

EPA ORD ENGINEERING HIGHLIGHTS

A bi-monthly compilation of EPA's Office of Research and Development engineering research activities and results and related research activities in pollution prevention and mitigation. To discuss any of these activities, contact the ORD lead person listed below. For general information, contact Darlene Williams of the Office of Technology Transfer and Regulatory Support, Phone : FTS 382-7891.

HAZARDOUS WASTE

Mining Waste Treatment Pilot Begins in Montana

The United States Congress recently appropriated \$3,500,000 to establish a pilot program for treating mining wastes in Butte, Montana. RREL will lead the implementation of the project which will involve an investigation and evaluation of promising new technologies for mining waste treatment. Heavy metals contamination, such as lead in soils, waste piles, and other areas, were identified as a continuing threat to public health and the environment in the western U.S. In establishing the pilot program, EPA was directed to collaborate with DOE's current program in Butte and with The College of Mineral Sciences and Technology (Montana Tech). The mining wastes present in the Butte area have had a negative impact on the environment and a large portion of the mined area has been designated as the Silver Bow Creek/Butte Area Superfund site, 48th on the 1990 National Priority List. (Jonathan Herrmann, RREL, FTS 684-7839)

New Technique Developed For On-Site Monitoring at Superfund Sites

ORD has developed a new portable monitoring technique for hazardous waste contamination at Superfund sites that will allow rapid and cost effective screening to determine the extent of contamination and the effectiveness of cleanup procedures. The technique detects nitroaromatics in ground water, soil, and human blood serum using systems of antibodies and proteins that operate in the same manner as the over-the-counter pregnancy test kit. (Nitroaromatics are used in the manufacture of plastics, pesticides, and explosives such as TNT.)

This method, widely used by immunologists to detect diseases and other conditions in humans, has been refined to allow scientists to detect amounts as small as one part per billion of important drugs, herbicides, and pesticides. The sensitivity of the analysis, called an immunoassay, is comparable to the analyses performed with more sensitive instruments usually found in commercial analytical laboratories. This immunoassay can be done at a fraction of the cost of commercial laboratory testing, \$2.50 per analysis as compared to hundreds of dollars. It is also very portable thereby allowing tests to be performed in the field right at the site of contamination. The monitoring technique is being evaluated and field tested, and efforts will be made to commercially produce the test kit. (Jeanette Van Emon, EMSL-LV, FTS 545-2154)

Organics Separation Process Slated for SITE Demonstration

In January 1991, the DehydroTech Carver-Greenfield process was installed at the RREL Edison, NJ facility. It is undergoing shakedown and optimization tests prior to a SITE demonstration of the process during the summer of 1991. The Carver-Greenfield process is a separation process that uses food grade oil to extract organic contamination from soils and sludges. Evaporation, centrifugation, and distillation are also used to completely separate multiphase wastes such as soils and sludges into their constituent solid, aqueous and organic phases. This type of separation will facilitate the ultimate treatment of each of the three phases, thus allowing a more complete cleanup of previously hard to treat waste.

The process was accepted into the SITE program in 1989 and is scheduled for demonstration at the PAB Oil Site in Abbeyville, LA. DehydroTech Corporation of East Hanover, NJ, has extensively refurbished their existing field unit in anticipation of this demonstration. Since they are a relatively small company, DehydroTech does not currently have a facility in which to test their newly renovated process. In order to provide them with a convenient location in which to complete this very important testing, EPA has agreed to allow them to temporarily install their equipment at the Edison, NJ facility. (Hugh Masters, RREL-Edison, FTS 340-6678)

Screening Level Treatability Protocols Developed

RREL has developed screening level treatability protocols for remedy screening programs. These protocols will provide detailed procedures for laboratory technicians affording greater testing uniformity. Protocols for the first two technologies, soil washing and in-situ soil vapor extraction, are complete. Protocols for soil flushing, in-situ steam stripping, and solvent extraction technologies will follow. Evaluations of the protocols are scheduled for this spring. (Michael Borst, RREL-Edison, FTS 340-6631)

