HAZARDOUS WASTE

Issues, Problems, Solutions

WATER for IDAHO

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Hazardous Waste Issues

State of Idaho Viewpoint

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Abstract not available.

Department of Energy Viewpoint

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The U.S. Department of Energy (DOE) is committed to achieving compliance with laws, regulations, and agreements aimed at protecting human health and the environment. To realize this commitment DOE will focus its resources to: (1) assess and cleanup inactive waste sites and facilities; (2) continue safe and effective waste management operations but emphasize systematic minimization of waste generation; and (3) coordinate aggressive applied waste research and development (R&D) programs keyed to developing innovative environmental technologies to yield permanent disposal solutions and lower costs.

DOE established an agenda for compliance and cleanup in it's Five-Year Plan for Environmental Restoration and Waste Management published in FY1989. The plan presented DOE's commitment to establish a consolidated approach to environmental restoration and waste management. The FY1990 revision of the plan is nearing completion. A number of accomplishments have been made in the past year. Within the department responsibilities and activities have been defined to facilitate effective implementation of the plan. A number of interagency agreements have been signed to assure timely identification of problems and transfer of technologies to solve environmental and waste management problems. An aggressive applied R&D program has been established which involves universities, national laboratories, industry and other federal agencies. The DOE is working very hard to identify and implement the corrective activities that are required to bring facilities into compliance with federal, state and local regulations. Significant resources have been committed to identify the compliance issues and solutions for the Rocky Flats Plant, Savannah River, and INEL. Road maps are being developed for Rocky Flats to identify technology requirements and interfaces between production, waste management, and environmental restoration. In some cases technology exists. When technology is not available, containment may be required (e.g. containment of contaminated ground water). There are a number of issues relative to transuranic waste disposal at WIPP. The major issues are evolving RCRA mixed waste regulations, issuance of EPA disposal standards (40CFR191), and lack of legislative land withdraw. The mixed waste regulations have a significant impact on both restoration and waste management activities. They require parallel solutions, imposing a burden on manpower, budget and schedule. Advanced technology to better manage future waste

Environmental Protection Agency Viewpoint

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The Resource Conservation and Recovery Act (RCRA) provides a "cradle-to-grave" waste management system. It includes tracking functions, handling and operating standards, and strong enforcement. Amendments to RCRA in 1984 broadened the program by adding corrective action authorities and restricting land disposal of wastes. The amendments promote waste minimization by requiring waste generators to certify or report their waste reduction activities.

The RCRA program of waste manifests, permit issuance, compliance with land disposal restrictions, and the complexities of state/federal privacy has resulted in a complicated regulatory climate. This can be avoided or minimized through pollution prevention practices that reduce or recycle wastes. Proposed legislation will reinforce pollution prevention as a national policy.

In the Superfund cleanup program, our experience is that cleanups are enormously expensive ($10-29 million per site) and time-consuming (3-5 years). On-site treatment is preferred to off-site disposal, and this requirement is pushing the limits of technology. The cleanup process is further lengthened by the policy of "enforcement first" that requires responsible parties to pay rather than tapping the Fund.

The Superfund program is being streamlined to reduce the time between site discovery and cleanup. Pollution prevention is a long-term solution to avoiding contaminated sites in the future. Aggressive enforcement is maximizing the leverage that Region 10 is getting out of the fund. Improved working relationships with the states is also increasing efficiency and promoting the total cleanup effort.

Environmental Viewpoint

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The Snake River Alliance is an Idaho citizens organization working for peace, the reversal of the nuclear arms race, and responsible solutions to nuclear waste.

Past nuclear weapon production has left both hazardous and radioactive contamination at Department of Energy sites nationwide. Environmental problems in the bomb plants continue today.

The Idaho National Engineering Laboratory must cleanup hazardous and radioactive contamination and is today a Superfund site with permitting and RCRA problems. There is an apparent reorientation of INEL's mission.

