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NOVEMBER 1997

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November 1997

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 January 1998

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

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Zip+4 \_\_\_\_\_ Phone \_\_\_\_\_

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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):

(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.

(26) Paper  (37) Trans. Equip.

(27) Print/Publish  (38) Instr./meas./analyze

(28) Chemicals  (39) Instrumental

(29) Petrol. & Coal  (30) Miscellaneous Mfg.

(30) Rubber/Plastic

B  Mining L  Consulting

C  Agriculture M  Insurance

D  Engineering & E  Utilities, public, Contracting

F  Govt. including municipal or district sanitary water or wastewater treatment sys. or plants

Type of Govt:

G  City H  County

I  State J  Federal

K  Transportation

N  Labs O  Training P  Real Estate

Z  Misc. Services

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

A  1-19 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

C  Noise G  Energy control/

D  Solid Waste energy conservation

E  The National Environmental Journal

F  Water Environment & Technology

G  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 Wastewater Treatment Chemical product(s) /services do you plan to purchase in the next 12 months?(Select all that apply)

800  Lime  
801  Activated Carbon  
802  Flocculants  
803  Odor Control Chemicals  
804  Chemical Feeders  
805  Antifoam/Defoamers  
806  Boiler Tube Descaling  
807  Chlorine

808  Algaecides/Bactericides  
809  Chlorine Dioxide  
810  Fuel Additives  
811  Emulsion Breakers  
812  Dewatering Aids  
813  Corrosion Inhibitors  
814  Coagulants  
815  Magnesium Hydroxide

816  Hydrogen Peroxide 817  
818  Dust Suppressants  
819  Potassium Permanganate  
820  Standard Solutions  
821  Sludge Stabilization

H. What is your reason for purchasing the selected products/services?

(Select one)  
822  New Construction  
823  Plant Upgrade  
824  Replacement/Maintenance

I. What is your projected budget for the selected products/services? (Select one)  
825  Over \$200,000  
826  \$100,001-\$200,000  
827  \$50,001-\$100,000

828  \$10,001-\$50,000  
829  \$5,000-\$10,000  
830  Under \$5,000

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

831  0-3 months  
832  4-6 months  
833  7-9 months  
834  10-12 months  
835  over 12 months

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November 1997

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 No, I'm not interested at this time.

Signature (Required) \_\_\_\_\_ Date \_\_\_\_\_

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

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- D  Provide professional consulting service on Pollution Control
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- Z  Other \_\_\_\_\_

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  - (25) Furniture
  - (26) Paper
  - (27) Print/Publish
  - (28) Chemicals
  - (29) Petrol. & Coal
  - (30) Rubber/Plastic
  - (31) Leather
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  - (33) Primary Metal
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  - (36) Elect. & Electron Mach.
  - (37) Trans. Equip.
  - (38) Instr./mess./analyze/controlling
  - (39) Miscellaneous Mfg.

- B  Mining
- C  Agriculture
- D  Engineering & Contracting
- F  Govt. including municipal or district sanitary water or wastewater treatment sys. or plants

- L  Consulting
  - M  Insurance
  - E  Utilities, public, private & cooperative
- Type of Govt:  
 G  City H  County  
 I  State J  Federal

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

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

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**

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- 801  Activated Carbon
- 802  Flocculants
- 803  Odor Control Chemicals
- 804  Chemical Feeders
- 805  Antifoam/Defoamers
- 806  Boiler Tube Descaling
- 807  Chlorine
- 808  Algaecides/Bactericides
- 809  Chlorine Dioxide
- 810  Fuel Additives
- 811  Emulsion Breakers
- 812  Dewatering Aids
- 813  Corrosion Inhibitors
- 814  Coagulants
- 815  Magnesium Hydroxide

- 816  Hydrogen Peroxide
- 817  Dust Suppressants
- 818  Potassium Permanganate
- 819  Sodium Bicarbonate
- 820  Standard Solutions
- 821  Sludge Stabilization

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

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  - 823  Plant Upgrade
  - 824  Replacement/Maintenance
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  - 827  \$50,001-\$100,000

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- 829  \$5,000-\$10,000
- 830  Under \$5,000

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- 832  4-6 months
- 833  7-9 months
- 834  10-12 months
- 835  over 12 months

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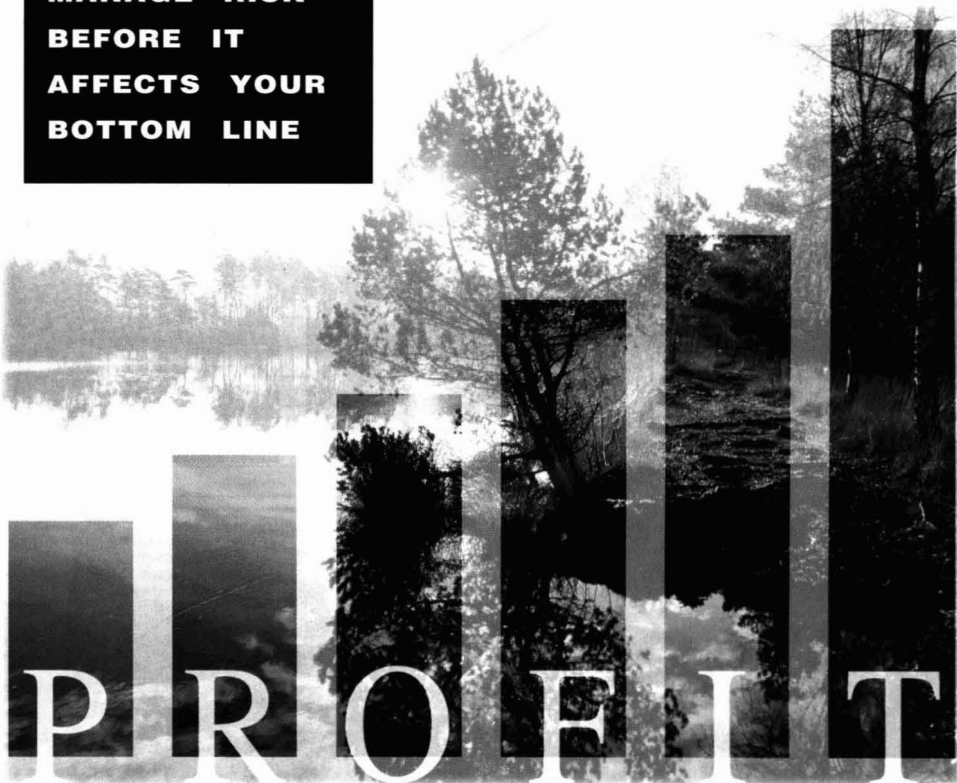
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## About the cover:

Many of today's businesses have employees whose job duties include loading, unloading and handling hazardous materials that are being shipped from one location to another. The U.S. Department of Transportation mandates that such hazmat employees must be properly trained by their employers. Look at the article beginning on page 12 for suggestions on training workers involved in transporting hazardous materials.

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Mark Howard, Photographer

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**By Bruce Myatt, PE**

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## On the Road Again

**H**azardous chemicals have become our constant traveling companions as they share the nation's highways with us during their transport.

Likewise, huge amounts of these dangerous materials are moved via air, rail, waterways and pipelines. Chemicals serve as the life blood of our modern industrialized society and, as such, are continually circulating throughout our country and abroad.

To minimize the possible harm that could result from the accidental releases of these chemicals while they're in transit, the U.S. Department of Transportation (DOT) is authorized to regulate both interstate transportation of hazardous materials and the inter- and intrastate transportation of hazardous waste. DOT has established requirements in its regulations for proper containers, marking and labeling of containers, shipping papers, placarding of transport vehicles, incident reporting and training for employees involved in hazmat transportation.

DOT frequently revises its regulations to better safeguard people and the environment from the dangers of these chemicals. For example, last year an unloading incident resulted in the department's discovery that emergency discharge controls on some cargo tank trucks won't stop the flow of liquefied compressed gases like propane and anhydrous ammonia if a delivery line breaks its connection during product transfer operations.

To address the problem, DOT's Research and Special Programs Administration (RSPA) issued a rule this year stipulating operational procedures that require the person attending the unloading operation must be within an arm's length of the discharge system's manual activation mechanism. The regulation requires these procedures continue in use through March 1, 1999. In the mean time, RSPA will continue to work with industry to identify solutions and install proven equipment on these vehicles that will resolve the problem.

This rule dealing with emergency discharges is just one of the myriad regulations DOT issues each year. If you want a convenient way of keeping up with all the new rules, try DOT's Internet home page, which was recently set up by RSPA. It contains a wide range of information, including copies of proposed and final rulemakings. To access this convenient information source, go to [www.volpe.dot.gov/ohm](http://www.volpe.dot.gov/ohm).

For those of you who don't feel like venturing into cyberspace to get your information, RSPA has opened the Hazardous Materials Information Center in Washington, D.C., to provide answers to questions about hazardous materials. The center's telephone number is 800-467-4922.

### One-Stop Shopping for Consultants

Whether you need to track down someone to provide hazmat transportation training for your facility's employees or want help with a tricky air permitting problem, you can probably find the information you're looking for in our 1997 Consultant's Guide. Turn to page 48 for our handy annual directory that offers a listing of more than 600 environmental consultants from all 50 states, as well as several foreign countries.

*Angela Neville*

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

# Environmental PROTECTION

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## Fertilizer Safety Plan Announced

**OLYMPIA, Wash.**—The state of Washington has proposed steps to make sure farmers know what is in the fertilizer they use, how to protect the environment, and how to assure that consumers know their food supply is safe.

The departments of Agriculture, Ecology and Health will work with an advisory group comprised of growers, the fertilizer industry, environmentalists, and government regulators to refine the proposal and determine how the ideas can be executed.

State Department of Health Secretary Bruce Miyahara said that more information about recycled waste products in fertilizer is needed. "The information we've seen so far says there is no reason to worry about the food supply," he said. "However, continued study of fertilizers should be done to ensure its safety."

"Growers have a right to know what they use is beneficial to crops, safe for the consumer and the environment," added Department of Agriculture Director Jim Jesernig. "This is a strong, well-balanced approach," said Tom Fitzsimmons, director of the state Department of Ecology, which regulates hazardous waste in Washington. "We'll look to people in agriculture, health and environmental fields to help us put this plan to work."

## Imported Gas Requirements Finalized by EPA

**WASHINGTON, D.C.**—The U.S. Environmental Protection Agency issued a revision to the requirements for importing conventional gasoline into the United States. The final rulemaking is consistent with the agency's commitment to fully protect public health and the environment and with the United States' commitment to comply with its obligations under the World Trade Organization agreement.

Under the final rule, any foreign refiner can choose to petition the EPA for an individual baseline reflecting the volume and quality of gasoline shipped to the United States in 1990. The foreign refiner is required to meet the same standards relating to the establishment and use of individual refinery baselines as domestic refiners, with additional requirements.

Additional requirements relate to

tracking the movement of gas from the refinery to the U.S. border, monitoring compliance with conditions that apply to parties outside the United States; and enforcement actions to correct violations.

The final rule will be published soon in the Federal Register. A copy of the rule can be seen via the Internet at <http://www.epa.gov/OMSWWW>.

## University Works With Golf Course To Enhance Environment

**COLLEGE STATION, Texas**—How to take golf courses from the manicured, pesticide-laden image of a few decades ago toward well-managed, pristine courses that permit quality play among wildlife and natural plant settings is the stroke many course superintendents are seeking.

More than 70 golf courses in Texas are pursuing certification as wildlife sanctuaries under a program by the Audubon Society and the United States Golf Association. Lake Side Country Club in Houston is the first fully certified course in Texas, according to Audubon ecologist Marla Briggs.

A unique boost to the Texas effort comes from Texas A&M University, where researcher Richard White and students are providing the first step toward certification.

They conduct initial resource assessment surveys to document the wildlife and plant species that already thrive on the university's course.

Working with golf courses, where many turf majors hope to land jobs after graduation, is an excellent teaching tool, White said. "They see the golf course as a whole, not just the turf, and start thinking about ways to make it better."

Texas A&M students begin the process by dividing into teams for photography, land use, plant inventory, wildlife inventory and superintendent information. Other steps involve learning about and practicing environmental planning specific to each course, as well as such issues as water quality management, water conservation, integrated pest management, wildlife and habitat management, and outreach and education.

Full certification may take one to three years. For more details, contact White at 409-845-3496 or e-mail him at [rh-white](mailto:rh-white). **EP**

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# Wastewater Treatment

## Measurement

The HydroRanger non-contacting, ultrasonic level and



flow measurement system is designed specifically for the wastewater industry. Applications include tank level measurement and complete lift station control. The ST-H transducer features an integral air temperature sensor, which has an operating range of 33 feet. **Milltronics Inc.**

Circle 202 on card.

## Solids Filter

The Cyclospray Continuous High Solids Filter never needs to go off line for backwashing. The unit provides an internal cleaning shower that continuously removes the captured particulate matter from the filter media. Continuous cleaning allows it to handle up to 5,000 ppm feed solids. **Lighthouse Separation Systems Inc.**

Circle 203 on card.

## Aerator

The AIRE-O<sub>2</sub>® TRITON™ Aerator forces more oxygen



into wastewater and mixes it more efficiently than conventional aspirating aerators. It also operates as a mixer. It is ideal for heavy industrial use, such as chemical plants and municipal wastewater treatment facilities. **Aeration Industries International Inc.**

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## Bellows Seal

The EB-55 Dura Seal® cartridge-mounted elastomer bel-

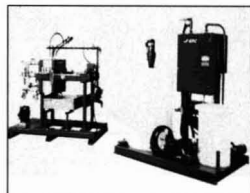


lows seal installs on both standard and enlarged bore seal chambers for pumps used in non-corrosive services. The design includes a hex drive, a convoluted bellows arrangement and a positively retained seal face. **Durametallic Corp.**

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## Dewatering System

The J-VAP™ Dewatering System dewateres and dries all

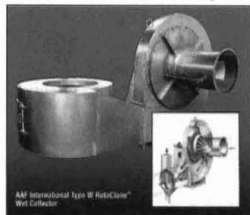


types of sludges to 95 percent total dry solids. One-step operation reduces costs for either process or waste treatment. Pilot units are available for rent. **JWI Inc.**

Circle 206 on card.

## Dust Control

Control dust with the Type W RotoClone in chemical, phar-



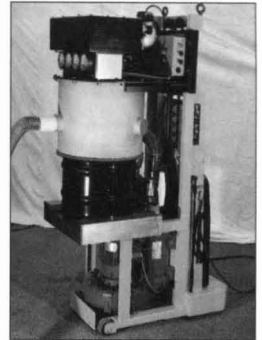
maceutical, plastics, paper, ceramics and food processing industries. It is ideal for collecting hot, light, sticky dusts that would normally clog fabric-type dust collectors. It refines

and combines dynamic precipitation with water sprays. **AAF International.**

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## Waste Collection

The portable vacuum VAC-PAC X-Series system supports

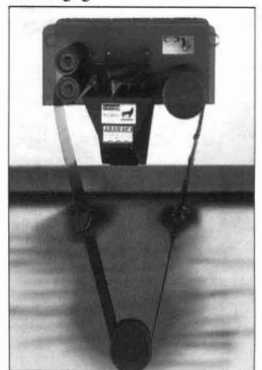


Pentek's line of dustless decontamination equipment, including the simultaneous operation of up to 10 shrouded power tools up to 100 feet away. Expandability features increase dustless operation to more than 200 feet. All models are upgradable. **Pentek Inc.**

Circle 208 on card.

## Skimmer

The Grease Grabber® removes floating grease and oil from



water mechanically. Its ceramic wiper blades and reinforced poly-fiber belts allow it to handle thicker, more viscous hydrocarbons with liquid temperatures up to 500 degrees Fahrenheit. It can be mounted on a flat surface or suspended. **Abanaki Corp.**

Circle 209 on card.

# the grapevine

Martin Marietta Magnesia Specialties Inc. has announced production of its magnesium hydroxide powder facility in Manistee, Mich.

Steve McElyea joined the technical services group of CSR Pipeline Systems as senior product engineer.

GZA GeoEnvironmental Inc., an environmental and geotechnical services company, teamed its top computer and information specialists into a new business unit, GZA Information Systems Division, specializing in the development of Internet-based systems to help businesses manage critical environmental and safety information.

Degussa Corp., supplier of emission control catalysts to the automotive industry, attained QS9000 certification.

Boart Longyear Co. sold its Materials Testing and Groundwater Remediation Pumps product lines to Durham Geo-Enterprises Inc., both of Stone Mountain, Ga.

American Quality Assessors certified that HF Scientific Inc.'s management system is in compliance with the International Quality System Standard ISO 9002 and Q9002.

Richard R. Bell is the new chairman of HDR Inc., Omaha, Neb., and retains the title of president and chief executive officer.

John R. Bratby, PhD, DEE, was appointed senior process engineer of Brown and Caldwell in Walnut Creek, Calif.

Kay Ramsey, CHMM, REM, was named vice president of sales and marketing for Auburn Environmental, a division of Auburn International Inc. in Danvers, Mass.

C. Ellen Gonter, retired from NSF International, Ann Arbor, Mich., received a 1997 American Society for Testing and Materials Award of Merit.

Bill Robertson, acting president and chief executive officer of Roy F. Weston Inc., accepted an offer to become the company's full-time chief executive.

Johnson Matthey's new Cam Converter Technology (CCT™) has been certified by the U.S. Environmen-

tal Protection Agency as an effective 0.1 particulate matter reduction technology for the Urban Bus Retrofit/Rebuild Program.

Dependable Drum Co. Inc. was given the 1996 Best Pollution Prevention Award by the Western Carolina Regional Sewer Authority.

U.S. Filter Corp. announced that Anil Jha was promoted to vice president of product development and Martha Shandan was promoted to vice president

of marketing in high purity division based in Lowell, Mass.

The National Environmental Training Association announced that Martin S. Wood, CET, has been certified as an environmental trainer in the occupational safety and health specialty.

Colvin T. Matheson, CFA, is the new chief financial officer and head of the business appraisal and internal ownership consulting service areas of Zweig White & Associates Inc. in Natick, Mass. **EP**



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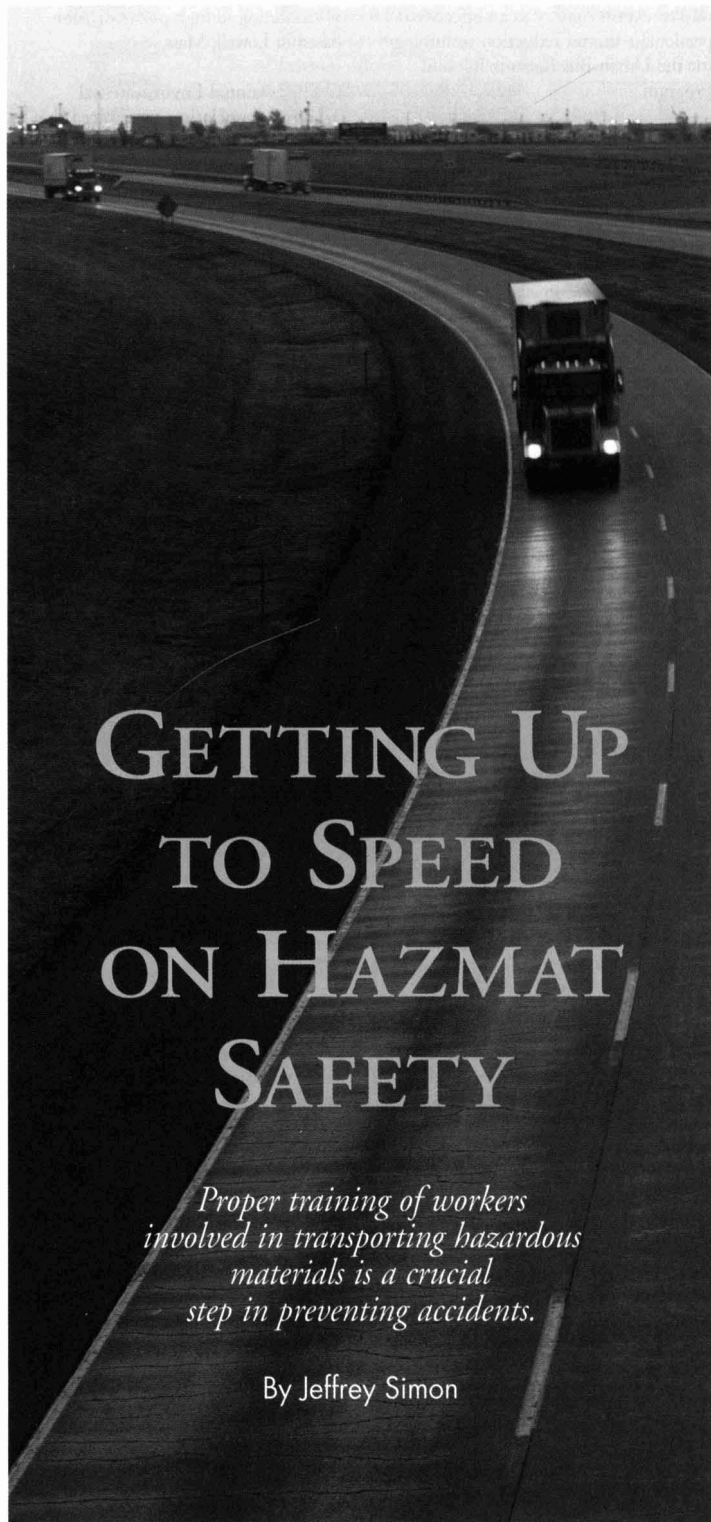
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# GETTING UP TO SPEED ON HAZMAT SAFETY

*Proper training of workers  
involved in transporting hazardous  
materials is a crucial  
step in preventing accidents.*

By Jeffrey Simon

**"A** hazmat employer shall ensure that each of its hazmat employees is trained in accordance with the requirements prescribed in this subpart" (*49 Code of Federal Regulations (CFR) Subpart H*).

When companies in the transportation industry first started hearing references to this training mandate as early as 1990, most of them had no idea how broad the final rule (*49 CFR 172.700, Docket No. HM 126F*) would be when it became effective October 1, 1993. Even though the law is directed at the transportation industry, the training applies to almost every company in business today, since all chemicals or hazardous materials used must be transported in and probably will be transported out in one form or another. Incidentally, a hazardous waste under the U.S. Environmental Protection Agency's definition in *40 CFR 262* automatically becomes regulated by the U.S. Department of Transportation (DOT) definition when prepared for and offered for transportation. "Hazmat employees may not perform any function subject to this requirement ... unless instructed in the requirements of this subchapter (i.e., DOT's HM regulations)." The definition of a hazmat employee (See *Sidebar*) includes several different job functions found in a typical company. As found in *49 CFR Section 171.8*, a hazmat employee is anyone "who in the course of employment directly affects hazardous materials transportation safety ... This term includes an individual, including a self-employed individual, employed by a hazmat employer who, during the course of employment: (1) Loads, unloads, or handles hazardous materials; (2) Manufactures, tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packagings as qualified for use in the transportation of hazardous materials; (3) Prepares hazardous materials for transportation; (4) Is responsible for safety of transporting hazardous materials; or (5) Operates a vehicle used to transport hazardous materials. Thousands of companies employing literally millions of employees across America have come under the jurisdiction of DOT's mandated training.

For those of us on the receiving end of new regulations, the thrill of compliance is lost somewhere in the drudgery of yet another mandate. Why would such a law make it past even its initial review?

According to the preamble discussion for this congressional directive, "Based on information provided to the DOT's Research & Special Programs Administration (RSPA) through its hazardous materials incident reporting system, human error has been determined to be the probable cause of most transportation incidents and associated consequences involving the release of hazardous materials." RSPA's 1994 hazardous materials incident statistics show that of 16,092 total incidents in 1994, 13,519 were caused by human error. Eleven fatalities and 577 injuries occurred as a result of hazardous incidents in 1994. Training, if conducted competently, is thought to be a step in the right direction toward safety.

Some may argue that the risk of an in-

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**All hazardous materials  
general awareness  
training sessions must  
include a basic  
discussion of DOT's  
safety procedures and  
jurisdiction.**

cident hurting anyone is so minimal that it hardly justifies the cost of compliance. For the 588 individuals directly affected in 1994, this argument is tragically vacuous. Unfortunately, what many in safety end up doing is playing a game to see how lucky they can be when determining the safety or training corporate priority. Luck eventually runs out. As we begin to construct a serious training program on hazardous materials awareness, two unique concepts lend urgency to the task at hand. First, the definition of a hazardous material is that it "poses an unreasonable risk to health, safety, and property ....;" in other words, if it is on the DOT HM table, it has the potential to do serious damage.

Second, the DOT communication system is relatively simple; therefore, if even a small detail is missing or inaccurate, it could cause serious injury to those subsequently working with that material. Emergency responders have been killed due to missing information

on the shipping papers, dock workers have been crippled as a result of missing labels, and countless employees have been scarred by packages that have failed. Shipping papers, package markings, labels and placards should all contain the same basic information.

Training always starts with an objective and everything that is said and done in that session should relate to that target. Congress' and DOT's objective in enacting these laws was simply to make hazmat employees' lives safer. To the credit of the authors of this law, no specific time has been specified to train an employee. In view of the fact that there are hundreds of positions filled by millions of employees, all with unique learning capabilities and requirements, each trainer's challenge is to determine the appropriate time to allocate his/her target. Creativity, including multiple minor sessions, may be necessary to squeeze these sessions into a busy schedule. The only training requirement given is that we cover three specific components: general awareness, function specific and safety training. All trainers concerned with quality and good retention will allow enough time to hit the target or they have wasted valuable time and resources. This is not just about DOT compliance. It's a terrific opportunity to increase safety awareness in each of our environments. See *Sidebar* for a sample outline.

