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In This Issue

The Metallurgy and Processing of Plutonium and Its Alloys Are Topics of Ongoing Research

Plutonium's dual roles as a nuclear fuel and as a weapons material require a thorough understanding of its properties and the relationship of its properties to the processing methods used to manufacture components. Further, the challenges presented by the needs of stockpile surveillance require the ability to design new processing methods that produce completely functional systems but without the means for verification by the testing that was available in past years. Still further, the task of stockpile stewardship requires the ability to accurately assess the physical state, the properties, and the functionality of older (i.e., "aged") components.

These needs have motivated new lines of research in areas related to process modeling, in particular casting; the physical metallurgy of aged alloys, including oxidation; and the mechanical properties of new and aged alloys. The present article will focus on new efforts to design casting process methods and very briefly mention a few issues related to the mechanical behavior of plutonium.

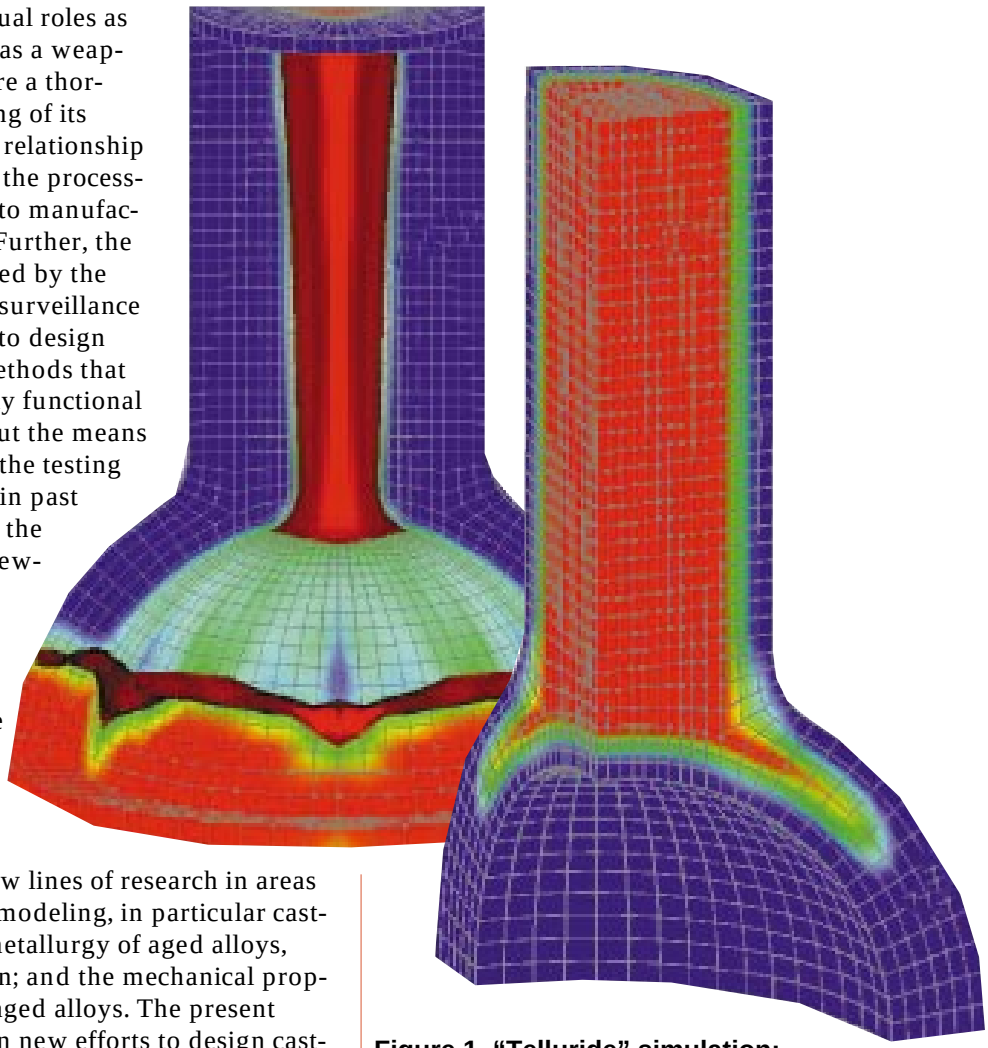

Figure 1. "Telluride" simulation: Filling of a chalice with molten copper after 0.5 second.

