



Editors

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Nicole Nickerson

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- **Evaluation of UST Regulations and Practices, Yields Surprising Results - 1**
- **Submitted Abstracts from The 15th Annual International Conference on Contaminated Soils & Water - 2**
- **SWEMP 2000: series of Conferences Focus on Developmental Methods for Mineral and Energy Production - 9**
- **Kuwait Institute for Scientific Research of Soil Management Invites Expertise Around the World - 10**
- **Upcoming Events - 11**
- **Brazil Conference Seeks Participation on Geoenvironmental Research and Technology - 11**

Evaluation of UST Regulations and Practices Yields Surprising Results

ENSR Corporation recently compared the underground storage tank (UST) regulations of the eight Northeast states and the federal government. ENSR also interviewed regulators and oil companies regarding UST databases and UST practices actually being implemented in the field.

The results were intriguing. State regulations were found to vary widely, and most went far beyond the federal requirements. For example, six states require all new USTs to have secondary containment although this is not required in the federal regulations. There were numerous areas of variability in the regulations.

Interviews with eight oil companies of varying size also yielded interesting findings. For example, all but one said they require all new USTs to be double-walled with continuous interstitial monitoring, which far exceeds the federal requirements.

This evaluation is detailed in a 32-page paper that includes a comprehensive 8-page table summarizing the UST regulations of the eight states and the federal government. A beneficial feature of the table is that, in areas where the regulations are ambiguous, ENSR interviewed the appropriate regulators for clarification and reflected this information in the table. For a copy of the paper, please contact Sabina Petersen by email at spetersen@ensr.com or by telephone at (978) 635-9500.

Selected Abstracts from the 15th Annual International Conference on Contaminated Soils and Water, October 18-21, 1999, University of Massachusetts at Amherst

Category: Remediation

Remedial Process Optimization Evaluation of a Dual-Phase Extraction System

Peter R. Guest, Douglas C. Downey, Thomas A. Larson, and William A. Plaehn, Parsons Engineering Science, Inc., Javier Santillan, Ph.D., AFCEE/ERC, Patricia Rowans, AFCEE/ERD

The U.S. Air Force is implementing a non-time-critical removal action to address soil and groundwater contamination associated with a former POL storage area located at an Air Force base in California. In April 1997, a dual-phase extraction (DPE) system began operating at the site as an interim removal action. Under current land-use conditions, no completed exposure pathways to contaminated groundwater or deep soil exist. However, under future land-use scenarios, the baseline risk due to contamination in groundwater would be unacceptable to residential and industrial receptors. Natural attenuation processes are containing the migration of the dissolved petroleum hydrocarbons; however there is insufficient organic substrate available to support reductive dechlorination of trichloroethene (TCE) and contain the dissolved terminating operation of the liquid recovery system and reducing the SVE system flow rate by 20 percent. If implemented, these short-term recommendations would result in more than \$100,000 in annual cost savings, which is equivalent to 30 percent of the annual OM&M budget for the system. Long-term opportunities include pursuing a technical impracticability (TI) waiver for the source area and organic substrate addition near the down-gradient portion of the TCE plume to enhance reductive dechlorination of TCE. Long-term cost savings could be in the millions of dollars. A TI waiver would include risk-based cleanup goals for soil and groundwater that would be protective of future industrial receptors.

Surfactant-Enhanced Aquifer Remediation for DNAPL Removal

S. Laura Yeh, Naval Facilities Engineering Service Center, Leland M. Vane and A. Lynn Wood, U.S. Environmental Protection Agency (EPA) National Risk Management Research Laboratory (NRMRL), Gary A. Pope, Mojdeh Delshad, Vinitha Weerasooriya, University of Texas at Austin, Edwin E. Tucker, University of Oklahoma, Fred J. Holzmer, John T. Londergan, Varadarajan Dwarakanath, Minquan Jin, Duke Engineering & Services