DOE's environmental problems reached such catastrophic proportions because nuclear weapon production has been carried forward behind a veil of national security/secrecy. Until recently, the Department of Energy has claimed exemption from major environmental laws, and compliance with those laws remains more rhetorical than real.

Where do we go from here? "Cleanup" of nuclear sites must be defined. Citizens and regulatory agencies must demand and ensure that the DOE comply with all environmental laws and regulations. Where any question of applicability remains, the laws must be amended. The Department of Energy must adequately plan and Congress adequately fund short-term control and long-term stabilization and "cleanup" of environmental hazards at DOE sites. The public must be involved in all cleanup discussions and decisions, and certain measures must be taken to facilitate that legally required participation. The federal government must reexamine its assumption that nuclear bombs can be made safely.

Industrial Viewpoint

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Hazardous waste is not only an environmental hazard, it is a waste of resources. It presents potential liability from generation, storage, treatment and disposal. It represents loss of material to the processor. It requires monumental effort to understand and comply with state and federal regulations governing hazardous wastes.

Industry's challenge in the hazardous waste area requires knowing and understanding the regulatory scheme, and working with the regulators to develop regulations that reasonably implement the intent of Congress and are based upon sound technical principles and a recognition that not all hazardous wastes present the same degree of risk. Industry must understand the liabilities associated with being a generator of hazardous waste and that it ultimately may be best served by staying out of the hazardous waste regulatory system through waste minimization.

Hazardous waste management is increasingly moving away from end-of-pipe treatment to in-process controls that reduce the amount and toxicity of waste generated. This includes waste reduction through source reduction, product substitution, recycling and reuse, inventory control, and good housekeeping. The rewards are both economic and reduced liability.

Waste minimization cannot always reduce the generation of waste to zero. The handling of residual wastes requires a realistic appraisal of technology required for the treatment and disposal of waste in the context of a rational waste management hierarchy. There has been a recognition by industry and government of the need for incineration capacity in the region as well as a need for metals recovery and technology transfer. Waste exchanges provide another outlet for wastes that serve as raw material to another's processes.

Often it seems that the regulatory system itself is a barrier to doing the right thing, i.e., to responsibly reuse or recycle hazardous waste. Industry will work within the present hazardous waste system, but will also work within the system to develop environmental regulations that encourage recycling and waste minimization and reduce the liabilities associated with the land disposal of hazardous waste.

Regulatory Viewpoint

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Within Idaho, the Hazardous Materials Bureau has recently assumed the duties of hazardous waste regulation from the federal Environmental Protection Agency. A state hazardous waste program has several advantages over a federal program. First, a state program has more to say over which companies and facilities receive attention. Second, the primary goal of the Hazardous Materials Bureau is to protect human health and the environment through enforcement of hazardous waste regulations, although bureau policy takes into account good faith compliance efforts that companies make to solve environmental problems. The state program will be faster, more responsive, more accountable, meet the minimum standards set by the federal government, and provide better overall service to people of Idaho.

There are several waste management principles that form the basis for hazardous waste regulations. The first principle states that the entity that generates hazardous, solid, or nuclear waste should be fully responsible for every aspect of dealing with that waste, including any future environmental damage. By changing the law to keep liability with the producer of the waste, clean-up costs will fall on those who have contributed to the problem rather than the state or federal government. In addition, this concept discourages the generation of waste and provides an incentive for reprocessing and reuse of waste products.

The second principle found in waste management regulations is that those producing or managing less waste should face less regulation. This regulation makes a lot of sense in Idaho where a large number of small businesses exist. Thus, the bureau can concentrate their regulatory efforts on firms where larger amounts of waste are being managed improperly.

The third major principle shaping today's environmental laws states that the best waste management option is to avoid the production of waste. Waste minimization is a concept finding wide acceptance throughout all levels of government and industry. Corollary to this principle is the principle that waste reduction must be a real reduction, not just a change in disposal methods.

