Savannah River Technology Center

Monthly Report

June 1994

Westinghouse Savannah River Company
Savannah River Site
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Executive Summary

Tritium

- Representatives from four DOE sites met at SRS to form an Interagency Task Group as a part of the program to develop resistance welding technology for fabricating reservoirs. The group consists of a representative from Allied-Signal (Kansas City Division), Los Alamos National Laboratory, Sandia National Laboratory (California), SRS, and others participating as appropriate. At the initial meeting this month, the four agencies determined the mission for the group, decided upon action items to implement the mission objectives, and elected W. R. Kanne of (SRS) as chairman. (page 7)

- A progress report on the process optimization program for metal hydride composites was issued. This report summarized several improvements in the performance of metal hydride composites that resulted from the process optimization studies. Work on this program has been discontinued for the remainder of the fiscal year due to funding limitations. (page 7)

- The Materials Technology Section is providing assistance to the Chemical and Hydrogen Technology Section and the Tritium Section in investigating unsatisfactory pinch welds made for qualification of the SP-981 reservoir in the Replacement Tritium Facility. Tube internal surface inspections indicate that the problem is associated with contaminants on those surfaces, possibly aggravated by non-optimum welding parameters. (page 7)

- Unusual bond interfaces were discovered when evaluating the SP981A pinch welds. It was concluded that this phenomenon was the result of a stem surface condition. One solution being pursued is to increase the voltage settings for the welds. (page 8)

- Tests were conducted to show that deuterium and protium can displace each other when one is absorbed on titanium sponge. (page 8)

- An investigation of new palladium alloys of nickel, cobalt, and chromium is underway in the SRTC Materials Test Facility. To date, data collection on two nickel alloys and one cobalt alloy is complete. The study is continuing with work on a second cobalt alloy. (page 9)

Separations

- SRTC is performing experiments as part of a study of the Tomsk, Russia accident. Two-layer calorimeter experiments show that self-cooling by water evaporation occurs when oxidation begins in the organic and aqueous phases. Initially,

the temperature increased due to the exothermic oxidation reaction. After the individual phases became saturated in the product gases, release of these gases forced evaporation of the volatile liquids in the solution (such as water and nitric acid). This forced evaporation caused a net cooling of the reaction solution. (page 11)

- Pu content of solids in several canyon tanks were determined to ensure there are no criticality issues. Increases in plutonium solids were found to be associated with corrosion products. (page 11)

- A deformed plutonium oxide storage can from FB-Line vault was sampled and was found to be bulged and pressurized from PVC radiolysis. (page 12)

Environmental

- An aquifer vulnerability assessment is being performed for SRS. This assessment will identify areas on site that are more susceptible to groundwater contamination based upon the hydrogeologic environment. (page 17)

- A commercially available adjustable frequency AC motor drive was tested on the groundwater pump in well P29B. The drive was able to successfully control the flowrate of the pump over the range from 1.2–22.2 gpm. The ability to control the speed of the pump to obtain low flowrates is important in minimizing the amount of entrained solids within a groundwater sample. The use of this technology could result in a significant cost saving over the replacement of the existing pumps. (page 17)

- A two-dimensional cross-section, saturated-unsaturated flow model of Tank 48 and berm, was developed using the TOUGH2 numerical code to determine whether leaked waste can seep out of the side of the berm. Simulations using a variety of soil types and horizontal to vertical conductivity ratios up to 10 demonstrate that liquid waste will not seep out of the berm. (page 17)

- SRTC met with the Sample Management Section and discussed the possibility of collaborating on using new analytical kits for petroleum hydrocarbons and other contaminants. The new assay kits cut analytical costs by more then 70%, reduce analytical time from one week to one hour, and do not produce a hazardous waste like the conventional GC assay does. (page 17)

- The WSRC Environmental Advisory Committee met at SRS from May 18–20, 1994. They participated in discussions with SRS management and staff on a variety of environmental topics including the SRS Watershed Management Plan, the Solid Waste Management Plan, the SRS Strategic Plan, the Citizens Advisory Committee, cost reductions in environmental monitoring, review of the *SRS Annual Environmental Report*, and a demonstration of the interactive computer sitewide *Environmental Information Document*. (page 18)

- Modeling of projected nitrogen oxides emissions was done for a vitrification facility to be built in M Area. The modeling work was done on an accelerated schedule which enabled the site to meet requirements that the permit application be submitted to the permitting agencies by June 30. (page 18)

- The document entitled, *"Assessment of Tritium in the Savannah River Site Environment"*, (WSRC-TR-93-214), was published. It is a revised and updated version of a document published in 1990. (page 18)

- Assembly of the Phase I prototype RADMAPS radiation detector and GPS system for DOE/NN-2D are nearing completion. The system will be preprogrammed from a host PC for autonomous use (single push-button start) in the field. (page 18)

- All electronics for the prototype aerial monitoring system have been assembled and field testing has begun. New Batch software for recording the radiation spectra in the multi-parameter pulse height analysis (MPHA) mode has been written. (page 18)

- In May 1994, the Environmental Protection Agency (EPA), South Carolina Department of Health and Environmental Control and DOE reached an agreement on the proposed interim remedial action for TNX groundwater. The interim remedial action was developed by ESS. The new interim remedial action is a hybrid groundwater clean-up system that incorporates *in situ* and *ex situ* treatment. (page 19)

- Several new groundwater recovery wells, RWM13B and C, 14B and C, and 15, were installed to clean up groundwater contamination in the vicinity of the SRTC. SRTC was requested to perform aquifer tests to evaluate the wells. Results of the test indicate that the aquifer is slightly more conductive than in other portions of the SRS. Chemical analyses show that the CVOC and tritium concentration are as expected. (page 19)

- The vegetation characterization of radionuclide and metals in the Old F-Area Seepage Basin was completed. Measured concentrations of radionuclides and toxic metal were used to calculate the total inventory of the vegetation growing on the Old F-Area Seepage Basin. Air concentrations and inhalation doses from exposure to smoke from burning the vegetation were calculated to evaluate the effect of open air burning to dispose of the vegetation. (page 19)

- EPA stated that plans that called for 80% of samples analyzed by innovative field screening methods and 20% baseline methods would be approved given evidence of the effectiveness of these field screening methods. (page 20)

- Innovative field screening methods integrating the cone penetrometer and depth-discrete gas and water sampling technologies were demonstrated at Fairchild Air Force Base in Spokane, WA. Personnel from the U.S. Air Force, Westinghouse Hanford Company, Battelle Pacific Northwest Laboratory, Applied Research Associates, Inc., and WSRC joined forces to rapidly characterize a waste site. (page 20)

- A presentation on barometric pumping was given at the volatile organic compound Arid Integrated Demonstration program review meeting in Oregon. Data were presented on the advantages of using a one way check valve to increase mass removal by barometric pumping, analytical modeling of subsurface pressure response to surface pressure fluctuations, and enhancing removal of volatile contaminants in the subsurface by combining barometric pumping with solar heated air injection. (page 20)

- SRS is the host site for demonstrating a new technology for the *in situ* remediation of groundwater contaminated with inorganic contaminants such as metals. The technology uses iron particles coated with ion exchange resin to remove contaminants from the water. The iron particles are then removed using a magnet. The site originally selected for the demonstration, D Area, was found to be incompatible with the resin and a new site selection process was initiated.

  A site screening for new technology demonstration sites was conducted and produced two potential alternative sites. (page 21)

- A small-scale soil vapor extraction (SVE) unit was fabricated from spare parts available in Stores. This unit is portable and can handle flows up to 15 scfm. It will be used to conduct small scale offgas treatment tests and perform soil gas investigations at vadose zone wells. The unit was tested at the former *in situ* heating demonstration site. (page 21)

- SRS personnel demonstrated innovative characterization techniques (developed as a part of the Savannah River Integrated Demonstration) at a commercial site in South Carolina. In an effort to facilitate technology transfer, engineers from an environmental consulting firm were trained in the field by SRS engineers to perform rapid soil gas analyses using a Bruel & Kjaer, Inc. multigas analyzer. Equilibrium gas concentrations were measured in twelve wells in one day at a site contaminated with chlorinated solvents. (page 21)

- The final report on the Gas Phase Bioreactor system was received from ECOVA. Results indicate a maximum of 29% degradation of TCE in the gas phase. (page 21)

- Activities supporting programs aimed at collaborating with environmental services companies, universities, and other organizations to develop new ways to monitor and clean up areas of undissolved pure solvents in soil and groundwater have made significant progress (these solvents are called Dense Non-Aqueous Phase Liquids, or DNAPLS). Test plans and permits supporting the evaluation of specialized uses of industry geophysical tools for DNAPLS were

completed. Preparations for the field work are underway. The U.S. Geological Survey, who is coordinating the geophysics work, will arrive shortly to begin their work. (page 21)

- J. Bowers gave a seminar to the Westinghouse GOCO Risk Assessment Committee in Hanford, WA on May 12, 1994. This seminar described the HOPS Office of Technology Development project to develop a software application for supporting ecological and human health risk assessments under EPA/CERCLA guidelines. After the seminar, the committee asked that they meet at SRS in November 1994 to host a nationwide workshop on risk assessment to include other DOE environmental contractors. (page 22)

