

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

SITE Demonstration of SoilTech Remediation

RREL performed a SITE Demonstration of the SoilTech "TACIUK" process being used to remediate the PCB contaminated soils at Wide Beach, New York, on May 21, 1991. Wide Beach became contaminated when contaminated oil was used on the roads to keep the dust down. A combined treatment system of thermal desorption and dechlorination is being used to volatilize and destroy the PCBs. The SITE Demonstration objectives were to measure the effectiveness of the combined processes; identify any toxic chemicals created by the process, e.g., dioxin; and determine the importance of the treatment mechanisms, e.g., volatilization, dechlorination, and coking. Beginning in November 1991, the "TACIUK" thermal desorber will be used to remediate the Waukegan Harbor, Illinois, PCB site, without the dechlorination step. A SITE Demonstration will be scheduled to allow further comparison of the treatment mechanisms. (Paul R. de Percin, RREL, FTS 684-7797)

Characterization and Treatment of Metal Finishing Wastes

A technical report was recently completed by RREL which describes activities associated with characterizing and treating metal-finishing wastes to support the EPA's development of treatment standards for regulations restricting land disposal of hazardous wastes. It includes information on the waste generators' manufacturing and wastewater treatment plant operations, chemical composition of the untreated wastes, and performance data generated during bench and pilot-scale testing.

The treatment technologies tested were alkaline chlorination, wet-air oxidation (WAO), ultraviolet light/ozonation (UV/O₃), electrolytic oxidation, stabilization/solidification (S/S), and metals precipitation. WAO bench-scale and pilot-scale tests indicated significant cyanide destruction; whereas, UV/O₃ provided partial cyanide destruction but essentially no iron cyanide destruction. Cement proved to be the most effective S/S binder for metals. (Ronald Turner, RREL, FTS 684-7775)

On-Site Waste Minimization Opportunity Assessment

The on-site assessment phase of a Waste Minimization Opportunity Assessment (WMOA) of the U.S. Department of Agriculture's Beltsville Agricultural Research Center (BARC) in Beltsville, Maryland, was conducted on May 7-10, 1991. Process and facility data were collected on specific analytical

and sample preparation waste streams in the laboratories. Two potential R&D laboratory opportunities for waste reduction are the Kjeldahl reactors and High Pressure Liquid Chromatography analytical equipment. The WMOA team sought to identify source reduction options and techniques, and is reviewing specific procedures used, range and number of samples requiring analysis, and the procedural and equipment changes that might result in source reduction. Source reduction alternatives (i.e., acids, bases, and solvents) of laboratory wastes are being studied relative to prescribed laboratory safety and disposal procedures. It is also necessary to consider waste reduction from procurement, management, and general operating procedural changes at BARC. A draft WMOA report and project summary will be available by September 1, 1991, for review and comment. It is anticipated that the final report will find broad application to USDA, EPA, Department of Energy, and other similar research facilities. (James S. Bridges, RREL, FTS 684-7683)

Steam Injection/Vacuum Extraction Demonstration

EPA and the Air Force are cooperating in steam injection/vacuum extraction (SIVE) research by having EPA evaluate a pilot-scale SIVE system installed by the Air Force at the McClellan Air Force Base, in Sacramento, California. On May 21, 1991, a meeting was held between representatives from RREL, EPA Region IX, McClellan Air Force Base, California Department of Health Services, and EPA contractors to: 1) finalize the sampling and analysis strategy for collecting needed data, 2) define the extent of site contamination and develop the SIVE process design, 3) review the Phase I treatability results, and agree on the Phase II treatability study objectives, and 4) obtain regulatory agency agreement to the research plan. In early July, a SITE Demonstration will begin the preliminary sampling with solvent contaminated soil and fill material at the base. Further pretreatment samples will be collected before the SIVE process begins remediation. Because this process is in-situ, it will be more than a year before samples can be collected to determine the treatment effectiveness. (Paul R. de Percin, RREL, FTS 684-7797)