Figure 2. Solid/liquid zones during copper chalice solidification after 425 seconds.
(see labeled figures page 3)
Figures provided by K. Lam, ESA Division.

The Metallurgy and Processing of Plutonium and Its Alloys Are Topics of Ongoing Research *(continued)*

Robert Asaro, who contributed this article, is Professor of Applied Mechanics and Materials Science at the University of California, San Diego.

Plutonium is, as a metal of the actinide group, active in nearly every way. The pure metal has six allotropes; properties such as density and the coefficient of thermal expansion vary significantly from phase to phase. The low symmetry of the alpha, beta, and gamma phases is, in fact, associated with several coefficients of thermal expansion, most of which are positive as they are for the more common metals. In contrast, the thermal expansion of the delta phase is negative, which can present problems during casting as noted below. The allotropic phase transformations also lead to significant changes in density, which again can lead to problems during processing. Mechanical properties are vitally important for component performance, and these too depend sensitively on phase as well as on alloy content and microstructure. Thus, it is critical to control phase and alloy content, and to insure phase and microstructural stability in aged materials. Some issues related to the process simulation of casting and mechanical properties will serve here as examples.

Of the six allotropic phases, alpha is the hardest and least ductile, and delta is the softest and most ductile. In terms of the material mechanical properties, system performance depends on achieving optimized strength and formability, which is related to ductility; for this reason the delta phase is preferred. The design of alloys and process controls are therefore required to stabilize the delta phase and to control its microstructural characteristics such as grain size and shape. Typical delta stabilizing solutes are Al, Ce, or Ga. The solidification processes that occur during casting and cooling with these solutes, for example plutonium with aluminum, would involve the general progression of states as follows: from liquid (L) to liquid / epsilon (L / ε), to epsilon (ε), to epsilon / delta (ε/δ), to delta (δ).

Problems that arise through these steps include segregation of the solute (also known as “coring”), grain size control, and a range of mechanical phenomena associated with the density changes that occur during the solid-state phase changes. For example, volume expansions during the phase change from epsilon to delta will, in particular, lead to internal stresses that can cause distortion of the component and even degradation of the tooling. The prevention of solute segregation requires, at the very least, homogenization treatments, which can be expensive and difficult to perform adequately. Depletion of alloying elements in regions of the microstructure can, of course, lead to nonuniform phase structure. Accurate design of the tooling, the starting alloy chemistry, and the imposed thermal history is therefore required. This, in turn, requires detailed modeling of the hydrodynamics of fluid flow in the tools, analysis of the evolving thermal and solute fields in the tools and the part, and analysis of the mechanical stresses throughout the solidifying part and on the tools.

At present the process modeling efforts involve the development and implementation of a new casting simulation tool called “Telluride” and a thermomechanical simulation tool for analyzing the stresses and deformations that occur during casting. Telluride employs robust, high-resolution volume algorithms for incompressible fluid flow, volume tracking of interfaces, and solidification physics. The governing (i.e., field) equations implemented in Telluride include mass, momentum, energy, and species conservation. These are supplemented by data derived from phase diagrams

and from models for permeability and back-diffusion. In particular, simulations using Telluride will analyze the motion of freezing interfaces and the solid-state transforming interfaces in addition to analyzing solute diffusion. These simulations will provide complete thermal, phase, and compositional fields as functions of time and, of course, as functions of the imposed boundary conditions. The boundary conditions will include tool characteristics and imposed external temperature conditions; these are, in fact, process design variables. Figure 1 and Figure 2 illustrate an example of a Telluride simulation of the solidification of metal shape; this particular example is that of a copper "chalice."