Waste Management

- SRTC testing has shown that saltstone vault deformation was not caused by expansion of the saltstone. (page 23)

- A health-based risk assessment is underway for the Consolidated Incineration Facility through an ERDA contract. ERDA completed a draft of inorganic emissions and the proposed risk assessment methodology to be used. (page 23)

- A container of cadmium contaminated waste was identified in the SRS Mixed Waste Inventory Report. SRTC characterization allowed it to be removed from the SRS Mixed Waste Inventory. (page 23)

- SRTC characterized the effect of pump leakage on Extended Sludge Processing (ESP) Tanks 42 and 51. (page 23)

- Analyses of samples from Tank 42H indicate that the supernate has reached between 47 and 54% of the expected fully mixed composition. This level of mixing was chiefly due to the operation of two of the four pumps within the tank for 9.5 days. (All sample analyses for direct support of the ESP Baselining Test have met the 14-day response target.) (page 24)

- Additional laboratory studies confirmed that unexpected odors around Tank 42H were caused by trace quantities of gases consistent with radiolytic decay of ion exchange resins from the separations facilities. (page 24)

- A draft version of the *Defense Waste Processing Facility Late Wash Technical Bases*, Rev. 4, was issued on June 20, 1994 for review. The draft document addresses the revised scope of the physical facility and incorporates recent experimental data and calculations. Formal issuance of the document is expected in early July 1994. (page 24)

General

- The modeling team successfully met the June 30, 1994 DOE-HQ Level A milestone to provide a working version of the High-Level Waste Integrated Flowsheet Model with comprehensive documentation in draft form and configuration control of the software. A three month verification and validation phase is in progress prior to final turnover to the customer at the end of the fiscal year. (page 27)

- A functioning storage facility for failed melters is a requirement for radioactive operation of the Defense Waste Processing Facility. Results from a two-dimensional scoping analysis found the concrete and glass temperatures to be unacceptable for the maximum melter decay heat power of 3 kW. (page 27)

- A statistically-based, decision support system consisting of two Microsoft™ Excel spreadsheets, was developed to assist in the in-tank precipitation benzene stripper test. (page 28)

- Bubblers have been used for years in the canyons for liquid level measurements because of their simplicity and low cost. However, in tanks containing slurry and glass frit, they plug so rapidly that a standard bubbler is not practical. A Holledge probe system that measures liquid level was installed; it is complex, easily damaged, and expensive. This study will evaluate new concepts and materials that may solve the standard bubbler plugging problem and allow them to be used. (page 28)

- The Packaging and Transportation group thermally tested two model variations in support of the 9972-series packaging assessment. Test units were prepared at SRS, testing was performed at Sandia National Laboratory (Albuquerque), and post-test evaluations were made at SRS. The packagings performed as designed and provided analytical benchmark data. (page 29)

- The first application of the WSRC 19Q, *Transportation Safety Manual (TSM)*, to a First Time Use condition is complete. An existing SRS shipping cask and proposed payload were technically reviewed and documented in accordance with the requirements of the TSM. (page 29)

Progress and Accomplishments

Tritium

Solid-State Weld Task Group

W. R. Kanne

Representatives from four DOE sites met at SRS to form an Interagency Task Group as part of the program to develop resistance welding technology for fabricating reservoirs. The group consists of a representative from Allied-Signal (Kansas City Division), Los Alamos National Laboratory, Sandia National Laboratories (California), SRS, and others participating as appropriate.

The mission of the Interagency Task Group is to determine what questions (technical and non-technical) should be answered before reservoirs are fabricated using solid-state resistance welding and systems where resistance welding can most appropriately be applied, to develop a strategy for marketing this fabrication process, and to provide liaison with DOE and its agencies. Ideas for implementing each area were discussed at the meeting and action items were determined accordingly. In the near-term, the task group plans to develop a cost analysis of resistance upset welding equipment, issue an interim report on the status of the upset welding program, establish a means to keep DOE informed on the program, and develop a means for marketing the program to the proper people or groups. The next meeting is planned for October 1994 at Sandia National Laboratory.

Metal Hydride Composites

J. W. Congdon

A progress report entitled, *Interim Report on the Metal Hydride Composite Development Program,* (SRT-MTS-94-3016) was issued. The report satisfied Milestone #4 of Plant Task Number SR-3-0302-91 in the FY94–96 Production Capability Assurance Program Plans and Budgets document.

The report summarized several improvements in the performance of metal hydride composites that resulted from the process optimization studies. The hydrogen storage capacity of the composites was increased and the process was modified to nearly eliminate the loss of metal hydrides from the surface of the pellets during cycling in hydrogen. Two types of hydrogen permeable coatings were developed to retain fines.

All work has been discontinued for the second half of FY 94, due to funding limitations. Tritium compatibility testing of the metal hydride composites, scheduled to start in FY 94, will be delayed until FY 95.

Pinch Weld Qualification

W. R. Kanne

The Material Technology Section is providing assistance to the Hydrogen Technology Section and the Tritium Department in investigating unsatisfactory pinch welds made for

qualification of the SP-981 reservoir in the Replacement Tritium Facility (RTF). Tube internal surface inspections indicate the problem is associated with contaminant on those surfaces, possibly aggravated by nonoptimum welding parameters.

Tube internal surfaces were examined by borescope inspections and lengthwise slicing of the tubes for direct visual examination. Tubes that produced pinch welds with unusual and rejectable weld interfaces had internal surfaces that appeared discolored compared to surfaces on tubes that did not produce the unusual interfaces. The discoloration was light brown or straw color, typical of oxidation. Welding parameters in the RTF were within specification and should produce good welds on normal clean tubes. Hotter welds would be more tolerant of variations in tube surface quality and more likely to produce acceptable welds.

Replacement Tritium Facility SP981A Pinch Weld Evaluations

C. L. Shelor, C. C. Wilkins, S. M. Wood, P. L. Morgan, B. Wilson, and S. B. Rhodes

As part of their TMS qualifications the Replacement Tritium Facility (RTF) was required to load eight SP981A reservoirs. After successful unloading, all pinch welds were evaluated for bond quality by EG&G Mound Laboratory or the Materials Testing Facility.

Five of the eight welds exhibited an unusual bond interface. Of these five, four were rated as Class 3 and one was rated Class 2. The remaining welds were rated Class 2 and displayed "normal" interfaces.

An as-polished weld that displayed this abnormal interface was examined in the scanning electron microscope. Energy dispersive x-ray spectroscopy was used to determine the elemental analysis of the "contaminants" at the bond interface. Results showed much higher levels of oxygen, chromium, and silicon at the interface versus the bulk material. No evidence of any corrosion products such as chlorine or flourine was discovered.

Because the 981 has a long fill stem, remnants of stems that showed the unusual interface (S/N 19437, 19452, and 19450) were available for further testing. Various welding was performed in 233-H and 234-H on these sections of stem along with control samples. In all cases, the control samples produced "normal" interfaces. The unusual interface was reproduced only with the stems that had originally exhibited the phenomenon (S/N 19437, 19452, and 19450).

Work on a borescopic technique to detect unacceptable stem surfaces is underway. Although RTF's current voltage settings produce good quality bonds, increasing the heat will minimize the chances of forming this unusual interface on future welds. Currently, RTF is performing test welds to justify increasing the voltage setting on War Reserve reservoirs. When an appropriate setting is determined, RTF will begin requalification of the 981 reservoir.

SP 993 welds also show evidence of the same unusual interface. The internal tube surfaces of this reservoir type are also less than ideal. Investigation continues to resolve this problems.

Titanium Sponge for Tritium Applications

L. K. Heung

Titanium reacts with hydrogen at temperatures above about 400°C. The equilibrium hydrogen pressure of the titanium-hydrogen system is low (about 1E-9 atm at room temperature). Titanium sponge has the potential to be used for long-term tritium storage, tritium transport, and tritium stripping from gas streams. Last month, it was reported that titanium sponge was shown to absorb hydrogen reversibly after activation at 500°C. Additional tests were conducted to evaluate its isotopic exchange properties.

Titanium sponge, in the form of 0.8 cm or smaller particles, was filled in a U-shaped column of 1.9 cm diameter. The titanium was first activated by bake-out at 500°C, followed by one cycle of hydrogen absorption and desorption. The column capacity for hydrogen was 34 STP liters. It was then saturated with protium at 2000 torr pressure. Deuterium was fed into the column to

displace the protium at a flow rate of 200 cc/min. The concentrations of protium and deuterium in the exit stream were continuously measured by gas chromatography. After the protium was completely displaced by the deuterium, the feed was changed to protium to displace the deuterium in the column.

Tests at three temperatures (25, 200, and 500°C) were conducted. The results showed that the exchange kinetics was slow at 25 and 200°C. At these temperatures, the feed gas broke through the column quickly, indicating little exchange. When the temperature was increased to 500°C, the exchange kinetics improved significantly. When protium was used to displace deuterium, about half of the column capacity was collected as high purity deuterium before protium began to break through. When all the deuterium had been displaced out of the column, the average concentration of all the exit gas was about 60% deuterium. Similar results were obtained when deuterium was used to displace protium.

These results show that it is possible to use isotope displacement, instead of absorption and desorption, to charge and discharge tritium from titanium sponge.