Surfactant-Enhanced Aquifer Remediation (SEAR) is an innovative method for rapid removal of nonaqueous phase liquids (NAPLs), i.e., organic contaminants which exist as an undissolved organic phase, from the saturated subsurface. While free-phase NAPL may be readily removed by pumping, residual NAPL that is trapped under capillary forces will persist as a source of contamination to surrounding soils and groundwater, thereby feeding plumes and prolonging cleanup times. In SEAR, a surfactant solution is swept across the NAPL-contaminated aquifer using a modified pump and treat well configuration that is especially designed to maintain hydraulic control of the injected surfactant solution. Surfactants are selected for compatibility with the NAPL and the soil matrix, and typically require an electrolyte and a co-solvent for optimum subsurface performance. By increasing the aqueous solubility of the NAPL approximately two orders of magnitude under field conditions, and by inducing a significant reduction in the interfacial tension between the NAPL and contacting (soil/water) phases, residual NAPL contamination is flushed from the soil pores. In field demonstrations conducted to date, up to 99% removal efficiencies have been achieved with as few as three pore volumes of a surfactant solution followed by water flooding.

Category: Chlorinated Hydrocarbons

Use of Fenton-Like Oxidation for Remediation of Trichloroethylene in aqueous and Soil Systems

Katherine R. Weeks & Clifford J. Bruell, Ph.D., University of Massachusetts Lowell, Nihar Mohanty, Massachusetts DEP.

In this laboratory study, Fenton's reaction was observed in aqueous and soil slurry systems using Trichloroethylene (TCE) as the target contaminant, with the goal of maximizing TCE degradation while minimizing H₂O₂ degradation.

It was found that Fenton's reaction triggers a complex matrix of reactions involving ·OH, H₂O₂, iron, TCE, and soil organics. In soil slurries with low natural iron content, H₂O₂ alone may be insufficient to promote TCE degradation and some iron addition may be required. In soil slurries with a high fraction of organic carbon (*foc*), more iron addition may be required to initiate Fenton's reaction, as iron tends to absorb to soil organics and/or particles and become unavailable for Fenton's reaction.

In aqueous systems the optimal ratio of

H₂O₂:Fe²⁺: TCE to degrade TCE in a timely fashion, minimize costs, and minimize H₂O₂ degradation is 300 mg/L: 25 mg/L: 60 mg/L (19:1:1 molar ratio), while soil slurries with a *foc* of no more than 0.68% and a soil: water ratio of 1:5 (weight ratio) require about ten times the amount of H₂O₂, the optimal ratio being 3000 mg/L: 5 mg/L: 60mg/L (190:0.2:1 molar ratio). TCE degradation rates were observed to decrease in soil slurries with higher *foc*, while H₂O₂ degradation rates tended to increase in soil slurries with higher *foc*, most likely due to increased demand for ·OH by soil organics, depressed pH, or other oxidation processes.

Removal of Chlorinated Solvent Contamination From Fractured Bedrock

William B. Kerfoot, Ph.D., LSP, K-V Associates, Inc., and Robert Baker, Environmental Applications, Inc.

A release of tetrachloroethene (PCE) had occurred from a dry cleaner along a storm drain line containing two catch basins. The CNAPL escaped through the concrete basins and pipe joints into weathered sand and gravel deposits overlying the fractured Lindero canyon bedrock. A surface area of about 4000 square feet along the drain contained contaminated soil. Initial concentrations of PCE in groundwater during boring wells were found as high as 197,000 ug/l-ppb, indicative of CNAPL presence. Other organic compounds included trichloroethene (TCE), dichloroethene (predominantly cis-1, 2), 1, 1, 1, trichloroethane (TCA), and 1, 1 dichloroethane (DCA).

Following review of site conditions, a four-well C-Sparge system was installed into the highly fractured bedrock along the storm drain line by a local environmental consultant. The intake screens were positioned in the upper weathered fractured sandstone, just above the water table at 20ft. below grade. The discharge screens were placed in the unweathered fractured Lindero Canyon Formation, extending to 55ft. below grade.

Mean maximum initial monitoring concentrations showed 36,026 ug/l-ppb total HVOC and intake water at the top screens of the C-Sparge units 41,325 ug/l=ppb total HVOC. After twelve months of operation, mean concentrations in the monitoring wells had been reduced to below 280 ug/l-ppb total HVOC. The reduction in the monitoring wells mimicked the reduction observed entering the intake screens at the top of the recirculation Sparge wells, indicating that recirculation was established in the fractured zone contact with the weathered zone.