The thermomechanical analysis tool involves the development of an accurate constitutive theory for the solid-state deformations, which themselves involve concurrent phase transformations. Thus, within this constitutive theory there must be algorithms for predicting the kinetics of phase transitions as functions of time and temperature and for quantitatively describing the deformations that result. For the immediate future this theory will be implemented within the computer code "Chad," which currently has the capability of performing stress analysis.

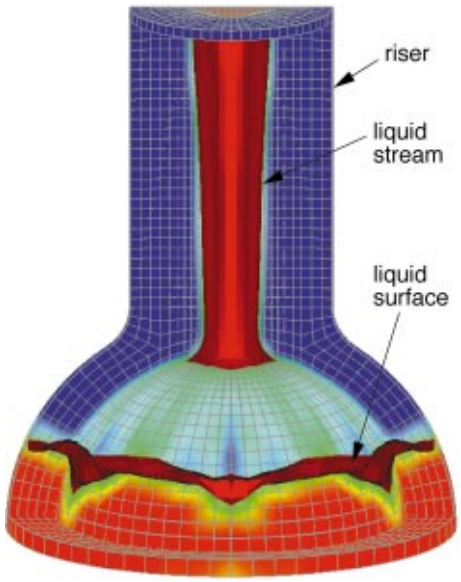

Figure 1

Both Chad and Telluride are high-performance parallel codes. The expected outcome of the development of these simulation tools is the ability to accurately predict the microstructure and stress states that result from the casting process; this predictive capability will, in turn, allow for more optimized designs of the casting process itself.

Still other efforts involve the development of diagnostic tools to characterize the mechanical properties of new and aged plutonium alloys as well as to provide a comprehensive documentation of both quasistatic and truly dynamic deformation behavior. Small-scale measurement techniques involving microindenters will be evaluated as to their suitability for characterizing strength on small samples extracted from new or aged systems. These will be supplemented by a host of more precise tests aimed at documenting dynamic mechanical response and correlating mechanical behavior with chemistry and microstructure. Mechanical behavior will be studied as functions of temperature and the rate of deformation.

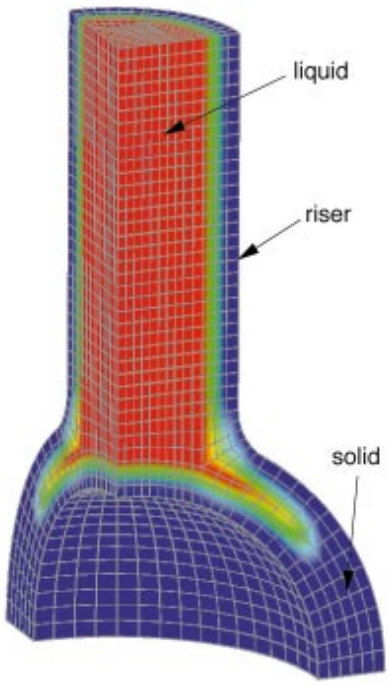

Figure 2

Acoustic Resonance Spectroscopy (ARS) Shows Promise for Measuring Gas Composition and Pressure in Sealed Storage Containers

The interim storage of plutonium-containing materials has raised concerns about the generation of dangerous gas pressures and gas compositions in hermetically sealed containers. Pure plutonium oxide powders, if not properly prepared, may be able to generate pressures exceeding several hundred pounds per square inch of H_2. Noninvasive characterization techniques would allow storage containers to be monitored for changes in gas composition and gas pressure and help to ensure the long-term safety of the materials stored under the Department of Energy's repackaging program.

We have been investigating the application of ARS to monitor changes in gas composition and pressure within sealed storage containers. The goal of our work is to design a robust, economical characterization system that can be used on containers destined for interim storage. In our experiments the speed of sound in the gas is measured utilizing a resonant gas cavity in the storage container. Standing waves in the gas are excited and detected using piezoelectric transducers mounted on the outside of the container. The frequencies of the standing waves depend upon the speed of sound in the gas—and therefore the gas composition—and upon the geometry of the resonant cavity. The signal intensities depend upon the gas pressure.