Waste Reduction Testing at Printed Circuits Manufacturer

A technology evaluation under the EPA/Minnesota Waste Reduction Innovative Technology Evaluation (WRITE) Program was recently conducted in the Minneapolis area by a flexible printed circuit manufacturer to determine the source waste reducing potential of two technologies. The first technology is an innovative polyvinyl alcohol sponge roller



system used as replacement for standard hard rubber squeegee rollers to reduce chromium drag out of a horizontal cleaning unit; the second is a conductivity activated flow controller installed on a tin lead plating line to reduce the rinsewater waste stream. Samples will be analyzed and a report will be available by December 1991. (Teresa Harten, RREL, FTS 684-7565)

EPA Mobile Laboratory Exchange

RREL and the Office of Emergency and Remedial Response's Environmental Response Team (ERT) are exchanging mobile laboratory facilities from June to September 1991. ERT will use RREL's High Hazard Sample Preparation Laboratory at a Superfund site in Louisiana to analyze samples suspected of containing dioxin. ERT needed to use the laboratory's special capabilities, which include a personnel decontamination area with showers, lockers, and toilet facilities; a sample preparation area with an interconnected glove box-fume hood combination equipped with safety alarms; and a single pass HVAC system that far exceeds the ventilation performance criteria specified in 29 CFR Part 1910. The exhaust vent from the fume hood also contains appropriate air pollution control devices, and operates under a permit issued by the NJ Department of Environmental Protection.

In exchange, RREL will use the ERT mobile laboratory which will provide greater bench space to conduct treatability tests and other small-scale extraction studies, a larger fume hood and chemical storage area, and a fully equipped gas chromatograph capable of analyzing a wide range of organic compounds. A major future cooperative activity will be a shared 6,500-square-foot treatability laboratory that is to be constructed by the ERT. (Ray Frederick, RREL, FTS 340-6627)

Pilot-Scale Treatability Study on PCBs

Three incineration tests on sediments containing 500-20,000 ppm of PCBs were run successfully at the Incineration Research Facility Rotary Kiln System in Jefferson, Arkansas. The treatability study was planned to determine the effectiveness of incineration for remediation of both solid and liquid PCB-contaminated materials. In addition to the PCBs, significant quantities of metals were also present in the sediment. The fate of the metals and the destruction of the organic material were the goals of this incineration test. (Marta K. Richard, RREL, FTS 684-7783)

Emerging Technologies Proposals Selected

Thirteen technologies were chosen for development as emerging technologies in the Superfund Innovative Technology Evaluation (SITE) program. The selected technologies are in the areas of thermal destruction, solidification/stabilization, materials handling and mining, chemical, physical, and biological treatment. The Department of Energy and the Air Force will co-fund some of the projects. (Randy Parker, RREL, FTS 684-7271)

Ash Exposure Document Released

A pre-publication version of the ash exposure document titled, "Methodology for Assessing Environmental Releases of and Exposure to Municipal Solid Waste Combustor

Residuals", (i.e., ash) has been released. The purpose of the document is to provide users with a methodology to assess the potential exposure to ash from municipal solid waste combustor (MSWC) facilities. Ash can be released to the environment at any time from the point it is generated within the facility to when it is disposed of in a landfill. This document identifies and provides methods to quantify all such releases. A comprehensive example is provided to demonstrate this methodology on an organic and an inorganic contaminant common in MSWC ash. This document also provides citations and general guidance on how to assess the subsequent exposure to these releases and their health impact. (Michael Callahan, OHEA, FTS 475-8909)

Air

Joint Oil Field Emissions Testing

ORD and Office of Air and Radiation have identified the need for methods for estimating VOC emissions from crude oil and natural gas production fields. The American Petroleum Institute (API) is interested in determining the level of toxic emissions from these sources. AEERL is joining API's test program by sponsoring tests for total VOC emissions and for additional emission sources not covered by API. EPA and API will share the emissions measurements data from the entire program. (Larry G. Jones, AEERL, FTS 629-7716)