Incineration Evaluated for Reducing K088 Listed Waste

The EPA is under Congressional mandate to reduce the volume and/or toxicity of many listed hazardous wastes. K088, spent pot liners from the primary reduction of aluminum, is a listed waste. Incineration has been identified as a method to reduce the concentration of polynuclear aromatic compounds contained in the waste as well as the elevated cyanide levels. Recently, RREL's Incineration Research Facility (IRF) was used to conduct the evaluation of incineration for K088 as part of the Best Demonstrated

Available Treatment Program for listed wastes. The specific objectives of the incineration tests are to completely characterize the composition of the feed and incineration residuals in terms of hazardous components and determine the applicability of incineration as a treatment technology for K088 waste. Additional research will be conducted to compare the cyanide data (K088) to the laboratory data collected in conjunction with RREL's Incinerability Index model development. (Robert Thurnau, RREL, FTS 684-7692)

Hydraulic Fracturing Successfully Demonstrated at Xerox Site

A demonstration of hydraulic fracturing of subsurface soils was successfully conducted by RREL in clean soils adjacent to the contaminated soil at the Xerox Corporation site in Chicago, IL. Six fractures were created at one borehole, with depths ranging from 6 to 15 feet. The fractures, which were filled with coarse sand, were up to 20 feet long and 0.2 inch thick. Hydraulic fracturing at a hazardous waste site will improve the rate of recovery of volatile materials and increase the radius of influence of recovery wells, resulting in lower cost and more rapid clean-up at the site. Based on the results, the remedial contractor for Xerox, in conjunction with RREL, will conduct a further pilot scale demonstration of hydraulic fracturing to enhance vapor extraction in a portion of the contaminated soils. (Herb Pahren, RREL, FTS 684-7874)

Technical Assistance Provided to Clear Creek, Colorado Superfund Site

Environmental problems associated with acid mine drainage and metals leaching from tailings and other mine wastes are major concerns at the Clear Creek Superfund Site in Denver, CO. RREL is providing technical assistance to Region VIII for remedial technology selection and evaluation of the effect of remediating the mine drainage on the overall water quality of Clear Creek. Through a jointly funded effort with the Region, RREL and its contractor will develop data on relationships between metal species and the observed in-stream toxicity; including chemical manipulations that may reduce bioavailable metals in the stream; determine the role of diffuse metal loads in preventing improvements in water quality; and determine the optimum chemical conditions in the stream and point source discharges to alleviate stream toxicity.

In the second phase of the project, scientists will examine the limitations of the WASP4 model to accurately predict improvements in water quality and the necessary model inputs to improve predictability under changes in major ion and toxic metals transformations. In addition, the effectiveness of additional remedial alternatives will be analyzed and a monitoring program for in-stream biological conditions will be established. (Ed Bates, RREL, FTS 684-7774)

NETAC Workshop Looks at R&D Commercialization

Under the auspices of OEETD, the National Technology Applications Corporation (NETAC) conducted a workshop for the commercialization of innovative environmental technologies as part of the Second International Symposium on Field Screening Methods for Hazardous Waste and Toxic Chemicals. The Symposium was sponsored by a variety of Federal agencies including EPA and was hosted by EMSL-LV.

The NETAC Workshop was designed to provide the technology developers an overview of the environmental

industry, a model of the commercialization process, the impediments and barriers to timely and orderly development, and critical technical and business success factors that must be concurrently addressed. Sixty-eight registrants participated in the workshop and several firms indicated an interest in exploring ways to cooperate with EPA and NETAC. NETAC is a product of a four-year cooperative agreement between OEETD and the University of Pittsburgh Trust, and was established to catalyze diffusion and commercialization of federal and private sector environmental research and development. (Michael Mastracci, OEETD, FTS 475-8933)

START Team Assists Region II Carlstadt, NJ Site

Technical assistance is being provided by RREL's Superfund Technical Assistance Response Team (START) to the S.C.P. Carlstadt, NJ site. The S.C.P. Carlstadt site is a six-acre, inactive chemical waste processing site. Two treatability studies, incineration and material handling, pertain to the selection of remedies for the fill material of the first operable unit at the site. The contamination of concern here is a mixture of heavy metals with volatile and semivolatile organics.