Let's consider the specific components of all hazmat training programs. The methods used must be tailored to every audience. General awareness training requires an overview of hazardous materials procedures to prepare all employees to recognize a situation, see where perhaps someone else has failed in his or her responsibility, and determine if such failures could cause subsequent injury. Detection of any abnormal procedures could prevent a disaster from happening.

All hazardous materials general awareness training sessions must include a basic discussion of DOT's safety procedures and jurisdiction. It is helpful to point out the distinctions between the three primary governmental agencies (DOT, EPA, and the Occupational Safety and Health Administration) concerning hazardous materials. To motivate employees to listen, one must show where each employee's responsibilities are defined within the regulations. Certain key definitions must be covered such as

"hazardous materials," "hazard class," "specification package," "proper shipping name" and "residue," along with any that pertain directly to your employer's business. The core of the session is the introduction into reading DOT's hazardous materials tables and Appendices A and B. After one knows how the hazardous material is described by DOT, then the communications procedures will include shipping papers, package markings, labels and placards. Finally, emergency response procedures and incident reporting should be included, as well as how to load and unload hazardous materials and segregate the loads.

Function-specific training simply means teaching the employees how to do their job. This sounds elementary, but surprisingly, we are discovering many trainers who haven't yet taken the time to do it. There is no better teaching method than to do it with them until they are competent. At a minimum, each training session must get as close to each attendee's specific job as feasible. Tell them, show them, demonstrate the task, and then let them do it. If they didn't get it right, do it again and again and again.

Finally, safety training is our opportunity to put together all procedures and resources available to ensure that if the incident involving a hazardous materials release ever does occur, everyone will be able to systematically and calmly respond to prevent further injury. Many OSHA or EPA training programs have this same feature incorporated into their objectives as well; therefore, DOT has recognized that it is not nec-

## **Hazmat Employee**

Anyone "who in the course of employment directly affects hazardous materials safety." who carries out any of the following duties:

- (1) Loads, unloads, or handles hazardous materials;
- (2) Manufactures, tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packagings as qualified for use in the transportation of hazardous materials;
- (3) Prepares hazardous materials for transportation;
- (4) Is responsible for safety of transporting hazardous materials; or
- (5) Operates a vehicle used to transport hazardous materials.

## Getting Up to Speed on Hazmat Safety

essary to duplicate this feature if it has already been covered. Remember, however, that for any of these required objectives, documentation and good records are your only proof that you've done it. No audit will ever recognize your word that it has been done without the documentation to prove it.

After training has been delivered, the record keeping requirement under DOT regulations mandates that five categories of information be maintained. Obviously, the employee's name and the date of the training must be recorded. To ensure that the above components were covered, an outline of the materials used must be specified and the identity of the instructor must be included. Then to wrap it all up, each employee must be tested and certified as trained. Incidentally, DOT can assess substantial fines for missing records (potentially \$500 per day, per employee).

After having conducted hundreds of these sessions for both private industries or in open seminars nationwide, I have found it difficult to score a hit on the

training objectives if given less than six hours for most job functions. A few clients have asked me to do it in less time, but I'd prefer three days if given the ideal. The more time allowed on any topic, the more opportunity to touch emotions, demonstrate skills required, try out performance and retrain as necessary, which will increase familiarity and retention.

Do you have any amount of hazardous materials received or offered for transportation? Have you identified who all of your hazmat employees are? Once the employees who need the training have been identified—including new hires—then different outlines for different jobs will most efficiently utilize valuable training time. All of your efforts will be wasted if records are not carefully created and monitored. **EP**

*Jeffrey Simon is a senior safety consultant with J.J. Keller & Associates in Neenah, Wis.*

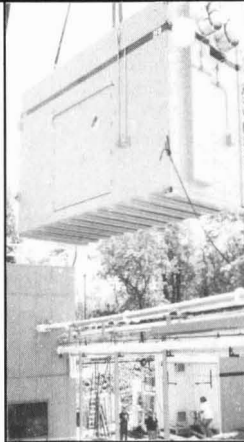
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## Sample Outline For Hazardous Materials Training

- Introduction – Why do this and what is DOT?
- Definitions – Key terms for specific jobs.
- Orientation to 49 CFR (DOT regulations)
- Hazardous Materials Table
  - Appendix A – Hazardous Substances
  - Appendix B – Marine Pollutants Package Selection
- Communications
  - Shipping Papers
  - Markings
  - Labels
  - Placards
- Emergency Response
- Loading/Unloading & Segregation
- Review
- Test and Grading (Use as training tool)

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# SERIOUS CONTROLS FOR SERIOUS TOXINS

*California's Silicon Valley offers some advice on how to clear the air.*

By Bruce Myatt, PE

The Silicon Valley—home to the world of “high-tech” electronics and silicon wafer manufacturing—has developed a wealth of technical information ready to be translated into solutions for other process and manufacturing industries. For example, semiconductor fabrication plants (fabs) utilize a variety of aggressive acids, toxic and pyrophoric gases, and specialty solvents that have required proactive environmental research and the development of workable solutions for air pollution control.

SEMATECH is a semiconductor industry consortium that supports the advancement of environmental, health and safety standards and encourages the sharing of information between its member semiconductor fabs. Alzeta Corp., a leader in advanced combustion technologies and located in the heart of Silicon Valley, is making valuable contributions to the advancement of air pollution control technologies for the semiconductor industry. New technologies developed by Alzeta and SEMATECH are now being incorporated into the modern fab.

## Incandescence and “Complete” Destruction

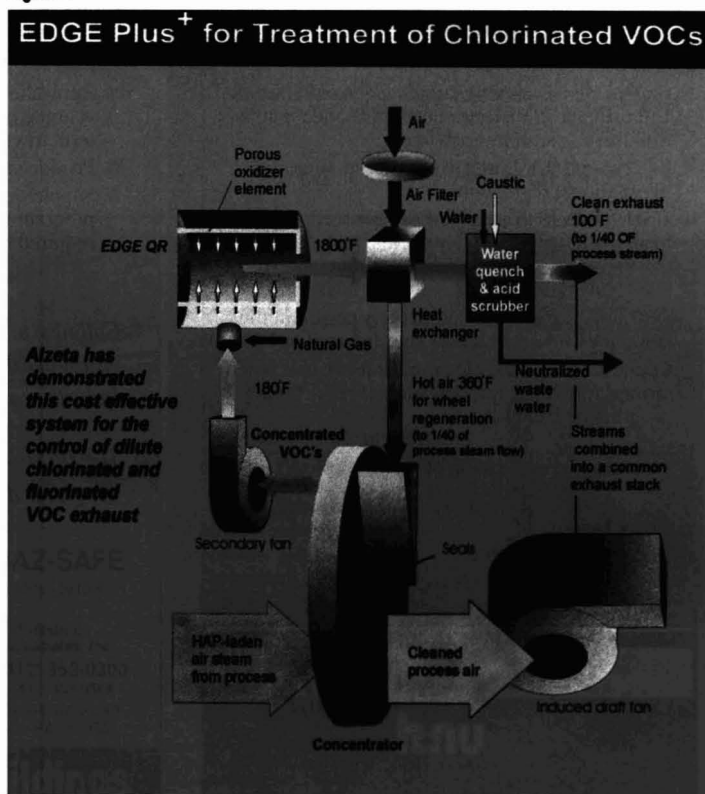
The need for virtually “complete” destruction of air contaminants is driven by the 1990 Clean Air Act and the U.S. Environmental Protection Agency’s list of 188 regulated hazardous air pollutants (HAPs). Subsequent air quality regulations have made the release of certain chemicals, such as halogens, dioxins and global warming gases, subject to rigorous hazards analysis and risk assessments. For

a given source, these studies establish HAP emissions limits—based upon a pollutant’s concentration and the likelihood of its exposure to humans.

The limits enforced at some sources, require as much as 99.99-percent destruction of the HAP before its release to the atmosphere.

Alzeta has developed a natural-gas-fired, incandescent and adiabatic (i.e., no radiant heat loss) oxidizer capable of meeting the most stringent of emissions standards. Testing conducted for the destruction of halogenated volatile organic compounds (VOCs), among the most difficult of HAPs to control, have been

Figure 1



made with the assistance of the EPA at Research Triangle Park in North Carolina. Results show destruction efficiencies of halogens (chlorinated and fluorinated VOCs) to be in excess of 99.99 percent for all cases tested.

The oxidizer is centered around a cylindrical and inwardly-fired Pyrocore® burner. HAP-laden air is mixed with natural gas and drawn through a porous ceramic media, where it is combusted on an incandescent surface fixed on the inside wall of the cylinder. The surface radiates heat to opposing walls of the cylinder creating "radiation-sustained" combustion.

Virtually "complete" destruction is achieved because all of the vapor-laden air must pass through the oxygen-rich combustion zone. Ultra low levels of hydrocarbon products of incomplete combustion (PICs) are characteristic of the burner. Oxides of nitrogen (NO<sub>x</sub>) and carbon monoxide (CO) emissions, are less than 5 parts per million (ppm), when corrected to 3 percent oxygen. This is more than a factor of over 20 lower than conventional open-flame incinerator emissions.

### Dioxins as Products of Incomplete Combustion

Some of the most serious PICs come from the combustion of halogenated hydrocarbons. The hazardous waste disposal industry experienced emissions of polychlorinated di-benzo dioxins and furans (PCDD/F) when liquid chlorinated chemicals were incinerated. Gas-phase chlorinated VOCs, when oxidized, can also form these dioxin and furan emissions.

Initiatives for the assessment and measurement of PCDD/F emissions (from gas-phase VOC oxidation) is currently undergoing scrutiny by U.S. environmental regulators. The European community, on the other hand, has already established some standards for its control; and, as the EPA refines its approach to the risk assessment of these emissions, new limits are expected to be established.

During combustion, dioxin and furan emissions stem from two mechanisms of formation. The first is "PIC formation," which is a result of stoichiometrically incomplete combustion. The second can occur as "de-novo formation," where oxidized chlorinated compounds react at the lower temperatures experienced during cooldown (especially be-

tween 1000 F and 400 F), to form PCDD/F compounds.

The Pyrocore burner avoids PIC formation because of its characteristically high destruction efficiencies. PICs are essentially immeasurable and calculated to be in the parts per billion range. "De-novo" formation is avoided by placing a water quench, after the Pyrocore burner, to quickly drop the temperature through the reactive regime, to about 200 F, avoiding "de-novo" formation.

A gas scrubber, mist eliminator and a

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## The need for virtually "complete" destruction of air contaminants is driven by the 1990 Clean Air Act and EPA's list of 188 regulated hazardous air pollutants (HAP).

neutralizer are incorporated into a typical thermal abatement system to remove the acids formed as products-of-combustion. These good combustion practices can help assure virtually "complete" destruction of PCDD/Fs as well as removal of acid gas emissions, with efficiencies in excess of 99.99 percent.

### The Burner and the Wheel

Semiconductor fabs operate with dilute emissions of specialty solvents and organic process chemicals such as PGMEA, HMDS and DMSO when using either positive or negative photoresist technologies. Because of the large quantities of fuel needed to oxidize a dilute stream, it is desirable to reduce the air volume and to increase the chemical concentration. Then, less air needs to be heated to the temperature of combustion—and less fuel is consumed, usually by a factor of 1/15 or 1/20.

Alzeta's "EDGE PLUS+™" thermal abatement system incorporates a zeolite adsorption media into the system to concentrate the flow. Zeolite is a hydrophobic mineral that captures organic molecules in its crystalline structure as

vapor-laden air passes through it. The zeolite is impregnated in a honeycomb substrate, and is manufactured in the shape of a wheel.

The wheel is mounted on a rotor that rotates slowly, at a rate of two to four revolutions per hour (See Figure 1). Vapor-laden air passes through the zeolite and organic material is removed with as much as 99 percent efficiency. A small section of the rotor is isolated and subjected to a reverse flow of heated air to desorb organics from the zeolite. The air flow containing concentrated organics (reduced to between 1/10 and 1/20 of the original volume), is then directed to the burner for oxidation.

A semiconductor fab can be forced to curtail operations due to environmental equipment failure, costing its owner hundreds of thousands of dollars a day. So these facilities always demand exceptionally high levels of equipment reliability and maintainability. The burner and wheel abatement system has set a standard in the semiconductor industry because of its consistent performance and ease of operation. It is also operating in a variety of other types of facilities, where reliability and economy of operation are valued.

The Rockwell International semiconductor fab in Newport Beach, Calif. (located in the South Coast Air Quality Management District of the Los Angeles basin), and many other fabs have benefited over the last several years from the exceptional emissions controls provided by Alzeta's EDGE PLUS+ system.

### Global Warmers and Particulate Forming Gases

Perfluorinated gases (PFCs) that contribute to global warming include C<sub>2</sub>F<sub>6</sub>, CF<sub>4</sub>, NF<sub>3</sub>, and SF<sub>6</sub>. These gases are common to chemical vapor deposition processes found in most semiconductor fabs, and are used in conjunction with silane and other gases that react to form solid silica dioxide (SiO<sub>2</sub>) particles when oxidized. The control of this mixture has presented an unusual challenge to semiconductor fabs ever since the promulgation of environmental regulations for global-warming gases.

SEMATECH called on Alzeta and supported the development of a Pyrocore burner capable of oxidizing PFCs when mixed with SiO<sub>2</sub> solid-forming chemicals. The solution to this challenge is now commercially available as the "Thermal

## Serious Controls for Serious Toxins

Processing Unit™ (TPU) that is supplied by Edwards High Vacuum. In 1996, the TPU won Semiconductor International's "Product of the Year Award" for its contribution to the advancement of semiconductor manufacturing health and safety.

The Pyrocore burner achieves virtually "complete" destruction of the global warmers, while minimizing NO<sub>x</sub> emissions. After oxidation, reacted gases move to a 3-stage wet scrubber to control off-gases. A flux-force condensation scrubber quenches the flow to prevent SiO<sub>2</sub> particulate agglomeration. A cy-

clone scrubber entrains particulates into liquid for removal through the acid drain. Finally, a packed water tower polishes acid gases and mists from the stream to 99.8-percent efficiency.

### In a Nutshell

U.S. EPA personnel have verified that Alzeta's incandescent burner is capable of virtually "complete" destruction of difficult HAPs. The technology has been integrated into systems that offer a variety of operating benefits for semiconductor fabs.

The Pyrocore burner provides 99.99-percent destruction efficiencies of halogenated chemicals and avoids the formation of dioxins and furans as products of incomplete combustion, while generating ultra-low levels of NO<sub>x</sub> and CO. The EDGE PLUS+ thermal abatement system concentrates organic air flows at ratios of up to 40:1 to minimize operating costs. The Thermal Pro-

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**A semiconductor fab can be forced to curtail operations due to environmental equipment failure, costing its owner hundreds of thousands of dollars a day.**

cessing Unit destroys global warming gases while managing solids generated during combustion.

Each of these technologies is currently operating in a variety of facilities and is certified by California Air Quality Management districts. Some of these solutions are certified and operating in industrial and soils remediation facilities, as well.

**EP**

*Bruce C. Myatt, PE, is national sales manager at Alzeta Corp. in Santa Clara, Calif.*

For more information, circle 216 on card.

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A black and white photograph of a person wearing a full-body white protective suit, a hood, and a respirator mask. The person is leaning over a large, dark, cylindrical container, possibly a drum or tank. The background is a plain, light-colored wall.

# THE ABCS OF PPE

*Choosing the appropriate personal protective equipment can be the most important thing you do for the safety of your workers and their families.*

By Norm Henry, CIH

**P**aracelsus (1493-1541) once said, "All substances are poisons. The right dose differentiates a poison and a remedy." In many cases, environmental professionals are in close contact with the poisons, but not the remedies. Traditionally, the industrial hygienist is trained to make these decisions, but because of changes in safety responsibilities, environmental professionals may be required to make decisions related to worker safety.

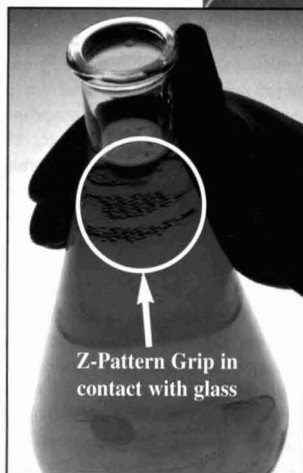
Occupational Safety and Health Administration guidelines are quite clear. "The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall select and have each affected employee use the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment." [29 Code of Federal Regulations 1910.132 (d)(1)] But how does one decide what type of PPE is necessary?

Imagine you had to deal with the following problem: Employees of an auto battery breaking plant were bringing lead into their homes on clothing, shoes and skin. Lead contamination on surfaces in their homes was excessive, and children, particularly toddlers, were showing signs of lead poisoning. A 2-year-old girl experienced severe neural damage that re-

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## The ABCs of PPE

sulted in permanent retardation. How would you resolve this situation? What is the right answer? Or, think about the following statistic: occupational dermatosis is one of the 10 leading illnesses reported in the United States. What is the risk of your workers encountering a hazard that could make them ill?

Clearly, it is increasingly important for environmental professionals to take greater responsibility when choosing PPE from head to toe, including head, face, respirator, body, hand and foot protection. To make these decisions, there is a widely recognized industrial hygienist PPE decision-making process that follows four steps: anticipate, recognize, evaluate and control.

### The Selection Process

**Anticipate:** The first step is to expect that you may have a problem or potential for a problem. Is there a potential hazard? It is essential to anticipate what

biological monitoring and surface contamination. Part of the evaluation is to characterize the risk and prioritize the hazards with the highest potential exposure. Then look for signs and symptoms of exposure, such as a skin rash or irritation and the presence of hazardous substances in the air, blood or urine. These signs of exposure would indicate a need for PPE or, if PPE is available, that workers are not using it.

**Control:** Finally, take measures to reduce or eliminate the risk of exposure. The first step in reducing risk is to establish engineering controls and/or work practices or substitute other materials for the hazards. If the hazards still exist, it is necessary to use PPE.

Choosing the appropriate PPE is based on certain performance standards. Is the PPE resistant to permeation, degradation and penetration? Is the PPE resistant to biological (i.e. pathogenic organisms) and physical (i.e. temperature extremes, fire, pressure and electricity) agents? One must consider compatibility with the specific job and climatic conditions as well as using a sizing chart to ensure protective clothing fits each worker properly.

Another choice the employer must make is between reusable or disposable. The two objectives in choosing between reusable and disposable equipment should be: prevent exposure at work and prevent contamination at home. The final consideration is a cost/benefit analysis that weighs the cost of reusable equipment and decontamination versus disposable equipment and waste handling.

In addition to being provided with the right PPE, workers should be trained in using it correctly and inspections should be conducted to ensure proper usage. Training includes inspection, donning and doffing procedures, decontamination, care and maintenance procedures. The procedure can also ensure that the ensemble is worn properly and reduces the effort required to put on and take off protective clothing. The procedure should include an adjustment and fit verification, such as a series of bends and stretches.

### The Solution

What was the answer in the lead dust contamination example? The result of poor personal hygiene and lack of proper protective clothing led to at least one case of severe lead poisoning. The solution was to control employees' clothing contamination by using disposable out-

**To make these decisions,  
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anticipate, recognize,  
evaluate and control.**

potential hazards employees may encounter before a problem arises.

**Recognize:** The second step is to identify the real problems. What are the hazards? Systematically classify hazards as chemical, biological or physical. Chemical hazards can include lead dust, toxic gases, acid mists, metal fumes, solvent vapors and asbestos fibers. Biological hazards may include bacteria, viral and bloodborne pathogens. Physical hazards include temperature extremes, pressure, radiation, electricity and fire. It is crucial for the decision maker to have full knowledge of the hazards workers may encounter on the job.

**Evaluate:** The third step is to assess the level of potential exposure and monitor it through airborne concentrations,





Photo courtesy of the DuPont Co.

erwear, with increased emphasis placed on personal hygiene of workers. After work, all workers enter a dirty change room to remove contaminated protective clothing, proceed to showers and dress in their own clothes in a clean change room before leaving to go home.

The process outlined above should give environmental professionals a basic overview of how to deal with hazards and protect workers in the workplace. However, there are many other resources and people available and willing to help.

#### Other Resources About the Selection Process

Selection responsibility is cited in the OSHA PPE general industry standard 29 CFR 1910.123, "Responsibility in selecting the appropriate protective clothing should be vested in an individual who is trained in both chemical hazards and protective clothing use such as a safety officer or industrial hygienist."

Readers may consult several other sources of information on the PPE selection process, including the *OSHA Technical Manual* (available from regional OSHA headquarters), standard practices (American Society for Testing and Materials [ASTM], American National Standards Institute [ANSI], National Fire Protection Association [NFPA], etc.), *Fundamentals of Industrial Hygiene* published by the National Safety Council, other technical guides and texts, and seminars. An excellent reference guide for selecting PPE is the *Quick Selection Guide to Chemical Protective Clothing*, 1997, by

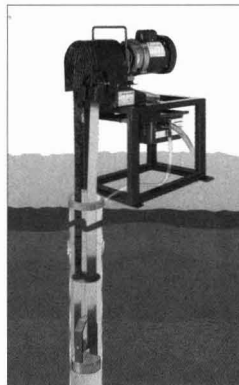
Krister Forsberg and S.Z. Mansdorf. Many manufacturers have their own Internet sites and OSHA posts regulatory and related information at <http://www.osha-slc.gov/search97cgi/vtopc>.

For case study analysis, DuPont, which manufactures Tyvek® for protective apparel, offers a comprehensive educational program to help industrial hygienists, safety professionals and environmental professionals make informed choices about personal protective equipment, especially protective apparel. The program covers hazard assessment, industrial hygiene principles, North American PPE regulations (depending on the country location of the seminar), types of personal protective apparel and common applications of personal protective apparel. Each 3-hour seminar is offered on a regular basis and free of charge. Locations are determined based on requests for the seminars with a minimum of 20 participants. If there are less than 20 participants, the needs of two or three different groups may be accommodated at a mutually convenient location. For more information call 1-800-44-TYVEK or visit the DuPont web site at <http://www.dupont.com/tyvek/protective-apparel>. **EP**

*Norm Henry, CIH, is a senior research chemist and consultant in protective clothing for Nonwovens at DuPont. He is based at the Stine-Haskell Research Center in Newark, Del.*

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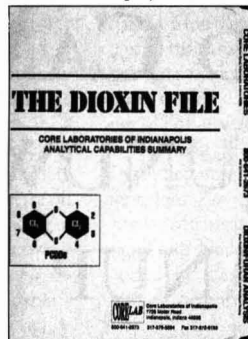
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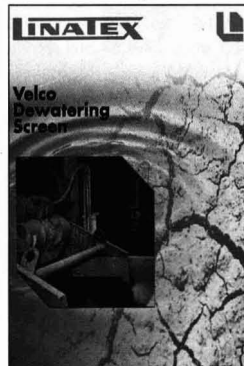
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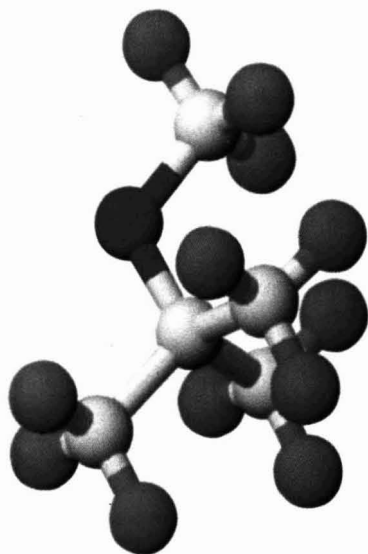
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# MTBE: WILD CARD IN GROUNDWATER CLEANUP

*The MTBE problem can be addressed with a new magnesium peroxide compound.*

By Stephen Koenigsberg, PhD

**S**ubsurface releases of the gasoline oxygenate, methyl tertiary butyl ether (MTBE), seriously compromise the remediation and closure of properties that have groundwater contaminated with BTEX and other conventional fuel hydrocarbon components. Several factors are responsible for the recent heightened level of concern, including the following: MTBE degrades very slowly under aerobic conditions; it is highly soluble and does not absorb on the aquifer matrix; it has a very low taste and odor threshold; and its toxicity and carcinogenicity profile are largely undetermined. The result is an environmental problem with a large element of uncertainty in terms of its pervasiveness and health consequences, which is receiving intense regulatory scrutiny.

Just when a coherent and manageable protocol for BTEX remediation is being formed by responsible parties, consultants and regulators, largely involving Risk Based Corrective Action (RBCA), the MTBE "wild card" has threatened to change the tenor of the issue. In the words of one national cleanup manager at a major oil company, "We have come so far in managing thousands of our sites and now I feel like I'm back to square one with the MTBE problem."

Yet another element of difficulty exists with the treatment of MTBE. Although

the compound is extremely volatile, MTBE has a high Henry's Constant, rendering it difficult to remove once it is made soluble in groundwater. This complicates active treatment methods such as air sparging and pump and treat. In the latter case, stripping inefficiencies

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**In the words of one national cleanup manager at a major oil company, "We have come so far in managing thousands of our sites and now I feel like I'm back to square one with the MTBE problem."**

encountered with extracted water have caused many consultants to evaluate aboveground biotreatment options.

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magnesium peroxide that slowly releases oxygen when hydrated. ORC treatment represents a "low intensity" approach to site remediation. It provides a simple, passive, low-cost and long-term enhancement of natural attenuation and repeatedly has been shown to economically reduce time to site closure. The use of Oxygen Release Compound is now a proven technology as evidenced by its use on more than 2,600 sites in 49 states and 10 countries and the existence of a full body of independent, peer-reviewed literature on its performance.