Category: Risk

Estimated vs. Measured Dietary Exposure of Terrestrial wildlife to Contaminants in Soil

P.N. Booth, Exponent, J.B. Medvd, General Motors Corporation, M.L. Moore, Exponent, C.E. Mackay, Exponent, R.M. Mellott, Ecological Field Services and T.C. Ginn, Exponent

Risk to terrestrial wildlife from chemical exposure typically is evaluated by comparing species-specific estimates of dietary exposure to toxicity thresholds for selected ecological receptors. In many assessments, chemical concentrations in food items are estimated from chemical concentrations in soil and other environmental media using bioaccumulation factors (BAFs). Despite the broad use of BAFs in ecological risk assessment, the uncertainty associated with concentrations using empirical data collected as part of an ecological risk assessment for a site in Michigan, USA. Soils at the site contained elevated levels of barium, cadmium, chromium, copper, lead, vanadium, zinc, and polychlorinated biphenyls. Ecological risks associated with exposure to these compounds are evaluated in four ecological receptor species: the northern short-tailed shrew (*Blarina brevicauda*), the white-footed mouse (*Peromyscus leucopus*), the American robin (*Turdus migratorius*), and the eastern screech owl (*Otus asio*). Species- and chemical specific dietary exposures are estimated using a standard food-web model that incorporates either measured or BAF-predicted chemical concentrations in food items. BAF-based concentrations for certain food items. Comparison of empirically and BAF-derived dietary exposure estimated indicates that the use of BAFs from the scientific literature substantially overestimates dietary exposure and ecological risk.

The Use of Forensic Geochemistry in Determining the Sources of Arsenic in Pond Sediments

Andy Davis, Geomega; Catherine Eby, QST Environmental

The source of arsenic in pond sediments was uncertain, but had been attributed to an adjacent waste disposal area associated with a former manufacturing facility. However, naturally occurring silver mineralization represents another potential arsenic source within the Worcester area. To elucidate the prevalence of arsenic in the pond sediment, samples of the manufacturing waste, pond sediments, and rocks from the up-gradient streambed was collected and analyzed for bulk arsenic, cadmium, iron, lead, and zinc. The samples were also examined using Electron Microprobe Analysis (EMPA); a forensic geochemical technique that allows source discrimination based on the elemental composition of representative grains in the sample.

The waste associated with the manufacturing disposal area had a lead/zinc signature with only background (14mg/kg) arsenic. The streambed rocks contained galena (PbS), arsenopyrite 46% arsenic and iron oxide, consistent with the mineralized phases in the Worcester area. Soil and sediment samples collected from the pond area typically contained higher arsenic concentrations, present in mineral phases such as iron sulfate (a weathering product of arsenopyrite), pyrite, and sphalerite. At one location in the pond, iron oxide formed when groundwater containing ferrous [Fe(II)] iron discharged and oxidized to the ferric [Fe(III)] form, subsequently precipitating as ferrihydroxide. This phase acts as a geochemical sponge, scavenging co-located dissolved arsenic (up to 144 ug/L in groundwater up gradient from the site) that also discharged into the pond.

The low bulk arsenic concentration in the former manufacturing facility waste and the incompatible mineralogy demonstrates that arsenic in the pond sediments was not from this source. Instead, arsenic in most of the sediments is due to weathering of naturally-occurring minerals, while in the hot spot area, arsenic dissolved in groundwater emanating from a source up gradient of the disposal area sorbs to, or co precipitates with iron oxide in the surficial sediments.