The incineration treatability study is being conducted at the Incineration Research Facility (IRF), in Arkansas. The material handling treatability study to control VOC emissions from soil excavation consists of two parts. The first part, conducted at RREL in Cincinnati, is a development of a general method to evaluate a potential for a volatile release during excavation. The second part, conducted at RREL's Edison, New Jersey facility, is the selection of methods to control VOC emissions at this site. (Richard Koustas, RREL-Edison, FTS 340-6898)

BIOREMEDIATION

Controlling Organics Stripped From Hazardous Waste Liquid Streams or Contaminated Soil

The biodegradation of gaseous volatile organic compounds (VOCs) by microorganisms in a packed bed filter (biofilter) is a promising technology for controlling organics stripped from hazardous waste liquid streams or contaminated soils. RREL is funding and providing technical advice on a University of Cincinnati (UC) project that is evaluating this concept.

The most successful of the four biofilters being operated by UC is packed with granular activated carbon (GAC) and is being maintained aerobically. Following the recent discovery and correction of a nutrient limiting condition and other minor barriers, significant quantities (>85%) of three test compounds (TCE, methylene chloride, and toluene) are biodegrading at gas flow detention times of several minutes. Operational difficulties are continuing to be resolved for the aerobic biofilter, but, overall, the technology appears to hold significant potential for eventual application to a broad range of hazardous waste gaseous VOC treatment situations. An additional aerobic biofilter will go on line in the near future that will be fed with additional gaseous compounds of petroleum derivation. It will be packed with an inorganic ceramic material that is non-adsorptive and will hopefully resolve some of the operational problems (primarily excessive biogrowth) experienced with the GAC unit. (Steven Safferman, RREL, FTS 684-7350).

Results of Bioremediation at Alaska Oil Spill

A bioremediation experiment was conducted which consisted of setting up treatment plots in a randomized complete block design replicated fourfold on Disk Island in Prince William Sound. Samples were collected during four nine-day intervals and analyzed for changes in oil residue weight, total resolvable alkanes, individual alkanes, and oil degrader numbers. Data were evaluated by analysis of variance using Statistical Analysis System software. Results indicated no statistically significant differences at the 5% significance level among the four treatments in the 27 day time period of the demonstration. Although the oil residue weight was high to begin with (approximately 3500 mg/kg of sediment), the total resolvable alkane hydrocarbons comprised less than 0.5% of the total oil mass, indicating the contamination remaining on Disk Island consists mostly of poorly degradable tar and asphalt. This suggests that substantially more time must be given to the evaluation of bioremediation of highly weathered crude oil before a proper conclusion is possible regarding enhancement either by nutrient application or microbial product inoculation. (Albert Venosa, RREL, FTS 684-7668)

POLLUTION PREVENTION

ORD Conducts Waste Minimization Assessment

An ORD team recently completed a waste minimization assessment at the Bureau of Engraving and Printing. The assessment team examined all production processes for stamps and currency. Of particular concern was the generation of ink sludges from intaglio, a printmaking process used to prevent counterfeiting money that wastes over 80% of the ink used. Waste minimization options will be proposed based on an analysis of operational feasibility and economic viability. In April, the final report will be available which will summarize the activities examined at the Bureau and propose waste minimization options. These options will be evaluated for their economic viability, and operational feasibility. (Kenneth R. Stone, RREL, FTS 684-7474).

New Industry-Specific Pollution Prevention Guides To Be Developed

In January, 1991, RREL initiated the development of pollution prevention guides for the following industries and commercial sectors: metal finishing, thermal metal working, non-agricultural pesticide applicators, building construction and trade, and mechanical equipment repair. Scheduled for publication by September, 1991, the guides will be the newest addition to the popular industry-specific pollution prevention guide series. (Teresa Harten (RREL) FTS 684-7565).