The resonant cavity in which the gas acoustic modes are excited must be accessible to ultrasonic transducers mounted on the outside of the container and be of a simple geometry for which the gas modes can be modeled with confidence. We have fashioned a cylindrical cavity within a storage container from a short section of thin-walled pipe fastened onto the bottom of a storage can with a circular plate glued on top of the pipe as a lid. The plate has a 50-mm filter fitted onto a small hole to let gas diffuse into the cavity. The storage container is filled with silica sand, surrogate for plutonium dioxide for these proof-of-principle experiments. The experimental geometry is shown in Figure 3.

The sand effectively dampens all container resonance modes except those from the area on the bottom of the can that is within the cavity. Transducers are glued to the bottom of the can. Data consist of the amplitude of an acoustic sine wave versus frequency.

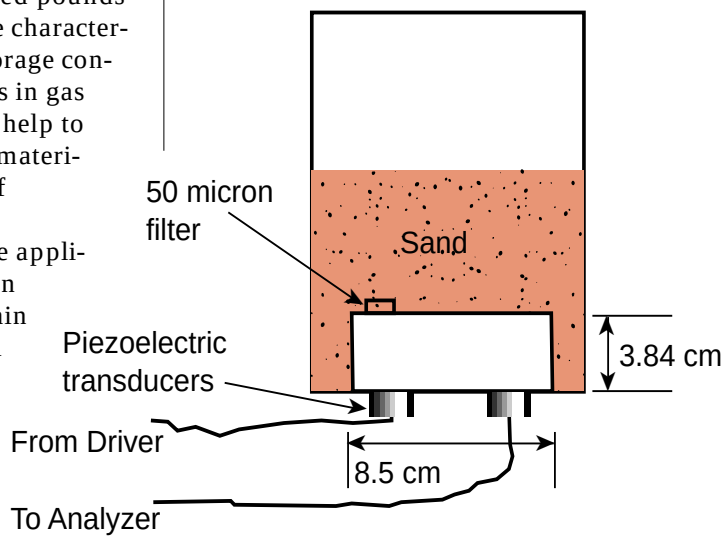

Figure 3. Schematic of storage can with a cylindrical resonant cavity. Acoustic resonance spectra are acquired by driving a piezoelectric transducer fastened to the bottom of the container with a variable frequency sine wave and picking up the response of the system using a second transducer.

Gas resonance modes are identified by comparing spectra acquired with the container under vacuum and filled with argon at a pressure of 40 psia. All observed gas resonances match with calculated resonances. Gas amplitudes are typically quite small, about one-tenth the amplitude of the continuous background and one-hundredth the amplitude of the strongest container mode observed.

The amplitude of a gas mode resonance is a function of the gas pressure, the gas composition, and whether there is a container mode with a frequency near that of the gas mode. The amplitude of a gas mode can be increased by orders of magnitude when the gas mode is resonant with a container mode. This is observed by gradually shifting a gas mode towards a container resonance by changing the gas composition. The integrated intensity of a gas resonance peak that is not appreciably affected by container resonances has been confirmed to increase linearly with gas pressure. Thus, the amplitudes—more precisely, the integrated intensities—of gas mode resonances can be used to obtain pressure information.

Collaborators on this research include **D. Kirk Veirs,** NMT-6; **Joseph P. Baiardo,** NMT-5; **Clinton R. Heiple,** Metallurgical Consultant, Boulder, CO; and **Gerd M. Rosenblatt,** Materials Sciences Division, Lawrence Berkeley National Laboratory.

Information about gas composition is obtained from the velocity of sound. The observed gas resonance frequency, temperature, and dimensions of the cylindrical cavity are used to calculate the velocity of sound of the gas. An effective mass for the gas is calculated directly from the sound velocity. This effective molar mass is a combination of the mean molar mass, mean compressibility factor, and the mean heat capacity ratio; it is equal or close to the mean molar mass depending upon the molecular complexity of the constituents. Figure 4 shows the resonance frequency of a gas mode as a function of effective mass for the geometry shown in Figure 3. The applicability of the effective mass was confirmed in experiments using gas mixtures in a spherical cavity. Spherical resonator cavities have sharper resonance peaks when the driving frequency is swept through a gas mode and can therefore be used to confirm at a more accurate level the theory relating gas composition to sound velocity.