Industry Perspectives

Land-Bans

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Abstract not available.

Agrichemical Use: Potential Hazards

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Abstract not available.

The Ultimate Goal of Zero

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In order to understand what we're facing today in the area of hazardous wastes issues, problems, and solutions, we need to look back to see where we have come from. This enables us to gain a perspective on how far we have come in terms of real and perceived progress. In 1970, there was no definition of toxic waste, chronic health effects were largely ignored, waste dumping was indiscriminate, air emissions were poorly controlled, water discharges were concerned primarily with visible contamination, and dilution was widely accepted as a satisfactory means of disposal. The chemical industry took the position that industry was the best judge of what actions were safe and environmentally responsible and the public was ignored. The public accepted this subservient position. Things have changed since then. The public is demanding not only the "right-to-know," but the right to approve decisions which industry makes involving the environment.

Industry has made significant progress in 20 years, but we have been dealing with the easier problems. Public tolerance and perceptions have changed. Public polls tell us that pollution is evil, the only way to stop polluters is with penalties, the public wants zero risk and threat, all chemical industry is negligent, and that industry must pay for negligence. Attitudes and actions of the chemical industry have, in part, led to this public perception. Some of these attitudes include a belief that everything that is not specifically prohibited is permitted, the longer we delay cleanup, the better off we are on a net present value basis, and the public will have to understand that the production of toxic wastes are necessary to an industrial society. If industry persists with this type of thinking, we will be perpetuating the kind of decision-making which led us into the current high environmental cost position.

Industry must change its vision with respect to the need for more aggressive improvement plans. In many cases, this is happening. This vision for new environmental, safety, and health perspectives must take us in the direction where we develop and market only products which benefit society without unacceptable risks to any group. Major environmental, safety, or health incidents cannot be allowed to happen. Industry must encourage outside peer review of its decision-making processes and proposed actions in environmental, safety, and health matters. Companies must know first whether their products, processes, plants, or people, may be causing potential problems. Companies must maintain a continuing multimedia toxic waste minimization program

Federal Facility Compliance

Environmental Management at the Idaho National Engineering Laboratory

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Transition of ECO Activities to Line Management

From the formation of the ECO, it was recognized that continuing environmental compliance must be a line management function. The transition effort has focused on retaining management tools and skills developed through the ECO effort to enhance existing line management capabilities.

Early this year, DOE-ID reorganized to parallel the DOE new Headquarters organization, which established a program office for environmental restoration and waste management. The new office of Environmental Restoration and Waste Management at DOE-ID assumed responsibility for many remaining ECO tasks. The team leaders and most personnel who were working on ECO tasks continue under the reorganization. In this way, DOE-ID hopes to maintain the momentum created from its ad hoc task force for self assessment in integrating compliance into the organizational culture.

Using Environmental Compliance Activities as Management Tools

Efforts to integrate environmental compliance into line management responsibilities have shown that compliance activities can often be useful management tools. The air emissions inventory conducted by the ECO Permits team provides a good example of putting environmental compliance to work as a management tool. The initial self-appraisal phase of ECO determined that the air permits at the INEL were not being prepared or negotiated efficiently. We determined, in concert with the State, that the permitting process could best be improved by obtaining INEL-wide information on emissions sources and moving toward the concept of permits to operate INEL facilities.

The first step taken by the permits team was to document the baseline emissions from INEL facilities. The baseline effort was conducted in three phases: a hands-on site survey to determine all the potential emissions sources (root stacks, tank vents, etc., at each of the nine principal operating areas), a second round of data gathering on sources

Characterization and Remediation of Past Practice Waste Units at the Hanford Site--An Engineering Perspective

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The Hanford Site was acquired by the Federal Government in 1943 for the construction and operation of World War II plutonium production facilities. The site encompasses approximately 560 square miles of semiarid land within the Columbia River Basin in southeastern Washington. For over 20 years, The Hanford Site facilities were primarily dedicated to national defense plutonium production and the associated waste management. In later years, programs at the Hanford Site have become increasingly diverse, including advanced reactor research and development of renewable energy technologies. The site is owned by the U.S. Department of Energy. Westinghouse Hanford Company is the present site operations and engineering contractor.