AIR

Ozone Depleting Halon-1301 Alternatives Sought

AEERL recently initiated a joint project with the North Slope oil companies and the New Mexico Engineering Research Institute (NMERI) to investigate new chemicals which may serve as alternatives to the stratospheric ozone-depleting Halon-1301, currently used as a fire

extinguisher. On the North Slope of Alaska, oil and gas production facilities are enclosed due to the extreme cold temperatures. These facilities house machinery and piping used to route and process 2.3 million barrels of oil each day. With this much oil and gas being handled indoors, a substantial risk of fire or explosion exists. A chemical called Halon-1301, is used to prevent explosions or fires from occurring in these facilities. However, the 1990 amendments to the U.S. Clean Air Act call for a virtual phaseout of Halon production by the end of this decade due to its ability to destroy stratospheric ozone. No other proven methods exist besides Halon-1301 that can provide adequate protection of the North Slope oil production facilities. In collaboration with the other partners, AEERL researchers will simulate North Slope-type fire and explosion scenarios in the laboratory; judge the behavior of the candidate alternatives; and make recommendations on replacement chemicals, some of which have been synthesized in the laboratory under other AEERL cooperative agreements. (N. Dean Smith, AEERL, FTS 629-2708)

Fuel Cells Tested for Electricity Production from Methane

Landfills are a major source of methane, a significant global warming gas. AEERL recently awarded a contract to International Fuel Cells Corporation (IFC) to conduct a demonstration for operating a 200 kW commercially available phosphoric acid fuel cell on landfill gas. The objective is to reduce landfill methane emissions and produce electricity as a by-product. Fuel cells are potentially superior technology when compared to commonly used technologies (boilers, internal combustion engines, gas turbines, and flares), because they are both a highly efficient and environmentally clean means of converting landfill gas to electricity and clean heat. However, technical and economic questions remain as to their ability to utilize landfill gas. This project will answer those questions. The one-year evaluation will document the amount of electricity produced, the availability factor, the efficiency factor, maintenance and operator requirements. (Ronald Spiegel, AEERL, FTS 629-7542)

Remote Sensing of Vehicle Emissions

Las Vegas, Nevada was the site of recent research using remote sensing to monitor vehicular air pollution emissions. An innovative instrument developed at the University of Denver, allows the carbon monoxide and hydrocarbon (CO and HC) emissions of vehicles to be monitored in a fraction of a second as they pass through an infrared light beam directed across the street. Each measurement is documented on a video tape that includes an image of the back of the vehicle being monitored (including license plate). This study involved EMSL-LV, Clark County (Nevada) Air Pollution Control District, the Nevada State Department of Motor Vehicles, the Southern Nevada Community College and the Department of Transportation.

The study consisted of three separate monitoring projects. The first was an investigation of the effects of minor repair and tuneups on emissions. The second project was designed to evaluate the effectiveness of oxygenated fuel for CO emission reduction by measuring emissions from the influx and exit of a substantial number of tourists at the California-Nevada state line. Preliminary data indicates a significant difference between the vehicles coming from California than those leaving Las Vegas. The third project was

a comparison of emissions from fully warmed vehicles to the same cold start vehicles. Final results of the study are expected by the end of the summer. The Clean Air Act Amendments of 1990 provide for the use of remote sensing technology for mobile source emissions monitoring. This work will help identify applications and also help in the evaluation of the use of alternative fuels. EMSL-LV involvement in this project began in FY-89 as an Innovative Research project. (Marc Pitchford, EMSL-LV, FTS 545-2363)

Innovative Paint Spray Booth Technology for Ozone Attainment

AEERL scientists have designed a paint spray booth for both military and industrial spray painting operations worldwide. The design allows for the significant reduction of volatile organic compound emissions and permits a 50% reduction in the volume of flow that must be controlled. Since the reduced volume of flow will significantly reduce the capital and operating costs of add-on pollution control for paint spray booths, it is expected that widespread use of the design will occur in the affected industry, having a potentially great impact on the ozone non-attainment problem. A patent application has been filed for this technology. (Charles H. Darwin, AEERL, FTS 629-1766)