Our experimental results to date show the following:

- Predictable resonant gas modes can be observed in a storage container filled with powder and fitted with a cylindrical resonant cavity.
- Peak positions reflect changes in gas composition, and peak intensities are proportional to changes in gas pressure.
- Well-established theory relates geometry, speed of sound, and gas resonant frequency.
- Observed spectra, even though complicated by interaction with container modes, can be fit to obtain quantitative information on gas mode positions, amplitudes, and peak widths.
- Small changes in gas composition (or more precisely in the average molar mass), better than 1:1000, can be observed when the temperature is known.

Applying ARS to the proposed 3013 storage system involves some significant technical barriers. The 3013 storage system calls for placing a welded inner container within a welded outer container. In order to use ARS to probe the gases within the inner container, we have to couple the acoustic energy from the outside of the outer container to the lid of the inner container. We have tested the concept of using small metal cylinders as acoustic couplers between the inner and outer containers and have observed gas resonances. However, our results to date suggest that probing a double-container system using couplers will reduce the intensity of observed gas modes and at the same time significantly increase the number and intensity of container modes, causing reliable measurement of gas modes to become difficult, perhaps impossible. Using ARS monitoring with a singly-contained storage system, e.g., the 3013 inner container without the outer container, may have advantages. The advantages include reduced costs, early detection of changes in the gas and therefore changes within the stored material, and enhanced ability to dissipate any heat generated in the storage container. Early detection of changes in the stored material will allow problem materials to be identified and stabilized before they have a negative impact on the storage facility. Monthly surveillance of newly filled containers should identify problems well before the problems affect the container integrity. After a container shows no unanticipated changes for some time, the surveillance interval can be increased.

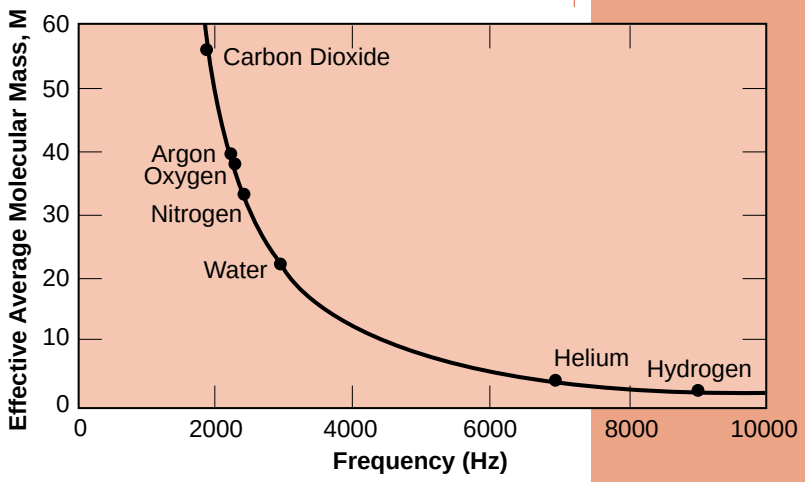

Figure 4. The relationship shown for effective mass as a function of frequency is for the cylindrical cavity of dimensions shown in Figure 3 at 23°C. Frequencies of some common gases are shown for illustration.

Funding for this effort was made possible through the Nuclear Materials Stabilization Task Group, EM-66, of the Department of Energy.

Bacteria in Radioactive Environments Can Affect Waste Storage

Microbial activity can play a major role in the performance of geological radioactive waste repositories (e.g., the Waste Isolation Pilot Plant, WIPP). The literature is replete with studies of microbially influenced corrosion of metals or alloys, microbial effects on the migration or retardation of heavy metals as a result of metal-binding and redox mechanisms, and the production of gas and various organic molecules. These effects are caused by metabolic processes that result in the degradation of organic material (used as microbial building blocks) and electron transfer processes that supply energy. They are significant both for a sealed geologic radioactive waste repository, especially those containing high levels of organic material, and for bacteria in contact with radionuclide-containing materials in the environment. Past studies have shown that many bacteria (specifically *archaebacteria* or *archaea*) can tolerate the extreme environments of radiation, desiccation, alkalinity, acidity, heat, high ionic strength, and pressure expected to be found in planned repositories. Also, because microbial populations are diverse and can be unique to their individual environments, microbial effects should be considered on a per-site or case-by-case basis.