Oxygen Release Compound is packaged in exchangeable filter socks and contacted with contaminated groundwater via an array of wells. This forms an "oxygen barrier" to facilitate plume cut-off. ORC may be injected as a slurry into direct push bore holes; this can be done to directly impact the contaminant source area in the saturated zone or to form a one-time oxygen barrier further downgradient. Finally, the compound may be dispersed as a free powder for the *in situ* or *ex situ* treatment of soil primarily associated with tank pit excavations (See *Environmental Protection*, February, 1997).

## **The Role of Oxygen And ORC in MTBE Remediation**

Several years ago, the staff at Regensis Bioremediation Products began to no-

tice that monitoring wells containing ORC filter socks exhibited an unusually high disappearance rate for MTBE. Though data was sparse at that time, as MTBE was rarely measured and reported, an intriguing trend was emerging. In some cases the rate of loss for MTBE, presumed to be a function of biological degradation, was extremely high. The literature reported aerobic degradation rate constants ( $k$ ) in a range of .0231 to .0038 (half-life of 30 to 180 days). In an early Regenes data set from 11 wells across three diverse oil company sites in California, Michigan and New Jersey,  $k$  ranged between .1447 to .0112 (half-life of 5 to 61 days). Subsequent laboratory experiments showed that there was no significant direct absorption or chemical oxidation of MTBE by ORC. Combined with the fact that stripping is not possible, especially with a slow release of oxygen, the hypothesis emerged that ORC was facilitating the aerobic bioremediation of MTBE by enhancing levels of dissolved oxygen in the aquifer.

Since these observations were made, others have reported evidence indicating a "dose response" to oxygen in the bioremediation of MTBE. First, there was a body of work by Joe Salanitro at Shell Oil, later supported by others, that simply established MTBE was biologically degradable under aerobic conditions. Most recently, in a symposium on MTBE conducted by the Division of Environmental Chemistry

of the American Chemical Society, Robert Cowan at Rutgers University reported that the biodegradation of MTBE was dependent on dissolved oxygen concentration. He further reported that organisms that use MTBE as the sole carbon source have a Monod half-saturation constant greater than that of other heterotrophs—revealing their higher sensitivity to adequate oxygen concentrations in performing MTBE degradation.

Early field reports from this conference and others support these laboratory observations. Amoco Oil reported that on a site in Michigan utilizing air sparging, significant biodegradation of MTBE occurred in the aerated portion of the plume; there was essentially no degradation in the anoxic regions. Matrix Environmental used direct injections of oxygen on a site in New York and demonstrated that BTEX and MTBE decreased with increasing dissolved oxygen.

Returning to the Regenes data sets discussed above, Figure 1 presents the levels of BTEX and MTBE degradation in a single well in the Michigan series. This representative data reveals a possible interference in the metabolism of MTBE by background hydrocarbons. Laboratory experiments further clarified the issue. Using microbes that use MTBE as a sole carbon source, Regenes has shown the metabolism of MTBE can be largely inhibited by the addition of xylene, as a representative hydrocarbon—causing it to fall behind in the preferen-

## Glossary of Terms

**Gasoline Oxygenate:** Combustible liquids that contain oxygen and are added to gasoline to reduce atmospheric pollutants.

**BTEX:** An acronym for benzene, toluene, ethylbenzene and xylene, which are the major volatile aromatic compounds in fuel hydrocarbons.

**Risk Based Corrective Action (RBCA):** A streamlined approach in which exposure and risk assessment practices are integrated with traditional components of the corrective action process to ensure that appropriate and cost-effective remedies are selected, and that limited resources are properly allocated.

**Henry's Constant:** Henry's (Law) Constant measures the distribution tendency of a chemical between its concentration in water and a vapor pressure. It applies to the volatilization tendency of chemicals from groundwater.

**Natural Attenuation:** Allowing naturally occurring microorganisms to degrade contaminants that have been released into the subsurface without any special treatments or amendments.

**Degradation Rate Constant:** A numerical value ( $k$ ) describing a compound's decay rate based on an equation relating the compound's change in concentration over time. The degradation rate constant is functionally related to the half-life, which is the time it takes for a compound to be reduced by one-half at a given decay rate.

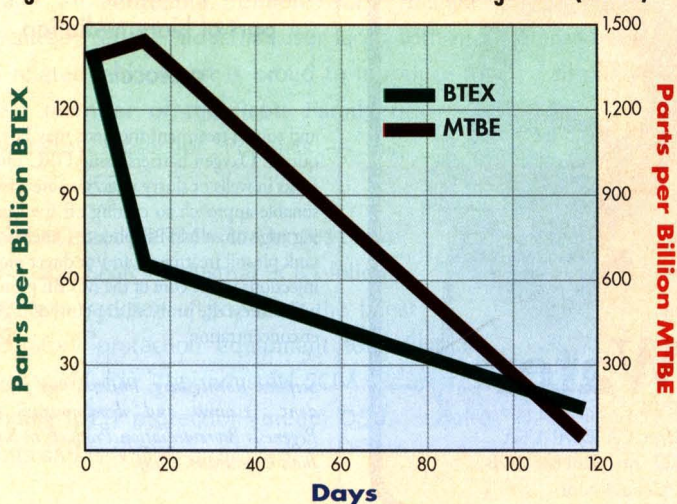
**Monod Half-Saturation Constant:** A value used to understand the dynamics of microbial growth in relation to their population and nutrient sources. The Monod half-saturation constant is used in this case to convey the sensitivity of growth to the presence or absence of a nutrient.

**Heterotroph:** Heterotrophy (feeding on others) refers to organisms that obtain carbon from their environment in a relatively complex form, i.e. carbohydrate.

**Competitive Inhibition:** When two compounds compete for the same enzyme, leading to interference in metabolism of one by the other.

**Oxygenases:** Enzymes that catalyze the insertion of one or both atoms of an oxygen molecule into an organic compound, thus effecting a chemical transformation.

**Figure 1: Reduction of MTBE in an ORC Well – Michigan Site (MW-3)**



**Table 1**

Site	ORC Application Method	Time in Days	Monitoring Well Distance from ORC Placement	Percent Reduction BTEX	Percent Reduction MTBE
PA	Slurry Injection	138	MW 1 - 60'	66%	70%
NJ	Barrier	182	MW 1 - 4'	24%	26%
			MW 2 - 4'	73%	99%
NJ	Slurry Injection	393	MW 1 - 7'	100%	90%
			MW 2 - 50'	100%	86%
			MW 3 - 85'	100%	100%
WI	Slurry Injection	118	MW 1 - 7'	77%	80%
			MW 2 - 13'	41%	98%
WI	Tank Pit Treatment and Injection	167	MW 1 - 4'	84%	84%
			MW 2 - 12'	60%	48%
			MW 3 - 23'	99%	96%
MA	Slurry Injection	187	MW 1 - 60'	100%	100%

tial sequence of degradation. Furthermore, MTBE metabolism can be predictably modulated by xylene, such that when it is removed from the culture MTBE degradation resumes. Of further

interest is that Cowan's group has presented evidence for the reverse condition, whereby excess MTBE can inhibit the reduction of other hydrocarbons. Does this point to competitive inhibition, whereby

MTBE and other hydrocarbons compete for the same enzyme such as an oxygenase? If so, it would help support the theory that excess background hydrocarbons interfere with MTBE degradation, as observed in the field. As an important practical matter, ORC can facilitate the remediation of both contaminants.

While the initial evidence and hypothesis about oxygen and MTBE were drawn from examples in wells containing ORC socks, new data is available concerning the effects of ORC at a distance. Several diverse sites were treated with slurry injections and other delivery methods, but this time the results were monitored at wells downgradient of the ORC application zone. A compilation of the data, presented in Table 1, indicates that oxygen from ORC is adequately distributed into the larger aquifer, which in turn stimulates bioremediation of both MTBE and BTEX.

In conclusion, MTBE is aerobically biodegradable, making the application of ORC technology a viable part of bioremediation protocols. Given the fact that an MTBE plume will move farther downgradient than the more highly retarded BTEX components, variations on barrier

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**MTBE is aerobically biodegradable, making the application of ORC technology a viable part of bioremediation protocols.**

and source treatment methods may be required. Oxygen barriers using ORC filter socks in wells or slurry injections are a reasonable approach to cutting off the leading edge of an MTBE plume. Otherwise, tank pit soil treatments and/or direct push injections in the core of the MTBE plume will address the problem at points of higher concentration. **EP**

*Stephen Koenigsberg, PhD, is vice president, research and development, of Regenesys Bioremediation Products in San Juan Capistrano, Calif.*

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# HELPING MOTHER NATURE HELP HERSELF

*Biofiltration systems may serve a critical role in the future.*

By Basil C. Baltzis, PhD

**T**he presence of volatile organic compounds (VOCs) in the ambient air is a serious air-pollution problem. Some of the compounds are carcinogens, and most are at least partially responsible for smog formation. Biofiltration has received a lot of attention in recent years as a possible air-pollution control technology. It is based on the ability of microorganisms to mineralize VOCs, using them as sources of carbon and energy in the cellular economy.

## Microorganistic Powerhouses

The term "biofiltration" is unfortunate, since it denotes a physical process (filtration) whereas the process actually involves biochemical reactions. The term has been widely used and will remain unchanged. The process occurs in structures—open or closed—known as biofilters.

Biofilters are packed with solid particles on which microorganisms form biofilms on the surface. When a VOC-laden airstream passes through a biofilter, VOCs diffuse into the biofilms and are decomposed to innocuous final products such as biomass, carbon dioxide and water. When biodegraded, chlorinated organics lead to formation of hydrochloric acid, which needs to be removed from the biofilter. Hydrochloric acid reduces the pH and can reduce or eliminate microbial activity.

Biofiltration has been around for some

*Envirogen's proprietary RenovAir™ biotrickling filter (skid mounted), which has an advanced design over conventional air biofiltration systems, is for the treatment of airborne compounds that are halogenated, have low water solubilities or slow biodegradation rates.*

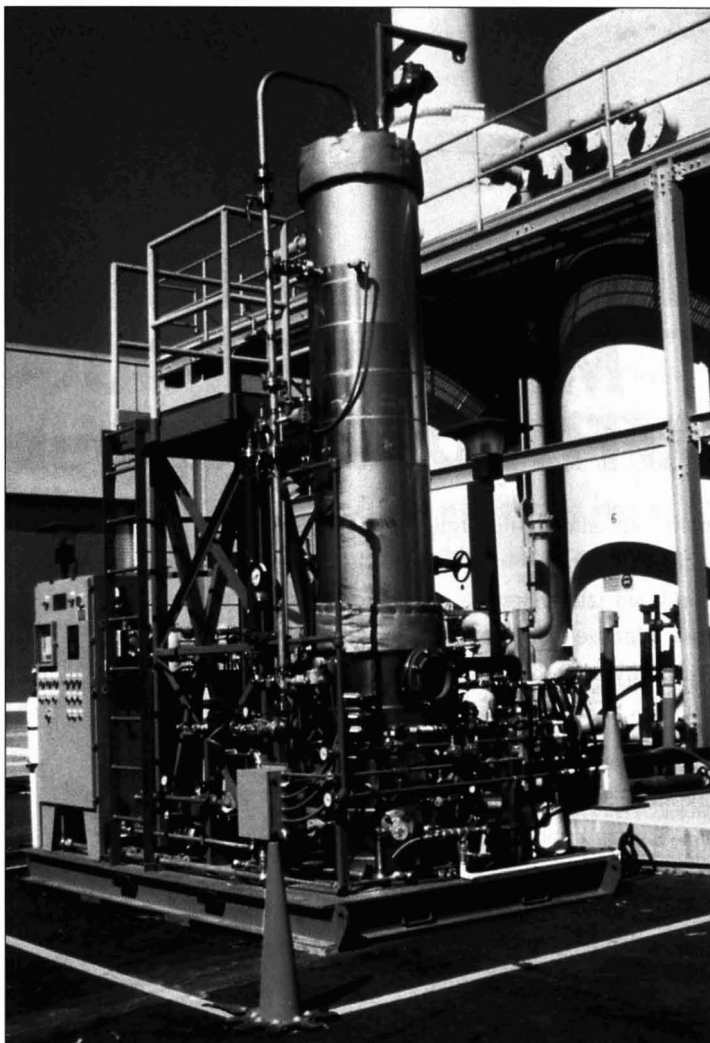


Photo courtesy of Envirogen.



time and has been used for odor control. New, however, is its use for treatment of VOC emissions. The technology is environmentally friendly, as it leads to harmless final products and is applied at ambient temperatures. It has clear advantages when compared to other well-established air-pollution control technologies, such as incineration, catalytic oxidation and activated carbon adsorption.

In the United States, serious interest in biofiltration for VOC treatment started in the early 1990s because of the Clean Air Act Amendments (CAAA) of 1990. Applications in the United States are limited compared to Europe, where studies started almost a decade earlier and applications are widespread. The reason for the difference is probably the energy cost. In the United States, the cost of energy is only a small fraction of Europe's, something that makes competing technologies economically viable in the U.S. market. Although data on the cost of biofiltration in the United States are limited, indications show that the technology has clear economic advantages in applications involving large flowrates of airstreams and very low—parts per million (ppm) or billion (ppb)—VOC-concentration levels. Nevertheless, advances in understanding biofiltration can make it an appealing option in other regimes as well.

### Classical and Trickling Filter

The term biofilter is sometimes used for what could be called the classical or conventional biofilter. Another more recent type of biofilter is the biotrickling filter. Classical biofilters are packed with particles of porous, organic materials, such as peatmoss, bark or even compost. Other solids, such as perlite, are used as bulking agents to increase the void fraction of the filter bed. In biotrickling filters, nonporous, inorganic materials, such as ceramics or plastics, are used. Biotrickling filters also use a liquid stream that recirculates through the bed and provides nutrients other than carbon and energy to the microorganisms. The liquid allows for pH control where acidic products, such as hydrochloric acid, are formed.

In classical biofilters, the small void fraction of the solids bed and the high porosity of the solids and their ability to retain water do not allow for liquid recirculation.

Originally, classical biofilters were the

focus of study and development. They are easy to operate, require little maintenance after installation, and the packing material cost is minimal. In many cases, the process relies on microorganisms indigenous in the solids. However, performance is much better when the solids are inoculated with biomass known to degrade pollutants.

The biomass consists of microbial consortia, or mixed cultures, isolated from contaminated sites or from activated sludge. One could even use pure cultures available from various banks, such as the American Type Culture Collection. However, since classical biofilters can be open structures and, if closed, do not operate with sterilized air, it is highly likely that culture contamination will occur.

Pollutants not readily degradable require mixed cultures that cannot yet be prepared by mixing available pure cul-

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**It seems that classical  
biofilters will continue to  
be investigated,  
but biotrickling filters  
will be at center stage  
for some time.**

tures. Despite claims to the contrary, there are no cultures capable of dealing with a wide variety of pollutants. Selection of the biomass depends on the specific application.

Classical biofilters are limited in handling chlorinated compounds or any compound leading to intermediate products affecting the pH of the filter bed, which is one reason why biotrickling filters are considered. Biotrickling filters also remove VOCs at higher rates per unit time and per unit volume of the filter bed.

For the same size job, biotrickling filters can be substantially smaller than classical biofilters. In many cases the capital cost makes classical biofilters uneconomical options because of the required size. On the other hand, biotrickling filters have a higher operating cost and require engineering attendance. As more information becomes available from systematic studies with classical and trickling biofilters, each type may

get its own niche in the market, depending on the application.

### Process Complexity

Although simple in concept, biofiltration is a complex process. It involves mass transfer of VOCs and oxygen from the air to the biomass, biochemical reactions and physical absorption of VOCs onto solids. Biochemical reactions—the basis of the process—depend on pH, moisture content and type of pollutants, to name a few. We have a relatively good understanding of some of these factors but we still have much to learn about others. For example, it is known that with polar VOCs, oxygen affects the process drastically—there is plenty of oxygen in the polluted air but not necessarily enough in the biofilms where the reactions are taking place. In addition, biofiltration of mixtures cannot be safely predicted from data on single compounds because pollutants (especially when similar in structure) interact both at the kinetic and absorption level.

Absorption occurs only in classical biofilters and is important when there are frequent variations in air flowrate and/or VOC concentrations. If variations are small or absent, absorption is at equilibrium and does not affect the process. With classical biofilters, moisture is important, although the optimal moisture content can be only empirically determined. Biotrickling filters are easier to understand at a fundamental level and more progress is expected.

Classical biofilters are more complex. We do not know what determines the percentage of surface coverage with biofilm and we do not have good ways to measure it. Classical biofilters will continue to be investigated, but biotrickling filters will be at center stage.

Biofiltration can also be part of hybrid technologies and can be used with soil venting to clean up volatile pollutants. Soil venting and/or extraction is a media transfer method—pollutants leave the soil and get in the air. Subsequently, the air can be treated in a biofilter. Biofiltration may play an important role in the future, similar to activated sludge systems in wastewater treatment. **EP**

*Basil C. Baltzis, PhD, is a chemical engineering professor at the New Jersey Institute of Technology, Newark, N.J.*

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# Superfund: Why the Shortcut Failed

*"Superfund has been a disaster." —President Bill Clinton,  
Los Angeles Times, May 10, 1993*

**A**s President Clinton recognizes, Superfund is indeed a disaster. Complaints have been loud and frequent almost since the Comprehensive Environmental Response Compensation and Liability Act (42 *United States Code 9601*), commonly known as Superfund, was enacted. Nearly everyone agrees that too little is being achieved, too much is spent on lawyers and administration, and cleanups are too costly. The process has led people living near waste sites in places such as Aspen, Colo., to resist Superfund designation of those sites.

**The basic problem is that the law was designed to be a "shortcut" that would eliminate the need to go through the lengthy legal process of proving that people living near a site with hazardous waste were endangered.**

The basic problem is that the law was designed to be a "shortcut" that would eliminate the need to go through the lengthy legal process of proving that people living near a site with hazardous waste were endangered. But that shortcut, combined with the "tunnel vision" typical of many government officials, has led to a program that both exaggerates the harms people face near Superfund sites and drastically curtails the legal rights of those accused of causing those harms. The law stripped away the rights of the

accused—indeed, it failed to accuse them of any wrongdoing before forcing them to pay taxes and/or large sums of money for cleanups. In doing so, the law unleashed government officials to pursue their narrow goals, often resulting in actions that wrongly frighten the people they are supposed to be helping.

Enacted in 1980, Superfund was the result of a crisis atmosphere largely caused by the furor over Love Canal, a waste site in Niagara Falls, N.Y., that had broken open, causing chemicals to leak into people's homes. Instead of having their day in court, as they should have, the people living near Love Canal were swept up in a wave of publicity and political activity in the late 1970s. Congress became involved, but never examined who was actu-

ally at fault—that is, who had allowed the release of chemicals to occur—or what the health risks really were, or what the remedy should be, or who should pay for the harm. Indeed, the supposed perpetrator, Hooker Chemical Co., had acted responsibly, but that wasn't widely known until several years later. Even today it is largely ignored in retrospective commentaries on Love Canal, as pointed out in Eric Zuesse's 1981 article in *Reason*, "The Truth Seeps Out." Political heat, and not carefully verified information, ruled the day.

Congress pulled out all the stops. The battle cry was "shovels first, lawyers later." The fine points of legal proof would not stand in the way of saving lives. As the U.S. Court of Appeals for the 5th Circuit later stated in the 1989 case *Voluntary Purchasing Group Inc. v. Reilly* (the U.S. Environmental Protection Agency), "Shooting first and asking questions later was the intent of Congress."

The lack of rationality is shown by the fact that Superfund was sold to Congress on the principle of "polluter pays," but the principle was violated by both the design and implementation of the law. To begin with, the three taxes that pay for the administration of the program (a chemical tax, a petroleum tax and an environmental income tax on large firms) violate the concept. Companies that may have never contaminated any waste site requiring cleanup must pay the tax. Production, not pollution, is taxed. In addition, the U.S. Environmental Protection Agency has no responsibility to prove that the "potentially responsible parties" are guilty of wrongdoing, or that they polluted the site in question, or even that serious risk from pollution exists.

In determining whether a site must be cleaned up, the EPA does not have to provide proof that the contamination in a Superfund site is posing harm—or even serious risk of harm—to anyone nearby. It can order cleanups and force payment without showing that the health benefits from the cleanups will outweigh the costs, or that the benefits will be attained at the lowest possible cost. Accused parties can do little to challenge the EPA's decisions until the remediation process is

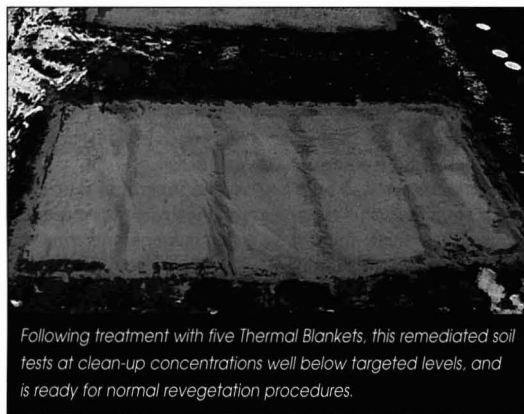
**Richard L. Stroup, PhD,** is a senior associate of PERC (the Political Economy Research Center) in Bozeman, Mont., and a professor of economics at Montana State University.

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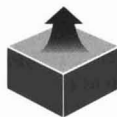
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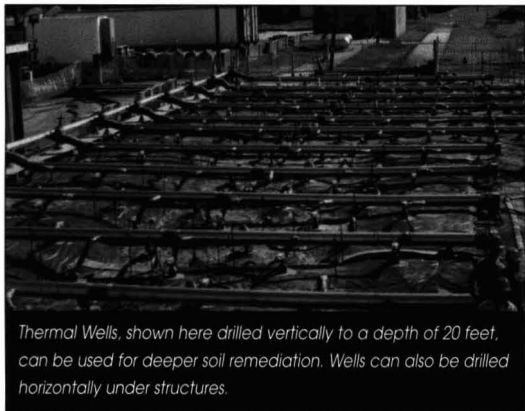


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*Thermal Wells, shown here drilled vertically to a depth of 20 feet, can be used for deeper soil remediation. Wells can also be drilled horizontally under structures.*

## Superfund: Why the Shortcut Failed

operational—currently, about 12 years after the expenses begin. Even then, the burden is on the accused to prove that the EPA has acted arbitrarily or capriciously or has violated its own plan. In some cleanups, so little risk is present to begin with that the cleanup itself may introduce more risk than it removes.

Unfortunately, this unleashing of bureaucratic power allows government officials to act on the basis of their “tunnel vision,” a term coined by U.S. Supreme Court Justice Stephen Breyer in his book *Breaking the Vicious Circle: Toward Risk Regulation*. In Breyer’s words, tunnel vision is a “classic administrative disease” that arises “when an agency so organizes or subdivides its tasks that each employee’s individual conscientious performance effectively carries single-minded pursuit of a single goal too far, to the point where it brings about more harm than good.” Agency officials try to push beyond the point at which the broader public would—if the public were fully informed—want them to stop.

The Superfund program is especially prone to tunnel vision because the focus of the program is so narrow. The stated purpose of Superfund is to protect citizens and their property against harm from hazardous wastes, a very limited kind of harm and (it turns out) a relatively rare one. Superfund managers are free to ignore the costs forced on those outside the program, even on the rest of the EPA, and, in some cases, even on those they aim to help.

Aiming at protecting local people, the site manager follows a risk assessment procedure that enormously magnifies the possible risk from a site.

To launch these multi-million dollar cleanups, the EPA must determine whether a risk of harm, either now or in the future, might be plausibly expected to exist for people living near the site or on it. The EPA procedures for estimating this risk are deliberately designed to be “conservative,” meaning that they are heavily weighted toward extra caution. Extra margins of safety are piled one on top of another. (On this issue and its effects, see Richard B. Belzer’s “The Peril and Promise of Risk Assessment,” featured in the Fall 1991 issue of *Regulation*). In their book *Superfund and Real Risks*, Kip Viscusi and James Hamilton cited that a study of a sample of 77 Superfund sites revealed that more than 91 percent of the

estimated cancer risk from the sites was based on people who might move near the site in the future, not on actual individuals at the site. Simply restricting the future use of contaminated land could avoid these exposures.

By taking a very conservative approach and by imagining future activities that would maximize exposure to pollutants, a Superfund site risk assessment can make a mountain out of a pollution molehill. For the manager of a site, the costs to the nation, to the EPA as an agency, and even to the Superfund program as a whole, become secondary to the protection at the site itself.

The Superfund shortcut has trampled legal principles and traditions developed over centuries. Solving these problems is not a matter of tinkering with Superfund rules, as the Clinton

administration and others have proposed, or even clarification by Congress of the goals of the program. Only the restoration of checks and balances—such as the burden of proof and rules of evidence—and thus the forces that lead to more informed decisions, can curb the program’s excesses. Abolishing the safeguards that led to informed decisions was the essence of Superfund. The program is fundamentally wrong and inherently unworkable. It should be abolished. We should return to a legal regime that protects victims and potential victims of pollution while also protecting innocent parties who have not put others at undue risk or harmed them.

In true emergency waste-site situations, public works emergency removals may be justified but should be selected and administered by local and state governmental units. The right to an impartial judicial review should be available both to those accused of imposing harm or risk and to those claiming to be victims of pollution or risk. Local governments should have primary responsibility for control of local hazardous waste problems.

Radical change is vital. The Superfund “shortcut” is not only inefficient and unjust, but it also breeds hatred and contempt for the very public policies and public servants whose goals are to protect citizens from harm. The actions of overreaching bureaucrats, however well-intended, are earning the scorn and the ire of many.



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*“In the interest of streamlining the judicial process, we’ll skip the evidence and go directly to sentencing.”*

For more information, circle 221 on card.