Category: Waste Containment Systems

A Comparative Analysis of Contaminant Migration Models Using Barrier Material Data

John L. Daniels, University of Massachusetts Lowell, Calvin C. Chien, DuPont Corporate Remediation, Vincent O. Ogunro and Hilary I. Inyang, Center for Environmental Engineering, Science and Technology (CEEST), University of Massachusetts Lowell

Waste containment facilities are often composed of barriers such as liners, grout curtains and slurry walls. Their objective is primarily to mitigate the release and transport of contaminants. It is often necessary to quantify barrier effectiveness so that risk and exposure assessment may be made. The extent to which a barrier material is effective can be assessed using analytical methods, laboratory testing and field monitoring. Obviously, there is a great deal of time and expense associated with both laboratory and field monitoring, making modeling an attractive first alternative. There are, however, numerous solutions to the well-know advection-dispersion equation that vary in accuracy and applicability, depending on initial and boundary conditions. Prudent model selection involves matching the conditions to be analyzed with the appropriate mathematical description. Results can differ significantly, complicating the appraisal of barrier performance. In assessing barrier materials, it is often desirable to determine the probable concentration of a particular contaminant as a function of time and space. In slurry walls comprising soil bentonite, for example, the hydraulic conductivity is often 10^{-7} to 10^{-8} cm²/s, depending on the porosity and extent of partitioning. Under saturated conditions, with a lead/soil-bentonite distribution coefficient of 550 mL/g, it would take approximately 700 years for 10% of the source concentration to penetrate a 1 meter-thick barrier, according to the solution provided by Ogata and Banks (1961). Unfortunately, this theoretical estimate is often not attained due to material heterogeneity and environmental stresses that degrade barrier materials as time progresses. Moreover, different estimates are produced when other models are employed. This paper addresses these differences and provides a framework for contaminant migration model selection.

A Survey of Regulations and Design Standards Employed in the Northeastern U.S.

Frank R. Sweet, P.G., L.S.P., L.E.P. and Ellen E. Moyer, Ph.D., P.E., ENSR Corporation

This paper explores underground storage tank (UST) regulations and practices in the eight Northeast states. The exploration included: a detailed review of the UST regulations and databases of the eight Northeast states; literature review; and interviews with regulators and companies to comprehend existing practices. During our research, we determined that most northeast state UST regulations and practices of the oil companies go beyond the federal requirements. However, the data strongly suggest a lack of uniformity in what the states require beyond federal level. Based on information from the states there are approximately 70,000 regulated gasoline USTs and an unknown number of unregulated gasoline USTs in the eight Northeastern states. Approximately 80% are estimated to be in compliance with the federal UST regulations. In our research we discovered significant data gaps in areas of field performance, leak detection, and points and rates of release. These data gaps would need to be addressed in order to evaluate whether current UST regulations are adequate or whether additional measures should be required. The survey may have raised more questions than it answered. For example, why are states requiring more than the Federal regulations? Why do the regulations vary so widely from state to state? Why are many oil companies doing more than most states require? Why isn't government capturing performance data on USTs and leak detection systems? Based on the results of the survey, we believe that a group of stakeholders, with diverse backgrounds, should review current UST regulations and practices to determine their effectiveness. Perhaps UST regulations should be managed uniformly like gasoline and air regulations, on a Federal basis. ENSR believes society would benefit from a current stakeholder evaluation, given that the 10-year UST regulation cycle is complete (and technology greatly improved), to assess if everyone is on the right preventive track.

Category: Sediments

PAH Degradation in Contaminated East River Sediment Materials Using Bioslurry Technology

John A. Glaser, Paul McCauley, Ronald Herrman, U.S. EPA, ORD, NRMRL, and Majid A. Donsani, IT Corp. Cincinnati, OH.

Contaminated sediments sampled from the New York Bay area near the East River between New York, NY and Jersey City, NJ were selected for a series of treat ability studies by bioslurry treatment. The sediment solids content averaged 41.8% with a total organic carbon content of 42.7g/kg and density of 1.33 kg/L. Experimental design of the study focussed on the availability of low molecular weight carbon sources (i.e. molasses and soy bean oil) to assist in the growth of PAH degrading microorganisms along with the required nitrogen and phosphorous nutrients. The total PAH removal over the 6-week study period for the bench-scale reactors ranged from 70 to 81 percent in the various test reactors. Small ring PAHs consistently had larger reductions during the study (57 to 74 percent). Pilot-scale reactor removal was less for both small and large ring PAHs. Small-ring PAHs represent 2- and 3- ring PAHs, whereas large-ring PAH represent 4-, 5-, and 6- ring PAHs.