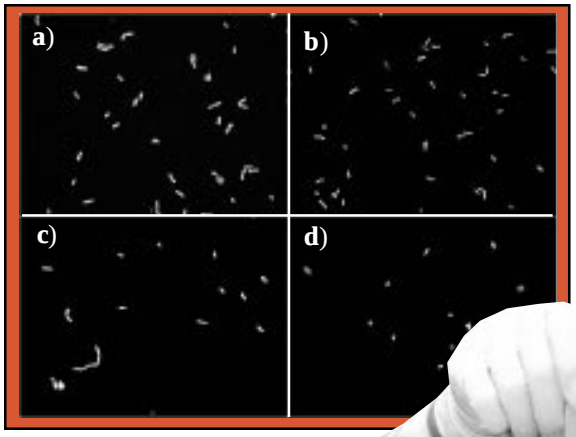

Figure 5. Epifluorescence micrographs of the "WIPP1A" archaebacterial cells after one day of growth. Micrograph a) shows the bacteria in plain growth culture. Micrographs b), c), and d) show the bacteria in growth cultures to which increasing amounts of plutonium have been added. Note that cells in d) are more coccoid in appearance compared to the rod-shaped bacteria shown in a). Changes to cellular morphology may be a result of toxic effects of the Pu on the bacterial cells.

Few studies have been conducted of microbial influences on materials in direct contact with high-activity actinides such as Pu and Am. Such studies are difficult because of the special facilities required and the problems of working with these materials at relevant concentrations. Recently, researchers at Los Alamos and Brookhaven National Laboratories embarked on collaborative studies to investigate the toxic effects of Pu, Am, Np, U, and Th on bacteria isolated from the environs of WIPP. The toxicity studies investigated possible adverse effects on the growth and morphology of the bacteria as a result of radionuclide toxicity.

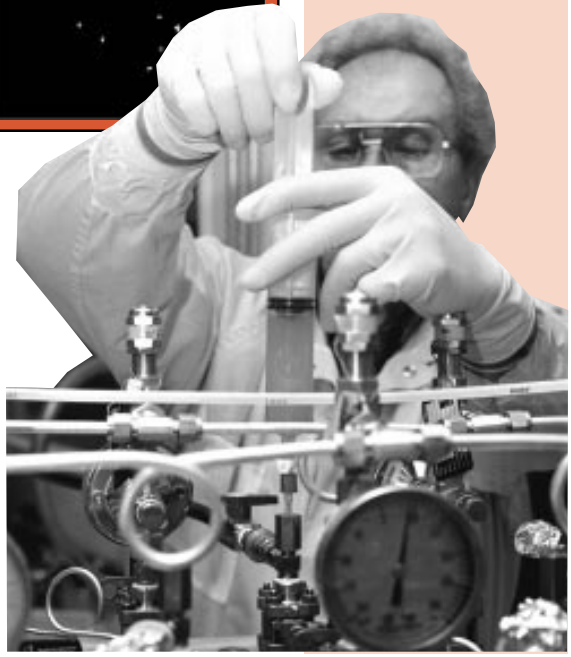

Figure 6. Walter Wright, MST-5, draws a sample that mimics WIPP-type waste to study the effects of brine on the actinides and the number and condition of bacteria in the waste, among other measurements.

The two laboratories have unique technical capabilities required for this study. A. J. Francis and his team of researchers at Brookhaven have made significant contributions in characterizing microbially catalyzed chemical changes to toxic metals and uranium and have also characterized microbial activity at the WIPP Site with respect to gas generation. His group isolated both pure (one species) and mixed (several species in a stable community) microbial cultures from the WIPP Site for these studies.