Tritium Isotherms Characterize New Palladium Alloys

J. S. Hölder, D. E. Moseley, and R. J. Stanley

As part of the Tritium Exposure Program (TEP) in the Materials Test Facility (MTF), a series of new palladium (Pd) alloys are under investigation to determine their applicability to tritium processing. For each material, a sample is activated, shown to be stable to tritium absorption, and characterized by the acquisition of desorption isotherms at three temperatures. To date, two nickel alloys and one cobalt alloy were characterized; these samples were fully loaded with tritium and placed into storage to initiate tritium aging.

This work is being conducted on the Experimental Tritium Manifold (ETM) in the MTF. The two Pd alloys of nickel (Ni) under study are designated PdNi-1 and PdNi-2, with approximately 5% and 10% Ni by weight, respectively. The cobalt (Co) alloy, PdCo-1, is also a 5% alloy. Activation of these samples requires repeated cycles of absorption followed by desorption and bake-out to vacuum at elevated temperatures. Stability is demonstrated by the reproducibility of tritium desorption isotherms at a single temperature. The acquisition of isotherms at three different temperatures completes the characterization, enabling the thermodynamic parameters of ΔH and ΔS to be determined and allowing the plateau pressure to be calculated as a function of temperature.

Figure 1 shows representative tritium desorption isotherms, collected with the sample temperature at 50°C, for each of the three Pd alloys. Here, the pressure of tritium in equilibrium with a sample was plotted versus the composition of the sample (expressed as the ratio of tritium to metal atoms in the solid phase). The solid symbols correspond to the PdNi alloys, and the open triangles represent the data from the PdCo alloy. The PdNi isotherms demonstrate two marked effects of alloy weight percent (wt %): the plateau pressure increases with wt % Ni, and the reversible capacity (ultimate composition) decreases with wt % Ni; these trends are

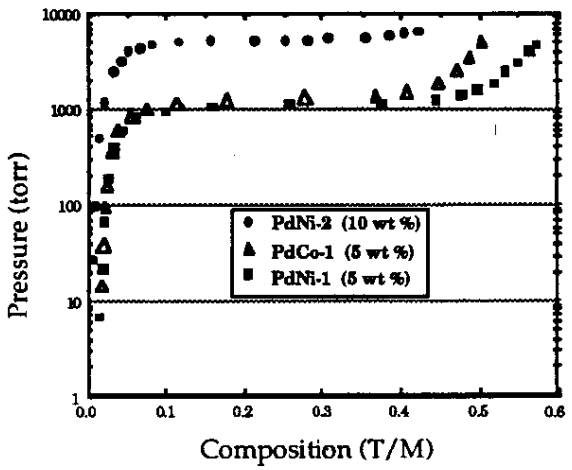

Figure 1. Tritium Desorption Isotherms for Palladium Alloys at 50°C

expected in the other alloy systems as well. Thus, the plateau or delivery pressure of the material may be elevated by increasing the alloy wt %, however, this is achieved at the cost of decreased tritium capacity.

A comparison of the tritium desorption isotherms for the PdCo-1 and the PdNi-1 samples illustrates the effects of alloying elements on the behavior of these tritides. The samples are composed of 5 wt % alloys. PdCo-1 has a slightly higher plateau pressure than the PdNi-1. On the other hand, the PdNi-1 sample exhibits longer plateau region and a greater tritium capacity than PdCo-1. However, these equilibrium measurements do not tell the entire story. The rate at which equilibrium is attained, referred to as the kinetics, is also an important factor to consider. Although not studied quantitatively, it was found that the kinetics of the PdCo-1 sample were favorable to that of the PdNi-1. The PdCo-1 sample was also found to activate and achieve reproducible behavior faster than the PdNi-1 alloy.

The thermodynamic parameters of the change in enthalpy (ΔH) and the change in entropy (ΔS) were determined for these three palladium alloys. The values obtained in this study compare favorably with those found for similar materials in the literature. These parameters allow the equilibrium plateau pressure to be predicted as a function of temperature. This information facilitates the selection of a metal tritide for a particular application to which it is well suited. The Pd alloys investigation continues now with the characterization of the PdCo-2 material.

Separations

Tributyl Phosphate Safety Studies

J. R. Smith and W. S. Cavin

An explosion in a separation facility in Tomsk, Russia led to studies at several DOE sites into the chemistry and conditions causing the accident. Calorimeter studies are being developed to support computer modeling of the heat produced in process tanks and evaporators containing organic layers of tributyl phosphate saturated with nitric acid.

A larger calorimeter system was designed and constructed for studies of the relationship between layer thickness and reaction characteristics. Three experimental runs were performed with four inches of aqueous phase in each and two-, five-, and eight-inches of organic phase. The aqueous phase was 0.65M $Fe(NO_3)_3$/0.7M $Al(NO_3)_3$/6M HNO_3 (to simulate the presence of uranium in nitric acid). The organic phase was tributyl phosphate pre-saturated with a five-fold excess of the aqueous phase. The system consisted of a clear dewar in an aluminum nitrate solution bath. A nichrome wire (in teflon%) was used to heat the aqueous phase.

Preliminary results of the two-layered runs show that when oxidation began in the organic phase, the organic phase was self-cooled by water evaporation. Oxidation usually occurred in the organic phase at about 94°C. At about 102°C, oxidation and bubbling occurred in the aqueous phase. Initially, the temperature rose due to the exothermic oxidation reaction. After the individual phases became saturated in the product gases, release of these gases forced evaporation of the volatile liquids in the solution (such as water and nitric acid). This forced evaporation caused a net cooling of the reaction solution. This net cooling was most pronounced when the temperature was close to the boiling point. Reduction of the heat added to the reaction solutions (by either the nichrome wire heater or the bath) caused a lowering of the aqueous and organic phase temperatures. The temperatures in the two phases mirrored each other with the organic phase typically about 1°C less than the aqueous phase.

Safe Storage of Fissile Material

J. H. Gray, K. J. Kalbaugh, and W. N. Wilson

Solutions containing solids from F-Canyon Tanks 10.2 and 13.5 and H-Canyon Tank 18.3 were received for characterization. This effort is part of the ongoing program to characterize solids and solutions from canyon tanks containing fissile material.

The determination of the plutonium (Pu) content of solids from canyon tank solution samples is performed because of criticality issues. Solutions from canyon tanks are being characterized due to earlier formation of plutonium-phosphorus in F-Canyon Tanks 9.6 and 9.8 and the recent increase in volume and Pu content in solids from solution samples from H-Canyon Tanks 12.1 and 18.3. The increase in volume of Tanks 12.1 and 18.3 solids and Pu content was due to an accumulation of corrosion product particles. A connection between solution compositions and the possibility of similar solids accumulations between F- and H-Canyon tanks is being investigated. So far, no correlation between solutions from F- and H-Canyon tanks has been made.

Mixing in Canyon Tanks

N. M. Hassan and Y. J. Simpkins

The Separations Engineering Section requested that the Chemical Technology Section develop the documentation necessary to quantify the mixing quality in the canyon tanks. The tanks may contain about 0.5% (volume) organic in aqueous phase, and the solutions are well-mixed before they are introduced into the process evaporators. To ensure adequate mixing of the two-phase immiscible liquids, flat-blade agitators with sufficient power input are used. However, no documentation of the mixing quality in the canyon tanks is available in SRP/SRL archives.

Scoping experiments to probe our ability to sample and accurately measure the volume fraction of organic in agitated two-phase immiscible liquids continues. A new set of experiments were performed to examine the effects of the sampling point and dispersed phase (organic) fraction on the degree of mixing of the two-phase liquid mixture. The experiments used a Plexiglas®

tank. The tank was geometrically similar to the canyon vessels. The details of the experimental apparatus and sampling procedures were presented in SRT-CTS-94-0066.

The experimental (with only six inches or one-third tank volume) results indicated that the percentage mixed of organic varied little with the sampling point as the dispersed (organic) phase fraction in the tank was varied from 0.03 to 0.1. Previous tests at the point above the tower agitator and below the top agitator showed dramatic differences with the sample point location.

Because of the need to validate our model studies as representative of plant conditions, preliminary discussions and a tour of existing test equipment were held with Professor A. H. Peter Skelland of Georgia Tech. Subsequently, a Scope of Work was prepared and submitted to ERDA (a consortium of Georgia Universities). The Scope of Work calls for consultation in a test program and development of a correlation of mixing efficiency as a function of the agitator speed, the height of liquid, and the number of agitators. The second phase will be to evaluate a solid-liquid mixing operation characteristic of the process tanks. Each phase is estimated to cover a period of four months with the final deliverable for each, a report of the results co-authored with a SRTC researcher who will perform the test program. A proposal from ERDA is expected within the next several weeks. This proposal, if accepted, will be followed with a Scope of Work and purchase requisition awarding the contract to ERDA.

Plutonium Recovery by Batch Extraction

D. G. Karraker, J. H. Gray, and W. N. Wilson

One option for recovering plutonium from irradiated fuel involves batch extraction of dissolver solutions. This approach would eliminate the need for operation of the first uranium cycle and could eliminate second uranium cycle operations if the uranium were to be sent to waste. Operation of the second plutonium cycle is necessary to obtain fission product DFs required for plutonium product to be compatible with FB-Line operations.