# No Easy Cure for Professional Growing Pains

*Recent article in Environmental Protection sparks a debate among our readers.*

**I**n his commentary, Growing Pains For the Environmental Profession, featured in EP's July 1997 issue, A. Scott McDowell focused on what he considers to be the need for environmental professionals to have their own specialized credentials, not those used by engineers and geologists. The range of responses we received to this article shows this is a hotly debated issue among the members of our newly emerging profession. Because of this topic's importance, we're providing a public forum for its discussion. We value your opinion on this matter and welcome your comments. [The editors]

In a recent commentary on *Growing Pains for the Environmental Professional*, A. Scott McDowell attempted to make a case for specialized credentials, and "not those worn by [professional] engineers and [professional] geologists." I believe that we have had enough of this sort of "vanity credentials" whining.

I'll admit that I'm being unnecessarily harsh, and that there are large numbers of extremely competent environmental professionals out there who do not have a PG or PE. God bless them all. However, your editorial misses the point. The PE and PG are licensed by the state and recognized as a business or trade.

The recognition is legal as well as professional. When I and many others obtained our credentials, we had to 1) submit character references from other recognized professionals attesting that we were of good moral character; 2) we had to apprentice for at least four years under the tutelage of a licensed professional engineer who would attest to our experience credentials; and 3) we had to pass two extremely rigorous 8-hour examinations on the practice and fundamentals of engineering and the ethics of engineering. I can't speak for the PGs, but I know that they have a similar sort of credential program.

Scott, the problem is not that you aren't qualified to do the work you are doing, but the question is what happens to you if you screw up? Can you be

sued on something other than a personal basis? What is malpractice in your field? How do you define it? What are the consequences of your malpractice? In short, can or will anyone stop you from practicing whatever it is that you do if you don't have the CHMM or REM after your name? Please understand that I'm not getting personal or demeaning, it is just that you have touched a hot button with me.

In my case, if I screw up or otherwise egregiously misbehave, I can lose my license to practice, and can be fined or sent to jail if I practice without it. Loss of license will have a severe impact upon my ability to earn my living. The same is true if I falsify records or in other ways behave outside the code of Engineering Ethics. I can be hauled up before a board of my peers on the complaint of a citizen or another professional and censured or have my license revoked. Can you make the same claim for the CHMM or REM? I believe not.

The environmental field is big and broad and there are many areas within it. We have air, water, groundwater, solid waste, hazardous materials, hazardous wastes and a host of other areas of practice. How does one differentiate or define the professional competency in the skills of the individual practitioner? The PEs make it easy. We are self-policing because we are prohibited from practicing outside our area of competency. If we screw up, we can lose our licenses and our careers.

That doesn't stop some of us from being charlatans or from being incompetent, liars, cheats or thieves. However, it does provide some degree of response when the malpractitioner is caught.

I don't oppose your desire to seek additional professional credentials—in fact, I applaud it—but unless you start at the right place and seek a clear definition that includes legislative recognition of your certification, liability or censure for misbehavior or departure from a recognized code of conduct, you are dealing with an organization where the penalties for falsification, professional misconduct and other unethical behaviors have no consequences.

The solution? One way would be to have the CHMMs and REMs develop a program where

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**That doesn't stop some of us from being charlatans or from being incompetent, liars, cheats or thieves.**

## No Easy Cure for Professional Growing Pains

there is a consequence for inappropriate behavior and get that accepted and recognized through the various state legislatures. California now has a Certified Environmental Assessor program, and that may be a good place to start. Direct your efforts with a positive focus rather than a negative focus.

*David L. Russell, PE  
President, Global Environmental  
Operations Inc., Lilburn, Ga.*

Upon my first read through Mr. McDowell's commentary, I thought,

"Here's someone else whining about the preferential treatment given to PEs and PGs in the environmental field." After thinking about it, I realized he does have a point. But, I'd like to add the following to the discussion.

First, when one looks at the general, broad range of services performed in this line of work, it is apparent that the most general underlying fundamentals are those taught during undergraduate and graduate training in either engineering or the geosciences. When one looks at specialty services (e.g. risk as-

essment, wetlands, regulatory compliance, etc.), the fundamentals skills are typically those learned in other disciplines (biology, zoology, law, etc.). To the hiring manager seeking a diverse, well-rounded employee who can perform a variety of functions, it's a simple matter of probability; the odds favor the engineering or geoscience graduate. To the prospective client seeking a full service consultant, the same argument applies. In the specialty areas, it is widely recognized that there is not a uniform standard for assignment of professional advancement or to business development.

Regarding credentials, I agree that there are many talented individuals in the field who cannot append meaningful

**The distinction between credentials that can be bought and those that must be earned is important.**

letters to their name simply due to choice of undergraduate major. Further, I agree that the need for a recognized credential exists. Unfortunately, the numerous attempts to establish such have been tarnished by the proliferation of credentials that are "for sale."


The distinction between credentials that can be bought and those that must be earned is important. I have seen too many programs which award a nice sounding 3- or 4-letter suffix based on a simple application and submittal of a fee. Some push the envelope by requiring attendance at a one-day course and completion of an "exam." Credentials which carry credibility, however, are those which require documented and verified experience, completion of a rigorous examination covering a range of fundamental concepts, and continuing professional education. These are some of the reasons that the PE and RG designations are preferred by both the environmental service companies and their clients.

Until we begin to see and recognize more credible registration programs like the LSP, many "credentials" will be dismissed by hiring managers as "alphabet soup." The problem lies not with a lack

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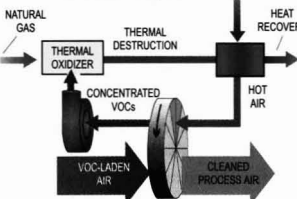



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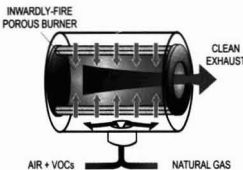


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of available credentials, but with a lack of recognized, credible credentials attainable by a larger portion of the work force.

*Robert W. Rooks, PE, Honolulu, Ha.*

I wish to commend Mr. A. Scott McDowell for his perceptive commentary. There has been a need for one or more third-party accredited credentials that define the requisite qualifications, experience and ethical bounds of practicing environmental professionals. There is an equal need for recognition of such accredited credentials by regulatory agencies, the public and the private commercial sector. There have been many groups that have attempted to fill these needs by creating a number of credentials. However, very few have been accredited by an independent third party, and many offer only specialist designations.

The Institute of Professional Environmental Practice (IPEP) offers the only third-party accredited multi-disciplinary, multi-media environmental credential—the Qualified Environmental Professional (QEP) on an international basis.

I believe that IPEP has developed and is implementing a broad-based, well-tested, and thoughtfully awarded credential that has garnered the active support of it participating organizations.

*Robert L. Eisenbach, Jr., QEP  
IPEP President, Board of Trustees,  
Pittsburgh, Pa.*

A figurative challenging gauntlet was slapped across the face of scientists and other practitioners the day the National Society of Professional Engineers reportedly released its manifesto allegedly proclaiming that it would oppose all attempts to certify nonengineers conducting environmental work.

Court records vividly illustrate the many failed attempts by certain engineering organizations to fix prices, conduct unfair competition and other unscrupulous acts. Today, certified professional geologists are often stopped in their tracks from being state licensed because of the furious lobbying efforts of engineering organizations. The fight is equally vicious against those with environmental degrees and certifications.

Daily, the National Registry of Environmental Professionals (NREP) receives and rejects applications from engineers and nonengineers looking for a quick way to gain environmental credi-

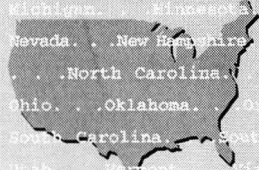
bility without the education or work experience to prove their abilities. It is possible for mechanical, electrical, structural, chemical and fire engineers to gain college degrees and never take a course dealing with environmental issues. Yet, given a PE license, all too many of them will try to conduct such work beyond their training and education. They call it, "learning on the job." I call it "learning at the cost of public health, safety and welfare."

An examination of the records of state licensing boards points out that

the engineering profession is not self-policing. In most states there are more engineers than doctors or lawyers. Yet, there are probably no more than a handful of engineers reprimanded annually by their state. The answer to the problem probably is that when engineers get sued, no one bothers to report them to the licensing boards, so they continue to conduct their work poorly and without insurance.

But all engineers practicing in the environmental arena should not be condemned. Many have expended the effort

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## No Easy Cure for Professional Growing Pains

to gain certifications from environmental organizations, thus proving they have environmental education and work experience, and have passed examinations proving their skills and knowledge. Those are the engineers you can trust, not those who say, "We've a PE and that proves we can do anything." As long defined by colleges and universities, environmental science and management is a totally different field of study than engineering and must be recognized as such.

Regretfully though, until the engineering profession helps environmental

professionals gain the credibility they desire, questionable practices will continue. Too many engineer associations seem determined to bring the environmental profession to its knees and make it subservient. And why? If you look carefully, it isn't a matter of credibility, it's the bottom line—money, money.

*Richard A. Young, REM, PE  
Executive Director, National Registry of  
Environmental Professionals, Glenview, Ill.*

In my article, *Growing Pains for the Environmental Professional*, I simply try

to point out that there is a legitimate issue of how professional credentials for environmental professionals are defined. Many environmental professionals understood exactly the point of my article and most of the response was positive.

Apparently pushing Mr. David Russell's "hot button" elicited this "unnecessarily harsh" response. Mr. Russell seems angry about the issue and somewhat defensive. Why? It is clear from the tone of Mr. Russell's response to my article that he feels a Professional Engineer's license is the top of the line, anything else is just for looks, and anyone that questions the situation is "whining." Wow, Dave, that is harsh.

Mr. Russell's main point is that a PE or PG is "recognized as a business or trade" and that because of that, the consequences of "screwing up" are greater for the PE or PG. I understand that there is a difference for a professional trade recognized by regulatory authorities. However, the REM is already recognized by the State of Alabama, Federal Resolution Trust Corp., U.S. Air Force, and U.S. Department of Energy as a professional trade and we hope that other states and agencies will follow suit.

The National Registry of Environmental Professionals (NREP) has a similar process to engineers. The NREP evaluated my credentials to determine if I was qualified for the Registered Environmental Manager's (REM) exam; required that I pass a comprehensive, legally defensible, written exam; and provides a code of ethics. I can lose my REM status if I practice outside of my area of expertise, "screw up," or engage in unethical behavior. Does Mr. Russell really think that there are no repercussions for malpractice simply because I do not have a PE or PG designation? I have installed monitoring wells next to 20,000-volt electric lines, drilled near hydrogen lines, natural gas lines, and communications lines, and placed my professional integrity on the line time and time again. In addition, our firm has millions of dollars worth of professional liability insurance.

The real point is not liability. In this society, we are all liable at all times.

The real point is that having a PE or PG license does not by itself qualify an individual to practice in many areas of the environmental field, such as risk assessments or wetlands delineations. There is absolutely no question that a

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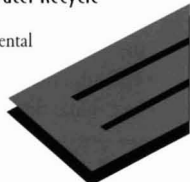
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background in biology and chemistry is essential to environmental science. The test I had to pass for the REM status may not have been as rigorous as two 8-hour exams addressing problem solving and differential equations. But that's just it—solving differential equations has almost nothing to do with environmental science. Every question on the REM exam directly applies to environmental

**It is clear from the tone of Mr. Russell's response to my article that he feels a Professional Engineer's license is the top of the line, anything else is just for looks, and anyone who questions the situation is "whining."**

science. And yet, with a graduate degree specific to environmental science and engineering, over a decade as an environmental professional including extensive field experience in site assessment, and REM status under the NREP, I must have one of the many "licensed professionals" in my firm affix their PE or PG seal to site assessments in the State of North Carolina.

Yes, the fact is that if a PE were to sign a site assessment about which he or she knew nothing about or were unqualified to sign, there could be serious repercussions. However, in the real world, not only would these repercussions probably not occur, but everyone stretches their "field" when the dollars come rolling in.

Projects such as design of a wastewater plant, water treatment plant, or remedial design need the experience and training of an engineer. Our environmental site assessment documents for North Carolina carry my REM seal and a North Carolina PE seal, which I think is a very strong combination.

Note that I have not suggested that only REMs be designated as qualified environmental professionals. In contrast to Mr. Russell's belief that it is acceptable to exclude environmental professionals such as myself, I stated that the regulatory agencies use the definition, "qualified environ-

mental professional" based on education and experience, to include Professional Engineers, Professional Geologists or anyone who is qualified. Mr. Russell's statement that, "The PEs make it easy," ignores the internal complications of exactly what is "engineering" and the fact that "self-policing" is all too often lax.

I do not believe that having multiple initials behind one's title is an end to all ends. However, it does provide a degree of consistency and a way for the regulatory authorities and the public to recognize professionals.

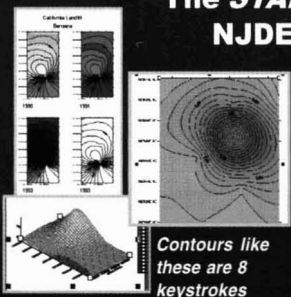
The fact is that environmental science is not engineering or geology. Environmental science is a specialized discipline that deserves specific credentials and a specific niche in the regulatory and legal system.

*A. Scott McDowell, MS, REM  
Hayes, Seay, Mattern and Mattern Inc.,  
Roanoke, Va.*

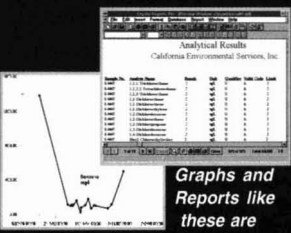
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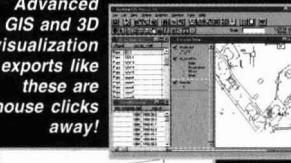
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# THE EVAPOTRANSPIRATION COVER

*Soil-vegetative covers for landfills save money without sacrificing performance.*

By Barron L. Weand, PhD, and Victor L. Hauser, PhD

**T**housands of landfills across the country need remediation in order to protect the public and the environment from contaminants. Most will eventually require the construction of a cover to prevent erosion, eliminate direct contact with waste and minimize the impact of infiltration on groundwater resources. The Evapotranspiration (ET) cover is an innovative technology that meets all these requirements at a lower cost than currently used covers. Its potential applications include not only hazardous and municipal landfills, but also reclaimed mine land, oil shale residues or other wastes.

## Two Distinct Approaches

Conventional landfill covers typically have a 2-foot top layer of fertile soil to support vegetation for erosion control and to protect the rest of the cover. However, the primary feature of conventional covers is a barrier or "impermeable" layer, which consists of a material having low hydraulic conductivity such as compacted clay, a synthetic membrane, or sometimes a combination of the two. In practice, these covers may control infiltrating water, depending on how well the barrier layers achieve the goal of being an impermeable material or actually meet construction specifications. However, conventional covers tend to become less effective over time because they are designed to oppose natural forces and are subject to deterioration. Clay layers will freeze and thaw, desiccate and wet, and naturally degrade. Synthetic liners can leak through pinholes and at seams, and

physical damage is also anticipated.

Natural landfill covers—also called vegetative covers, monofill covers or monocovertures—in their simplest form consist of a layer of uncompacted soil in which native vegetation is grown. There is no barrier or impermeable layer. The natural process of evapotranspiration (ET), the removal of water from the soil by evaporation and by transpiration of plants, is a prominent feature of this type

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**Although the underlying principles have been known for at least 50 years, the effective design and use of natural landfill covers appears to have been neglected.**

of cover. The uncompacted soil provides a reservoir to store rainfall that infiltrates into the soil until the natural ET mechanism can empty the reservoir for another cycle. If the cover is properly designed it can control or prevent movement of precipitation into the waste.

## Scientific Foundation

Validation of the ET cover concept is derived from two sources: field experi-

ments and hydrologic computer simulations. Native grass mixtures and associated forbs have extensive, fibrous root systems and are capable of consuming all the water stored in the soil within the plant root zone. Field experiments conducted primarily by agricultural scientists and engineers demonstrate that grasslands in semiarid climates extract nearly all the water from wetted soil, essentially preventing any water from percolating below the root zone. One hydrologic study of native grassland near Amarillo, Texas, where the average precipitation is just over 18 inches per year, concluded that no water has moved below the root zone during the past several hundred years. In east-central Texas, where the average annual precipitation is nearly 35 inches, a 6-year study found that no water penetrated below the root depth of the perennial grasses, except for one unusually wet winter. Short-term field studies conducted in New Mexico, Idaho and Washington, have also demonstrated that natural covers effectively manage infiltration and keep underlying wastes dry in the intermontane region of the West.

The ET concept is also supported by hydrologic simulation models. The Erosion/Productivity Impact Calculator (EPIC), a comprehensive and well-tested model developed by the U.S. Department of Agriculture's Agricultural Research Service, has proved to be an effective model for this purpose. The EPIC model simulates the physical processes involved in water movement, uses readily available data, and addresses all major

aspects of hydrology, climate, soils, plant nutrients, plant growth, soil temperature and plant environment. Another hydrologic model, the Hydrologic Evaluation of Landfill Performance [HELP] model developed by the U.S. Army Corps of Engineers, is also well known and widely used to design landfill covers and predict infiltration through them. Both models confirm that, when properly designed and constructed, the ET cover can prevent movement of precipitation into the underlying waste.

### Design and Evaluation

The design requirements for the ET cover are different from those of a conventional cover because of the mechanisms for water control. The ET cover uses a mixture of native grasses and forbs growing on the cover to control soil erosion and remove water from the soil water reservoir. Sloping surfaces encourage surface runoff and reduce infiltration. If the wastes produce significant volumes of hazardous gases, the gases must be collected and managed safely. To reduce cost, the ET cover should be constructed from

soils found near the site. The soil should be loose, friable and have a high plant-available, water-holding capacity. An adequate supply of nutrients to support vigorous plant growth is required, but if amended, subsoil is often satisfactory.

**The design requirements  
for the ET cover are  
different from those of a  
conventional cover  
because of the  
mechanisms for water  
control.**

The ET cover must be evaluated for its suitability at each site, and a site-specific design is needed to construct an effective cover using locally available soil and plant resources. Hydrologic computer simulations are needed to evaluate future

performance over extended time periods, including the impacts of variable climatic forces and precipitation events.

### Geographic Range

The success of the ET cover relies primarily on the characteristics of the soil and vegetation used and the climate at the specific location. We have used EPIC computer simulations to explore the potential for successful application of the ET cover in the conterminous United States and concluded it is a generally applicable to areas west of the Mississippi River. Notable exceptions are in western coastal areas where precipitation is high, and at high-altitude locations where vegetative growth is curtailed. Sites in the wetter, more humid eastern climates can also have potentially successful applications of the ET cover, but need a detailed analysis to assess suitability.

### Cost

Construction costs depend primarily on the thickness of the cover required to prevent or minimize deep percolation into the waste. The thickness is de-

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## The Evapotranspiration Cover

pendent on site-specific conditions such as climate and on the characteristics of locally available soils. Per-acre costs will be different for each site, but the estimated cost of an ET cover is generally half the cost of a conventional landfill cover, and may be less.

The ET cover is also less expensive to maintain than conventional covers. There is little damage from settling, which is common in landfills, because soil naturally fills voids and the loose, disturbed soil—such as that found near shear zones—is very favorable to root growth. ET covers are not subject to long-term damage from wetting and drying, a process that naturally degrades compacted clay layers, or to the deterioration of synthetic materials. Damage caused by burrowing animals or surface depressions caused by settlement can be repaired easily and economically by filling the holes with soil, regrading the surface and replanting grass. Potential major expenses related to the failure of barriers, such as compacted clay and geomembranes, are avoided. Like any cover, periodic mowing and brush removal is required as determined by the climate and ecological setting of the site.

### Obstacles to Implementation

Although the underlying principles have been known for at least 50 years, the effective design and use of natural landfill covers appears to have been neglected. One problem is the technology transfer across interdisciplinary boundaries. Most of the fundamental scientific and technical work related to hydrolog-

**The success of the ET cover relies primarily on the characteristics of the soil and vegetation used and the climate at the specific location.**

ic interactions in natural systems has been performed by agricultural scientists and engineers, whereas the design of landfills generally falls to civil engineers. Also, regulators sometimes insist on performance guarantees for innovative technologies that cannot be reasonably provided. In addition, they often rely on regulations or guidance not appropriate for the new technology. For example, where the conventional landfill cover requires a low permeability layer, the ET cover actually requires the opposite—an uncompacted soil that can readily absorb water. Overcoming these obstacles will require educating both the engineering and regulatory communities and presenting a solid scientific basis for new technologies. The Texas Natural Resource Conservation Commission recently designated the ET cover as an innovative technology, which—while not implying an endorsement or recommendation—does mandate that projects and permits that make use of the ET cover receive a priority in technical review.

*Barron L. Weand, PhD, is a senior environmental scientist. Victor L. Hauser, PhD, is an agricultural engineer and a lead engineer for Mirretek Systems, San Antonio, Texas.*

For more information, circle 222 on card.

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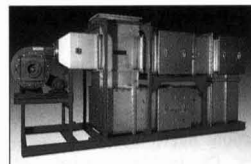


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## Industrial Gas Analyzers

The new FTIR Spectrometers give real time, multiple



compound analysis of gases. New Autoquant Software provides automated data collection, with real time displays. The new Standards library provides the spectral files used for identification and quantification of many compounds. MIDAC Corp.

Circle 169 on card.

## Storage Pallets

P&D's Totally Enclosed Containment Pallet accom-



modates one, two or four drums of hazardous materials. Drums sit on galvanized steel grating over a 62-gallon sump, which meets EPA and OSHA compliance regulations. Pallets are made of rugged steel and coated with polyurethane. P&D Solutions Corp.

Circle 170 on card.

## Cooling Products

The AOSafety® COOL Stuff™ bandanna helps workers stay cool and comfortable in high temperatures. It contains



crystals that are activated when soaked in water, absorbing moisture and evaporating at different rates to create and maintain a lasting cooling sensation. Aearo Co.

Circle 171 on card.

## Multi-Use Lens

The TrueView™ multi-use lens for varying light conditions



meets ANSI Traffic Signal Color Recognition and Impact Standards. It offers a single wrap-around, fogless, polycarbonate lens designed for unobstructed peripheral vision. It reduces glare from artificial and natural light. H.L. Bouton Co.

Circle 172 on card.

## Sulfur-in-Oil Analyzers

Models SLFA-1100H and SLFA-1800H sulfur-in-oil analyzers use X-Ray Fluorescence to provide measurement sensitivity down to 5 wt. ppm sulfur, with a 1.6 wt. ppm repeatability. It is ideal for measuring the new low-sulfur diesel fuels and reformulated



gasolines (RFG), as required by the U.S. Environmental Protection Agency. Horiba Instruments Inc.

Circle 173 on card.

## Chlorine Analyzer

The chlorine Single-Analyte Meter (SAM) determines free



and total residual chlorine in potable water. It uses CHEMetrics' Vacu-vials® self-filling ampoules and liquid DPD reagent. Each kit comes with a portable hand-held instrument, a rugged carrying case and accessories needed to run 30 tests. CHEMetrics Inc.

Circle 174 on card.

## Work Gloves

Comfor-Knit™ gloves are vinyl-coated, knit-lined general



purpose work gloves. The interlock knit lining stretches for flexibility and dexterity, making them ideal for small parts handling, assembly, packaging, maintenance, shipping and receiving, and general plant use.

Available in four sizes. North Safety Products.

Circle 175 on card.

## Stem Auger

Little Beaver's hollow stem auger for soil testing and

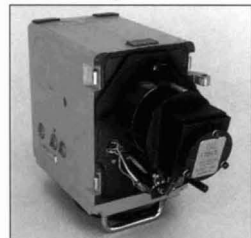


foundation repair weighs less than half of other hollow stem augers. It comes in 4-foot segments that can be linked for deeper drilling, sampling and earth testing. The bodies and blades are made of hardfaced ductile mild steel. Little Beaver Inc.

Circle 176 on card.

## Audit Device

The new audit device for the Lear Seigler RM 41, the



RM-4200 and the Land Combustion 4500 Continuous Opacity Monitors (COMS), features a new mounting system. The system produces a repeatable zero on these monitors to demonstrate instrument stability. A fixed-iris option is available. Cal Check.

Circle 177 on card.

## Humidity Conversion Calculator

To simplify conversion of water concentration in gas units, Perma Pure offers a free circular slide calculator to convert among six different scales. The other side of the calculator selects the appropriate Perma Pure gas dryer for each application based on the

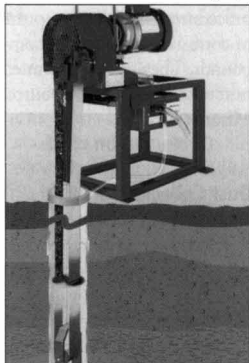


desired final dew point and flow rate of the gas to be dried. Perma Pure Inc.

Circle 178 on card.

### Belt Skimmers

The PetroXtractor removes oil, fuel and other floating hy-

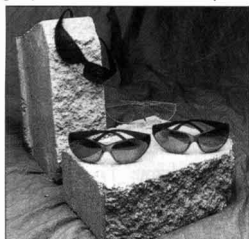


drocarbons from areas where access is limited and there is a deep drop between the well opening and the surface of the water. Package includes underground installation, explosion proofing, high-capacity tail pulley and increased volume troughs. Abanaki Corp.

Circle 179 on card.

### Protective Eyewear

The Boas is a lightweight polycarbonate frame stylish



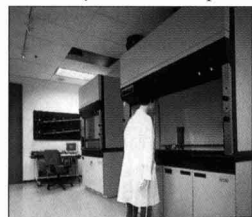
enough to ensure worker acceptance. The wraparound design fits snugly for total opti-

cal protection. Lenses provide 99-percent UV protection. Lenses and frames are available in a variety of colors. It meets ANSI Z87.1 requirements. ERB Industries Inc.

Circle 180 on card.