Savings by Replacing Petroleum with Hydrocarb Methanol

The Hydrocarb process under development by AEERL can produce methanol using biomass or coal plus natural gas as the reactants. Recent cost analyses indicate this new process may eliminate the cost of volatile organic compounds and ozone control in the transportation sector. Results indicate that it is feasible that methanol can be produced for 19 cents/gallon less than the equivalent gasoline price. If control of CO₂ emissions should become part of a national strategy to mitigate global warming, the Hydrocarb process should be capable of eliminating net CO₂ emissions from the transportation sector at an incremental cost of about 14 cents per gallon of gasoline displaced by methanol. The equivalent cost per ton of CO₂ emission reduction is \$15.4 which is substantially less than the cost of most alternative CO₂ control options. The external costs to society of petroleum use are not currently accounted for in the price of those fuels. In 1989, the minimum estimate of those external costs was \$0.29 per gallon of gasoline (the maximum estimate is ten times that amount). An equally important aspect of this process is the fact that it can utilize abundant domestic coal to produce clean fuels for the transportation and utility sectors without a net CO₂ emission to the atmosphere. (Robert Borgwardt, AEERL, FTS 629-2336)

Support for Field Tests to Develop Refrigerant Recycling Standard

The standard for recycled refrigerant from stationary refrigeration systems now accepted by industry is the Air Conditioning and Refrigeration Institute (ARI) 700-88 standard. This standard is too stringent to allow on-site recycling of refrigerant. ARI is undertaking a project to determine the contaminant types and levels in equipment of 3 to 6 years of age which has not required recharging of

refrigerant in order to determine acceptable levels of contaminants in operating systems. This effort will provide information to base a relaxed standard that will permit on-site recycling. AEERL will provide sampling and analysis from ten categories of stationary refrigeration equipment to provide data for a recycled refrigerant standard. AEERL's Quality Assurance support to the project will ensure that the data developed have a sound scientific basis and will make it more useful for setting standards as required by the Clean Air Act Amendments. (Dale L. Harmon, AEERL, FTS 629-2429)

Immunoaffinity Techniques Applied to Personal Exposure Monitoring

Scientists at EMSL-LV have developed immunoaffinity personal exposure monitors (PEMs) that can alert an individual within minutes of potentially harmful exposures to a pesticide or other chemical. The utility of immunoaffinity based PEMs to detect pentachlorophenol (PCP) vapors at 1 ppb within 15 minutes of exposure has been demonstrated. This constitutes the first application of an immunochemical technique to direct vapor sampling. The antibody-based sampling device has the advantage of being compound specific, thus will provide superior protection against exposures to compounds of concern. EMSL plans to undertake a rigorous series of field evaluations of these PEMs. (Jeanette M. Van Emon, EMSL-LV, FTS 545-2154)

Improved Chamber for Estimating Biogenic Emissions

AEERL, in cooperation with Duke University, has initiated an effort to develop improved emission estimates of hydrocarbons from vegetation. An open top exposure chamber is being modified to regulate air flow and monitor isoprene and terpene emissions. Initial tests of emissions from loblolly pine will determine if it is necessary to remove background hydrocarbons from ambient air via carbon filtration. AEERL will also evaluate multisorbent cartridge systems as opposed to traditional measurement techniques. Natural hydrocarbons are an important consideration in developing effective control strategies for urban ozone. Results of this research could be a factor in developing standards for volatile organic compound emissions. In addition, the chamber will allow ORD to develop more environmentally realistic emissions equations. (Christopher D. Geron, AEERL, FTS 629-4639)

FTTA Agreement Signed for Research of SO_x/NO_x Reduction in Boilers

Through the Federal Technology Transfer Act, a Cooperative Research and Development Agreement has been signed between AEERL and Nalco Fuel Tech to investigate combined technologies for SO₂/NO_x reduction in utility and industry boilers. AEERL and Nalco Fuel Tech will co-fund research at the AEERL flue gas cleaning facilities that investigate injection of a slurry containing a Ca-based sorbent and NO_x OUT, a urea-based solution. This combined technology would be applicable to both new and retrofit boilers and could have a significant role in meeting the standards of the Clean Air Act Amendments. NO_xOUT, although appropriate as a low cost, stand-alone technology, can be combined with burner and combustion modifications to achieve NO_x reductions similar to those of selective catalytic reduction, yet several times more inexpensively. Sorbent slurry injection is a low capital cost technology shown to

achieve 70 to 80% SO₂ removal at the pilot scale. (Brian K. Gullett, AEERL, FTS 629-1534).