A process flowsheet for recovery and purification of plutonium was developed. It involves a series of batch extraction, multiple strippings of the organic, and operation of the second plutonium cycle. Even though long-cooled fuel will be processed, semi-continuous clean-up of the solvent will be necessary to maintain good solvent quality.

Experimental data was obtained to provide support data for multiple extraction of uranium into the organic phase. Agreement between calculated and experimental results for uranium extraction was good. Additional laboratory studies will be required to obtain distribution of plutonium between the phases in the presence of excess uranium. A report (SRTC-CTS-94-0091) was issued describing the flowsheet details.

Analysis of Failure Data from the F-Canyon Vessels

E. W. Jenkins

The lifetimes of the vessels in F Canyon have recently been questioned. To aid in the determining whether or not these vessels need to be replaced, an analysis of these lifetimes was undertaken.

Data from the service histories of the F-Canyon vessels were used to model the failure distribution of the vessels. The analysis was based on the initial vessel failures and any failures that occurred after they were repaired and placed back into service. The percentiles of the fitted lifetime distribution were estimated for batch pots, tube bundles, and hold tanks. In addition, survival probabilities were calculated for each type in service. The analysis documentation will be used by F-Canyon personnel as part of the justification for restarting the facility.

FB-Line Storage Issues

R. A. Pierce, J. D. Clark, and R. M. Younkins

SRTC tested a deformed plutonium oxide storage can from the FB-Line vault. Tests were conducted to determine if the deformation is the result of internal gas generation or mechanical malfunction.

These tests clearly demonstrated that gas generation from PVC radiolysis and degradation caused the can deformation. Preliminary calculations estimate the internal can pressure at 15.0 ± 1.5 psig with a gas volume of 730 ± 10 mL. The accuracy of this number is lower than expected because of restricted diffusion of gases from the inner can to the can tester and possible desorption of gas from the oxide powder.

Gas analyses (J. Young and D. Ferrara) indicate that the gas contains the following: PVC decomposition products 40.4% H_2, 27.7% N_2, 5.6% O_2, 14.0% CO_2, 3.0% CO, 9.1% H_2O, and 0.2% Ar. No HCl or other organics were detected. The nitrogen level is lower than predicted from the measured pressure (expected 38.7% because of dilution by other gases). The proposed mechanisms for nitrogen depletion are adsorption onto the oxide powder and formation of ammonia. Extrapolation of data in the literature suggests that the oxide powder could adsorb enough gas to account for the nitrogen depletion. The same article also states that the adsorption is reversible. Ammonia could have been formed from the combination of nitrogen, hydrogen, pressure, and radiation; the ammonia is then absorbed onto the oxide powder. Observations of desorption effects during gas sampling indicate that adsorption is the more likely mechanism.

Additional PVC bag samples are being submitted for TGA and dissolution/ISE to quantify the variations in different PVC bag samples. Earlier results from neutron activation qualitatively show a difference between the chloride content of a severely discolored sample and a slightly discolored sample. A final report will be issued as WSRC-RP-94-0629.

Frames Waste Processing of Plutonium-238

E. A. Kyser, J. H. Gray, and K. J. Kalbaugh

After the Pu-238 drops from HB-Line Phase I and III operations to Tank 8.2 are complete, the solids usually found are characterized to determine if sufficient Pu-238 is present to require a dissolution step before loading on the frames waste anion exchange column. The dissolution operation involves heating the solution to 75°C–80°C, with or without KF, and takes place in column feed Tank 16.4.

Recent results from the analysis of solids heated in Tank 16.4 to 75°C–80°C for eight hours, without KF, indicated approximately one-third of the Pu-238 had dissolved. The other two-thirds of the Pu-238 is probably the high-fired PuO_2 from Phase I. However, the total amount of Pu-238 remaining in solids was low enough to permit column loading without additional dissolution treatment. This Pu-238 inventory in Tank 16.4 is now being processed through the anion exchange column to produce feed material for HB-Line oxide production.

Dibutyl Phosphate in Stored 1EU Solutions

E. A. Kyser and K. J. Kalbaugh

Dibutyl Phosphate (DBP) is a degradation product from acid hydrolysis of Tributyl Phosphate (TBP) used in our solvent extraction processes. Since TBP is slightly soluble in acid solutions, some TBP remains in plutonium (Pu) or uranium (U) product solutions after processing and gradually degrades to DBP. DBP has limited solubility in Pu or U nitric acid solutions and will precipitate as a Pu or U-DBP solid. This raises criticality concerns. Studies in 1992 indicated that no solids would form at levels of DBP of up to 100 ppm. Since 1991, SRTC has been periodically looking at samples of stored enriched uranium solutions from 211-H to monitor the levels of DBP.

A series of samples was taken from the four 211-H tanks of interest between February and April 1994. It appears that in three of the four tanks, the levels of DBP are probably elevated over the levels of the last several years. The highest level of DBP found was 60 ppm, which is still well below the 100 ppm level, where solids have been observed to form. However, this is 20–30 ppm higher than one to two years ago. If the DBP levels continue to increase (it is not clear how much TBP there is), it is possible that over the next one to three years precipitation could occur.

H-Canyon Degradation Mechanisms

S. L. West and R. L Sindelar

The H-Canyon Structural Integrity Program Committee tasked the Materials Technology Section to document mechanisms that would degrade Nuclear Safety and Critical Protection Systems. Information from existing inspection reports and analyses of components that were repaired or replaced will be used to generate a database of current conditions and rates of degradation.

This program seeks to document the mechanisms whereby Nuclear Safety and Critical Protections Systems in H Canyon may undergo degradation in service. This knowledge will permit better estimation of the life of critical components to ensure structural integrity.

During approximately 40 years of service, a great deal of information was generated on the degradation of tanks, cells, pipes, and other canyon systems that can be repaired or replaced. This information reveals how specific materials behave when exposed to the canyon environment. Of greatest concern are systems such as the building itself and its associated structural materials such as corrosion of concrete rebar, leaching of calcium hydroxide, chemical attach, and high temperature exposure may degrade the materials of these systems. Also, the ventilation headers and vacuum systems are critical to the continued operation of the canyon, as well as the control systems and instrumentation.

A report is being generated to summarize the known degradation mechanisms and rates for equipment documented by inspection reports and area metallurgical reports. This information will be extended to those systems critical to service life (i.e., non-replaceable) to estimate their current (baseline) condition and rates of degradation. The report will include recommendations for future inspections and analyses.

HB-Line Hydrogen Monitor

S. E. Nave and J. E. McCarty

Hydrogen gas is generated in the dissolution of recycled plutonium solids. Vapor space purge is used to ensure that the hydrogen concentration does not reach the lower explosive limit. However, it is desirable to be able to measure the hydrogen concentration to prove that it is maintained below safety limits. Because of NOx gases, hydrogen measurement in the dissolver offgas is difficult. The Analytical Development Section is developing an online hydrogen monitor using fiber-optic Raman spectroscopy.

Pressurization of the offgas sample is necessary to obtain the desired 0.1% sensitivity for hydrogen. The gas sample to be measured is delivered to a single stroke pressurizing sample cylinder with a diaphragm pump. A new, larger diaphragm pump was installed to allow precharging the gas sample to 40 psi to increase the final pressure to 500 psi after the compression stroke. The system was tested and calibrated with 2% hydrogen in nitrogen with this new configuration. To more closely simulate the HB-Line offgas for testing of the prototype, work to install a system for mixing hydrogen with NOx began.

HB-Line Laboratory Support

R. R. Livingston

The HB-Line laboratory uses a Hewlett-Packard Diode Array Spectrometer to make process plutonium measurements. This system, which is essential for HB-Line operation, uses a fiber-optic interface to allow measurements to be made in the laboratory glovebox. This month, emergency, off-hour service was provided to change the system monitor and replace a broken fiber-optic cable. M. Whitaker and L. Baylor are developing an updated system to replace the existing instrument.

Radwaste Solvent Decontamination

N. M. Askew, D. G. Karraker, and J. E. Laurinat

Radioactively contaminated solvents from the PUREX process are stored in waste tanks onsite. The Chemical Technology Group is investigating the possibility of disposing of the solvents by distillation and incineration or by using an oxalate wash and incineration. A similar procedure (distillation) was used by Hanford for remediating contaminated hexone solvents. SRS's remediating solvents contain a higher percentage of tributyl phosphate, which partially decomposes below its boiling point. Work on this project was delayed because of lack of funds.

5320 Package—Plutonium Oxide and Americium Oxide Shipping Cask

A. G. Eggers

The 5320 Package is used primarily for shipping heat source plutonium (Pu) oxide (up to 357 grams of Pu in any solid form) with a maximum decay heat limit of 202 watts. The package is operating under a Certificate of Compliance extended until February 28, 1995, but has been under recertification since 1990. Numerous design changes were made as a result of regulator concerns regarding the 1990 SARP submission (Rev. 2), which led to the October 1992 SARP submittal (Rev. 3). EH-332 issued questions regarding this submission on April 14, 1994. Actions are now underway to revise the SARP to resolve these questions. It should be noted that EH repeatedly granted permission for special shipments in this package, which are outside of the envelope of the SARP indicating their confidence in the package given convincing engineering arguments.