Inorganic nutrients and 0.1 weight percent soybean oil showed the largest reduction of total PAH concentration averaging 77.5%. Small and large ring PAHs concentration changes averaged 87 and 68.5 percent, respectively. Inorganic nutrients and 0.1 weight percent molasses consistently showed the second largest PAH reductions with total PAH reduction averaging 75.5 percent. Small ring and large ring PAHs concentrations averaged 86.5 percent and 66.5 percent, respectively. The use of the soy bean oil and molasses appears to support the conjecture that the leveling of microbial activity in soil biotreatment systems may be assisted by the addition of carbon substrates which continue to assist the growth of the culture of PAH degraders encountered under treatment conditions.

Category: UXO

Unexploded Ordnance (UXO) Detection, Discrimination, and Identification Using Geophysical Methods – A Review of the State of the Art

Ernesto Cespedes, Ph.D. and Dwain Butler, Ph.D., Us Army Engineer Research and Development Center, Environmental Laboratory, Jim McDonald, Ph.D., U.S. Army Engineer Research and Development Center, Cold Regions and Engineering Laboratory

The removal of UXO from formerly used defense sites (FUDS) and from base realignment and closure (BRAC) installations is a costly and technically challenging problem. Millions of acres throughout the United States are involved and cleanup is projected to cost hundreds of billions of dollars using current technologies. Historically, UXO cleanup efforts have relied primarily on magnetometers to detect and locate buried ordnance; a technique commonly referred to as "mag and flag." Although proven to be very effective in detecting buried ferrous objects in a wide range of environments, this technique provides very limited information about the size, shape, material composition, and depth of the buried objects. As a result, it is extremely difficult to reliably discriminate buried UXO from scrap metal or geologic anomalies using only this technology. In an effort to improve UXO environmental remediation capabilities and reduce costs, researchers from the Department of Defense, industry and universities have been actively developing advanced geophysical methods, including sensing, modeling, analysis, location and display technologies. This paper describes recent progress in these areas, with emphasis on phenomenology modeling and analysis of UXO signatures; advanced geophysical sensors, including electromagnetic induction; and ground-penetrating radar; and integrated systems such as the Navy's Multi-Sensor Towed Array Detection System (MTADS)

Category: Cold and Winter Remediation

Plant Assisted Remediation, an Option for Cold, Remote Sites

C.M Reynolds. USA-CRREL, Hanover, NH.

Contaminated soils may present human and environmental health risks at installations built by the US Departments of Defense. In cold regions many installations are remote. Mobilization and demobilization expenses, short treatment seasons, and limited infrastructure at these sites result in high cleanup costs and limit the suitability of many treatment options. Rhizosphere-enhanced biotreatment-a low-cost, easily implemented treatment technology that relies on stimulating indigenous microorganisms-overcomes many of the limitations, but wider application is hampered by sparse information on which to base predictions for using this on a range of soil-contaminant-climate scenarios.

In cold regions it is often difficult to confirm contaminant decreases due to relatively slow biodegradation rates and the inherent heterogeneity of contaminant distribution. Because rhizosphere-enhanced treatment relies on changes in soil microbiology, using microbial changes may be a practical confirmation tool. We have demonstrated successful rhizosphere-enhanced biotreatment at a petroleum-contaminated site in Fairbanks Alaska and our data suggested that decreases in contaminant concentrations were preceded by measurable changes in soil microbial ecology. Initial data suggest that we may be able to sufficiently characterized soil microbiology and use this to monitor treatments.

Category: Analysis and Fate

The Fate and Transport of Methyl tert-Butyl Ether (MTBE) in Small Surface Spills of Gasoline

Andrew Stoking, P.E., Shane McDonald, P.G., Bryn Woll, Michael C. Kavanaugh, Ph.D., P.E., Malcolm Pirnie, Inc.

Peer Reviewed by: Randall Charbeneau, Ph.D., P.E.