The Hanford Site facilities are centralized in numerically designated areas and include nuclear reactors, fuel fabrication plants, chemical processing plants, and waste management facilities. The reactor facilities in the 100 Areas are situated along the Columbia River. The reactor fuel processing and waste management facilities in the 200 Areas are located on a plateau about seven miles from the river. The 300 Area is just north of the City of Richland and contains the reactor fuel fabrication facilities and research and development laboratories. The 1100 Area is situated in the northern end of the City of Richland and contains maintenance and transportation facilities for the Hanford Site.

The Hanford Site contains more than 1,100 identified waste management units (including both designed waste management facilities and unplanned releases). These units will be investigated and remediated over the next 30 years in accordance with Federal and State environmental statutes and regulations, as outlined in the Hanford Federal Facility Agreement and Consent Order. Over fifty treatment, storage, or disposal groups must be permitted and/or closed in accordance with the Resource Conservation and Recovery Act of 1976 (RCRA) and the State of Washington Hazardous Waste Management Act. In addition, over 1,000 past practice units must be investigated and cleaned up if necessary. This paper will focus on the process by which past practice units are grouped, investigated, and remediated.

and Washington State Department of Ecology will jointly decide which will serve as the lead regulatory agency for each operable unit.

This paper will provide a detailed discussion of progress made to date on the first six operable units and will include descriptions of contaminants and environmental media of concern, conceptual exposure pathways, investigative techniques, and lessons learned from the initial phases of the remedial investigations.

Air Force Issues and Answers

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HISTORY: Mountain Home Air Force Base was established in 1943. For the remainder of World War II, it served as a base for several different bombardment groups. The base was deactivated twice after the war, once in Fall of 1945 and again in 1950. From 1951 through 1953, Mountain Home Air Force Base served as a training base for Aerial Resupply and Communications operations. From 1965 through the present, Tactical Air Command has been in control of the base.

The 366th Tactical Fighter Wing was assigned to Mountain Home Air Force Base in 1972. The mission of the 366 TFW is to train and maintain tactical fighter air crews ready to deploy world-wide. Since its inception, the major aircraft stationed at Mountain Home AFB include the B-24, RF-4C, F-111A, F-111F and EF-111A, an electronic jamming aircraft. From 1960 to 1965, Mountain Home AFB provided support for three Titan I missile complexes. The aircraft currently flown by the wing are the F-111A and EF-111A.

WASTE: Mountain Home Air Force Base generates, stores and transports for disposal, a variety of hazardous wastes. Wastes generated are no different than those associated with any major aircraft generation process and include spent solvents and diluents, paint solids and slops, halogenated and nonhalogenated solvents and some chemotherapeutic agent wastes. Petroleum, oil and lubricating products are not routinely disposed of as hazardous waste. POL products are, in general, recycled or reclaimed.

PROGRAM MANAGEMENT: Management of wastes at Mountain Home Air Force Base is a group responsibility. Commanders at all levels actively participate in the Environmental Protection Committee which reviews all compliance issues. Representatives of the Legal Office and Bio-Environmental Engineering meet weekly with the Base Environmental Coordinator to review on-going projects. An aggressive waste minimization program is in place.