Environmental

Assessment of Aquifer Vulnerability

C. Eddy-Dilek, G. Flach, D. Jackson, B. B. Looney, J. Noonkester, and R. Nichols

An aquifer vulnerability assessment is being performed for SRS. This assessment will identify areas on site that are more susceptible to groundwater contamination based upon the hydrogeologic environment. This assessment will examine the contamination potential for the water table aquifer and the first confined aquifer on a sitewide basis. Structure contour maps representing the top and bottom of the "green clay" and the top of the Crouch Branch Confining Unit were developed on a sitewide level. These surfaces delineate the water table aquifer from the first confined aquifer. The maps are being used to develop a sitewide water table map and a potentiometric map of the first confined aquifer.

Use of Variable-Speed Drives for Groundwater Pumps

D. Jackson and J. Noonkester

A commercially available adjustable frequency AC motor drive was tested on the groundwater pump in well P29B. The drive was able to successfully control the flowrate of the pump over the range from 1.2- 22.2 gpm. The ability to control the speed of the pump to obtain low flowrates is important in minimizing the amount of entrained solids within a groundwater sample. The Environmental Monitoring Section is replacing existing pumps with variable speed pumps to minimize the amount of entrained solids in their samples. The use of this technology could result in a significant cost saving over the replacement of the existing pumps.

An additional test is being developed to examine the influence of entrained solids with flowrate and possible heat rise in the pump motor. Discussions are ongoing with motor vendors to determine motor cooling mechanisms and the influence of operating speed on motor assembly temperature.

Subsurface Contaminant Transport Analyses to Support In-Tank Precipitation/ H-Area Safety Basis

G. Flach

A two-dimensional cross-section, saturated-unsaturated flow model of Tank 48 and berm, was developed using the TOUGH2 numerical code to determine whether leaked waste can seep out of the side of the berm. Simulations using a variety of soil types and horizontal to vertical conductivity ratios up to 10 demonstrate that liquid waste will not seep out of the berm. Rather, the waste will remain subsurface with relatively low exposure consequences compared to a surface release.

Biotech Analytical Kits for Contaminants

T. Hazen and K. Lombard

SRTC met with the Sample Management Section and discussed the possibility of collaborating on using new analytical kits for petroleum hydrocarbons and other contaminants. ESS has been testing new immunoassay kits from several companies for the past several months as part of the research and development related to the sOILS Bioremediation Facility. Sample Management will analyze soil concomitantly with samples taken for conventional analyses during storage tank removals for the remainder of the FY 94. One hundred samples will be taken and compared for analytical verification. This series of tests should provide the data needed to allow the kits to be substituted for the conventional analyses required by South Carolina Department of Health and Environmental Control. The new assay kits cut analytical costs by more then 70%, reduce analytical time from one week to one hour, and do not produce a hazardous waste like the conventional GC assay does.

Environmental Advisory Committee Meeting

C. E. Murphy, Jr.

The WSRC Environmental Advisory Committee met at SRS from May 18–20, 1994. Present were Drs. E. Berkey (University of Pittsburgh), K. Cartwright (Illinois Geologic Survey), B. Kahn (Georgia Institute of Technology), M. Russell (University of Tennessee), S. N. Davis (University of Arizona), and R. Patrick (Academy of Natural Sciences, Philadelphia). They participated in discussions with SRS management and staff on a variety of environmental topics including the SRS Watershed Management Plan, the Solid Waste Management Plan, the SRS Strategic Plan, the Citizens Advisory Committee, cost reductions in environmental monitoring, review of the *SRS Annual Environmental Report*, and a demonstration of the interactive computer sitewide *Environmental Information Document*. The committee returned its reviews of the *SRS Annual Environmental Report* and agreed to review the environmental monitoring system to look for potential cost savings. Subcommittees of one or more members were active in reviewing the Solid Waste Management Plan, groundwater modeling, and records related to human experimentation.

Modeling of Nitrogen Oxides Emissions

J. Stewart

Modeling of projected nitrogen oxides emissions was done for a vitrification facility to be built in M Area. The modeling work was done on an accelerated schedule that enabled the site to meet requirements that the permit application be submitted to the permitting agencies by June 30, 1994. Two emission scenarios were modeled. The results showed that maximum concentrations of nitrogen oxides at the site boundary, resulting from emissions by the facility, would be minute and would make an insignificant addition to the maximum concentrations resulting from emissions from all site nitrogen oxide sources combined. These concentrations are small in relation to the SCDHEC ambient standard.

Assessment of Tritium in the Savannah River Site Environment

W. H. Carlton and C. E. Murphy

The document entitled, *Assessment of Tritium in the Savannah River Site Environment* (WSRC-TR-93-214), was published. It is a revised and updated version of a document first published in 1990. Significant enhancements were made to sections on atmospheric transport, groundwater, and dose calculations. Twelve current and former WSRC scientists contributed in their respective areas of expertise. This document will receive widespread public distribution and serve as a reference document to those interested in the effect of SRS operations on the environment.

RADMAPS Radiation Detector Unit for DOE/NN-20

K. J. Hofstetter

Assembly of the Phase I prototype radiation detector and GPS system are nearing completion. The TISA radiation spectra acquisition card and the Rockwell GPS card (both commercial units) are controlled by the custom CPU motherboard along with PCMCIA removable memory mass storage RAM. The Phase I prototype will acquire spectra for a 2" x 2" NaI(Tl) radiation detector and intermittent GPS coordinates. The system will be preprogrammed from a host PC for autonomous use (single push-button start) in the field.

The Mark I version of the controlling software was written. The hand-held radiation and GPS data acquisition system (DAS) is scheduled for field testing next month.

Aerial Monitoring System

K. J. Hofstetter, G. E. Reeves, and R. F. Eakle

All electronics for the prototype aerial monitoring system were assembled and field testing began. The system consists of a custom designed high voltage supply and preamplifier to operate:

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- the large 4" x 4" x 16" NaI(Tl) detectors
- a NavCore V GPS
- a PCMCIA Data Logger
- a Custom LCD Display

All these components reside in an external case and are powered by the DOLCH computer via a custom AT bus card.

New Batch software for recording the radiation spectra in the multi-parameter pulse height analysis (MPHA) mode was written. The spectra are displayed on the DOLCH for realtime alert of operators. The GPS coordinates are displayed by the second CPU and recorded on a 2 MEG memory card.

Following the run, the memory card is downloaded to the DOLCH hard disk through a custom PCMCIA interface. Spectra and positions are then correlated using the UTC satellite time recorded during data acquisition. Special software to convert this data to a form usable in any spreadsheet has been written. The AMS is being tested by recording spectra and positions in a moving vehicle equipped with a DC/AC inverter.

TNX Groundwater

R. L. Nichols and M. Phifer

The TNX Area is a pilot-scale test facility for SRTC. Groundwater at the TNX Area is contaminated with chlorinated volatile organic compounds (CVOCs), mercury, and nitrate. In May 1994, the Environmental Protection Agency (EPA), South Carolina Department of Health and Environmental Control, and DOE reached an agreement on the proposed interim remedial action for TNX groundwater. The interim remedial action was developed by Environmental Sciences Section. A revised Interim Action Proposed Plan was prepared in the new interim remedial action. The new interim remedial action is a hybrid groundwater clean-up system that incorporates *in situ* and *ex situ* treatment. A series of groundwater recovery wells with an air stripper will be used to stop the migration of and collect groundwater that exceeds the cleanup goal of 500 ppb trichloroethylene. Additionally, an innovative technology—recirculation wells—will be used to enhance natural *in situ* bioremediation to accelerate the cleanup. The clean-up goal was established using the results of the TNX Interim Risk Evaluation.

The procurement package for a bench-scale treatability study of zero valence iron enhanced abiotic degradation of CVOCs in groundwater (permeable treatment wall) was delivered to Procurement on May 26, 1994.

On May 9, 1994, representatives of the EPA Environmental Research Laboratory in Athens, GA collected vegetation and surface soil samples from the TNX flood plain to test for the presence of plant enzymes capable of degrading CVOCs.

A/M Area Northern Sector Aquifer Tests

R. Nichols, C. May, B. Pemberton, and J. Haselow

Several new groundwater recovery wells, RWM13B and C, 14B and C, and 15, were installed to clean up groundwater contamination in the vicinity of the SRTC. SRTC was requested to perform aquifer tests to evaluate the wells. A short constant rate pumping test was conducted on recovery well RWM14B. The wells were pumped at 36 gallons per minute for 90 minutes. During pumping, samples were collected for CVOC and tritium analysis. Results of the test indicate that the aquifer is slightly more conductive than in other portions of the SRS. Chemical analyses show that the CVOC and tritium concentration are as expected.

Old F-Area Seepage Basin Vegetation Characterization

C. E. Murphy, Jr.

The vegetation characterization of radionuclide and metals in the Old F-Area Seepage Basin was completed. Measured concentrations of radionuclides and toxic metal were used to calculate the total inventory of the vegetation growing on the Old F-Area Seepage Basin. Air concentrations and inhalation doses from exposure to smoke from burning the vegetation were calculated to evaluate the effect of open air burning to dispose of the vegetation. The

radionuclide inventory is one order of magnitude (10x) less than those necessary to produce a 1 mrem dose. Air concentrations of toxic metals are less than one third the permissible occupational dose. The total inventory of radionuclides was estimated to be 0.43 microcuries.