While there are many possible mechanisms for the introduction of gasoline components, and specifically MTBE, into the environment, the most significant mechanisms are likely:

- * evaporative emissions into the atmosphere during combustion and fueling;
- * underground fuel tank (UFT) releases to the soil and groundwater during storage, transport, and usage of gasoline;
- * exhaust and fueling emissions to surface waters resulting from recreational activity on reservoirs (esp. 2-stroke engines).

However, it has been suggested that numerous small, discrete surface spills of gasoline can cumulatively result in wide spread contamination of groundwater by MTBE (Zogorski et al., 1999; Maine State Agencies, 1998). This conclusion was based on several cases where MTBE was detected in groundwater and there were no known leaking underground storage tanks in the immediate vicinity (Maine State Agencies, 1998). In addition there have been several reported sites where small spills are known to have occurred and coincide with the detection of MTBE in groundwater. Small surface spills of gasoline specifically refer to those spills, which occur during automobile fueling onto a paved surface or during small engine repair/cleaning onto soil (e.g., emptying a lawnmower prior to the onset of winter, or disposing of gasoline used to clean car parts or other engine parts).

The purpose of this paper is to determine whether small spills of gasoline, under a variety of environmental and release settings, will result in a significant threat to groundwater relative to the threat posed by leaking underground fuel tanks (LUFTs). Malcolm Pirnie developed a conceptual model as a tool to understand the fate of gasoline following a small spill. This conceptual model is divided into five stages: 1) initial release; 2) surface evaporation from pooled release; 3) infiltration of release into the subsurface; 4) transport of the release through the vadose zone to the groundwater; and 5) dissolution of

mass reaching the water table into the groundwater. We used published analytical and/or numerical models to estimate the mass to MTBE one could expect to enter and leave each stage.

Category: TPH

Bioremediation of Diesel Contaminated Soil under Denitrifying Conditions

C. Rodriguez, E Diaz, University of Puerto Rico, R. Alvarez, On-site Environmental and A. Massol-Deya, University of Puerto Rico

Spills and leaks of petroleum hydrocarbons have resulted in the contamination of soil and water. Microbial degradation of hydrocarbons, by either naturally occurring processes or engineered systems, has been successfully used to reduce concentrations of these pollutants to environmentally safer levels. In cases where oxygen availability limits microbial activity, microorganisms in biodegradative processes could employ alternative electron acceptors such as nitrate. In this study we examined the effectiveness of anaerobic nitrate respiration to remediate saturated soil contaminated with diesel fuel. Microcosm systems were prepared with soil samples obtained directly from a diesel-contaminated site in San Juan, PR. One system consisted of soil amended with a commercially available denitrifying petroleum degrading bacteria and a nitrate solution (30 mg of nitrate per kg). Two additional systems were also amended with nitrate solution (10 and 30 mg of nitrate per kg) to stimulate indigenous denitrifying populations. Microcosms were incubated in the dark at 20°C. Finally, substrate degradation and denitrifying population densities were subsequently examined by total petroleum hydrocarbon (TPH) analysis and the most probable number technique (MPN) respectively. In general, degradation of diesel was observed in all nitrate-treated systems. However, the non-seeded 30 mg of nitrate per kg microcosm showed the highest degradation activity, with initial TPH levels of 4,596 mg/kg dropping to less than 981 mg/kg after 35 days incubation. Concurrently, denitrifiers increased in this system from 1.3×10^8 to 1.7×10^9 MPN/g of soil. These results suggest that biostimulation of indigenous populations may induce *in situ* anaerobic bioremediation of this and other similarly contaminated sites.

Category: Radionuclides

Construction and Operation of a Chemical Extraction Soil Treatment Plant for Remediation of Uranium Contaminated Soil

Jeffrey P. Kulpa and John E. Hughes, RMI Environmental Services, Ward E. Best, U.S. Department of Energy.