Proactive Hazardous Materials Management on Public Lands

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The BLM became involved with hazardous materials management in 1981 in response to the EPA's request for a list of potential problem sites. This list included mostly illegal promiscuous dump sites. In 1982, a number of livestock were killed from ingesting lead mill tailings from an abandoned mill site in eastern Idaho. Subsequently, the BLM expended about $150,000 to reclaim the site in 1983-84. At that time hazardous materials management was handled through the BLM's soil, water, and air program. In 1986, the BLM established a separate hazardous materials management program. Idaho's first budget was less than $50,000. In 1990, Idaho's base budget for hazardous materials management is about $550,000. Funding for special projects is accommodated on a case-by-case basis. In 1989, for example, Idaho BLM spent over $900,000 on special site assessments and cleanup projects. The BLM in Idaho completed detail studies on two landfills in Idaho and has responded to numerous illegal dump sites containing hazardous waste. The BLM currently funds a cooperative program with the State of Idaho to improve the management of hazardous material on public lands. This includes a full-time position at the State Division of Environment, Bureau of Hazardous Materials. The BLM has a bureau wide contract for conducting compliance inspections at a number of landfills throughout the West. We are finding that some of the inspections previously conducted by our employees and state inspectors have been less than desirable. We hope to work with the State in improving the quality of landfill inspection. The Idaho BLM is emphasizing a proactive hazardous materials program. Hazardous materials problems are inherently dangerous and expensive, therefore, we believe proactive management is the only prudent approach.

Innovative Technologies

Issues Associated with Solidification/Stabilization As a Waste Treatment Technology

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Solidification/stabilization (S/S) technology involves the use of additives (e.g., portland cement, fly ash, cement kiln dust, silicates, and others) to treat hazardous waste. The technology has been used for 30 years or more, but recent regulations and other factors have caused an increased interest in the technology. Advantages and disadvantages of S/S vary with the process, the additives, the waste, site conditions, and other factors. There are technical and regulatory factors which affect its application and how it will be applied in the future. This presentation will discuss these factors and other issues which are important in evaluating, selecting, and implementing S/S as a waste treatment alternative.

Use of Immobilized Microorganisms to Degrade Hazardous Chemicals in Ground Waters and Subsurface Soils

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Specific objectives of the research program we will discuss are (*a*) to encapsulate pollutant-degrading bacteria within microbeads (5.50 μm diameter) of various polymeric matrices, (*b*) to determine whether or not catabolic activities of the microencapsulated cells can be maintained, and (*c*) to determine differences in survivability and degradation rates between free and microencapsulated cells under *in situ* aquifer conditions. Ultimately, we will determine if active, bacteria-loaded microbeads can be distributed within sand-gravel and fractured basalt aquifers. For initial experiments, a pentachlorophenol-degrading *Flavobacterium* was immobilized within microbeads of agar. This was accomplished by dispersing a suspension of catabolically active cells in 45°C agar through a low-pressure nozzle into cold water where solidification of the agar occurred. Beads of 5-100 μm diameter were collected, and incubated within batch microcosms containing various subsurface soils and water obtained from the University of Idaho Ground Water Research Site. Microencapsulated *Flavobacterium* cells maintained their ability to degrade pentachlorophenol better than free cells under these conditions which simulated the *in situ* aquifer environment closely. Our results indicate that *in situ* destruction of environmental pollutants using microencapsulated microbial cells is a realistic goal.

Plasma Processing of Hazardous and Radioactive Wastes

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A plasma is a highly ionized gas, occasionally referred to as the "fourth" stage of matter. Plasma can be generated by a variety of techniques and occur over a wide range of pressures and energy levels. For the purposes of this discussion, the term "plasma" will be limited to plasmas at atmospheric pressure and temperature from 5,000 to 15,000 K, generated by electric discharges.

Plasma processing is a unique, innovative, and very promising waste treatment technology. It is believed that this technology will be particularly effective in the treatment of mixed (i.e., contaminated with both radioactive and hazardous components) wastes and soils. A plasma furnace can achieve: (1) the highly efficient destruction of organics; (2) volume reduction; and (3) the formation of a high integrity final waste form.