Field Test Platform

J. Rossabi, B, Riha, and B. Pemberton

A presentation was given to the EPA, Region 4, in Atlanta, GA and on the Savannah River Environmental Technology Field Test Platform and innovative characterization and monitoring technologies at SRS. EPA personnel were supportive of the efforts to field-test new technologies that are better, faster, or less expensive than baseline technologies. Several EPA staff members directly involved with SRS encouraged the inclusion of promising new technologies in future remedial investigation and restoration plans. EPA stated that plans that called for 80% of samples analyzed by innovative field screening methods and 20% baseline methods would be approved given evidence of the effectiveness of these field screening methods. This presentation will be given to the EPA analytical laboratory section in Athens, GA at their invitation in July 1994.

Technology Transfer and Demonstration

J. Rossabi, B. Riha, and C. May

Innovative field screening methods integrating the cone penetrometer and depth-discrete gas and water sampling technologies were demonstrated at Fairchild Air Force Base in Spokane, WA. Personnel from the U.S. Air Force, Westinghouse Hanford Company, Battelle Pacific Northwest Laboratory, Applied Research Associates, Inc., and WSRC joined forces to rapidly characterize a waste site. Gas and water samples from several locations were analyzed and used to develop a contaminant plume map to aid in remediation efforts at the site. Two of the technologies, the baroball and the cone penetrometer sampling tool, and a technique, rapid gas phase sampling with a B & K photoacoustic analyzer, were developed by the SRTC Groundwater Group.

Barometric Pumping

J. Rossabi, B. Pemberton, B. Riha, C. May, and J. Simmons

A presentation on barometric pumping was given at the volatile organic compound Arid Integrated Demonstration program review meeting in Oregon. Data were presented on the advantages of using a one way check valve to increase mass removal by barometric pumping, analytical modeling of subsurface pressure response to surface pressure fluctuations, and enhancing removal of volatile contaminants in the subsurface by combining barometric pumping with solar heated air injection. Passive soil vapor extraction researchers from Westinghouse Hanford Company, Battelle Pacific Northwest Laboratory, Lawrence Livermore National Laboratory, Idaho National Engineering Laboratory (INEL), and Los Alamos National Laboratory presented results on soil gas flux measurements, the use of straddle packers to isolate zones of higher permeability or higher concentrations, and numerical modeling support. The presenters from the various organizations and an advocate of a team led by INEL researchers and assisted by WSRC researchers will consult with personnel from Hill Air Force Base to install passive systems to remediate subsurface contamination. Two sites at the base contaminated with petroleum products will be fitted with passive air injection systems using one-way check valves to permit air flow into the subsurface. A third site contaminated with volatile chlorinated organics will use a passive air extraction system with a one-way check valve allowing gas flow out of the subsurface, but preventing air flow in. Both systems use pressure gradients induced between the surface and subsurface by natural atmospheric pressure fluctuations to generate gas flow. Aerobic biodegradation of the subsurface petroleum contamination will be enhanced by the injection systems and the extraction system will optimize the mass removal of the volatile chlorinated organic contaminant. Both passive systems will be used as low-cost, long-term complements to active injection and extraction activities at the site.

Magnetic Separation

M. Phifer, R. Nichols, and C. Betivas

SRS is the host site for demonstrating a new technology for the *in situ* remediation of groundwater contaminated with inorganic contaminants such as metals. The technology uses iron particles coated with ion exchange resin to remove contaminants from the water. The iron particles are then removed using a magnet. The site originally selected for the demonstration, D Area, was found to be incompatible with the resin and a new site selection process was initiated.

On May 11, 1994, funding for this work was reinstated. A site screening for new technology demonstration sites was conducted and produced two potential alternative sites. Groundwater samples were collected from existing monitoring wells at the two new potential sites for the technology demonstration. Data from the new samples will be used to confirm historic well data and compatibility with the resin.

Offgas Treatment Testing

T. R. Jarosch, J. S. Haselow, and S. A. Burdick

A small-scale soil vapor extraction (SVE) unit was fabricated from spare parts available in Stores. This unit is portable and can handle flows up to 15 scfm. It will be used to conduct small scale offgas treatment tests and perform soil gas investigations at vadose zone wells. The unit was tested at the former *in situ* heating demonstration site.

A technical proposal for demonstrating an innovative offgas treatment technology developed by Process Technologies, Inc. of Boise, Idaho was received and reviewed. The technology uses high intensity mercury lamps to produce free radicals by photolysis. The highly reactive free radicals facilitate the destruction of the chlorinated solvents in the offgas stream. The demonstration will take place at the *in situ* heating demonstration site and will use the new small scale SVE unit.

Technology Transfer

J. Rossabi, B. Riha, B. Pemberton, R. Nichols, B. Looney, and J. Haselow

SRS personnel demonstrated innovative characterization techniques (developed as part of the Savannah River Integrated Demonstration) at a commercial site in South Carolina. In an effort to facilitate technology transfer, engineers from an environmental consulting firm were trained in the field by SRS engineers to perform rapid soil gas analyses using a Bruel & Kjaer, Inc. multigas analyzer. Equilibrium gas concentrations were measured in twelve wells in one day at a site contaminated with chlorinated solvents. Baroball check valves fabricated at SRS were mounted on the wells one week prior to the measurements to ensure accurate analyses. These valves prevent subsurface dilution from surface air during periods of high barometric pressure. The information obtained from this activity will be used to develop a cost-effective remediation system for the site.

Gas Phase Bioreactor

C. J. Berry

The final report on the Gas Phase Bioreactor system was received from ECOVA. Results indicate a maximum of 29% degradation of TCE in the gas phase. The bacteria used during the test, Pseudomonas cepacia G4, was unable to maintain large cell numbers. Indigenous organisms with the ability to degrade phenol may have displaced a majority of G4 in the system. The percentage of active G4 in the system appears to have compromised system performance.

Dense Non-Aqueous Phase Liquids

B. Looney, S. Burdick, C. Eddy-Dilek, A. Corbly, and D. Tuck

Activities supporting programs aimed at collaborating with environmental services companies, universities, and other organizations to develop new ways to monitor and clean up areas of

undissolved pure solvents in soil and groundwater have made significant progress (these solvents are called Dense Non-Aqueous Phase Liquids, or DNAPLS). Test plans and permits supporting the evaluation of specialized uses of industry geophysical tools for DNAPLs were completed. Preparations for the field work are underway. The U. S. Geological Survey, who is coordinating the geophysics work, will arrive shortly to begin their work. A summary of the DNAPL program, past results, and copies of slides from the recent ER Technology Information Exchange were forwarded to EPA in Washington, DC to assist in developing national DNAPL policies.

The plans and approach for the DNAPL program were discussed with the DOE-OTD program manager. An interagency agreement between DOE and the USGS was finalized and is in place. Evaluation of specialized uses of industry geophysical tools for DNAPLS will begin later this month. Test plans for the geophysics activities and other tests planned for this summer were completed this week or are near completion.

An RFP was sent out to seven universities for conducting the DNAPL mobilization study. One proposal was received and is currently in technical review. The review will be completed during the week of June 13, 1994.

Seminar to the Westinghouse GOCO Risk Assessment Committee

J. A. Bowers

J. Bowers gave a seminar to the Westinghouse GOCO Risk Assessment Committee in Hanford, WA on May 12, 1994. This seminar described the HOPS Office of Technology Development project to develop a software application for supporting ecological and human health risk assessments under EPA/CERCLA guidelines. After the seminar, the committee asked that they meet at SRS in November 1994 to host a nationwide workshop on risk assessment to include other DOE environmental contractors; the HOPS application will be demonstrated at this workshop.

Waste Management

Saltstone Facility Support

C. A. Langton

The Saltstone facility is designed to treat and dispose of the decontaminated liquid waste stream from the SRS Tank Farm via stabilization with cement, flyash, and slag. A disposal vault contains six cells. Recently, Cell A at one end of Vault 1 was filled. The sliding roof over Cell A was moved to another cell and a clean grout cover was poured. Following recent rains, the three walls of Cell A deformed outward from two to four inches, forming a gap that was filled with water. Initial calculations and hypotheses by E&PD focused on the hydrostatic pressure and/or saltstone expansion due to submersion in water. Refined calculations later showed that the vault deformation could be completely accounted for by the hydrostatic head alone. The hypothesis for saltstone expansion was disproved by SRTC (Langton/Wingard) tests on five archive saltstone samples that showed no measurable saltstone expansion (within experimental error) over a one week period. The Analytical Development Section provided prompt analyses for the water that leaked out of the vault and water/leachate drained from the vault. Analyses of gross alpha-beta activity, tritium, metals, and salts indicated compositions as expected. Interim Waste Technology (IWT) department is providing support on a project to fill the gap and provide a water seal. IWT (Yu) is also conducting performance assessment modeling runs to determine whether the current Cell A cover design/configuration will satisfy long-term saltstone waste disposal performance objectives. If so, the final closure may be simplified to provide significant cost savings.