### Air Flow Technology Lab

Labconco's new air flow test laboratory is a 500-square-

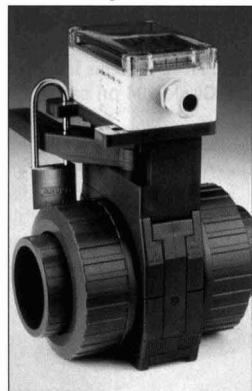


foot sealed room with an air handling system capable of in-putting 8,000 CFM of 100-percent fresh air. The air is HEPA and carbon filtered and heated or cooled to pre-set temperatures. Humidity is also monitored and controlled. Labconco Corp.

Circle 181 on card.

### Position Indicator

George Fischer releases a new electric position indicator

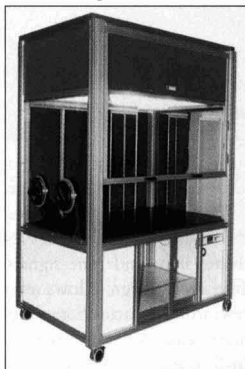


for ball valve Type 346 to provide accurate electric indication of valve positions for 1/2-inch to 2 inches. It is simple to install and provides visual indication of the open and closed valve positions. It carries an IP 65/Nema 4X protection rating and a strong corrosion resistance. George Fischer Inc.

Circle 182 on card.

### Robotics Chamber

The Robotics Chamber for automated processes and deli-

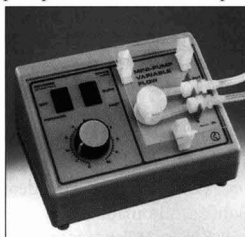


cate or hazardous procedures features a HEPA filter that removes .03 micron-size particles. The positive pressure enclosure tent surrounds experiments in Class 100 air. It can be designed for negative pressure to vent fumes and vapors, or with recirculating air to maintain consistent air conditions. HEMCO Corp.

Circle 183 on card.

### Variable Flow Pumps

A new series of variable flow pumps controls flow in liquid



chromatography, collecting fractions, circulating fluids/buffers in baths and moving corrosive materials. Flow rates are from 0.005 to 85 milliliters per minute. It has variable speed flow control and five different tubing sizes. Control Co.

Circle 184 on card.

### Carbon Cylinder

The new Scott Carbon Cylinder for firefighters is lightweight, designed for superior strength-to-weight ratio. Lightweight carbon compos-



ites are fully wrapped around an aluminum liner. Available in 30-minute 2216 psi and 30-, 45- and 60-minute 4500 psi durations. Scott Health and Safety.

Circle 185 on card.

### Reusable Container

The ECON34 is a 34-gallon reusable container used to safe-

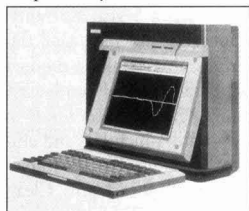


ly remove and transport regulated medical waste (RMW) from hospitals and healthcare facilities. The polyethylene construction will not crack and is impervious to cleaning and germicidal agents. Rotronics Manufacturing Inc.

Circle 186 on card.

### Leak Detection System

LeakLoc® Continuous Rapid Response Systems detect and



locate leaks in cross-country pipelines within three minutes of occurrence and make the data simultaneously available to centralized data acquisition systems. Signal processing and

# new products

acoustical modeling locate leaks by analyzing pressure waves. Tracer Research Corp.

Circle 187 on card.

## Air Monitor

The MIRAN SaphiRe Series of Ambient Air Ana-



lyzers features a single dedicated factory-calibrated analyzer, the ability to measure up to five compounds simultaneously, factory calibration for more than 100 gases, on board datalogging, spectral matching software, lightweight design and more. Foxboro.

Circle 188 on card.

## Remediation Pump

The controllerless pneumatic remediation AP-4 Auto-



Pump has a 5-year warranty. Applications include total fluids, dissolved, sinkers, product only, leachate and condensate pumping. It extracts fluids in wells with 4-inch IDs and efficiently handles 16 GPM flow rates at 300-foot depths. Clean Environment Equipment.

Circle 189 on card.

## Narrow Water Level Indicator

The In-Situ Water Level Indicator's stainless steel mea-

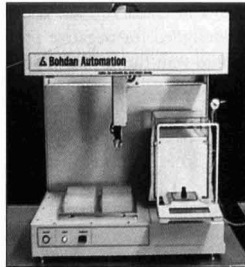


suring and conductor tape is jacketed in Teflon®. Contact between the 3/8-inch diameter shrouded probe and water activates light and tone signals. The reel design allows easy rewinding, battery replacement and decontamination. In-Situ Inc.

Circle 190 on card.

## Weighing Workstation

The Bohdan standard weighing workstation is ideal for re-

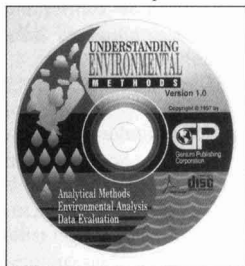


search, QC/QA and monitoring applications. Features include a standard X-Y-Z transport chassis, 3-place pan balance, sample grippers, container nest and rack, IBM-compatible PC, all weighing software and an installation video. Bohdan Automation Inc.

Circle 193 on card.

## Testing Methods on CD-ROM

"Understanding Environmental Methods" CD-ROM contains a compilation of

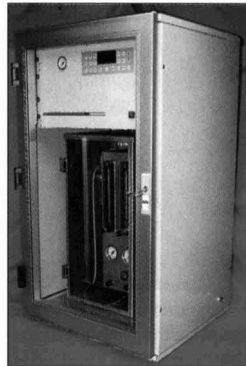


Genium's three top-selling environmental books along with the full text of approximately 700 EPA analytical methods. All three books and the EPA text are electronically linked for volume-to-volume searches. Genium Publishing Corp.

Circle 191 on card.

## VOC Water Analysis

HNU's series of systems for on-line determination of VOCs

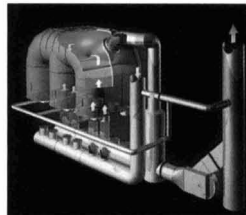


in water measures total VOCs or individual hydrocarbons from sub-ppb to ppm levels. Total VOCs are measured by photoionization or flame ionization. Also available are selective determination of hydrocarbons and chlorinated hydrocarbons. HNU Systems Inc.

Circle 194 on card.

## Regenerative Thermal Oxidizer

In the Ross Air Systems oxidizer, structured media are al-



ternately heated and cooled. Shallow media beds eliminate media crushing; special high-temperature, light-weight insulation minimizes total unit weight and valves and actuators are located at ground level. Ross Air Systems.

Circle 195 on card.

## Scrubbing Systems

The expanded line of MYS- TAIRE® Point of Use Scrub-



bing Systems is effective in laboratory scrubbing applications including digestion, wet ashing procedures and source capture of corrosive and odorous compounds. They can be mounted next to the contaminant source. Misonix Inc.

Circle 196 on card.

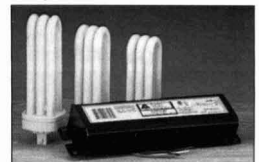
## Dust Collector Monitoring Network

TriboLink is a networked dust collector monitoring system that offers monitoring, data acquisition and reporting for maintenance management programs and particulate emissions monitoring required by MACT standards and Title V CAM Rule. It operates on a dedicated PC with Windows 95 and CAN architecture. Auburn Environmental.

Circle 197 on card.

## Ballasts

Mark X™ Architectural Dimming Ballasts for 120- or 277-



volt operation of one 26-, 32- or 42-watt "triple" compact fluorescent lamp. They provide full-range dimming from 100 percent to 5 percent of full light output. Dimming signals come directly through the power leads. Advance Transformer Co.

Circle 198 on card.



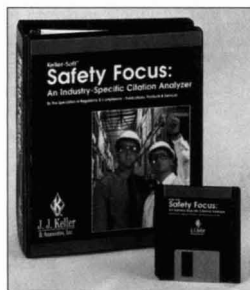
## Refrigerant Compliance Software

"Refrigerant Compliance Manager 97 Professional Edition" software, designed for Windows 95, addresses the "Year 2000 Compliant" issue. Date fields accommodate 4-digit years for future events. The tabbed screens organize information and the browse screens can be sorted and filtered. Environmental Support Solutions.

Circle 201 on card.

## OSHA Compliance Software

The Keller-Soft™ "Safety Focus: An Industry-Specific Citation Analyzer" is a planning tool that identifies common and recent OSHA violations and U.S. Bureau of Labor Statistics on injury, illness and violations by industry. Users can search by in-



dustrial SIC code for violations, fines, regulations and checklists. J.J. Keller & Associates Inc.

Circle 199 on card.

## Cleaner Disinfectant

The Multi-Wash Mini is an iodine-based disinfectant and an all-purpose cleaner for respiratory protection instruments. The pre-mixed solution is a tuberculocidal, virucidal, germicidal, bactericidal, fungicidal, psuedomonacidal in a



spray-on application. Available in 16-ounce or 1-gallon bottles. Scott Health and Safety.

Circle 200 on card.

## Portable Labs

Hach's new CEL/800 Series Wastewater Laboratories are pre-programmed to test for water quality parameters. Labs include aluminum, iron, nitrate, pH, phosphate and more. Each lab comes with all nec-



essary instrumentation and reagents for comprehensive evaluation of wastewater. Hach Co.

Circle 225 on card.

## Chemistry Software

CAChe 3.0 is a software package for experimental chemists for Windows 95 and NT. It includes ProjectLeader™ interface that lets chemists solve research problems by focusing on properties. Chemists can explain activities of compounds, model reactions and predict a variety of chemical and physical properties for small molecules. Oxford Molecular Group.

Circle 226 on card.

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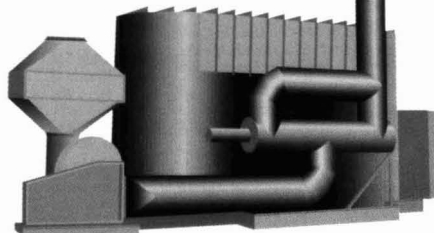
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We present Environmental Protection's sixth guide to consultants. Firms are listed under easy-to-access state headings, providing a network of resources for compliance information, troubleshooting, independent validation and possible alternatives for solving air, water/wastewater and hazardous materials problems.

## Alabama

**AMERICAN ENVIRONMENTAL ENGINEERING INC;** P O Box 10; Leeds, AL 35094; PHONE: 800-238-8744; FAX: 205-699-5697; Phase I & II Environmental Site Assessments; UST Closures; Permitting & Environmental Audits

**CARTER DARNELL AND GRUBBS ENGINEERS INC;** 1840 US Hwy 29 N; Andalusia, AL 36420; PHONE: 334-222-9431; FAX: 334-222-4018; Tank Closures & Assessments-Trust Fund Contractor; Cathodic Protection; Environmental Site Assessments

**ENVIRONMENTAL RESOURCES MANAGEMENT;** One Perimeter Park South; Birmingham, AL; PHONE: 205-970-6052; FAX: 205-970-6403; Groundwater Resources Management; Environmental Management; Solid Waste Management

## Alaska

**DAMES & MOORE;** 5600 B Street; Anchorage, AK 99518; PHONE: 907-562-3366; FAX: 907-562-1297

## Arizona

**A C E ENVIRONMENTAL INC;** P O Box 13623; Scottsdale, AZ 85267-3623; PHONE: 602-948-7688; Regulatory Compliance Assistance; Environmental Management Systems Consulting; Site Assessment & Remediation



**ADVANCED ENVIRONMENTAL SOLUTIONS;** 4214 E Indian School Road, Ste 201; Phoenix, AZ 85018; PHONE: 602-956-2181; FAX: 602-956-7311; Bioremediation of Petroleum Contaminants; Safe Solvents & Absorbent Cleaners; Phase III Remediation

**APPLIED ENVIRONMENTAL CONSULTANTS INC;** 2465 W 12th St Ste 6; Tempe, AZ 85281; PHONE: 602-829-0457; FAX: 602-829-8985; Air Quality Permits & Regulatory Analysis; Ambient Air Quality & Meteorological Monitoring; Emission Source Monitoring

**AQUATIC CONSULTING & TESTING INC;** 1525 W University Dr Ste 106; Tempe, AZ 85281; PHONE: 602-921-8044; FAX: 602-921-0049; Biomonitoring & Aquatic Toxicology; Chemical & Biological Contaminant Identification; Water & Wastewater Chemistry & Microbiology

**BALLARDS CONSULTING;** 1232 Orlando Dr; Coolidge, AZ 85228-3208; PHONE: 520-723-4247; FAX: 520-723-7187; Facility Audits; Site Investigations; OSHA Training

**DAMES & MOORE;** 7500 North Dreamy Draw Drive, Ste 145; Phoenix, AZ 85020; PHONE: 602-371-1110; FAX: 602-861-7431

**ENVIRONMENTAL MATRIX INC;** 5125 N 16th St B-223; Phoenix, AZ 85016; PHONE: 602-274-2147; FAX: 602-265-0381; Industrial Hygiene; Asbestos Inspections; Environmental Phase I Site Assessments

**MCPHEE ENVIRONMENTAL SUPPLY;** 11460 N Cave Creek Rd; Phoenix, AZ 85020; PHONE: 602-943-9565; FAX: 602-944-6559; Alternative Landfill Covers; Oil Water Separators; Emergency Response & Cleanup

**NEXGEN BIOTECH LTD;** 7150 East Camelback Rd Ste 300; Scottsdale, AZ 85251; PHONE: 800-773-8750; FAX: 520-525-1575; Bioremediation; Environmental Cleanup Products; Agricultural Enhancement Products



**RAL CONSULTING INC;** 4214 E Indian School Road, Ste 201; Phoenix, AZ 85018-5338; PHONE: 602-956-0638; FAX: 602-956-7311; Phase I Environmental Site Assessments; Physical Audit Inspections; Asbestos Inspections

**SA&B ENVIRONMENTAL & CHEMICAL CONSULTANTS;** 3001 W Indian School Rd Ste 312; Phoenix, AZ 85017; PHONE: 602-263-0045; FAX: 602-263-0749; Environmental Site Assessments/Remediation; Air Pollution/Air Quality Engineering; Asbestos/Lead/Industrial Hygiene



**TIERRA DYNAMIC CO;** 8152 N 23rd Ave; Phoenix, AZ 85069-5188; PHONE: 602-864-3887; FAX: 602-864-3990; Soil & Groundwater Remediation; Hazardous Waste Management; Water & Wastewater Engineering

## Arkansas

**CARLISLE CONSULTING INC;** 2805 Fox Glenn St; Jacksonville, AR 72076; PHONE: 501-982-0456; FAX: 501-982-0456; Indoor Air Quality; EPA & OSHA Training; Environmental Health & Safety Program Audits

## California

**A R E A ENVIRONMENTAL;** 150 Shoreline Hwy Ste A-6; Mill Valley, CA 94941; PHONE: 415-331-4410; FAX: 415-331-3011; Phase I Environmental Site Assessment; Lead & Asbestos Sampling;

**AJ ENVIRONMENTAL INC;** 4100 Easton Dr Ste 12; Bakersfield, CA 93309; PHONE: 805-327-7429; FAX: 805-327-1707; Phase I Environmental Site Assessments; Phase II Environmental Site Assessments; Site Characterizations

**AERVIROMENT ENVIRONMENTAL SERVICES INC;** 222 E Huntington Dr; Monrovia, CA 92557; PHONE: 626-357-9983; FAX: 626-359-9628; Water; Air; Soil

**ALTON GEOSCIENCE;** 30 A Lindbergh Ave; Livermore, CA 94550; PHONE: 510-606-9150; FAX: 510-606-9260; UST Removals/Replacements; Soil & Groundwater Site Assessments; Remedial Testing/System Design/Construction

**APPLIED MODELING INC;** 21395 Castillo St; Woodland Hills, CA 91364; PHONE: 818-716-5347; FAX: 818-716-6930; PC-Based Software Development; Health Risk Assessment; Regional Air Quality Modeling

**ARTESIAN ENVIRONMENTAL;** P O Box 3649; San Rafael, CA 94912; PHONE: 510-307-9943; Phase I & II Environmental Site Assessments; Brownfields; Expert Witness Testimony

**ATKINS ENVIRONMENTAL H.E.L.P. INC;** 24932 Ave Kearny Unit 6; Valencia, CA 91355-3424; PHONE: 805-295-5001; FAX: 805-295-0015; Environmental Compliance Management, Air, Water; Environmental Site Assessments, Phase I, II, III; Asbestos Building Inspections/Project Design/Mgmt

**AVANT ENVIRONMENTAL GROUP;** 1020 San Bernardino Ave; Spring Valley, CA 91977-4626; PHONE: 619-464-0069; FAX: 619-464-1960; Site Assessment; Hazard Surveys; Soil/Groundwater Investigation

**BLOCK ENVIRONMENTAL SERVICES INC;** 2451 Estand Way; Pleasant Hill, CA 94523; PHONE: 800-682-7255; FAX: 510-686-0399; Aquatic Bioassay Laboratory; Risk Assessment; Indoor Air Quality Evaluations

**CALIFORNIA WASTE ASSOCIATES;** P O Box 5177; El Dorado Hills, CA 95762; PHONE: 916-333-2327; FAX: 916-933-3157; Feasibility Studies & Regulatory Compliance; Solid Waste Management Planning

**CALSAFE CONTROLS;** 1506-A Canterbury Ct.; Placentia, CA 92870; PHONE: 714-562-6831; FAX: 714-524-7952; Toxic & Combustible Gas Detection Systems; Control & Alarm Panels; Data Acquisition Systems

**CERES TECHNOLOGIES;** 3530 Camino Del Rio N #107; San Diego, CA 92108; PHONE: 619-584-3555; FAX: 619-584-2105; UST Removal; Environmental Site Assessment; Characterization & Remediation

**CHEMICAL DATA MANAGEMENT SYSTEMS;** 6515 Trinity Ct #201; Dublin, CA 94568; PHONE: 510-551-7300; FAX: 510-829-3886; Air Permits; Wastewater Discharge Permits; Hazardous Waste Training

**CONSULTING GEOPHYSICIST;** 39462 Prospect Dr; Forest Falls, CA 92339; PHONE: 909-794-0840; FAX: 909-794-0840; Geophysics; Geology; Remedial Investigations

**DAROS ASSOCIATES;** 7013 Realm Dr Ste F; San Jose, CA 95119-1354; PHONE: 408-629-7700; FAX: 408-629-3282; Emission Inventories; Source Sampling & Analysis; Particle Sizing; Stack Emissions Testing

**DAMES & MOORE;** 221 Main St Ste 600; San Francisco, CA 94105-1917; PHONE: 415-896-5858; FAX: 415-882-9261

**DAMES & MOORE;** 8801 Folsom Blvd Ste 200; Sacramento, CA 95826; PHONE: 916-387-8800; FAX: 916-387-0802

**DAMES & MOORE;** 911 Wilshire Blvd Ste 700; Los Angeles, CA 90017; PHONE: 213-383-1560; FAX: 213-489-4269

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**DEEP INC;** 1903 N Durfee Ave; So El Monte, CA 91733; PHONE: 213-686-1600; FAX: 818-575-1252; Underground Storage Tank Installations; Storage Tank Removal; Bioremediation & Vapor Extraction

**ECOTECH SERVICES;** 1920 A Del AMO Blvd; Torrance, CA 90501-1303; PHONE: 310-320-7735; FAX: 310-320-7735; Recovery of Metals from Industrial Wastewater; Silver Recovery Systems & Services

**ECOLOGY CONTROL INDUSTRIES INC;** 20846 Normandie Ave; Torrance, CA 90502; PHONE: 310-320-2555; FAX: 310-320-1561; Hazardous Waste Management & Transportation; Industrial Services; Remediation & Abatement

**ENGINEERING PROCESS & INFORMATION CONSULTING;** 12397 Pictus St; San Diego, CA 92129-4113; PHONE: 619-484-9855; FAX: 619-484-9856; Pollution Prevention/Waste Reduction; Process Design; Information System & Training

**ENVIRO SOLVE CORP;** 28720 Roadside Dr Ste 127; Agoura Hills, CA 91301-3317; PHONE: 818-889-0058; FAX: 818-889-6973; Environmental Engineering; Data Management & Automation; Site Characterization & Remediation

**ENVIROWARE;** 85 Aragonaut Ste 190; Aliso Viejo, CA 92656; PHONE: 800-524-8877; FAX: 714-457-8586; Property Managers Environmental Mgt Software; Site Assessment Management and Writing Software; Historical and Regulatory Research

**ENVIRONMENTAL REMEDIATION TECHNOLOGIES INC;** 2305 S Winchester Blvd; Campbell, CA 95008-4058; PHONE: 408-866-4141; FAX: 408-866-4186; Asbestos & Lead; Inspection & Testing; Project Management & Training

**ENVIRONMENTAL SAFETY SERVICES;** 4501 Paradise; Modesto, CA 95358-9264; PHONE: 209-544-6624; FAX: 209-544-6624; Safety/Environmental Training; Environmental Site Assessments; Site/Industrial Safety

**ENVIRO SOL ENVIRONMENTAL SOLUTIONS;** 1700 N Fiske Ave; Pasadena, CA 91104-2318; PHONE: 626-797-9581; FAX: 626-791-3743; Fugitive Air Emissions; Asbestos & Related Activities; Air Quality Phenomena

**EXECUNET;** 24452 LaHermosa Ave; Laguna Niguel, CA 92677; PHONE: 714-363-5262; FAX: 714-363-5263; Employment Consulting; Executive Recruiter (Chemical & Environmental); Staffing

**F&J CONSULTING;** 23807 Fairlands Rd; Hayward, CA 94541; PHONE: 510-538-0741; FAX: 510-538-6445; pH Monitoring; Control, Neutralization; Turbidity, Suspended Solids; VOCs, Air Quality

**FAST-TEK ENGINEERING SUPPORT SERVICES;** 247B Techsby Ave; Pt Richmond, CA 94801; PHONE: 510-232-2728; FAX: 510-232-2823; Geoprobe/HSA; Tank Removals; Oxy-Plug ORC Installation



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**FOSSIL ENERGY RESEARCH CORP**; 23342 C SouthPointe Dr; Laguna Hills, CA 92653; PHONE: 714-859-4466; FAX: 714-859-7916; Gaseous & Particulate Pollutant Sampling-Measure; Air Pollution Control, Esp. NOx Control; Combustion/Burner Optimization in Boilers

**GEOMATRIX CONSULTANTS INC**; 20201 SW Birch St Ste 150; Newport Beach, CA 92660; PHONE: 714-474-9181; FAX: 714-474-9064; Environmental; Engineering; Geotechnical

**GERHARDT GIBSON & ASSOCIATES**; P O Box 6408; Anaheim, CA 92816-0408; PHONE: 714-635-8329; FAX: 714-635-7325; Phase III Remediation System Design & Permitting; Chemical Process Design; General Engineering Services

**HANS TECHNOLOGIES INC**; 4249 Sherwood Ct; Concord, CA 94521; PHONE: 510-691-5864; FAX: 510-825-5771; Industrial Wastewater Treatment; Municipal Wastewater Treatment;

**HARGIS & ASSOCIATES INC**; 2223 Avenida De La Playa Ste 300; LaJolla, CA 92037; PHONE: 617-454-0165; FAX: 619-454-5839; Hydrogeology/Hydrology; Geology; Environmental Engineering

**JTH ASSOCIATES INC**; 19 Silveroak; Aliso Viejo, CA 92656; PHONE: 714-586-9738; Phase I,II Env Assessments & Investigation; Remedial Action Management; Computer Modeling - Air/Soil/ Groundwater

**K P LINDSTROM INC**; 729 Bayview Ave; Pacific Grove, CA 93950-6008; PHONE: 408-372-5989; FAX: 408-372-6168; Facilities Planning; Wastewater Management; Water Quality

**KAM CONSULTANTS INTL**; Box 7418; Fremont, CA 94537-7418; PHONE: 510-793-5366; FAX: 510-796-3114; Environmental Engineering; Geological; Mechanical Engineering

**KATZ & ASSOCIATES INC**; 4275 Executive Sq Ste 530; La Jolla, CA 92037; PHONE: 619-452-0031; FAX: 619-552-8437; Public Information/Community Relations; Public Affairs; Consensus Building

**KOMEX H2O SCIENCE**; 5500 Bolsa Ave Ste 105; Huntington Beach, CA 92649; PHONE: 714-379-1157; FAX: 714-379-1160; Contaminant Hydrogeology; Water Resources; Environmental Engineering

**KRAIM ENVIRONMENTAL ENGINEERING SERVICES**; 11437 Eriwanda Ave; Northridge, CA 91326-2038; PHONE: 818-363-0492; FAX: 818-363-0492; Air Quality Compliance-Permitting; Air Pollution Control Technology; Risk Management & Assessments

**KUBIK ASSOCIATES**; 3089 Fandoras Cir; Oakley, CA 45611-1712; PHONE: 510-778-2823; FAX: 510-778-2823; Training Environmental & OSHA; Environmental Compliance; Environmental Site Assessments & Investigations

**LEE & RO INC**; 1199 S Fullerton Rd; City of Industry, CA 91715-3070; PHONE: 626-912-3391; FAX: 626-912-4015; Environmental Site Assessments; Groundwater Treatment/Services; Remediation Services

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**STRAW & GOUGH**; 12100 Wilshire Blvd Ste 1650; Los Angeles, CA 90025; PHONE: 310-826-7766; FAX: 310-207-7164; Air Pollution Regulation; Soil & Groundwater Contamination; Defense of Enforcement Actions



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Colorado



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**JYO J PATEL CONSULTANTS**; 10424 W 44th Ave 3A; Wheat Ridge, CO 80033-2753; PHONE: 303-425-1858; FAX: 303-425-1858; Health & Safety; Hazardous Waste; Radon

**MACTEC**; 4747 Table Mesa Dr Ste 201; Boulder, CO 80303; PHONE: 303-494-3010; FAX: 303-494-3137; Risk Management; Risk Assessment; Risk-Based Corrective Action