At the RMI Decommissioning Project (RMIDP) in Ashtabula, Ohio, soil remediation in the approved project baseline was estimated to cost over \$45 million of total project cost of \$150 million. In an effort to reduce project costs and shorten project schedules, the RMIDP has undertaken an initiative to design and build a chemical extraction soil washing facility. The facility was constructed between September 1998 and February 1999. The RMIDP soil washing initiative has included bench scale testing to establish the viability of the process, pilot scale testing to refine engineering approaches and to answer technical questions regarding reliability of plant operations, and finally design and construction of a first of its kind soil washing plant. The RMIDP soil washing plant uses 0.2M-carbonate solution, which is heated to approximately 155°F and contacts the soil for approximately 90 minutes to leach the uranium from the soil. The process has been proven to result in contaminant removal efficiencies of approximately 85% and volume reductions in excess of 90%. The chemical extraction technology provides a remediation approach for the 40,000 tons of uranium-contaminated soil at the RMIDP in Ashtabula, Ohio. The soil washing approach provides projected savings of approximately \$300 per ton when compared to ship and bury costs. This paper describes the process flow for the carbonate extraction plant and provides detailed description of monitoring conducted to ensure that clean soil meets regulatory requirements to be used as clean back fill in restored areas.

**Series of Conferences Focuses on Developmental Methods for Mineral and Energy Production:
*The International Symposium on Environmental Issues and Waste Management in Energy and
Mineral Production (SWEMP 2000) Calgary, Canada from May 30 to June 2, 2000***

The basic aim of this series of conferences is to contribute to the development of methods and technologies for assessing, minimizing and preventing environmental problems connected with mineral and energy production.

By offering a multi-disciplinary agenda, the conference will appeal to professionals working in mining, oil and gas, environment, waste management, research and government, and will help promote technology transfer, effective policy decisions and international cooperation. The first conference of this series was held in New York (1990); followed by a second, third, fourth, and fifth in Calgary (1992), Perth (1994), Cagliari (1996), and Ankara (1998) respectively. The next two conferences have been scheduled : Calgary Canada (2000) and Cagliari, Italy (2002).

Conference Themes:

- Sustainable mineral and energy resources development-the philosophy.
- Provincial (State) and Federal Environmental regulations.
- Environmental impact assessment and permitting
- Environmental compliance in third world countries *vis a vis* social, cultural and economic impact
- Environmental issues in underground mining
- Environmental issues in oil sands and oil shale developments
- Improving coal processing, and utilization technologies for a cleaner environment
- Current and emerging waste management practices
- Tailings disposal
- Underground waste disposal
- Uranium mine waste
- Electric utility industry waste
- Petroleum industry waste
- Waste characterization and monitoring
- Resource recovery from industrial waste
- Excavation, transportation, and disposal of overburden
- Mine site closure, acid mine drainage, decommissioning and reclamation
- Role of the computer in solving environmental issues
- Geographic information systems (GIS) and environmental issues
- Waste and pollutant minimization; technology development need

SWEMP 2000 Environmental Conference is also inviting anyone interested in submitting papers that could be used for the Calgary, Canada conference.

For additional information please contact:

Dr. Raj K. Singhal

P.O. Box 68002

Crowfoot Postal Outlet

28 Crowfoot Terrace N.W.

Calgary, Alberta, T3G 1Y0 Canada

Tel: (403)239-3849

Fax: (403)241-9460

Kuwait Institute for Scientific Research of Soil Management Invites Expertise From Around the World

International Symposium on the Classification and Management of Soils in Arid Regions, April 23-25, 2000, Institute for Scientific Research, the State of Kuwait

Organized by:

*Kuwait Institute for Scientific Research (KISR)
Public Authority for Agriculture Affairs and Fish Resources (PAAFR)
Kuwait Foundation for the Advancement of Sciences (KFAS).*

Recently, a state-of-the-art soil survey of Kuwait was completed. A reconnaissance soil survey was completed for the entire state of Kuwait at a scale of 1:100,000. Soil, interpretation and current land-use maps were produced. The results of the reconnaissance survey were used to identify 200,000 ha having potential for irrigated agricultural development. The area was surveyed at a semi-detailed scale of 1:25,000 using USDA standards. The coinciding of the proposed symposium with the launching of the Soil Survey of Kuwait will provide the participants with opportunities to share scientific ideas about the soils from arid regions.