Waste subjected to a plasma torch is exposed to extremely high temperatures, virtually guaranteeing the destruction of organic material while melting inert materials into a slag. This glassy slag may render heavy metals and radionuclides nonleachable. This overall capacity makes plasma processing a very versatile and omnivorous technology, capable of treating a wide variety of waste problems.

While the application is new and innovative, plasma technology is not new. Industry is using plasma torches in various applications that require heating. Some of the applications of plasma heating currently used around the world include:

- metal and ceramic powder production,
- composites production (e.g., metal on metal, metal on ceramic, etc.),
- titanium dioxide pigment production,
- chemical (acetylene, ethylene, etc.) production,
- metal ore smelting,

Solutions

Creating Solutions to Meet Remedial Challenges

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There are numerous challenges associated with solving hazardous waste remedial problems. The best solutions accommodate cost; appropriate and available technologies; and legal, public, and regulatory issues to name just a few.

Cost is a principal consideration in overcoming remedial challenges, and specifically the practicable management of remedial costs. Whether a private-sector industrial firm or a government agency which operates regulated facilities, all of us are increasingly pressured to control costs. The most consistent method of controlling short- and long-term costs associated with remedial actions involves (1) quality data and (2) innovative technologies.

All too often remedial costs are excessive due to the generation and reliance upon poor quality data. Remedial cost management starts with the compilation and analysis of quality data. Once reliable data are established and remedial solutions are identified, innovative technologies are often the most appropriate means of achieving a cost-effective remedy. These range from the innovative application or adaptation of conventional technologies, to the development of leading-edge technologies.

The following case-histories illustrate that quality data and innovative technologies are a cost-effective way of achieving remedial solutions.

- For a commercial Treatment, Storage, and Disposal Facility in the Pacific Northwest, significant cost reductions and other benefits were realized by gathering and analyzing quality data. This step disproved existing data and eliminated the need for future site characterization and potential corrective action.

- For a titanium production facility closure in eastern Washington, cost savings of 75% were achieved by developing and implementing an innovative application of an existing technology.

Waste Minimization Strategies and Successes

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In the early 1980s, the Boise site of Hewlett Packard embarked on a program to reduce the hazardous waste generated and to increase the amount of remaining waste which is recycled. As a result, the amount of waste landfilled has been reduced by 68 percent to 4 percent of their total, while the amount recycled has been increased by 50 percent to 92 percent of their total. The amount of waste electroplating sludge generated has been cut by 72 percent from 2 pounds to 0.6 pounds per square foot of printed circuit board produced. The strategy and specific actions taken to achieve these results are presented.

Hewlett Packard's strategy for addressing environmental issues in the 90s is also presented. The focus of the strategy is to consider environmental issues and impacts during the design of products and processes in order to eliminate or minimize those impacts before they occur rather than attempt to mitigate them afterwards. The primary mechanism to implement the strategy is the incorporation of environmental checkoffs into new product life cycles.

Stream Bank Tailings and Revegetation Study on the Silver Bow Creek Site, Montana

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Silver Bow Creek stretches approximately 27 miles from Butte to Warm Springs Ponds, Montana. Past mining practices have resulted in significant impacts on the entire creek. Ore mined in the Butte area was ground into powder. Metals were extracted from the pulverized rock and the waste rock (known as tailings) was then discharged into the creek. As a result, large stretches of the stream banks are covered with these tailings in depths varying from a few inches to several feet.

Unfortunately, these tailings still contain significant concentrations of various heavy metals such as copper, zinc, and cadmium. Sulfides, which were once bound up in the rock matrix, are now exposed to the air where oxidation converts them to acid. This acid lowers the pH of the tailings and the surface water and ground water that flows adjacent and below them, respectively. In addition, these acidic conditions increase the mobility of the heavy metals present in the tailings. Low pH combined with high metal concentrations has significantly affected the aquatic life in the creek and the vegetative life on its banks. For many years Silver Bow Creek was "dead," devoid of all aquatic life, and the tailings-covered stream banks were barren. In recent years, with the reduction of mining activities and the increase in wastewater treatment, aquatic life has begun to reestablish itself in the creek. However, many miles of stream banks remain that are devoid of vegetation.