Consolidated Incineration Facility Health Risk Assessment

D. A. Burge

A health-based risk assessment is underway for the Consolidated Incineration Facility (CIF) through an ERDA contract. This will evaluate human health risk to the public and onsite workers from hazardous and radioactive constituents from CIF emissions. ERDA completed a draft of inorganic emissions and the proposed risk assessment methodology to be used. These drafts were reviewed by an independent review panel of national experts on May 26, 1994; responses to the panel's comments are in progress. ERDA also issued a draft of a risk assessment comparing radionuclide dose from the CIF for solid low-level waste with the dose from a compactor. This latter study will be used in the Waste Management Environmental Impact Statement. The next ERDA task will determine organic emissions, which will be based primarily on burn data. The final risk assessment is scheduled to be completed in April 1995.

Characterization and Reclassification of SR-W052, Cadmium Glovebox Waste

C. A. Langton

One of the wastes identified in the SRS Mixed Waste Inventory Report was a 55 gallon container of cadmium contaminated glovebox waste. In support of the draft of the Site Treatment Plan, which will recommend treatments for all mixed waste streams on site, Interim Waste Technology opened the drum to obtain better characterization. No cadmium metals, salts, or solutions were found and subsequent Toxicity Characteristic Leaching Procedure (TCLP) tests showed that toxic metals in the waste were well below the hazardous levels. As a result, this waste was removed from the SRS Mixed Waste Inventory and will be treated as a low-level waste. A cost savings submission is being pursued.

Effect of Slurry Pump Leakage on Extended Sludge Processing Process

M. R. Poirier

Three determinations were made about leaking bearing water from slurry pumps in Tanks 51 and 42 during Process Verification Tests (PVT) for the Extended Sludge Processing (ESP). First, the pump leakage in Tank 42 will not have a significant effect on sludge washing in that tank. Second, pump leakage in Tank 51 will

significantly increase the volume of wash water needing treatment. This can be resolved by using the leakage bearing water as wash water. Third, pump leakage before ESP-EWPF sludge transfers could cause operational difficulties for ESP and the Defense Waste Processing Facility.

Slurry pump preparations are underway for a scoping test at the TNX Full Tank Facility. This test will help determine if Tank 51 slurry pumps can operate without bearing water.

Extended Sludge Processing Baselining Test Support

M. S. Hay and N. E. Bibler

SRTC received eleven slurry samples for analysis during the initial Tank 42H test phase of the Extended Sludge Processing Baselining Process Verification tests. During most of the test period, two of the four slurry pumps operated. Two pumps were not operated due to low amperage readings, indicating that the sludge was not entering the pump head. The anion concentrations in the supernate increased over the course of the test. The increase in anion concentrations indicates that the wash water was being mixed with the more concentrated interstitial supernate in the sludge layer. A large jump in concentration occurred between Data Points 3 and 4. During the two and one-half weeks between Data Points 3 and 4, the two operating slurry pumps ran for ~9.5 days. One of the other pumps operated intermittently. The total solids in the final sample reached 10.1 wt%. The Sludge Washing Model was used to determine the amount of sludge that must be mixed to achieve the observed anion and solids concentrations. The modeling results indicate approximately 47 to 54% of the sludge was mixed into the wash water. The analytical results of all eleven samples were transmitted to the customer within the 14 day time limit.

Tank 42H Odors

M. S. Hay, J. E. Young, R. Weller, C. Crawford, and N. E. Bibler

During the Tank 42H test period, operators noticed an odor emanating from the tank. Two of the slurry samples obtained were submitted to Analytical Development Section (ADS) for volatile organic analysis along with gas samples obtained from the Tank 42H gas inlet and exhaust. The samples were analyzed in ADS using gas chromatography-mass spectrometry. The estimated detection limits of this technique are 10 ppb in liquid samples and 0.5 ppb in gas samples. Trace levels of toluene and long-chain hydrocarbons were detected in the gas and liquid samples. An organic byproduct (trimethylamine) from the degradation of an ion exchange resin used in the canyons was suspected of causing the odor. Although trimethylamine was not detected in these samples, other gas samples analyzed by Environmental Technology Section contained trace levels of trimethylamine, toluene, long-chain hydrocarbons, and siloxanes. Recent radiolysis experiments of the DOWEX anion exchange resin, by C. Crawford in SRTC, confirmed that trimethylamine and toluene are the major volatile degradation products. From these analyses, the likely cause of the odor was due to a combination of these organics, which result from the degradation of ion exchange resins used in canyons and defoamers used in the evaporator system.

Filtration and Water Quality

D. J. McCabe and B. W. Walker

The Late Wash Facility Technical Bases is being revised due to a modified scope of the facility. Emphasis was placed on rewriting the requirements for the filter cleaning system and the water quality. Details on sequencing of events

during the cleaning cycle were specified. Estimates of radioactivity levels and chemical composition during cleaning were also completed.

Deionized water from D Area and domestic water from H Area were collected to conduct water quality studies. These water samples were filtered through a Dead End Mott filter. Axial plugging was not observed with the deionized water from D Area, but was observed with domestic water from H Area. Turbidity measurements were made on the samples showing the H-Area domestic water with a greater NTU value.

General

High-Level Waste Integrated Flowsheet Model

M. V. Gregory, R. A. Dimenna, P. K. Paul, and K. L. Shanahan

The High-Level Waste Integrated Flowsheet Model (HLWIFM) is a coupled, dynamic model of virtually the entire SRS high-level waste complex:

- canyon waste receipts
- tank farm waste storage (transfer and evaporator operations)
- waste preparation in extended sludge processing and in-tank precipitation
- waste processing in Late Wash, the Effluent Treatment Facility, Saltstone, and the Defense Waste Processing Facility
- production of treated effluent, grout, and steel/glass canisters

The HLWIFM representing all the above was developed within the SPEEDUP™ modeling architecture and consists of approximately 7800 coupled differential-algebraic equations that represent detailed mass and volume balances throughout the complex. To provide the necessary details, 27 chemical compounds are tracked throughout the complex with the minimal dynamic chemistry necessary to do the balances correctly. Customized FORTRAN that controls the batch processing that characterizes much of the complex is linked with the dynamic model.

The HLWIFM will provide the customer with a tool that can perform systematic analyses of the effects of various operational strategies. The impacts of schedule changes, facility availability, and operational set-points will be calculable for the first time in an integrated framework that couples the significant portions of the high-level waste complex. Though the initial version of the model is focused primarily on volume balances, it provides a basic foundation upon which more complex, integrated models may be built in the future.

The inter-departmental modeling team met a major milestone—the delivery of the first working version of HLWIFM (with comprehensive documentation and configuration control of the software) at the conclusion of an accelerated, nine-month development phase. Over the past two weeks, the product was demonstrated on several occasions to WSRC and DOE management with a favorable response. For the remainder of the fiscal year, the team will be working in close concert with the customer to verify and validate the model in detail. At the end of that phase, the model will be ready for turn-over to the customer.

Scoping Thermal Analysis of Failed Equipment Storage Vault Thermal Model

S. J. Hensel, J. W. Jerrell, and B. J. Hardy

A functioning storage facility for failed melters is a requirement for radioactive operation of the Defense Waste Processing Facility. Currently, it is proposed that failed melters be stored in the Failed Equipment Storage Vaults (FESV), which are concrete lined pits. Failed melters must be placed into a steel Melter Storage Box and lowered by crane into the FESV. The FESV is sealed by placing a concrete lid on top of the vault. The vault contains no forced ventilation.

A two-dimensional steady-state thermal analysis was performed using the general purpose heat conduction based code P/Thermal. Results from the scoping analysis found the concrete and glass temperatures to be unacceptable for the maximum melter power of 3 kW. It appears that melter decay heat power levels need to be below 0.45 kW to achieve acceptable concrete temperatures. The insulating properties of the concrete and surrounding soil allow temperatures to reach excessive levels. Design modifications to the melter box and vault will be required to substantially decrease concrete temperatures.

Decision Support System for In-Tank Precipitation Benzene Stripper Experiment

T. B. Edwards

Before testing the benzene stripper at the in-tank precipitation (ITP), the benzene concentration in the tank must be raised to a level that ensures an opportunity for an effective evaluation of the stripper's performance. The benzene concentration is raised by injecting an amount of benzene into the tank (within safety limits) and by agitating the tank contents. The test of the benzene stripper will be initiated if the resulting dissolved benzene concentration in the salt solution exceeds one-half of the benzene solubility limit for the given salt solution with a user specified confidence level. The dissolved benzene concentration and the solubility limit involved in the decision to launch the test are to be determined via a system of measurements and statistical models, which were discussed and developed as part of this study. A decision support system was developed to provide a "user-friendly" interface to the statistically-based assessment of the confidence level associated with the decision to initiate the test.

The decision support system, consisting of two Microsoft™ Excel spreadsheets, was developed to assist in the benzene stripper test. This system requires a measurement of the benzene concentration in the salt solution at room temperature and measurements of the temperature and density of the tank contents. The measurement of the benzene concentration to be entered into the system is the average of the analytical results from two samples of the salt solution. The analytical results are determined using one of two available sample preparatory procedures, filtered and unfiltered. Measurements of the temperature and density (at room temperature) of the tank contents, which are also inputs to the decision support system, are used to estimate the benzene solubility limit for the salt solution. Laboratory data were analyzed using statistical methods to provide the formulas necessary for implementing these spreadsheets. The final input to the system is the desired confidence level associated with the decision rule for conducting the benzene stripper test. The results of this analysis were issued in SRT-ASG-940051. An additional decision support system is being developed for the dilute salt solution phase of these benzene stripper tests.