Soviet Wet-Bottom Utility Boiler Reburn

Plans are final for the demonstration of natural gas reburn technology on a wet-bottom, coal-fired, 300 MW utility boiler. A U.S. delegation, headed by Robert E. Hall, of AEERL, spent four days at the Ladyzhin plant in the Soviet Union where they inspected the No. 4 boiler, installed a TECO NO_x analyzer, and reviewed final drawings and plans for the boiler modification. The Soviets agreed to add valves to reburn gas lines for enhanced control of the reburn system and will consider a request to increase the duct size in the superheater area to improve boiler operation capability. The NO_x analyzer will be used to obtain baseline NO_x data while firing coal, natural gas, and combination of the two fuels. Once the boiler is modified in late 1991 or early 1992 the analyzer will be used to collect data while applying reburn technology for NO_x control. Data collected from this boiler will be useful for regulation of NO_x from U.S. wet-bottom boilers. The technology may be applied to other boilers in the Soviet Union. (Robert E. Hall, AEERL, FTS 629-2477)

Control of Indoor Radon Through Natural Ventilation

Natural ventilation studies in two New Jersey houses during both the summer and winter seasons have demonstrated an impressive potential for reducing indoor radon levels. Simultaneous measurements of radon concentrations and tracer gases concentrations allowed the effects of dilution by infiltration and reduction in the rate of entry of radon into the basements to be distinguished. While natural ventilation increased the air exchange rate by about a factor of 2, the radon concentration was reduced by a factor of five or six. This approach could yield mitigation systems much lower in purchase costs than active subslab depressurization (ASD). However, the estimated increase in annual heating cost was \$225 which compares to a typical annual operating cost for an ASD mitigation system of \$150. (Ron Mosley, AEERL, FTS 629-7865)

ADVACATE Capable of Effective SO₂ Control at Low Costs

The ADVACATE process is capable of greater than 90% SO₂ control at costs projected at less than half that of conventional scrubber technology. Suitable for both new and retrofitted coal-fired utility/industrial boiler applications, ADVACATE could play a significant role in meeting the Phase II requirements of the Acid Rain Title included in the 1990 Clean Air Act Amendments. The Tennessee Valley Authority (TVA), the nation's largest public utility, will provide a host site and the major funding for a 10 megawatt pilot evaluation of the process at their Shawnee Station in Paducah, Kentucky, with testing scheduled to begin in late-1991. Cost-sharing partners in this \$4 million pilot project are EPA, the Electric Power Research Institute, and ABB Environmental Systems (an international supplier of air pollution control systems which will license and market the ADVACATE technology). TVA and ABB are preparing a Clean Coal IV proposal to demonstrate the ADVACATE process at the full commercial scale following the pilot testing. If selected by DOE, demonstration results could be available as early as mid-1995. In-house research supporting the pilot testing and demonstration will continue at AEERL. (Michael

A. Maxwell, AEERL, FTS 629-3091)

Radon Mitigation Testing Achieved in Difficult-to-Mitigate Houses

Testing in six difficult-to-mitigate slab-on-grade houses in New Mexico has demonstrated the ability to achieve indoor radon levels below the current guideline of 4 pCi/L in such houses using one to three-pipe sub-slab depressurization systems. Four of these houses have consistently been reduced to below 1 to 2 pCi/L, consistent with the ambient radon levels required in the Indoor Radon Abatement Act. Researchers believe the use of a developmental diagnostic technique, "radon entry potential" approach, during sub-slab depressurization system design, might have contributed to the system's success. The results of these tests suggest effective mitigation of these houses will not be significantly more expensive than costs of mitigation for similar houses. (Bruce Henschel, AEERL, FTS 629-4112)

EPA Recommends Ways for DOD to Minimize Ozone-Depleting Chemicals

EPA is required by Congress to participate on an Advisory Committee with the Department of Defense (DOD) and industry to define ways in which DOD can eliminate its use of ozone depleting compounds. AEERL assisted in writing the proposed final draft of the report to Congress. The final report will recommend specific actions that DOD can take. These include administrative actions, a review of existing technology alternatives that could be used, technology that may be available in the near term, research and development recommendations for mission critical uses, and technology transfer from EPA and industry to DOD as well as within DOD. (William J. Rhodes, AEERL, FTS 629-2853)