**MARKET ACCESS INTERNATIONAL;** 198 Union Blvd Ste 200; Lakewood, CO 80228; PHONE: 303-914-0334; FAX: 303-642-3577; Internl Marketing & Consulting; Internl Technology Transfer/Solid Waste Recycling; Source/Place Metallic Residues for Recycling

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**R H B CO;** 1365 Amstel Dr; Colorado Springs, CO 80907; PHONE: 719-522-0329; Environmental Site Assessments - Phase I, II

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**ROTHBERG, TAMBURINI & WINSOR;** 1600 Stout St Ste 1800; Denver, CO 80202-3126; PHONE: 303-825-5999; FAX: 303-825-0642; Water-Treatment, Collection, Storage and Dist; Wastewater Treatment; Supervisory Control & Data Acquisition Systems

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## Connecticut

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**APPLIED EARTH TECHNOLOGIES INC;** 571 Bee St; Meriden, CT 06450-3558; PHONE: 203-634-9110; Geo-Environmental Engineering; Environmental Site Assessment; Groundwater Contamination Investigation

**AQUA SOLUTION;** 60 Burnside Ave; East Hartford, CT 06108; PHONE: 860-289-7664; FAX: 860-289-7664; Ecosystem Management

**DIVERSIFIED ENVIRONMENTAL SERVICES INC;** 1755 Meriden Waterbury Turnpike; Milldale, CT 06467; PHONE: 860-621-3630; FAX: 860-621-9609; Soil & Groundwater Remediation; Environmental Site Assessments; Regulatory Compliance

**DIVERSIFIED LAND SURVEYORS INC;** P O BOX 789; Watertown, CT 06795-0789; PHONE: 860-274-5053; FAX: 860-274-7740; Land Surveying; Global Positioning Systems; Geographical Information Systems

**ENVIROSCIENCE CONSULTANTS INC;** 795 N Mountain Rd; Newington, CT 06111; PHONE: 860-957-2700; FAX: 860-953-3203; Soil & Groundwater; Underground Storage Tank Closure; Hazardous Materials Consulting (Lead, Asbestos)

**ENVIRONMENTAL RISK LTD;** 120 Mountain Ave; Bloomfield, CT 06002; PHONE: 860-242-9933; FAX: 860-243-9055; Air Quality Management; Environmental Investigations/Remediation; Water & Wastewater Management

**GOODSON ASSOCIATES;** 51 Anvil Dr; Avon, CT 06001; PHONE: 860-673-1294; FAX: 860-673-1294; Hazardous Waste Management; Regulatory Compliance & Training; Health & Safety Management

**HRP ASSOCIATES INC;** 167 New Britain Ave; Plainville, CT 06062; PHONE: 800-246-9021; FAX: 860-793-6871; Environmental Investigations/Remedial Actions; Tank Management; Hazardous Waste Compliance

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**R W POWITZ & ASSOCIATES PC**; P O Box 502; Old Saybrook, CT 06475-0502; PHONE: 860-388-0893; FAX: 860-388-9566; Environmental Health & Safety; Training; Litigation Support & Expert Witness

**REID LIFSET**; 228 Everit ST; New Haven, CT 06511-1322; PHONE: 203-432-6949; FAX: 203-432-5912; Solid Waste Policy; Industrial Ecology; Extended Producer Responsibility

**TRC**; 5 Waterside Crossing; Windsor, CT 06095; PHONE: 860-289-8631; FAX: 860-298-6399; Health Risk Assessment; Air Quality Management; Solid & Hazardous Waste Management

**THOR ANALYTICS**; P O Box 2060; Vernon, CT 06066-2060; PHONE: 860-875-0052; FAX: 860-875-0052; Modeling; Database Analysis; Air Permitting

**WRIGHT HAMILTON ASSOCIATES**; P O Box 242; Groton, CT 06340-0242; PHONE: 860-445-6310; FAX: 860-445-6310; Strategic Environmental Management; Pollution Prevention; Hazardous Materials Management

## Delaware

**ENVISION INC**; 130 Hickman Rd Ste 26; Claymont, DE 19703; PHONE: 800-292-0740; FAX: 302-791-9937; Environmental Site Assessments; Site Remediation; Environmental Planning

**PROCESS SAFETY ENGINEERING INC**; 207 Bancroft Bldg Concord Plaza; Wilmington, DE 19810; PHONE: 302-477-1473; FAX: 302-477-1473; Quantitative Hazards, Risks & Consequence Analysis; Accident Investigation; OSHA Process Safety Audits

## District of Columbia



**INVESTOR RESPONSIBILITY RESEARCH CENTER**; 1350 Connecticut Ave, Ste 700; Washington, DC 20036; PHONE: 202-833-0700; FAX: 202-833-3555; Corporate Environmental Performance & Management; Corporate Environmental Benchmarking; Corporate Environmental Profiles

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**N W BERNSTEIN & ASSOCIATES**; 2000 M St NW Ste 745; Washington, DC 20036; PHONE: 202-466-8100; FAX: 202-466-8877; Brownfields Redevelopment; Contaminated Sediments Management; Natural Resource Damage Claims

**THE TECHNICAL GROUP INC**; 1300 I St NW Ste 1000 W; Washington, DC 20005; PHONE: 202-962-8531; FAX: 202-962-8542; Trainings; Regulatory Compliance; Hazardous Waste

## Florida

**ACE ENVIRONMENTAL SERVICES**; P O Box 610071; N Miami, FL 332161; PHONE: 305-932-7799; FAX: 305-932-8149; Contamination Assessment; Environmental Engineering; Remedial Design

**AIR OBSERVATIONS INC**; P O Box 295053; Tampa, FL 33687; PHONE: 813-988-5100; FAX: 813-987-2242; Air Pollution Source Testing; Air Pollution Permit Preparation; Air Pollution Consulting

**ALEXANDER WHITMER INC**; 2999 Hardley Rd Ste 302; Jacksonville, FL 32257; PHONE: 904-268-8393; FAX: 904-268-8560; Air Permitting (Including Title V Operating Permit; Other Environmental Permitting-Water, Wastewater; Environmental Documents-SPCC Plans, SWP3 Plans Etc

**AMERICAN COMPLIANCE TECHNOLOGIES INC**; 1875 W Main St; Bartow, FL 33830; PHONE: 941-533-2000; FAX: 941-534-1133; Environmental Compliance; 24 Hour Emergency Spill Response; Remediation & Tanks

**APPLIED EARTH SCIENCES INC**; 2101 NW 33rd St Ste 1700A; Pompano Beach, FL 33069; PHONE: 954-975-9995; FAX: 954-975-0569; Soil & Groundwater Characterization; Remediation System Design & Installation; Hazardous Waste Management

**BIOMAGNETICS INTERNATIONAL INC**; 2301 Park Ave Ste 102; Orange Park, FL 32073-5558; PHONE: 904-264-8564; FAX: 904-264-5934; Physical; Environmental; Medical



**BOCK ENVIRONMENTAL SERVICES INC**; 3108 Rolling Acres Place Ste A; Valrico, FL 33594; PHONE: 800-654-4880 Nationwide; FAX: 813-653-3000; Regulatory Compliance; Contamination Assessments; Remediation

**CONDOR EARTH TECHNOLOGIES INC**; P O Box 30035; Pensacola, FL 32503-1035; PHONE: 850-477-0454; FAX: 850-477-0534; Ground Waste Quality; Solid Waste Management; Environmental Data Management

**CUSTOM SOLUTIONS INTERNATIONAL INC**; 2460 Minton Rd; West Melbourne, FL 32904-6629; PHONE: 407-722-3060; FAX: 407-722-1090; Environmental Services; Engineering Services; Bioremediation Services

**DAMES & MOORE**; 6400-A Congress Ave, Ste 2500; Boca Raton, FL 33487; PHONE: 561-994-6500; FAX: 561-994-6524

**DAMES & MOORE**; One North Dale Mabry, Ste 200; Tampa, FL 33609; PHONE: 813-875-1115; FAX: 813-874-7424

**EHS MANAGEMENT SERVICES INC**; 938 Joshua Dr; ChIPLEY, FL 32428-4373; PHONE: 850-638-2105; FAX: 850-638-0545; Health & Safety Programs; Pollution Prevention/Waste Minimization; Compliance Management Systems

**ETG INC**; 154 Woodcreek Dr; Safety Harbor, FL 34695; PHONE: 813-797-1280; FAX: 813-724-0326; Pump Installation; Environmental Engineering-Air, Water, Waste; Air Pollution Control Equipment Installation

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**JIM STIDHAM & ASSOCIATES**; P O Box 3547; Tallahassee, FL 32315-3547; PHONE: 850-222-3975; FAX: 850-681-0560; Environmental Engineering; Hydrology/Geology; Civil Engineering

**JONES EDMUNDS & ASSOCIATES INC**; 730 N Waldo Rd; Gainesville, FL 32641-5699; PHONE: 352-377-5821; FAX: 352-377-3166; Health & Safety; Environmental Engineering; Solid Waste

**PERFORMANCE IMPROVEMENT INC**; 11782 SE Federal Hwy Ste 200; Hobe Sound, FL 33455; PHONE: 561-776-5705; FAX: 561-624-1690; ISO 14000 Registration Process; Environmental Review; Process Measurement & Improvement

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## Georgia

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**CARNOW CONIBEAR & ASSOC LTD**; 242 Lawrence St; Marietta, GA 30060-1658; PHONE: 770-424-9088; FAX: 770-424-9194; Occupational Safety & Health Compliance; Environmental (Regulatory) Compliance; Industrial Hygiene/Indoor Air Quality

**CONSULTECH ENGINEERING INC**; 5961 A Live Oak Parkway; Norcross, GA 30093; PHONE: 888-368-9222; FAX: 770-368-0090; Petroleum & Hazardous Waste Remediation; Interactive Telemetry; Multimedia Data Management

**DAMES & MOORE**; 235 Peachtree St NE, N Tower Ste 2000; Atlanta, GA 30303; PHONE: 404-577-2122; FAX: 404-577-5120

**ECS LTD**; 1590 N Roberts Rd Ste 201; Kennesaw, GA 30144; PHONE: 770-590-1971; FAX: 770-590-1975; UST Management; Environmental Assessment; Remediation Design & Implementation



**EMR (DIVISION OF CONTINUUM HEALTH CARE)**; 4360 Chamblee Dunwoody Rd Ste 202; Atlanta, GA 30341-1055; PHONE: 800-229-3674; FAX: 770-457-1429; Case Management Services (Workers Compensation); Medical Surveillance; Drug & Alcohol Testing

**ENVIRONMENTAL CONSULTING SERVICES**; 330 Providence Rd; Alons, GA 30606; PHONE: 706-543-9357; Process Safety Management; Risk Management Plans; Facility Audits

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**LAKE ENGINEERING INC**; 35 Glenlake Parkway Ste 500; Atlanta, GA 30328; PHONE: 770-395-0464; FAX: 770-395-0474; Site Evaluation & Remediation; Air Pollution Control & Permitting; RCRA Permitting & Design

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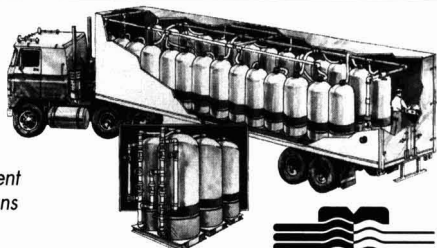
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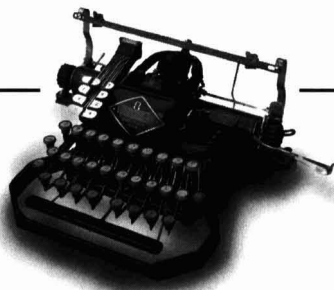
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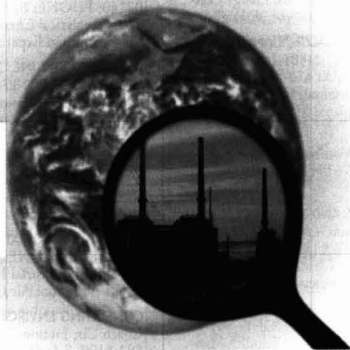
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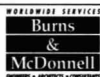
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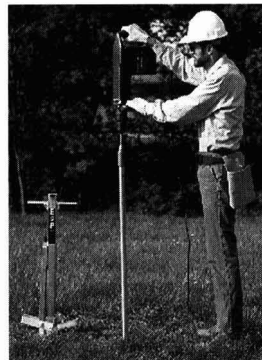
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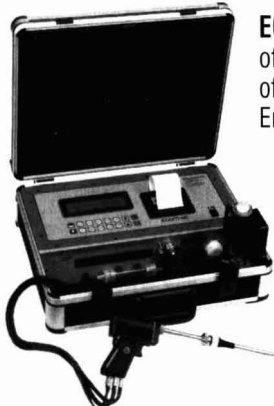
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**ZBA INC ENGINEERS/CONSULTANTS;** 36 E. Seventh St Ste 200; Cincinnati, OH 45202-4400; PHONE: 513-421-3363; FAX: 513-421-3364; Indoor Air Quality; Title V Analysis & Application; Fuel Analysis & Conversion

## Oklahoma

**ADVANTAGE ENVIRONMENTAL SERVICES;** P O Box 558; Mustang, OK 73064-0558; PHONE: 405-324-8860; FAX: 405-324-7001; Compliance Auditing; Surface & Subsurface Investigations; Phase I/II Environmental Site Assessments

**APPLIED GEOSCIENCE ENVIRONMENTAL SERVICES INC;** 3408 French Park Dr Ste C; Edmond, OK 73034; PHONE: 405-348-5332; FAX: 405-348-1660; Environmental Site Assessments (Phase I & II); Storage Tank Technology; Remediation of Soil & Groundwater

**BENTLEY ENVIRONMENTAL ENGINEERING INC;** 204 N Robinson Ste 1600; Okla City, OK 73102; PHONE: 405-235-5551; FAX: 405-235-5574; Soil & Groundwater Remediation; Air Emissions Control & Permitting; Wastewater Control & Plant Design

**BLACK & ASSOCIATES ENVIRONMENTAL CONSULTANTS INC;** 1908 W Boyd; Norman, OK 73069-4830; PHONE: 405-360-2852; FAX: 405-360-2880; Regulatory Compliance Assistance; Ground & Surface Water; Design & Implementation of Environmental Plans

**ENVIRONMENTAL HAZARD CONTROL INC;** 1406 S Terrace Dr; Tulsa, OK 74104; PHONE: 818-747-1330; FAX: 817-743-3961; PLM & PCM Analysis; Phase I Environmental Site Assessments; Lead-based Paint Inspections

**GENESIS ENVIRONMENTAL SOLUTIONS INC;** 2010 Exchange Ave; Oklahoma City, OK 73108; PHONE: 405-235-3371; FAX: 405-235-4150; Soil & Groundwater Investigation; Soil & Groundwater Remediation; Lead Paint Inspection & Abatement

**J A GEARHART ENTERPRISES INC;** 3224 NW 50th St; Oklahoma City, OK 73112-5325; PHONE: 405-942-5635; FAX: 405-949-0116; Petroleum Refining & Processing; Energy Conservation & Utility Audits; Control of Air & Water Contaminants

**L I ZINN & ASSOCIATES INC;** 9833 S 72nd E Ave; Tulsa, OK 74133-6030; PHONE: 918-299-4525; FAX: 918-299-8199; Environmental Toxicology Consulting; Environmental Investigations; Risk Assessment

**POE ENVIRONMENTAL SERVICES INC;** 5208 W Reno Ste 100; Oklahoma City, OK 73127-6317; PHONE: 405-949-1962; FAX: 405-949-2376; Industrial Waste Treatment; Landfill Design & Survey; Environmental Audits

**RFS CONSULTING INC;** PO Box 470947; Tulsa, OK 74146; PHONE: 918-663-9850; FAX: 918-663-9856; Permitting; Compliance; Reporting

**SAFETY & HEALTH ASSOCIATES;** 3131 N MacArthur Ste 213-F; Oklahoma City, OK 73122; PHONE: 405-787-8494; Hazard Communications; OSHA Compliance; Ergonomics

**STOVER & ASSOCIATES INC;** P O Box 2056; Stillwater, OK 74076-2056; PHONE: 405-624-0018; FAX: 405-624-0019; Laboratory Services; Environmental Engineering; Operations Management

**WOLVERINE CONSTRUCTION MANAGEMENT INC;** 5404 NW 1155; Oklahoma City, OK 73162-3747; PHONE: 918-225-7693; FAX: 918-225-7749; Construction Management of Remedial Const. Project; Hydrocarbon Acid Sludge Neutralization & Stabilize; Landfill Construction Quality Assurance

## Oregon

**CE/WESTERN ENGINEERING INC;** 1025 Bain St SE; Albany, OR 97321-5247; PHONE: 541-928-5040; FAX: 541-928-4846; Air; Wastewater; Stormwater

**CASCADE EARTH SCIENCES LTD;** 7150 Supra Dr SW; Albany, OR 97321; PHONE: 541-926-7737; FAX: 541-967-7619; Land Application; Hazardous Waste; Water Resource/Wastewater Management



**ENVIRONMENTAL CONSULTING GROUP (ECG);** PO Box 230263; Tigard, OR 97281-0263; PHONE: 503-692-7053; FAX: 503-692-3516; Asbestos Lead Management; Electronic Asbestos Database Management; Hazardous Material Consulting

**LPG ASSOCIATES INC;** 25 NE 11th Ave Ste 200; Portland, OR 97232; PHONE: 503-230-1240; FAX: 503-230-2892; Hydrogeologic Investigations; Air Quality Modeling & Permitting; Landfill Design & Monitoring

**OMNICON ENVIRONMENTAL MANAGEMENT;** 90380 Sheffer Rd; Elmira, OR 97437-9766; PHONE: 541-935-1742; Contamination Investigation & Remediation; Env Assessments & Occupational Health Audits; Compliance Program Development/Permit Assistance

## Pennsylvania

**AIR SCIENCE CONSULTANTS INC;** 347 Prestley Rd; Bridgeville, PA 15017-1949; PHONE: 412-221-6000; FAX: 412-221-3160; Air Dispersion Modeling; Meteorological Instrument Auditing

**ANALYTICAL & ENVIRONMENTAL CHEMISTRY CONSULTANT;** 12 Birch Rd; Malvern, PA 19355-1644; PHONE: 610-651-0132; FAX: 610-651-0132; Chromatography; Spectroscopy; Environmental Analysis

**BUCHART-HORN INC;** 4445 W Philadelphia St; York, PA 17405-7040; PHONE: 717-852-1400; FAX: 717-852-1401; Drinking Water; Wastewater; Hazardous Wastes

**CIVIL & ENVIRONMENTAL CONSULTANTS INC;** 601 Holiday Dr Foster Plaza 3; Pittsburg, PA 15220-2728; PHONE: 412-921-1815; Environmental Engineering; Civil/Site and Geotechnical Engineering; Landfill Design, Permitting and Construction

**COLUMEN MENARD CO;** 111 Presidential Blvd Ste 240; Bala Cynwyd, PA 19004; PHONE: 610-667-9050; FAX: 610-667-9915; Financial Consulting; Mergers & Acquisitions; Corporate Finance

**D R ENVIRONMENTAL;** 303 Independence Rd; King of Prussia, PA 19406-2209; PHONE: 610-265-9039; Environmental Health & Safety; Indoor Air Quality; OSHA Compliance

**DALE ENVIRONMENTAL INC;** 310 S River St; Wilkes-Barre, PA 18702; PHONE: 717-820-8160; FAX: 717-820-8389; Asbestos Consulting; Indoor Air Quality Testing; Lead-Based Paint Consulting

**DAMES & MOORE;** 2325 Maryland Road; Willow Grove, PA 19090; PHONE: 215-657-5000; FAX: 215-657-5454

**DATAGRAPHICS INC;** 518 Laurel Dr; McMurray, PA 15317-3222; PHONE: 412-941-3500; FAX: 412-942-3250; Industrial Wastewater; Hazardous & Solid Wastes; Federal & State Environmental Regulations

**DIXON ENVIRONMENTAL ASSOCIATES INC;** Swedesford Corp Cntr 605 Swedesford Rd; Frazer, PA 19355; PHONE: 610-722-9444; FAX: 610-722-9447; Air Pollution Control & Air Quality; Wastewater Pollution Control & Design; Environmental Compliance



**ESA-ENERGY SYSTEMS ASSOCIATES;** 564 Washington Ave; Pittsburgh, PA 15106-2848; PHONE: 412-429-2713; FAX: 412-429-4068; Nitric Oxide Reduction; Computational Furnace Modeling Using CFD; NOx Reduction with Controlled Gas Injection

**EARTH SCIENCES CONSULTANTS INC;** 1 Triangle Dr; Export, PA 15632; PHONE: 412-733-3000; FAX: 412-325-3352; Soil & Groundwater Investigations; Engineering; Waste Management

**ENVIRONEX INC;** P O Box 159; Wayne, PA 19087-0159; PHONE: 610-975-9790; FAX: 610-975-9793; Air Emissions; Catalysts; Refining for Clean Fuels

**ENVIRONMENTAL COORDINATION SERVICES & RECYCLING;** 3237 US Hwy 19; Cochran, PA 16314; PHONE: 814-425-7773; FAX: 814-425-3201; Waste Management; Environmental Compliance; Recycling

**ENVIRONMENTAL STANDARDS INC;** 1140 Valley Forge Rd; Valley Forge, PA 19482-0911; PHONE: 610-935-5577; FAX: 610-935-5583; Risk Assessment; Chemistry Consulting; Consulting Geosciences

**ENVIRONMENTAL STANDARDS INC;** 1140 Valley Forge Rd; Valley Forge, PA 19482-0911; PHONE: 610-935-5577; FAX: 610-935-5583; Risk Assessment Services; Chemistry Quality Assurance & Data Validation; Geoscience Services

**GA GROUP;** 1510 Chester Pike 401 Baldwin Tower; Edyestown, PA 19022; PHONE: 610-874-7405; FAX: 610-874-7845; Project Management; Environmental Consulting; Engineering

**GANNETT FLEMING INC;** P O Box 67100; Harrisburg, PA 17106-7100; PHONE: 717-763-7211; FAX: 717-763-7323; Wastewater; Hazardous/Toxic Waste; Air



**GEOSERVICES LTD;** 1240 N Mountain Rd; Harrisburg, PA 17112-1754; PHONE: 717-541-0799; FAX: 717-541-8930; Risk Assessment; Groundwater Investigations/Remediation; Brownfields

**GREAT VALLEY CONSULTANTS;** 2 Meridian Blvd Ste 201; Wyomissing, PA 19610-3202; PHONE: 610-375-8822; FAX: 610-375-8977; Water; Wastewater

**H J HARTZ & ASSOC INC;** 1 Jenkintown Station 115 West Ave #201; Jenkintown, PA 19046; PHONE: 215-572-5220; FAX: 215-884-1385; Strategic Planning; Mergers/Acquisitions/Divestitures; Financing

**HERMAN W LEVIN ASSOCIATES;** 1919 Chestnut St Apt 2706; Philadelphia, PA 19103-3449; PHONE: 215-561-5831; FAX: 215-564-1029; Industrial Hygiene; Indoor Air Quality; Chemical Hazards

**HOLLANDER ASSOCIATES;** 1605 Sherwood Rd; Wyomissing, PA 19610-1127; PHONE: 610-678-9756; Solid Waste Processing; Waste-to-Energy; Ash/Residue Processing

**ICF KAISER INTERNATIONAL INC;** 1600 W Carson St Gateway View Plaza; Pittsburgh, PA 15219-1031; PHONE: 412-497-2000; FAX: 412-497-2212; Site Investigations & Feasibility Studies; Remedial Design, Construction & Construction Mgmt; Risk Assessment, Permitting & Clean Air Act Plans

**IVL ASSOCIATES;** 276 Fieldbrook Dr; Pittsburgh, PA 15228-2531; PHONE: 412-341-0379; Radioactive Waste Management; Waste Treatment - All Waste; Information Management

**JG CONSULTANCY;** 9335 Donald Dr; Emmaus, PA 18049-1501; PHONE: 610-967-1267; FAX: 610-967-1267; Environmental Management; Environmental Services; Management & Technical Services

**JELTECH INC;** P O Box 196; Gwynedd, PA 19436; PHONE: 215-661-8777; FAX: 215-661-8778; Asbestos Abatement; PCB Disposal & Remediation; Hazardous & Non-hazardous Waste Recycling/Disposal

**KANTER LABORATORY;** 1172 Colgate Dr; Monroeville, PA 15146; PHONE: 412-372-6419; Stack-gas NOx/SOx Removal Technology; VOC Reduction; Novel Technologies for Pollution Abatement

**LEADER ENVIRONMENTAL OF PA INC;** P O Box 14935; Pittsburgh, PA 15234; PHONE: 412-531-2380; FAX: 412-531-1920; EH&S Management; Environmental/Industrial Hygiene/Safety Compliance; Risk Management Plans & OSHA Process Safety Mgmt

**LEED ENVIRONMENTAL INC;** 124 Deborah Dr; Reading, PA 19610-3104; PHONE: 610-670-7310; FAX: 610-670-7311; Superfund Project Mgmt/Tech Committee Coordination; Regulatory Compliance Services, Auditing/Planning; Environmental Due Diligence & Site Assessments

**MAINE (MICHAEL A NAWROCKI ENGINEERING);** P O Box 60156; Harrisburg, PA 17106-0156; PHONE: 717-671-4902; Water Quality & Pollution Control; Ground & Surface Water Hydrology; Environmental Site Assessments & Remediation

**MARCOR REMEDIATION INC;** 540 Trestle Place; Downingtown, PA 19335; PHONE: 610-269-3250; FAX: 610-269-3393; Total Site Remediation; Asbestos/Lead Hazard Abatement; Plant Decommissioning/Demolition