Development of a Liquid Level Bubbler for Defense Waste Processing Facility Canyon Vessels

M. R. Duignan

Bubblers have been used in the canyons for years for liquid level measurements because of their simplicity and low cost. However, in tanks containing slurry and glass frit they plug so rapidly that a standard bubbler is not practical. A Holledge probe system that measures liquid level was installed; however, it is complex, can be easily damaged, and is expensive. This study will evaluate new concepts and materials that may solve the standard bubbler plugging problem and allow them to be used. During the shakedown phase of testing, several difficulties were encountered that needed addressing before the tests could begin. Shakedown testing with water went as expected, but with the introduction of simulate DWPF mixing-tank slurry the following occurred:

- The original design of the air impulse system was inadequate to obtain the proper movement of liquid in the bubble tube to model the expected prototypical movement in the field. (The air system was modified to obtain the proper movement.)
- The ions in the slurry mix intensified the magnetic field from the heating unit such that it interfered with the thermocouple response. (An insulated thermocouple replacement relieved this problem.)
- The slurry eventually caused the magnetic chemical stirrer in the slurry beaker to cease functioning, thereby hindered mixing. (A top-mounted impeller-type stirrer was placed in the beaker to have continual mixing throughout the test.)

- The heated slurry (to about 90°C) manifested irratic vapor releases that disrupted testing. (A well mixed slurry should not display the same phenomenon because further testing showed the vapor build up and subsequential release occurred in the sludge that settles on the bottom of a vessel when the slurry is not mixed.)

9973 and 9975 Thermal Testing

M. N. Van Alstine

Certification of the 9972 series packagings required that regulatory fire safety be demonstrated. In conjunction with the ATS Modeling and Simulation Group, Packaging and Transporation selected to thermally test an impact-damaged model 9973 and the undamaged model 9975. The 9973 test was to demonstrate previously untested design features, while the 9975 test was to provide benchmark data for analytical modeling. The 9975 test unit included an internal heat source.

Both test units were prepared at SRS. Testing was performed at Sandia-Albuquerque using a well-controlled quartz-electric heater facility. Both test units performed as expected during testing. Each was then carefully disassembled at SRS. Thermal performance was acceptable in both models.

The Modeling and Simulation group is using the data to benchmark analytical assessments of the remaining 9972 series packaging models. The Safety Analysis Report Packages will include the test results and ensuing analytical assessments to demonstrate regulatory fire safety.

Technical Review of CD-1 Cask for First Time Use

T. K. Houghtaling

The CD-1 cask is one of SRS's fleet of 70 ton shipping casks (EP-85s) formerly used for moving highly radioactive reactor materials and components. Project 5550, Cadmium Control and Safety Rod Disposal, will use the CD-1 cask to collect cadmium rods from the reactor areas. The cask with its mixed waste payload will be transported to the SRS burial grounds for storage on a transuranium pad until the mixed waste vaults are available. A technical review of the package is required by the WSRC 19Q, *Transportation Safety Manual*, because the intended payload is not one for which the cask is approved and represents a First Time Use condition.

The completed technical review is the first such activity documented since approval of the 19Q manual and follows the format and content guidelines provided by Regulatory Guide 7.9. The review describes the cask and payload relative to the current requirements of radioactive material packaging for onsite transport, and includes eight major areas of evaluation (structure, thermodynamics, containment, shielding, criticality, operation, maintenance, and quality assurance). The technical review is a prototype from which one or more procedures will be written to guide this activity in the future.

Items of Interest

S. Korom, an ORISE post doctorate with the Groundwater Group, accepted an Assistant Professor appointment with the University of North Dakota.

Presentations

On June 19–24, 1994, P. K. Paul presented a technical paper entitled, "RELAP5/MOD2.5 5-Ring Savannah River Site Reactor Model for Simulating L-Reactor Tests" at the ANS Annual Meeting in New Orleans, Louisiana. Paul also presented two other technical papers for Dr. M. Ades of WSRC who was unable to attend the meeting. The papers were entitled, "Radiological Safety Evaluation for a Savannah River Site Waste Transfer Facility" and "Critical Protection Item Classification for a Waste Processing Facility at Savannah River Site." S. Y. Lee also attended the meeting and presented a technical paper at the General Thermal Hydraulic Session-II entitled, "FLOWTRAN-TF Benchmarks with SRS Experimental Data."

On June 23, 1994, N. K. Gupta presented a technical paper entitled, "Flaw Acceptance Criteria for Transuranic Waste Drums" at the ASME Pressure Vessel and Piping Conference in Minneapolis, MN.

On June 19–24, 1994, J. C. Whitehouse presented a technical paper entitled, "Measurement of SRS Reactor Recirculation Pump Performance Using Pump Motor Power" at the ASME Fluids Conference in Lake Tahoe, NV.

T. C. Hazen, B. B. Looney, M. Enzien, J. M. Dougherty, J. Wear, C. B. Fliermans, and C. A. Eddy presented "*In Situ* Bioremediation of Chlorinated-Solvents Via Horizontal Wells" in May 1994 in Las Vegas, NV at the Annual Meeting of the American Society for Microbiology.

M. V. Enzien, T. C. Hazen, C. B. Fliermans, M. M. Franck, and P. McKinsey presented "Microbial Community Structure in Unsaturated Sediments during *In Situ* Bioremediation of Chlorinated Solvents" in May 1994 in Las Vegas, NV at the Annual Meeting of the American Society for Microbiology.

C. B. Fliermans, J. E. Wear, M. M. Franck, P. C. McKinsey, and T. C. Hazen presented "Use of Biolog Technology to Assess Remediation and Groundwater Perturbations" in May 1994 in Las Vegas, NV at the Annual Meeting of the American Society for Microbiology.

T. C. Hazen was invited to meet with representatives of the Institute for Wood Research to present, "Bioremediation at SRS in June 1994 in Aiken, SC (SRS).

H. Hanlin presented a paper, co-authored by L. D. Wike, B. M. Dietsch, and J. P. McClendon entitled, "Lost Lake: Restoration of a Carolina Bay," at the 21st Annual Conference on Wetlands Restoration and Creation.

V. Rogers presented a paper entitled, "Investigation into a Case of Tree Stress and Death in Wetlands," at the 21st Annual Conference on Wetlands Restoration and Creation in Tampa, FL.

A presentation was given to the EPA, Region 4, in Atlanta, GA and on the Savannah River Environmental Technology Field Test Platform and innovative characterization and monitoring technologies at SRS. EPA personnel were supportive of the efforts to field-test new technologies that are better, faster, or less expensive than baseline technologies.

June 21, 1994, Presentation to Site Geotechnical group on using RESRAD for calculating soil concentration guidelines.

Publications

C. Ray, "Good Environmental News at SRS", *Charleston Post and Courier*, June 4, 1994, p. 18A.

"SRS Integrated Demo, *In Situ* Bioremediation, Bioreactor Project will Demonstrate Gas-phase Bioremediation, sOils Facility uses Naturally Occurring Microbes to Cleanup Oil in Soils" *DOE TIE Quarterly*, vol. 3, pp. 6, 10, 11, and 13.

S. Delaney, "SRS Sees Future in Soil Bacteria, Researchers Say", Interviews and pictures of T. C. Hazen and K. H. Lombard, May 21, 1994, *Augusta Chronicle*, pp. 15–16A.

M. Toner, "Weapons Plant Cleanup: Army of Soil Microbes Wins War on Toxic Waste", Interview of T. C. Hazen, May 27, 1994, *The Atlanta Journal/The Atlanta Constitution*, p. A4.

"Microbe Recruits Devour Smorgasbord of Pollution", Interview of T. C. Hazen, May 28, 1994, *The Cleveland Plain Dealer*, p. 10A.

P. Weber, "SRS Takes Up Raising Bugs?", *SRS News*, June 1994, p. 6.

M. V. Enzien, F. Picardal, T. C. Hazen, R. G. Arnold, and C. B. Fliermans, 1994, "Reductive Dechlorination of Trichloroethylene and Tetrachloroethylene Under Aerobic Conditions in a Sediment Column", *Appl. Environ. Microbiol.*, 60:2200–2205.

June 3, 1994, *CERCLA Data Evaluation Methodology for Radionuclides* (SRT-ETS-940071).

June 3, 1994, *Offsite Liquid Dose from High Heat Waste Tank Releases* (SRT-ETS-940075).

June 3, 1994, *Interim Management of Nuclear Material EIS Environmental Dosimetry Calculations* (SRT-ETS-940079).

June 14, 1994, *Amendment to SRT-ETS-940079, Interim Management of Nuclear Material EIS Environmental Dosimetry Calculations* (SRT-ETS-940083).

June 17, 1994, *Follow-up Review of the F-Area Burning/Rubble Pits Baseline Risk Assessment* (SRT-ETS-940085).

June 20, 1994, *Dose from Potential Liquid Release of Radioactive Materials from 737-A* (SRT-ETS-940087).

June 21, 1994, *Defense Waste Process Facility SEIS Environmental Dosimetry Calculations* (SRT-ETS-940089).

June 27, 1994, *Comments on Predecisional Draft of DWPF SEIS* (SRT-ETS-940091).