Silver Bow Creek was designated as a Superfund site because of the impact that mining has had on surface water, ground water, and stream banks in the area. In examining various remediation alternatives for the tailings-covered stream banks, it became obvious that typical options such as removal are not very attractive. Since millions of cubic yards of material are involved, the cost for removal would be quite high. In addition, the process of removing these materials could have adverse environmental impacts of its own if tailings were released into the creek during the remediation. Because of these and other considerations, CH_2M HILL, in conjunction with Montana State University Reclamation Research group and Schafer and Associates, proposed the development of an innovative remedial alternative.

over amended tailings to determine its effect on plant survival. Once the pH of the plots stabilized, they were seeded with a variety of acid-tolerant plants. Seeding took place in spring 1989.

The performance of the plots was measured in the fall 1989. Mean seedling density was measured on all plots. Initial results indicate that amended plots performed much better than the control plots that received no amendments. In addition, it appears that the deep plow method of incorporation is more effective than shallow incorporation or deep injection. The soil cap over amended tailings proved to be the most effective treatment. This investigation will continue during the next few growing seasons in order to evaluate seedling survival, canopy cover, productivity, reproductive effectiveness, and rooting depth. In addition, lysimeters will be installed to evaluate the effect of this remedial alternative on metal transport in water as it percolates through the soil matrix.

Hazardous Waste Case Studies

Large-Scale Processes for Decontamination of Soil and Water

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New technologies for treatment of hazardous waste are being rapidly developed. In the last decade, for example, microbiologists have isolated numerous bacteria possessing the metabolic capabilities to degrade many of the priority pollutants. However, while laboratory studies have been highly successful, the scale-up and implementation of large-scale systems based on novel microbiology has not kept pace. The translation of a new technology from the laboratory to full-scale requires interdisciplinary effort which is often thwarted by the inertia of the separate disciplines.

BioTrol has developed large-scale processes for treatment of contaminated soil and water. The water treatment process is bases on amendment of a fixed-film bioreactor with specific bacteria. The process is traced back to basic research done by scientists at the University of Minnesota. A soil treatment process has also been developed which is based on segregation of the highly contaminated soil fractions from the less contaminated fractions. The contaminated fractions are then treated by biodegradation. The development of the soil treatment process will be traced from the bench to full-scale.

Finally, new areas of research will be mentioned, including cell immobilization, and biodegradation of TCE.

The Bunker Hill NPL Site: An Historical Perspective of a Complex and Lengthy Superfund Project

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The twenty-one square mile area designated for the Bunker Hill Remedial Investigation and Feasibility Study (RI/FS) represents one of the nation's largest and most complex Superfund sites. The area is located in a steep mountain valley drainage in northern Idaho that was the center of one of the world's most active and productive lead, zinc, and silver industries for over a century. The current site boundaries encompass four incorporated cities; an affected population of more than 5000 persons; a large contaminated river floodplain; an immense, largely dormant, industrial facility including a major mine and mill works, primary lead smelter, primary zinc smelter, ammonium phosphate fertilizer plant, over 200 acres of impounded tailings, and several hundred acres of contaminated soils and waste piles.