**MOODY & ASSOC. INC;** 11548 Cotton Rd; Meadville, PA 16335; PHONE: 814-724-4970; FAX: 814-724-4973; Hydrogeology; Groundwater Supply Development; Groundwater Remediation

**PENNERSEY ENVIRONMENTAL CONSULTING INC;** 2034 E Wellington Rd; Newtown, PA 18940-3708; PHONE: 215-860-1231; FAX: 215-860-9988; Environmental Site Assessments; Underground Storage Tanks; Litigation Support

**POWELL HARPSTEAD INC;** 1313 W Chester Pike; West Chester, PA 19382; PHONE: 610-430-7866; FAX: 610-430-7872; Geotechnical Engineering; Environmental Investigation & Remediation; Lead & Asbestos Survey/Abatement/Monitoring

**ROY F WEST INC;** 1 Weston Way; West Chester, PA 19341; PHONE: 610-701-3182; FAX: 610-701-3124; Consulting; Environmental Construction; Knowledge Solutions

**STV INC;** 205 W Welsh Dr; Douglassville, PA 19518; PHONE: 610-385-8200; FAX: 610-385-8501; Hazardous Material Management; Environmental Studies & Permitting; Solid Waste Management & Planning

**SCHAIBLE ASSOCIATES;** 1008 Country Place Dr; Lancaster, PA 17601-7109; PHONE: 800-832-5564; FAX: 717-892-3098; Industrial Hygiene; Indoor Air Quality; Auditing

**SKELLY AND LOY INC;** 2601 N Front St; Harrisburg, PA 17110; PHONE: 717-232-0593; FAX: 717-232-1799; System Installation, Operation, Maintenance; Environmental Assessments; Remedial Design

**THE EADS GROUP;** 1126 Eighth Ave; Altoona, PA 16602-2500; PHONE: 814-944-5035; FAX: 814-944-4862; Water/Wastewater Treatment; Wetlands; Hazardous Waste Evaluations

**THE WHITMAN COMPANIES INC;** 620 W Germantown Pike Ste 450; Plymouth Meeting, PA 19462; PHONE: 610-238-0868; FAX: 610-238-0869; Industrial Hygiene; Brownfields Redevelopment; Groundwater Investigation & Remediation

**URBAN ENGINEERS INC;** 530 Walnut St 14th Fl; Philadelphia, PA 19106-3685; PHONE: 215-922-8080; FAX: 215-922-8082; Hazardous Waste Management; Environmental Impact Assessment; Industrial Hygiene & Safety

**VIKING SYSTEMS INTERNATIONAL;** 2070 Wm Pitt Way; Pittsburgh, PA 15238; PHONE: 412-826-3355; FAX: 412-826-3353; Wastewater Treatment Systems; Process Systems Design; Waste Remediation

**WILLIAM M BERNHART ESG CIH;** 4008 Alden Dr; Pittsburgh, PA 15220-1022; PHONE: 512-561-5510; FAX: 412-561-0191; Industrial Hygiene; Safety; OSHA Compliance

## Rhode Island

**ENVIRONMENTAL SCIENCE SERVICES INC;** 532 Arnells Ave; Providence, RI 02909; PHONE: 401-421-0398; FAX: 401-421-5731; Hazardous Material Assessment & Remediation; Regulatory Permitting; Stack Emissions Testing

**WARWICK LABORATORIES;** 118 Edmond Dr; Warwick, RI 02886; PHONE: 401-884-0009; OSHA/EPA Compliance; Industrial Hygiene; Environmental Science

## South Carolina



**AAA ENVIRONMENTAL;** 300 Henry Place; Spartanburg, SC 29305; PHONE: 864-582-1222; FAX: 864-583-0709; Asbestos Consulting/Training; Lead; Indoor Air Quality Consulting

**CARNES & ASSOCIATES;** 10 Fieldstone Place; Greenville, SC 29615-3822; PHONE: 864-987-0329; FAX: 864-987-0329; RCRA Audits; Hazardous Waste Incineration-RCRA & BIF; Facility Oversight Activities

**MILLENNIUM SCIENCE & ENGINEERING INC;** 250 Executive Center Dr Ste 114 B-157; Greenville, SC 29615; PHONE: 864-627-4370; FAX: 864-627-4377; Engineering; Hazardous Waste Management; Pollution Prevention

## Tennessee



AccuLab  
Environmental  
Services, Inc.

**ACCULAB ENVIRONMENTAL SERVICES INC;** 2274 Hollywood Dr; Jackson, TN 38305-4331; PHONE: 901-668-2008; FAX: 901-668-2002; Environmental Site Assessment (Phase I,II,III); RCRA & OSHA Training; Hazardous Waste & UST Management

**APPLIED EARTH SCIENCES INC;** 5425 Raines Rd Ste 10; Memphis, TN 38115; PHONE: 901-360-1776; FAX: 901-360-1636; Soil & Groundwater Characterization; Remediation System Design & Installation; Hazardous Waste Management

**BUSINESS ENVIRONMENTAL INC;** 1125 Winding Way Dr; Knoxville, TN 37923-6607; PHONE: 423-691-9825; FAX: 423-691-1255; Environmental Permitting & Regulatory Compliance; Training In Use of Environmental Regulations; Water & Wastewater Engineering

**BUSINESS ENVIRONMENTAL INC;** 665 Emory Valley Rd; Oak Ridge, TN 37830; PHONE: 423-691-9825; FAX: 423-691-1255; Environmental Permitting & Regulatory Compliance; Training In Use of Environmental Regulations; Water & Wastewater Engineering

**E ROBERTS ALLEY & ASSOCIATES INC;** P O Box 2365; Brentwood, TN 37024; PHONE: 615-373-1567; FAX: 615-373-3697; Wastewater Treatment Design; Soil/Groundwater Remediation; Air Pollution Control/Permitting

**ECKENFELDER INC;** 227 French Landing Dr; Nashville, TN 37228-1605; PHONE: 615-255-2288; FAX: 615-256-8332; Solid Waste Management; Industrial Wastewater Treatment; Hydrogeology

**ENVIRONMENTAL HEALTH SERVICES INC;** 5519 Cove Island Rd; Knoxville, TN 37919; PHONE: 423-450-9669; FAX: 423-909-0717; Public Health Disease & Toxic Substances; Environmental Safety & Health; Indoor Air Quality/ Environmental Sensitivities

**G S E INC;** 599 Waldron Rd; LaVergne, TN 37086; PHONE: 615-793-7547; FAX: 615-793-5070; Industrial Wastewater Treatment Design; Aeration Testing & Application; Expert Witness

**GOBBEL HAYS PARTNERS INC;** 271 5th Ave N; Nashville, TN 37219; PHONE: 615-254-8500; FAX: 615-256-3439; Bird Pest Control/Remediation; Indoor Air Quality; Asbestos

**INTERTECH;** P O Box 4575; Oak Ridge, TN 37831-4575; PHONE: 423-220-0503; FAX: 423-220-0908; Management Training; Site Restoration Management; Project Management

**J B PLAK & ASSOCIATES;** 116 Lexington Ave; Elizabethton, TN 37643-7228; PHONE: 423-543-8772; Electrostatic Precipitators; Project Management; Solid Waste

# LMS, Inc.

**LITIGATION MANAGEMENT SPECIALISTS INC;** 414 Union St Ste 2051; Nashville, TN 37219; PHONE: 615-255-5510; FAX: 615-255-4679; Development & Programs to Enhance Effectiveness; Audits of Active Projects; Audits of Litigation

**QUANTUM ENGINEERING CORPORATION;** 1920 Breezy Ridge Trail; Knoxville, TN 37922-7115; PHONE: 423-675-5917; FAX: 423-966-1762; Constructed Wetlands; Small Community Wastewater Treatment; Groundwater Hydrologic Investigations

**THE ENVIRONMENTAL CONSULTING GROUP INC;** 2039 Hidden Cove Ln; Knoxville, TN 37922-6156; PHONE: 423-671-3848; FAX: 423-671-3848; Health & Safety Programs; Air Pollution Control & Permitting; Wastewater Systems

**TRIAD ENVIRONMENTAL CONSULTANTS INC;** 207 Donelson Pike; Nashville, TN 37214; PHONE: 615-889-6888; FAX: 615-889-4004; RCRA Permitting & Compliance; Solid Waste Planning, Design & Permitting; Contaminated Site Investigation & Remediation

## Texas

**ADVANCED ENVIRONMENTAL SERVICES INC;** 1112 Charleston Ct; Keller, TX 76248-5246; PHONE: 817-379-6968; FAX: 817-337-0615; Risk Assessment; Environmental, Health and Safety Training; Indoor Air Quality

**AIR & WASTE ENGINEERING;** 18352 Dallas Parkway Ste 136-366; Dallas, TX 75287-5203; PHONE: 972-307-2292; FAX: 972-307-1693; Continuous Emissions Monitoring; Quality Assurance Expert in Air & Hazardous Waste; Source Sampling



**ALAN PLUMMER ASSOCIATES INC;** 75324 Mosier View Ct Ste 200; Ft Worth, TX 76118-7110; PHONE: 817-284-2724; FAX: 817-589-0072; Water Quality Modeling & Water Quality Management; Planning, Design & Const Admin of Water Facilities; Air, Water & Solid Waste Permitting

**ALPHAS ENVIRONMENTAL INC;** 1302-A Petroleum Dr; Abilene, TX 79602; PHONE: 915-695-6400; FAX: 915-692-1587; Environmental Site Assessments-Phase I,II,III; Petroleum Storage Tank Management; Environmental Impact Statements

**ANDERSEN & ASSOCIATES COMPLIANCE CONSULTANTS INC;** 3416 G Olsen Blvd; Amarillo, TX 79109; PHONE: 806-353-2298; FAX: 806-353-1576; Soil, Water & Air Sampling; Underground Storage Tank Investigation; Phase I Environmental Site Assessments

**APPLIED EARTH SCIENCES INC;** 1828 Grandstand; San Antonio, TX 78238; PHONE: 210-647-0114; FAX: 210-647-1761; Soil & Groundwater Characterization; Industrial Hygiene; Hazardous Waste Management

**APPLIED EARTH SCIENCES INC;** 2833 Trinity Sq Ste 149; Carrollton, TX 75006; PHONE: 972-416-7171; FAX: 972-416-7175; Soil & Groundwater Characterization; Remediation System Design & Installation; Hazardous Waste Management

**APPLIED EARTH SCIENCES INC;** 4455 S Padre Island Dr Ste 28; Corpus Christi, TX 78411; PHONE: 512-854-9182; FAX: 512-854-0734; Soil & Groundwater Characterization; Remediation System Design & Installation; Hazardous Waste Management



**APPLIED EARTH SCIENCES INC;** 7322 SW Freeway Ste 1000; Houston, TX 77074; PHONE: 713-981-7140; FAX: 713-981-8821; Soil & Groundwater Characterization; Remediation System Design & Installation; Hazardous Waste Management

# BDM

Environmental Services

**BDM ENVIRONMENTAL SERVICES;** 415 W Wall Ste 1818; Midland, TX 79701; PHONE: 915-682-0008; FAX: 915-682-0028; Risk Assessments; Environmental Site Assessments; Soil & Groundwater Remediation

**BMD CONSULTING;** P O Box 5032 No 116; Sugarland, TX 77487-5032; PHONE: 281-265-6406; FAX: 281-265-6406; Industrial Wastewater Treatment & Permitting; Hazardous Waste Treatment & Permitting; Waste Management Plans

**CTS INC;** P O Box 162605; Austin, TX 78716-2605; PHONE: 512-422-7388; FAX: 512-306-1398; Labor, Transportation, Experience, Treatment-CW-SW; Clean Water Act; SW 846

**CITY SURVEY;** 3202 Brass Buttons Trail; Austin, TX 78734; PHONE: 888-250-2336; LPST Risk Based Assessments; Phase I Environmental Site Assessments; Phase II Environmental Site Assessments

**CURA EMERGENCY SERVICES I C;** 2735 Villa Creek Dr Ste 275; Dallas, TX 75234; PHONE: 972-488-2222; FAX: 972-488-1741; Emergency Management & Waste Management; Site Investigations

**CURT B BECK CONSULTING ENGINEER;** P O Box 2442; Pampa, TX 79066-2442; PHONE: 806-665-9281; FAX: 806-665-1965; Environmental Compliance Auditing; Environmental Permits; Required Environmental Plans

**CURT BECK CONSULTING ENGINEER;** P O Box 2442; Pampa, TX 79066-2442; PHONE: 806-665-9281; FAX: 806-665-1965; Water & Waste Required Questionnaires; Air-Water-Solid Waste Permitting; Environmental Audits & Compliance Determinations

**DAHL & ASSOCIATES INC;** 6100 Southwest Blvd Ste 304; Ft Worth, TX 76109-3964; PHONE: 817-377-2208; FAX: 817-377-8806; Innovative Client Programs; Surface/Subsurface Characterization & Remediation; Environmental Engineering & Waste Management

**DB ASSOCIATES;** P O Box 92; League City, TX 77574-0092; PHONE: 281-334-3217; FAX: 281-334-4060; Environmental Auditing; Air Permitting; Wastewater Treatment

**DAMES & MOORE;** 2550 North Loop West, Ste 700; Houston, TX 77092; PHONE: 713-688-4541; FAX: 713-588-2314

**DAVID CORNISH & CO;** 1635 Rogers Rd; Ft Worth, TX 76107-6513; PHONE: 817-338-1052; FAX: 817-338-0118; ESA Investigations & Regulatory Audits; UST/AST Removal-Installation-Upgrades; LPST Corrective Action

**DI SCIULLO & TERRY INC;** 401-A W Abram; Arlington, TX 76010; PHONE: 817-275-3361; Stormwater Regulations; Landfills; Flood Plains & Wetlands

**EA ENGINEERING SCIENCE & TECHNOLOGY;** 1420 Valwood Parkway Ste 170; Colleyville, TX 76034; PHONE: 972-484-1420; FAX: 972-247-7220; Risk Sciences & Management; Site Characterization & Remediation; Water Quality & Water Resources Management



**ENVIRONMENTAL CONSULTING SERVICES INC;** 5433 Westheimer Ste 820; Houston, TX 77056; PHONE: 713-622-4800; FAX: 713-622-4828; Indoor Air Quality; Site Inspections & Remediation; Asbestos & Lead Surveys

**FACILITIES ENVIRONMENT GROUP INC;** PO Box 572754; Houston, TX 77257-2754; PHONE: 713-783-6888; FAX: 713-785-6699; Solid Waste Management; Hazard; Wastewater Management

**FORBES ENVIRONMENTAL ENGINEERING;** 435 Isom Rd Ste 228; San Antonio, TX 78216; PHONE: 210-342-8382; FAX: 210-344-5407; Waste Reduction; Regulatory Compliance; Resolution of Enforcement Action

**GZA GEOENVIRONMENTAL INC;** 1801 Royal Ln; Dallas, TX 75529; PHONE: 972-444-8444; FAX: 972-401-3796; Soil & Groundwater Contamination; Pre-acquisition Due Diligence Studies; Remedial Investigations and Design

**GEOMATRIX CONSULTANTS INC;** 1214 W 6th St Ste 261; Austin, TX 78763; PHONE: 512-494-6333; FAX: 512-494-6334; Environmental Site Investigations; Environmental Site Remediation; Engineering Designs and Regulatory Liaison

**HERS;** P O Box 701275; San Antonio, TX 78270; PHONE: 210-497-8980; FAX: 210-497-4227; Comprehensive Microbial Remediation Programs; Spill Response Products, Brooms, Socks, Absorbents; Water & Soil Treatment

**HUIT ZOLLARS INC;** 3131 McKinney Ave St 600; Dallas, TX 75204; PHONE: 214-871-3311; FAX: 514-871-3319; Full Service Engineering/Architecture; Environmental Studies/Assessments; Environmental Permitting/Compliance

**JK INC;** 8926 Kirby Dr; Houston, TX 77054; PHONE: 210-497-1697; FAX: 213-664-6443; Environmental Management; Industrial Hygiene; Occupational Safety & Health

**K W BROWN ENVIRONMENTAL SERVICES INC;** 2210 Dorrington #202; Houston, TX 77030-3249; PHONE: 713-839-9393; FAX: 713-839-9444; Bioremediation; Human & Ecological Risk Assessment; Environmental Litigation Support

**KSYS;** 5107 Del Monte Ste 2; Houston, TX 77056-4318; PHONE: 713-621-7530; PHONE: 713-621-7530; Desktop Client/Server Software Solutions; Air Emissions Compliance Software-Tracker; Record-keeping: VOCs, HAPs, SARA

**LOCKHEED MARTIN ENVIRONMENTAL SERVICES;** 1200 Smith St #2885; Houston, TX 77002-4309; PHONE: 713-654-4809; FAX: 713-654-4850; Site Characterization & Analysis; Environmental Management Systems and GIS; Pollution Prevention

**MOUNCE & ASSOCIATES INC;** 3620 N Jose Ln Ste 118; Carrollton, TX 75007; PHONE: 972-492-3911; FAX: 972-394-0763; Regulatory Compliance; Industrial Environmental Remediation; Environmental Site Assessments

**PASS ASSOCIATES INC;** 6900 Anderson Blvd Ste 234; Ft Worth, TX 76120-3025; PHONE: 817-429-7798; FAX: 817-457-1612; Phase I & II Environmental Site Assessments; Asbestos Abatement; Lead-Based Paint Abatement

**ROBERT J MEYERS & ASSOCIATES INC;** 14423 Cornerstone Village Dr; Houston, TX 77014-1206; PHONE: 281-893-6737; FAX: 281-893-6756; Environmental Site Assessments; Oil Spill/Emergency Response Planning; Training

**ROEHRIG AND ASSOCIATES INC;** 2306 Stonebrook Cir; Carrollton, TX 75007-5726; PHONE: 972-245-0543; FAX: 972-245-0543; Quality Assurance; Chemicals; Hazardous Waste

**ROUX ASSOCIATES INC;** 1110 Nasa Road One Ste 207; Houston, TX 77058; PHONE: 281-335-4000; FAX: 281-335-8600; Remedial/Engineering Design; Environmental Compliance Services; Groundwater & Soil Investigations

**SEIFERT ENTERPRISES INC;** P O Box 894; Cypress, TX 77410-0894; PHONE: 281-373-5721; FAX: 281-373-5721; Risk-Based Cleanup; Environmental Compliance; Groundwater Remediation



**SOURCE ENVIRONMENTAL SCIENCES INC;** 4100 Westheimer Ste 106; Houston, TX 77027; PHONE: 713-621-4474; FAX: 713-621-4588; Wastewater Permitting; Air Quality Permitting; Air Dispersion Modeling

**T K MAIT & ASSOCIATES INC;** 2510 Southwell Ste 112; Dallas, TX 75229-4628; PHONE: 972-243-4194; FAX: 972-243-4194; Lead-Based Paint Management/Lead Air Analysis; Asbestos Management-Air Monitoring/Sample Analysis; Environmental Site Assessment - Phase I&II

**T SQUARE DESIGN ASSOCIATES INC;** P O Box 7831; Longview, TX 75607-7831; PHONE: 903-758-6898; FAX: 903-758-6897; Project Engineering; Environmental Permits; Compliance Strategies

**TERRA-SOLVE INC;** 3216 Commander Dr Ste 103; Carrollton, TX 75006-2518; PHONE: 972-267-1900; FAX: 972-267-1902; Site Characterization/Remediation; Soil & Groundwater Assessments; Engineering/Geology

**THE ENVIRONMENT CO;** 3400 Silverstone #125; Plano, TX 75023; PHONE: 972-612-5636; FAX: 972-612-5637; Oil Field Cleanup; Contamination Remediation & Assessment; Tank Management

**THE WCM GROUP INC;** P O Box 3247; Humble, TX 77347-3247; PHONE: 281-446-7070; FAX: 281-446-3348; Conceptual & Detailed Engineering Design; Air Permitting; Investigation & Remediation

**TRAVIS L SHACKELFORD & ASSOCIATES;** 20525 Red Bluff Rd; Porter, TX 77365-1844; PHONE: 281-354-2386; FAX: 281-354-2386; Site Assessments Phase I-IV; RCRA RI/FS; Soil & Groundwater Remediation; Surface Investigations

**TREWIM & SMITH INC;** 100 N Central Expressway Ste 500; Richardson, TX 75080-5322; PHONE: 972-479-9138; FAX: 972-234-2123; Air Pollution Control Systems; Environmental Consultants; Environmental Engineering

**TREWIM & SMITH INC;** 25701 1-45 N Ste 2-451; The Woodlands, TX 77381-3500; PHONE: 281-296-9296; FAX: 281-362-0266; Air Pollution Control Systems; Environmental Consultants; Environmental Engineering

**TRINITY CONSULTANTS;** 12801 N Central Expressway Ste 1200; Dallas, TX 75243; PHONE: 972-661-8100; FAX: 972-385-9203; Environmental Data Management; Air Quality; Process Safety/Risk Management

**V TECH ENVIRONMENTAL SERVICES;** 5121 69th St Ste A-102; Lubbock, TX 79424-1694; PHONE: 806-794-3613; FAX: 806-783-9966; Remedial & Closure Design; Industrial Compliance; Pollution Prevention/Waste Minimization

**W C ENGINEERS INC;** 26102 FM 529; Katy, TX 77493-7811; PHONE: 281-371-7845; FAX: 281-371-2330; Water/Wastewater; Privatization; Operations & Maintenance

**WAID & ASSOCIATES;** 14205 Burnet Rd; Austin, TX 78728; PHONE: 512-255-9999; FAX: 512-255-8780; Air Quality; Permitting; Wastewater Management

**WESTWARD ENVIRONMENTAL INC;** P O Box 2205; Boerne, TX 78006; PHONE: 210-698-2432; FAX: 210-698-2496; Land Acquisition; Environmental Compliance Programs; Endangered Species

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**ENVIRONMENTAL ENERGY;** 1281 E Federal Heights Dr; Salt Lake City, UT 84103; PHONE: 801-596-2166; FAX: 801-596-2166; Water & Wastewater Treatment; Anaerobic Digestion; Solid & Hazardous Wastes

**ENVIROL INC;** 1770 Research Park Way Ste 160; North Logan, UT 84341; PHONE: 800-748-3548; FAX: 801-787-2878; Field Test Kit Manufacturer; Testing Services

**IHI ENVIRONMENTAL;** 640 E Wilmington Ave; Salt Lake City, UT 84106; PHONE: 801-466-2223; FAX: 801-466-9616; Industrial Hygiene; Occupational Health & Safety; Environmental Consulting

**INTERA/DUKE ENERGY CO;** 50 W Broadway Ste 600; Salt Lake City, UT 84101; PHONE: 801-364-1906; FAX: 801-363-3932; Environmental Site Assessments & Remediation; Environmental Audits & Due Diligence; Environmental Services for Mining



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**RESOURCE SYSTEMS GRO;** 76 Olcott Dr; White River Jct, VT 05001-2313; PHONE: 802-295-4999; FAX: 802-295-1006; Air Pollution Modeling/Permitting; Transportation Planning/Traffic Impact; Demand Estimation/Surveys

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**ATC ASSOCIATES INC;** 4701 Columbus St Ste 301; Virginia Beach, VA 23462-6725; PHONE: 757-456-9100; FAX: 757-456-9160; Comprehensive Remedial Investigation & Development; Underground Storage Tank Investigations; Phase I,II Environmental Site Assessments & Audits

**B & B CONSULTANTS;** 121 N Mecklenburg Ave; South Hill, VA 23970; PHONE: 804-447-7621; FAX: 804-447-4257; Landfills; Water/Wastewater; Site Development

**COMMONWEALTH ENVIRONMENTAL ASSOCIATES INC;** 3000 E Boundary Terrace Ste 1; Midlothian, VA 23112; PHONE: 804-744-3527; FAX: 804-744-6832; Phase I Environmental Site Assessments; Asbestos Surveys; UST/AST Consulting

**CREATIVE COST CONTROL;** 1411 Brushy Mt Dr; Salem, VA 24153; PHONE: 540-389-5818; FAX: 540-389-3753; Waste Management; Overall Cost Reductions-Utilities-Environmental

**DOMINION ENVIRONMENTAL CONSULTANTS INC;** 729 Thimble Shoals Blvd Ste 1B; Newport News, VA 23606; PHONE: 757-599-7501; FAX: 757-599-7509; Mitigation Strategies; Phase I & II Environmental Site Assessments; Wetland Delineations & Regulatory Permitting

**DYNACORP;** 2000 Edmond Halley Dr; Reston, VA 22091-3436; PHONE: 703-264-8770; FAX: 703-264-9210; Information Management Systems; Industrial Hygiene; Occupational Safety

**E H PECHAN & ASSOCIATES;** 5528 Hempstead Way; Springfield, VA 22151; PHONE: 703-642-1120; FAX: 703-642-1258; Regulatory Impact Assessment; Air Pollution Emissions Inventory Development; Air Pollution Control Measure Analysis

**EHS ASSOCIATES;** 101 Rachel Lane; Yorktown, VA 23692-4745; PHONE: 757-898-2962; FAX: 757-890-9315; Environmental Compliance; Environmental Management Systems; Oil and Hazmat Spill Response Management

**ENVIRONMENTAL REALTY CONSULTING SERVICE INC;** 3818 Charles Stewart Dr; Fairfax, VA 22033-2418; PHONE: 703-716-4889; FAX: 703-620-4358; Environmental Chemistry on Pesticides; Expert Witness for RCRA-FIFRA-FDCA on Chemistry; Seminars on Environmental Risk in Real Estate

**ENVIRONMENTAL STRATEGIES CORP;** 11911 Freedom Dr Ste 900; Reston, VA 20190-9602; PHONE: 703-709-6500; FAX: 703-318-3972; Environmental Engineering; Haz Waste Investigations & Remediation; Environmental Site Assessments & Audits