Woodstove Technology Achieves Reduction of Particulate Emissions

AEERL demonstrated a woodstove technology which achieves a 100-fold reduction in particulate emissions compared to conventional stoves. This technology, directly applied to a popular stove on the market, uses a small natural gas or propane fueled pilot flame to sustain secondary combustion under typical low burn conditions. As marketed, the stove is certified to EPA's 1 particulate emission standard. The EPA-modified stove has an emission rate of only 0.15 g/hr as compared to conventional stove emissions of 24.3 g/hr. At the same time, carbon monoxide emissions are reduced by over 50%, from over 100g/hr to less than 50 g/hr. When fully developed, this technology is estimated to add approximately 5% to the purchase price of the stove. Gas to fuel the pilot is estimated at around \$0.3 per hour, or \$2.25 per month for natural gas and \$4.50 per month for propane if used 100% of the time. These costs would be partially offset by the reduction in wood use due to (1) the increased efficiency of the stove and (2) the heat output from the gas pilot. This technology offers communities across the country that are heavily impacted by woodsmoke better than a 99% reduction in woodsmoke and a 50% reduction in carbon monoxide. (Robert C. McCrillis, AEERL, FTS 629-2733)

New Technology Destroys VOCs at Low Concentrations

AEERL researchers have designed and built a semi-pilot scale corona reactor capable of handling 10 to 50 cfm to

evaluate the packed bed corona process. This process allows for destruction of volatile organic compounds (VOCs) even at low concentrations. The destruction of VOC laden air is characterized using barium titanate as the packing material and an AC power supply. The performance of the semi-pilot packed bed corona reactor will be evaluated on a wide range of air toxics. These tests will support the development of predictive mathematical models. The operation of the system is computer automated. Electrical performance testing has begun and initial tests have been successful. The semi-pilot packed bed corona reactor will test destruction of low concentration VOCs/HAPs. (Carlos M. Nunez, AEERL, FTS 629-1156)

Small-Chamber Testing Guide Developed by AEERL

The American Society for Testing and Materials (ASTM) recently published the "Standard Guide for Small-Scale Environmental Chamber Measurements of Organic Emissions from Indoor Materials/Products" (ASTM Standard D 5116-90). The guide describes the methods and procedures for determining organic emissions rates from indoor materials and products using small environmental test chambers. The methods in the guide are based on procedures developed by AEERL's Indoor Air Branch. Publication of the guide by ASTM provides a common basis for testing indoor sources. This will promote source testing by a broad spectrum of IAQ interests, including manufacturers, builders, architects, and researchers. The testing procedures provided in the guide will encourage the production of low emitting products and enhance the opportunities for consumers to select products that will reduce their exposure to indoor air pollutants. (Bruce A. Tichenor, AEERL, FTS 629-2991)

Water

EPA Develops Improved Anaerobic/Aerobic Process

RREL has developed an anaerobic/aerobic bioprocess for improved treatment of CERCLA/RCRA leachates and listed "RCRA industrial wastes" in industrial or municipal wastewater treatment plants. The process has the potential of serving as a basis for upgrading these plants to control most specific toxicants (priority pollutants, etc.) and bioassay toxicity. The two-sludge process includes an anaerobic, contact-stabilization process followed by aerobic-activated sludge for increased removal and degradation of organic wastes including toxic organics. The anaerobic process uses carbon-assisted, anaerobic treatment to remove 40-50% of conventional organic wastes and most of the toxics before aerobic treatment. The process is ready for pilot-scale testing to evaluate the replacement requirements for the support media (granular, activated carbon) used in the anaerobic stage of the process. The process controls VOC emissions in the aerobic (aeration) stage without installation of systems for VOC capture and destruction. The combined anaerobic/aerobic system can be installed into the existing tankage space in activated sludge wastewater treatment plants and potentially has operating costs similar to conventional aerobic treatment. (Dolloff F. Bishop, RREL, FTS 684-7629)