The Bunker Hill situation is, in many ways, representative of the evolution of environmental and hazardous waste regulation in this country. Nearly every major environmental law has impacted the industry and community in some manner. Examination of the history of hazardous waste practices, human exposure, health risks, and regulatory expenditures provides an interesting perspective on the development of current control programs and the on-going Superfund investigation. This site first came to national attention after lead health surveys conducted in 1974 showed the most severe epidemic of childhood lead poisoning and environmental heavy metal contamination levels ever documented in the United States. Results of those studies were instrumental in the development of national lead health policy in the last decade. Blood lead levels in the community continued to exceed federal criteria throughout the remainder of the decade until smelter closure in 1981. Following closure, airborne lead levels decreased almost immediately to concentrations below acceptable health standards. In 1983, a comprehensive study of blood lead and environmental exposure levels indicated that one-quarter of the pre-school children residing within one-mile of the complex continued to exhibit lead toxicity. Residual lead contamination in local soils and house dusts was identified as the principal source of the excess absorption. As a result of these findings, the federal Superfund effort was initiated in this area to comprehensively address environmental metals exposures.

In recognition of the history and complexity of this site, and the continuing need for active health intervention efforts, the State od Idaho and federal government negotiated an integrated project structure for RI/FS activities. The site was divided into

Fungal Degradation of Environmentally Persistent Compounds in Soils with White Rot Fungus

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Since the 1960s, it has been known that the enzyme systems of white rot fungus (WRF), *Phanerochaete chrysosporium*, had the ability to degrade certain chlorinated organics. This knowledge led to experiments with compounds such as DDT, pentachlorophenol, dioxin, Lindane, creosote, polychlorinated biphenyls (PCBs), and others.

There has been interest in the ability of bacteria to degrade PCBs and other chemically persistent compounds for many years. As the behavior of these compounds was studied in the environment, it was noticed that there often was partial degradation or slight degradation with time. While this research continues, other organisms are being studied to see if they can degrade these compounds within EPA guidelines.

It has been demonstrated in the laboratory that WRF has the ability to degrade a number of different organopollutants through the use of its lignin degrading enzyme system.

1. The WRF enzyme system has been shown to be capable of organopollutant degradation over a wider range of temperatures than bacterial systems.

2. It has the ability to completely mineralize the pollutants to carbon dioxide, water, and certain other innocuous compounds in a shorter time than most bacterial systems.

3. The rate of degradation is not necessarily dependent on the concentration of the pollutant.

In laboratory experiments performed at Utah State University, approximately 62 percent of the most persistent constituents of creosote in samples taken from a site in Idaho were degraded at the end of 60 days. Fungal inoculum has since been applied to field text plots at the site. To the knowledge of the author, this application is the first EPA sanctioned application of WRF to an on-site hazardous waste problem. Of the 21 valid plots on the site, 19 were remediated to EPA standards by the WRF.

Exposure Assessment at the Tucson Airport Area Superfund Site

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Hazardous waste site investigations, such as those conducted in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or "Superfund," and the 1986 Superfund Amendments and Reauthorization Act (SARA), require the integration of data from various disciplines, collected across several media and representing different levels of quality, concern, and potential impact. The risk assessment step in these investigations estimates the likelihood of adverse health effects resulting from releases of toxic materials from an uncontrolled waste site. Often, the efficacy of the risk assessment process is limited by the inability to quantify historical exposures because information management systems lack the flexibility necessary to assimilate the wide variety of data generated by CERCLA and SARA procedures.

Improper waste disposal caused contamination of the ground water and the water supply in Tucson, Arizona. State and federal health officials concluded that historical exposures could not be quantified at this Superfund site. An evolving data management and computer mapping system, known as a Geographic Information System (GIS), can enhance interdisciplinary investigations of hazardous waste sites. A historical exposure assessment of the Tucson site was accomplished to demonstrate GIS capabilities.

The results of the Superfund site investigation were integrated into a GIS. Using the GIS, cartographic models were developed to simulate (1) contaminant release, (2) contaminant plume migration, (3) well pumpage, (4) water distribution system development, and (5) population growth. The models provided estimates of the degree and extent of contaminated water service over the twenty-five year history of the site. Stratified exposure estimates for the area population and for individual residents were developed. The results are discussed in the context of the site's case history, the implications supporting future health-effect studies, and the benefits of employing GIS in assisting complex environmental studies.

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