Low Cost Technology Demonstrated For SO2 Control

ORD has successfully demonstrated a low cost SO2 removal process for power plants. The demonstration, in cooperation with the Ohio Coal Development Office, the Ohio Edison Company, and Babcox and Wilcox, achieved 50% removal of SO2. The process, called E-SOx, injects an alkaline slurry into a modified existing electrostatic precipitator. Because of low capital costs, E-SOx is considered to be one of the least expensive methods of controlling SO2. Its low cost and simplicity make it an attractive candidate for use in older power plants and for adoption in such areas as Eastern Europe, where 50% removal of SO2 would be a substantial improvement. (Louis S. Hovis, AEERL, FTS 629-3374)

International Task Force Reports on VOC Controls and Ozone Abatement

The Economic Commission on Europe (ECE) Task Force on volatile organic compound (VOC) Control Technology recently completed its report on the technical and economic viability of an array of VOC control options. The conclusions and recommendations of the Task Force will guide the multi-national effort to control VOC emissions and reduce tropospheric ozone concentrations worldwide. Engineers from AEERL have worked extensively with the Task Force to ensure that the U.S. approach for ozone abatement using Best Available Control Technology, Lowest Achievable Emission Rate for new sources, and Reasonably Available Control Technology for existing sources is represented in the technical report. They were also instrumental in including other issues of concern to the U. S., such as the role of biogenic emissions and NOx in ozone formation; the assessment of the control effectiveness of existing control technologies on major sources, and the improvement of existing emissions inventories. The VOC Control Protocol will be signed by 16 nations, including the U. S., in November 1991. (Wade H. Ponder, AEERL, FTS 629-2818)

Global Inventory of VOC Emissions Published

Global atmospheric models for ozone require, as one input, an emissions inventory of reactive volatile organic compounds (VOCs). AEERL has published a report that (EPA-600/8-91-002, January 1991) provides a global inventory for each of seven pollutant groups--paraffins, olefins, aromatics [benzene, toluene, and xylene (BTX)], formaldehyde, other aldehydes, other aromatics, and marginally reactive compounds. AEERL researchers identified the major anthropogenic sources of VOC emissions in the U.S. and grouped them into categories according to: development of U.S. emission factors; multiplication of the U.S. emission factors by production/consumption statistics for other countries; and geographic distribution of the emissions. The study shows total global anthropogenic emissions of about 121 million tons of VOC per year with the U.S. the largest emitter with 21 percent of the total. Fuel wood combustion and tropical grassland burning are the largest sources, accounting for over 35 percent of global VOC emissions. (Julian Jones, AEERL, FTS 629-2489)

WATER

Research on Small Drinking Water Systems Discussed With Region III

Region III and the state of West Virginia have requested help for their several hundred small drinking water systems. A small drinking water system is defined as serving less than 100 connections. A meeting to discuss the feasibility of developing a research effort to help small drinking water systems (micro-systems) to meet existing and pending federal regulations was held in Charleston, WV. Members of RREL presented possible research directions. Representatives from Region III, WV State Health Department, American Water Works Service Company, WV- American Water Company, and American Water Works Association Small Systems Committee discussed areas of concern and suggested approaches to the research effort. RREL will be developing a research plan for comment that will include a total package to help micro-systems, including: liability, customer acceptance, treatment efficiency, operation and maintenance, and cost. This research will include a concept on "Electronic Circuit Rider" control of small systems. (Ben Lykins, RREL, FTS 684-7460)

Municipal Technology Transfer Workshop

EPA recently held a Municipal Technology Transfer Workshop, at which RREL provided an overview of promising innovative and alternative technologies which they have evaluated. Information was provided on state-of-the-art small community technologies, stormwater and sludge management regulations, ultraviolet light disinfection, upgrading technologies and toxic compound removal in treatment facilities. The topics selected as a result of a survey that polled state, local, and private entities in the region on municipal technology topics. The conference attendance exceeded 300 people, indicating the level of interest in wastewater engineering technology. (James Kreissl, RREL, FTS 684-7611)