390
102	119	136	153	170	187	204	221	238	255	272	289	306	323	340	357	374	391
103	120	137	154	171	188	205	222	239	256	273	290	307	324	341	358	375	392
104	121	138	155	172	189	206	223	240	257	274	291	308	325	342	359	376	393
105	122	139	156	173	190	207	224	241	258	275	292	309	326	343	360	377	394
106	123	140	157	174	191	208	225	242	259	276	293	310	327	344	361	378	395
107	124	141	158	175	192	209	226	243	260	277	294	311	328	345	362	379	396
108	125	142	159	176	193	210	227	244	261	278	295	312	329	346	363	380	397
109	126	143	160	177	194	211	228	245	262	279	296	313	330	347	364	381	398
110	127	144	161	178	195	212	229	246	263	280	297	314	331	348	365	382	399
111	128	145	162	179	196	213	230	247	264	281	298	315	332	349	366	383	400
112	129	146	163	180	197	214	231	248	265	282	299	316	333	350	367	384	401
113	130	147	164	181	198	215	232	249	266	283	300	317	334	351	368	385	402
114	131	148	165	182	199	216	233	250	267	284	301	318	335	352	369	386	403
115	132	149	166	183	200	217	234	251	268	285	302	319	336	353	370	387	404
116	133	150	167	184	201	218	235	252	269	286	303	320	337	354	371	388	405

Card Expires July 1997

Interested because of: **95** ■ New Construction **96** ■ Adding Capacity **97** ■ Plant Upgrade **98** ■ Maintenance **99** ■ 1 for 1 Replacement

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Yes! Send/Continue to send *Environmental Protection* free of charge.

No, I'm not interested at this time.

Signature (Required) _____ Date _____

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Zip+4 _____ Phone _____

Fax _____ E-Mail _____

**FOR FASTER SERVICE
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A. Function which best describes your activity in Pollution Control (check only one):

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

B. Type of Business (check only one):

A Manufacturing (if manufacturing, please check the appropriate SIC (check only one):
 J(20) Food J(31) Leather
 J(21) Tobacco J(32) Stone/Clay/Glass
 J(22) Textile J(33) Primary Metal
 J(23) Apparel J(34) Fab. Metal
 J(24) Lumber & Wood J(35) Mach., except Elect.
 J(25) Furniture J(36) Elect. & Electron Mach.
 J(26) Paper J(37) Trans. Equip.
 J(27) Print/Publish J(38) Inst./meas./analyze/controlling
 J(28) Chemicals J(39) Miscellaneous Mfg.
 J(29) Petrol. & Coal J(30) Rubber/Plastic

C. Approximate number of employees at this address (check only one):

A J1-19 D J100-249 G J1000-1499
 B J20-49 E J250-499 H J1500-2499
 C J50-99 F J500-999 I J2500 and up

D. In your job function do you recommend, specify or purchase? (check all that apply)

A Pollution Control Equipment
 B Instrumentation
 C Chemicals
 D Parts & equipment for maintenance operation and control

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

Type of Govt.:
 G J City H J County
 I J State J J Federal

**K J Transportation
 N J Labs O J Training P J Real Estate
 Z J Misc. Services**

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

A Air F Toxic & hazardous
 B Water material
 C Noise G Energy control/
 D Solid Waste energy conservation
 Disposal H None of the above

E. Industrial hygiene

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

A Pollution Engineering
 B Environment Today
 C Environmental Solutions
 D Pollution Equipment News
 E The National Environmental Journal
 F Water Environment & Technology
 G None of the above

G. Which of the following Respirators and Personal Protective Clothing products/services do you plan to purchase in the next 12 months?(Select all that apply)

800 Self-Contained Breathing Apparatus 806 Goggles
 801 Cartridge Respirators 809 Overpack Drums
 802 Gloves 810 Storage Enclosures
 803 Hazmat Suits 811 Secondary Containment
 804 Leak Detectors 812 Waste Bags
 805 Hazmat Storage Buildings 813 Bulk Storage Bags
 806 Handheld Gas Detectors 814 Portable Tanks
 807 Sorbents

H. What is your reason for purchasing the selected products/services? (Select one)

815 New Construction
 816 Plant Upgrade
 817 Replacement/Maintenance

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

818 Over \$200,000
 819 \$100,001-\$200,000
 820 \$50,001-\$100,000
 821 \$10,001-\$50,000
 822 \$5,000-\$10,000
 823 Under \$5,000

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

824 0-3 months
 825 4-6 months
 826 7-9 months
 827 10-12 months
 828 Over 12 months

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Signature (Required) _____ Date _____
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 Title _____
 Company _____
 Address _____
 City _____ State _____ Zip _____
 Zip+4 _____ Phone _____
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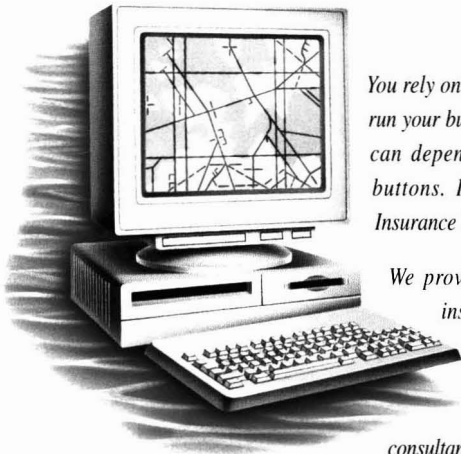
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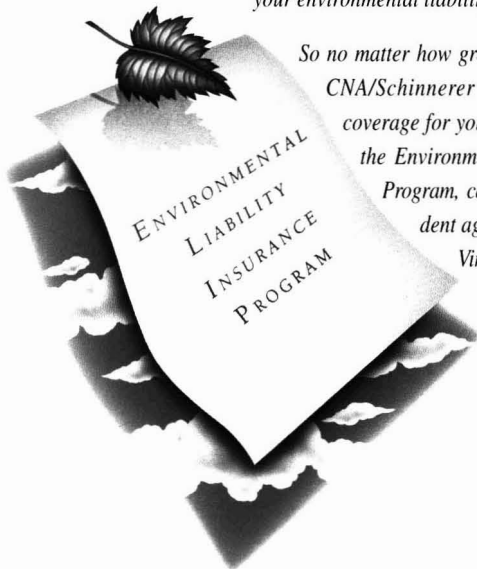
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