Symposium Structure:

The symposium will include:

- * Launching of the Soil Survey of Kuwait.
- * Plenary papers by invited speakers on various symposium topics.
- * Volunteered papers for oral presentation selected by the scientific committee of the symposium.
- * Volunteered poster presentations selected by the scientific committee of the symposium.
- * A post-symposium tour to observe the soils of Kuwait, in particular, oil-polluted soils.

Objectives:

- * To share local experience on soils with scientists from all over the world.
- * To discuss state-of-the-art technologies for soil management in arid regions.
- * To present recent soil survey information, including field and laboratory techniques for the launching of the Soil survey of Kuwait, including soil maps, thematic maps, an integrated database and analytical information.
- * To disseminate scientific knowledge about the soils of the arid regions for a better understanding of their formation, characterization, classification, distribution and capability for sustained land use at local, regional and international levels.

For additional information concerning this symposium please contact:

Dr. Samira A. S. Omar
Chairperson, Scientific Committee
International Symposium on the classification and Management of Soils in arid Regions
Aridland Agriculture Department
Kuwait Institute for Scientific Research
P.O. Box 24885, Safat 13109, Kuwait
E-mail: somar@kisir.edu.kw
Tel. & Fax. (965)483-4198

Upcoming Events

March 3, 2000: Tropimar Club and Convention Center, Puerto Rico. "Environmental Situation in Puerto Rico: A Challenge for the New Millenium" seminar. For information please contact; Ricardo Alvarez, PE, REM, On-Site Environmental, inc. P.O. Box 249, Dorado P.R. 0646. Tel. (787) 278-0560 & Fax. (787) 278-0560.

March 20-23, 2000: DoubleTree Hotel, Mission Valley, San Diego, CA. Tenth Annual West Coast Conference on Contaminated Soils and Water: Analysis, Fate, Environmental and Public Health Effects, and Remediation. Sponsored by AEHS. For more information contact; Heather McCreary at (413)549-5170.

Call for Papers

We invite you to submit an abstract for consideration for the **16th Annual International Conference on Contaminated Soils, Sediments & Water**, October 16-29, 2000 at the University of Massachusetts, Amherst. Abstracts must be submitted by **February 7, 2000**.

For further information contact:

Environmental Health Sciences
N344 Morrill Science Center
Amherst, MA 01003
email: dleonard@schoolph.umass.edu
telephone: 413-545-1239

* information can also be found at: <http://www.aehs.com/ECC/echomepage2000.html>

Brazil Conference Seeks Participation on Geoenvironmental Research & Technology

5Th International Symposium on Environmental Geotechnology and Global Sustainable Development

The School of Engineering – Universidade Federal de Minas Gerais, is pleased to announce researchers, policy-makers, design engineers from academia, industry, and governmental/global agencies to participate in the 5th International Symposium on Environmental Geotechnology and Global Sustainable Development. It will be held in Belo Horizonte, Minas Gerais, and Academic Cultural and Historical Center of Brazil, August 17-21, 2000. Several representatives from mining companies, government agencies, universities have collaborated to plan this Symposium.

Geoenvironmental research advances, technological innovation, appropriate technology transfers are important elements of sustainable development. This symposium is appropriately scheduled to address relevant technical and policy issues, to provide a forum for discussion and to exchange information. The complexity of environmental issues has necessitated the adoption of integrated approaches to the formulation of possible solutions.

Exhibition space will be rented to companies and agencies interested in displaying their equipment, technologies, services, and/or capabilities related to in-site testing, site characterization, drilling, sampling, soil reinforcement, and geophysical methods. Details concerning the application for obtaining

an exhibit booth, contractual agreement, and the terms of conditions are contained in the exhibitor prospectus, which will be available, soon, in the home page of this event. A series of one-day technical short courses will be held two days before the symposium. These courses cover diverse topics such as environmental monitoring. Noted experts in their respective fields will teach all the planned short courses.

For more information on this Symposium please contact:

Prof. Hilary I. Inyang, Ph.D.
University of Massachusetts
One University Avenue
Lowell, MA 01854, USA
Tel: (978)934-2285
Fax: (978)934-3092
E-mail: Hilary_Inyang@uml.edu