**GCC INC;** P O Box 4163; Glenn Allen, VA 23058-4163; PHONE: 804-364-2884; FAX: 804-364-3622; Waste Management Consulting; Environmental Consulting/Contracting; Hazardous Waste Disposal

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**HAYES SEAY MATTERN & MATTERN INC ENVIRONMENTAL DIVISION;** 1315 Franklin Rd; Roanoke, VA 24034; PHONE: 540-857-3100; FAX: 540-857-3296; Municipal & Industrial Wastewater Treatment; Sanitary Landfills; Environmental Site Assessments & Corrective Action

**HYDROGEOLOGIC INC;** 1155 Herndon Parkway Ste 900; Herndon, VA 20170-5526; PHONE: 703-478-5186; FAX: 703-471-4180; Water Resource Studies; Environmental Site Investigation; Remediation; Groundwater/Contaminant Transport Modeling

**INTERDEVELOPMENT INC;** 515-B E Braddock Rd; Alexandria, VA 22314; PHONE: 703-548-1909; FAX: 703-548-2029; International Business Development; Market Research & Analysis; Techno-Economic Surveys & Technology Transfer

**MALCOLM PIRNIE INC;** 11832 Rock Landing Dr Ste 400; Newport News, VA 23606-4206; PHONE: 757-873-8700; FAX: 757-873-8723; Hazardous Waste; Water/Wastewater; Air Quality

**MILLENNIUM SCIENCE & ENGINEERING INC;** 1364 Beverly Rd Ste 302; McLean, VA 22101; PHONE: 703-734-1099; FAX: 703-734-1093; Industrial Wastewater Engineering; Hazardous Waste Management; Pollution Prevention



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**WAYNE C MICHELETTI INC;** 977 Seminole Trail Ste 300; Charlottesville, VA 22901-2824; PHONE: 804-977-8330; FAX: 804-977-6117; Industrial Water & Wastewater Management; Recycle/Reuse/Zero Discharge; Discharge Compliance

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**JERRY W GERALD PHD;** 3190 George Washington Ste A; Richland, WA 99352; PHONE: 509-372-9531; FAX: 509-372-9292; Biology & Ecology; ISO 14000 Environmental Management Systems; Environmental Compliance


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**SUMMIT ENVIROSOLUTIONS INC**; 1800 112th Ave NE #312; Bellevue, WA 98004; PHONE: 425-646-0808; FAX: 425-646-0888; Aquifer Resource Management; Spill Response; Remedial Investigation/Alternatives

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**C B WORDELL CERTIFIED SOIL TESTER**; 1422 N 50th Place; Milwaukee, WI 53208; PHONE: 414-258-1260; Onsite Wastewater Siting; Soil Morphology & Mapping; Tech Support for Landspreading Biosolids Etc

**CEDARBURG SCIENCE**; 8733 Bridge St; Cedarburg, WI 53012; PHONE: 414-376-7626; FAX: 414-376-7658; Science Education Programs; Travelling Nature Education Programs

**COLDFIRE CONSULTING**; P O Box 17961; Milwaukee, WI 53217-0961; PHONE: 414-961-0594; FAX: 414-961-0594; Contamination Remediation Design & Management; ASTM E 1527-97 Phase I Environmental Site Assess; Environmental Research & Investigation

**DPPA INC**; W134 N4981 Campbell Dr; Menomonee Falls, WI 53051; PHONE: 800-759-3772; FAX: 414-783-4221; Brownfield Investigations; Environmental Compliance; Litigation Support

**ENVIRONMENTAL ASSESSMENT SERVICES**; P O Box 1312; Milwaukee, WI 53201; PHONE: 414-871-4680; Lead Abatement; Phase I Environmental Site Assessments/Audits; Asbestos Abatement

**ENVIRONMENTAL SYSTEMS CONSULTANTS INC**; 107 S Main St; Lodi, WI 53555-0046; PHONE: 608-592-7508; FAX: 608-592-7506; Environmental Geophysics; Environmental Site Assessment; Site Investigation

**FOX ENVIRONMENTAL SERVICES INC**; 5150 N Port Washington Rd; Milwaukee, WI 53217; PHONE: 414-332-5857; FAX: 414-332-5003; Environmental Site Assessments; Phase II Investigations; Storage Tank Management/Closures

**GLOBAL SAFETY MANAGEMENT SERVICES LLC**; 601 Knightsbridge Rd; Waunakee, WI 53597-1816; PHONE: 608-849-3838; FAX: 608-849-3842; Safety Consulting; Safety Program Management; Government Regulatory Compliance & Audits

**MSA PROFESSIONAL SERVICES INC**; 1230 South Blvd; Baraboo, WI 53913-2791; PHONE: 608-356-2771; FAX: 608-356-2770; Soil & Groundwater Assessment & Remediation; Wastewater Treatment Engineering; Water Quality

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**MICHAELS ENGINEERING INC**; P O Box 2377; Lacrosse, WI 54602-2377; PHONE: 608-785-1900; FAX: 608-784-2270; Leaking UST Sites/Investigations; Compliance Consulting; Wastewater Discharge Permits-Consulting

**OMNINI ASSOCIATES**; 1 Systems Dr; Appleton, WI 54914-1654; PHONE: 920-735-6900; FAX: 920-830-6100; Wetland Creation & Mitigation; Environmental Investigation/Remediation; Brownfield Redevelopment

**STS CONSULTANTS LTD**; 1035 Kepler Drive; Green Bay, WI 54311-8320; PHONE: 920-468-1978; FAX: 920-468-3312; Landfill Design, Permitting & Closure; Remediation; Environmental Compliance

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**SUMNER ASSOCIATES**; 2780 El Rancho Dr; Brookfield, WI 53005-3718; PHONE: 414-786-9195; FAX: 414-786-9195; Compliance Management; Pollution Prevention;

**SUPERIOR ENVIRONMENTAL CORP OF WISCONSIN**; P O Box 1281; Waukesha, WI 53187-1281; PHONE: 414-896-0456; FAX: 414-896-0457; Real Estate Inspection & Testing Services; Contamination Assessments & Cleanups; Industrial & Agricultural Compliance Issues

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combat pollution.

**Executive Forecast**  
*EP* asks the leading  
environmental  
professionals in the  
country what trends they  
forecast for 1998.

## February

**Pollution Prevention  
Special Report**  
Look ahead to product  
stewardship.

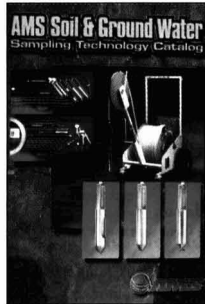
## March

**1998 Buyer's Guide**  
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of environmental products  
and services at your  
fingertips to hang onto all  
year long.

# product literature

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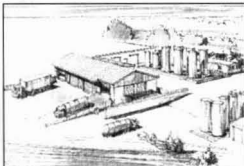
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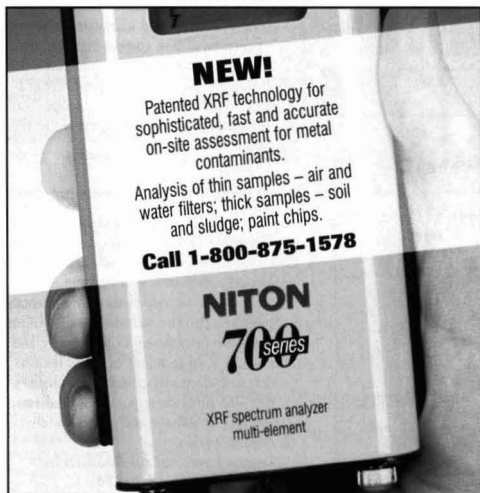
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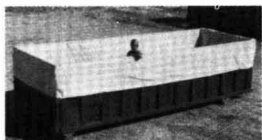
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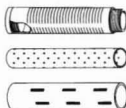
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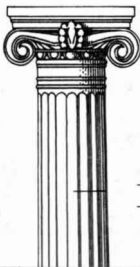
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American Aquatic Testing, Inc., 1111 Union Blvd. Allentown, PA 18103. (610) 434-9015, FAX: (610) 434-2510, internet address: [amercroaqua@aol.com](mailto:amercroaqua@aol.com).

NIJEP certified biomonitoring services, acute, chronic and sediment toxicity studies.  
**See our ad in Classifieds**

## LABORATORY - ASBESTOS/LEAD

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

Asbestos and lead analytical services. NVIAP, AIHA, and NY-ELAP accredited.  
**See our ad in Classifieds**

## LABORATORY TESTING

Quanterra Environmental Services, 5251 DTC Parkway, Suite 415, Englewood, CO 80111. (800) 891-0188, FAX: (303) 796-2002.

Leader in environmental analytical testing, with nationwide network of laboratories.  
**See our ad in Classifieds**

## LINERS: TRUCK

Packaging Research & Design, P.O. Box 678, Madison, MS 39130. (800) 833-9364, FAX: (601) 853-1202.

Disposable Bag Liners for roll-offs, dump trailers & railroad gondolas.  
**See our ad in Classifieds**

## MAPS & AERIALS

Phase One, 85 Argonaut #190, Aliso Viejo, CA 92656. (714) 457-0097.

**See our ad in Classifieds**

## PERMIT TRACKING SOFTWARE

Permit Tracker Software, P.O. Box 3846, Indialantic, FL 32903-3846. (800) 365-3962, FAX: (407) 723-6213, Internet Address: <http://www.mccooneil.com>.

Track permit pulling process and compliance stages for any permits.  
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## PROTECTIVE CLOTHING - HAND PROTECTION

Top Hand Glove, 426 Vanderrbit Rd., Asheville, NC 28803. (704) 274-2900, FAX: (704) 274-5757.

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## RENTAL EQUIPMENT

ASC Professionals, 15075 E. Eleven Mile Rd., Roseville, MI 48066. (800) 372-4260, FAX: (810) 771-0098. Safety equipment rental & repair.

**See our ad in Classifieds**

## SAFETY TRAINING AND CONSULTING

Environmental & Safety Services, Inc., P.O. Box 3394, Wilmington, NC 28406. (910) 763-6999, FAX: (910) 763-8709.

Full service company specializing in OSHA and EPA training and consulting.  
**See our ad in Classifieds**

## SAMPLING SYSTEMS-WASTEWATER

Siroc Industrial Ltd., Div. of Southwell Controls LTD., 857 W. 3rd St., North Vancouver, BC V7P 1e3. (604) 980-3688, FAX: (604) 980-4578. Manufacturer of precision wastewater sampling systems for compliance monitoring programs.

## SLUDGE DEWATERING SERVICES

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

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T-4 Technology Inc., Suite 130, Box 10, 1187 Throm Run Ext., Coropopolis, PA 15108. (412) 269-2709, FAX: (412) 269-2710.

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## SOFTWARE

Paradise Software, Inc., 324 S. Husband, Stillwater, OK 74074. (405) 377-5995, FAX: (405) 372-8934. <http://www.kllnet.net/paradis/>. Affordable regulatory compliance software which also inventories hazardous substance information.

**See our ad in Classifieds**

Phase One, 85 Argonaut #190, Aliso Viejo, CA 92656. (714) 457-0097.  
**See our ad in Classifieds**

## SOURCE TESTING EQUIPMENT

Apex Instruments, Inc., P.O. Box 727, 125 Quantum Street, Holly Springs, NC 27540. (919) 557-7300, FAX: (919) 557-7110.

Apex Manufacturers and distributes air pollution source testing equipment.  
**See our ad in Classifieds**

## SURPLUS CHEMICALS

Triple S Chemical Products, 3464 Union Pacific Ave., Los Angeles, CA 90023. (213) 261-7301, FAX: (213) 261-5567. **See our ad in Classifieds**

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Modutank, Inc., 41-04 35th Avenue, Long Island City, NY 11101. (718) 392-1112, FAX: (718) 786-1008. Low-Cost bolt-together modular tanks in all capacities, rent or buy.

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New Environment, Inc., P.O. Box 205, Brookfield, HI 44403. (800) 732-3073, FAX: (330) 448-7902. Rush service hazwoper training. Turn-key "Train The Trainer" program.

**See our ad in Classifieds**

Rocky Mtn. Center for Occupational & Environmental Health, Bldg 512, SLC, UT 84112. (801) 581-5710, internet address: [Allantic@ce.net](mailto:Allantic@ce.net). E-Mail: [ccordell@cmcoeh.utah.edu](mailto:ccordell@cmcoeh.utah.edu)

Training in occupational & environmental health including lead & asbestos.

## TRAINING/CONSULTING SERVICES

Excel Partnership, Inc., 75 Glen Rd., Sandy Hook, CT 06482. (800) 374-3818, FAX: (203) 426-7811. E-Mail: [www.xlp@xlp.com](mailto:www.xlp@xlp.com). Excel Partnership, Inc. offers a full range of environmental management training and consulting services.

## WATER METERS AND METER READING SYSTEMS

Badger Meter, Inc., 4545 W. Brown Deer Rd., Milwaukee, WI 53223. (414) 371-5894, FAX: (414) 371-5980. Manufactures the latest in flow measurement and automatic meter reading technologies.

## WATER MONITORING

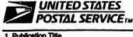
Atlantic Screen & Mfg. Inc., 118 Brookhill Road, Milton, DE 19968. (302) 684-3197, FAX: (302) 684-0643, internet address: [Atlantic@ce.net](mailto:Atlantic@ce.net). Slotted, perforated or threaded pipe, well gravel, manholes, benthonic, sampling pumps.

**See our ad in Classifieds**

Scientific Instruments, Inc., 518 W. Cherry St. Milwaukee, WI 53212. (414) 263-1600, FAX: (414) 263-5506, internet address: [sis518@aol.com](mailto:sis518@aol.com).

Stream gaging/water monitoring.

To place your company's listing in *Environmental Protection's* Referral Directory, contact Donna Rhoades at: 972-687-6727.

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1. Publication Title Environmental Protection		3. Filing Date 9/30/97	
4. Issue Frequency Monthly		5. Number of Issues Published Annually 12	
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13. Publication Title Environmental Protection		14. Issue Date for Circulation Data Below 10/96 - 9/97	
15. Extent and Nature of Circulation		Average No. Copies Each Issue During Preceding 12 Months	
a. Total Number of Copies (Net press run)		95,880	
b. Paid and/or Requested Circulation (1) Sales Through Dealers and Carriers, Street Vendors, and Counter Sales (Not mailed) (2) Paid or Requested Mail Subscriptions (Include advertiser's proof, co-ops and exchange copies)		91,832	
c. Total Paid and/or Requested Circulation (Sum of 15b(1) and 15b(2))		91,832	
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f. Total Free Distribution (Sum of 15d and 15e)		3,054	
g. Total Distribution (Sum of 15c and 15f)		94,886	
h. Copies not Distributed (1) Office Use, Leftovers, Spoiled (2) Returns from News Agents		994	
i. Total (Sum of 15g, 15h(1), and 15h(2))		95,880	
Percent Paid and/or Requested Circulation (15c / 15g x 100)		97%	
16. Publication of Statement of Ownership and Circulation required. Will be printed in the <u>November 97</u> issue of this publication. <input type="checkbox"/> Publication not required.			
17. Signature of Title of Editor, Publisher, Business Manager, or Owner <i>Craig Stevens</i> Date <u>9-23-97</u>			
I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including multiple damages and civil penalties).			

### Instructions to Publishers

- Complete and file one copy of this form with your postmaster annually on or before October 1. Keep a copy of the completed form for your records.
- In cases where the stockholder or security holder is a trustee, include in items 10 and 11 the name of the person or corporation for whom the trustee is acting. Also include the names and addresses of individuals who own or hold 1 percent or more of the total amount of bonds, mortgages, or other securities of the publishing organization. In item 11, if none, check the box. Use blank sheets if more space is required.
- Be sure to furnish all circulation information called for in item 15. Free circulation must be shown in items 15d, e, and f.
- If the publication had second-class authorization as a general or requester publication, this Statement of Ownership, Management, and Circulation must be published. It must be printed in any issue in October or, if the publication is not published during October, the first issue printed after October.
- In item 16, indicate the date of the issue in which this Statement of Ownership will be published.
- Item 17 must be signed.

Failure to file or publish a statement of ownership may lead to suspension of second-class authorization.

PS Form 3526, September 1995 (Revised)

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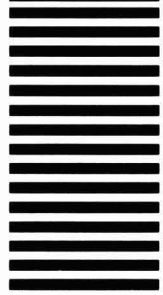


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**FREE PRODUCT INFORMATION FOR ENVIRONMENTAL PROTECTION**

November 1997

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 January 1998

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

**FREE SUBSCRIPTION INFORMATION** 11/97

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 \_\_\_\_\_

**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):  
 (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.  
 (26) Paper  (37) Trans. Equip.  
 (27) Print/Publish  (38) Instr./meas./analyze  
 (28) Chemicals  (39) Controlling  
 (29) Petrol. & Coal  (39) Miscellaneous Mfg.  
 (30) Rubber/Plastic

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

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

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

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

A  1-19 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  
 C  Noise G  Energy control/  
 D  Solid Waste energy conservation  
 H  Disposal I  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

**Environmental  
PROTECTION**

**G. Which of the following Wastewater Treatment Chemical product(s) /services do you plan to purchase in the next 12 months? (Select all that apply)**

800  Lime 808  Algalocides/Bactericides  
 801  Activated Carbon 809  Chlorine Dioxide  
 802  Flocculants 810  Fuel Additives  
 803  Odor Control Chemicals 811  Emulsion Breakers  
 804  Chemical Feeders 812  Dewatering Aids  
 805  Antifoam/Defoamers 813  Corrosion Inhibitors  
 806  Boiler Tube Descaling 814  Coagulants  
 807  Chlorine 815  Magnesium Hydroxide

816  Hydrogen Peroxide 817  
 818  Dust Suppressants  
 819  Potassium Permanganate  
 820  Standard Solutions  
 821  Sludge Stabilization

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

822  New Construction  
 823  Plant Upgrade  
 824  Replacement/Maintenance

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

825  Over \$200,000  
 826  \$100,001-\$200,000  
 827  \$50,001-\$100,000

828  \$10,001-\$50,000  
 829  \$5,000-\$10,000  
 830  Under \$5,000

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

831  0-3 months  
 832  4-6 months  
 833  7-9 months  
 834  10-12 months  
 835  over 12 months

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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
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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 January 1998

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

FREE SUBSCRIPTION INFORMATION 11/97

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 \_\_\_\_\_

- 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  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):  
 (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.  
 (26) Paper  (37) Trans. Equip.  
 (27) Print/Publish  (38) Inst./Inst./Analyze  
 (28) Chemicals  (39) Controlling  
 (29) Petrol. & Coal  (99) Miscellaneous Mfg.  
 (30) Rubber/Plastic

- B  Mining L  Consulting  
 C  Agriculture M  Insurance  
 D  Engineering E  Utilities, public, Contracting & cooperative  
 F  Govt. including municipal or district sanitary water or wastewater treatment sys. or plants  
 Type of Govt:  
 G  City H  County  
 I  State J  Federal

- K  Transportation  
 N  Labs O  Training P  Real Estate  
 Z  Misc. Services  
 C. Approximate number of employees at this address (check only one):  
 A  1-19 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  
 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

**Environmental PROTECTION**

G. Which of the following Wastewater Treatment Chemical product(s) /services do you plan to purchase in the next 12 months?(Select all that apply)

- |   |  |
|---|--|
| 800 <input type="checkbox"/> Lime                   | 806 <input type="checkbox"/> Algaecides/Bactericides |
| 801 <input type="checkbox"/> Activated Carbon       | 809 <input type="checkbox"/> Chlorine Dioxide        |
| 802 <input type="checkbox"/> Flocculants            | 810 <input type="checkbox"/> Fuel Additives          |
| 803 <input type="checkbox"/> Odor Control Chemicals | 811 <input type="checkbox"/> Emulsion Breakers       |
| 804 <input type="checkbox"/> Chemical Feeders       | 812 <input type="checkbox"/> Dewatering Aids         |
| 805 <input type="checkbox"/> Antifoam/Defoamers     | 813 <input type="checkbox"/> Corrosion Inhibitors    |
| 806 <input type="checkbox"/> Boiler Tube Descaling  | 814 <input type="checkbox"/> Coagulants              |
| 807 <input type="checkbox"/> Chlorine               | 815 <input type="checkbox"/> Magnesium Hydroxide     |

- |   |   |
|---|---|
| 816 <input type="checkbox"/> Hydrogen Peroxide      | 817 <input type="checkbox"/> Dust Suppressants    |
| 818 <input type="checkbox"/> Potassium Permanganate | 819 <input type="checkbox"/> Sodium Bicarbonate   |
| 820 <input type="checkbox"/> Standard Solutions     | 821 <input type="checkbox"/> Sludge Stabilization |

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

- 822  New Construction  
 823  Plant Upgrade  
 824  Replacement/Maintenance

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

- 825  Over \$200,000  
 826  \$100,001-\$200,000  
 827  \$50,001-\$100,000

- 828  \$10,001-\$50,000  
 829  \$5,000-\$10,000  
 830  Under \$5,000

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

- 831  0-3 months  
 832  4-6 months  
 833  7-9 months  
 834  10-12 months  
 835  over 12 months

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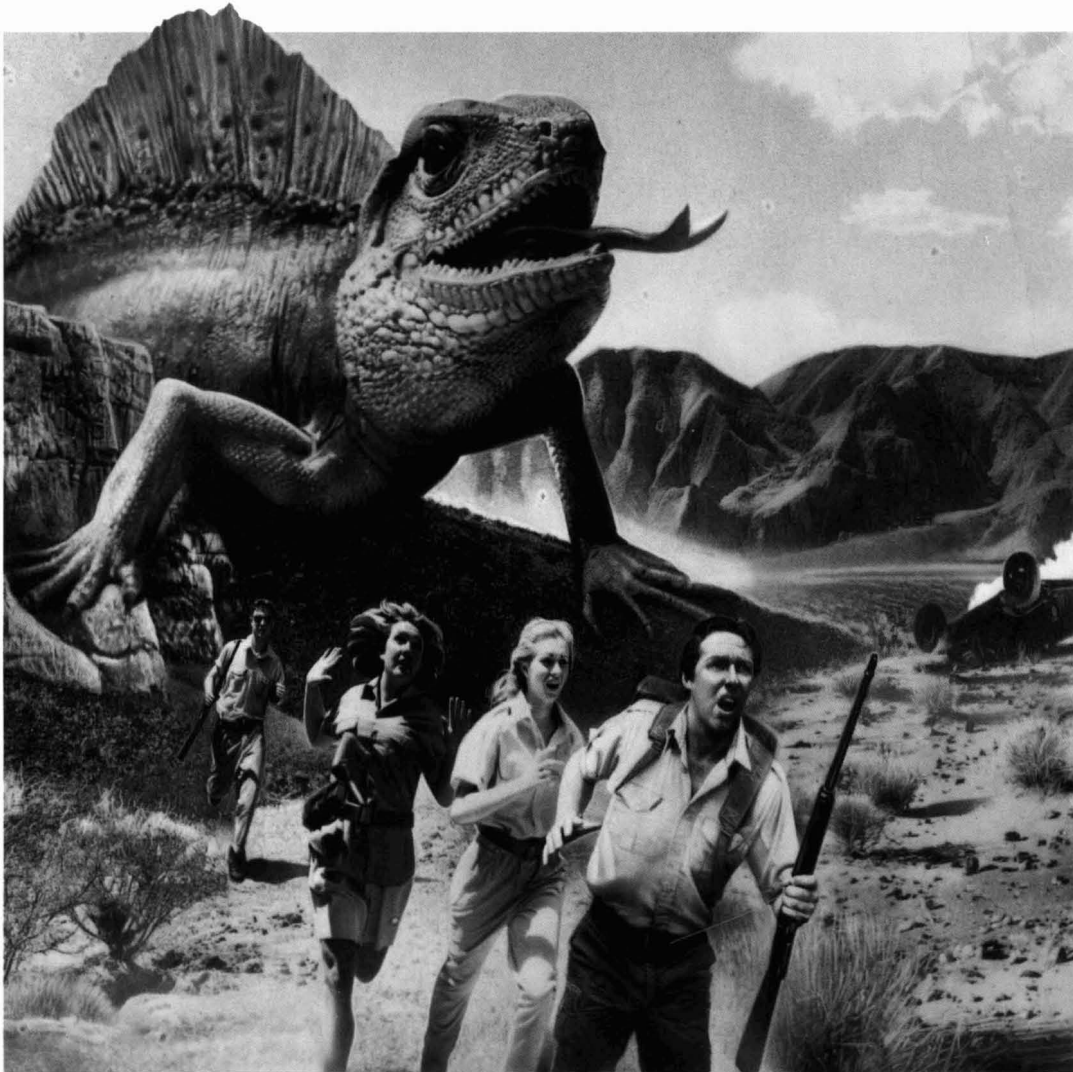
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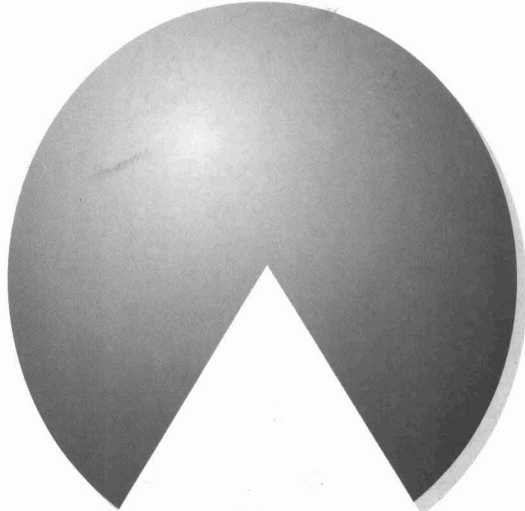
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