Los Alamos researchers (L. E. Hersman, LS-7; E. A. Strietelmeier, CST-7; and J. R. Brainard, CST-18) have also contributed to our understanding of microbial effects on radionuclide transport as applied to both repository performance and the environmental bioremediation of radionuclides. In addition, and most importantly, the Los Alamos researchers (Strietelmeier, M. T. Paffett, CST-18; M. E. Pansoy-Hjelvik, NMT-9) have the expertise and facilities at Los Alamos to perform the microbiological studies and to work with plutonium and americium at levels potentially toxic to the WIPP bacteria.

The microbial cultures studied were isolated from a mixture of muck pile salt, hypersaline lake brines, and sediment slurry from the WIPP environs. The pure and mixed cultures were designated "WIPP1A" and "mixed BAB," respectively. Both cultures grow only at high salt concentrations and are capable of using an alternate to oxygen as an electron acceptor (e.g., nitrate) during metabolic respiration.

The Los Alamos toxicity studies consisted of generating growth curves of the two cultures after adding various concentrations of radionuclides. Toxicity to the microorganisms appeared as temporal variations in the growth curves (plotted as total number of cells per milliliter) in comparison to growth curves in control samples with no actinide present. Growth was determined as total cell counts, as shown by epifluorescence microscopy, which allowed for visualization, by fluorescence staining, of both live (viable) and dead (non-viable) cells. Although morphology differences are difficult to see using light microscopy, the enhancement provided by staining shows distinct morphology differences resulting from a toxic effect of Pu or Am. The stain fluoresces blue when bound to bacterial DNA and fluoresces yellow when bound to phosphate rich regions of nonbacterial organic material. Thus, in studies of bacterial populations in complex environmental samples, bacteria are readily distinguishable from nonbacterial organic matter.

Both controls and inoculated samples were analyzed for soluble actinide by liquid scintillation counting. The difference in concentrations between the control, together with the filtrate from the inoculated samples gave a rough measure of the amount of actinide associated with the bacteria.

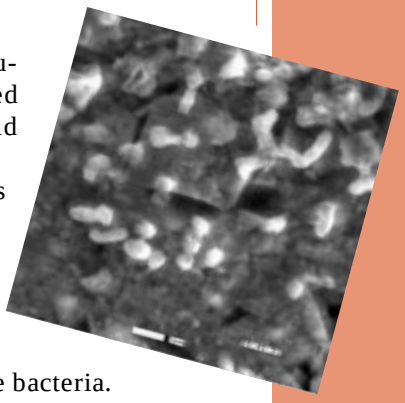

Figure 7. Image taken with UNM's environmental electron microscope of "WIPP1A" archaebacterial cells in pure culture in a 20% brine medium in the absence of plutonium.

The results of our studies showed that toxic effects on the growth and morphology of the cultures from Pu and Am at the lower concentrations were negligible, even though there was some radionuclide association with the bacteria. We also observed a toxic effect to the growth and morphology of the pure culture as a result of somewhat higher Pu concentrations. Toxicity from actinides may be a result of either radiological or chemical effects (the latter resulting from the heavy-metal characteristics of actinides). This research has enabled us to begin to sort out which of these plays a bigger role. Our results indicate that chemical toxicity may be the more important source of toxicity since we observed a greater toxic effect from Pu at higher chemical concentration and lower radioactivity than we did with Am at lower concentration and higher radioactivity.

In another set of studies, total numbers of bacteria were determined in tests of actual low-level transuranic waste under high-ionic strength environmental conditions. In the Actinide Source-Term Waste Test Program (STTP) that supports WIPP tests are being conducted on 54 different test containers holding waste items such as gloves, cellulosic materials, plastics, etc. from typical actinide research and processing laboratories. Fifteen drums (55-gallon-sized) and 39 small (2–3-liter-sized) titanium test containers hold solidified inorganic process sludge, pyrochemical salts, and cemented materials immersed in synthetic brines, which emulate WIPP brines.

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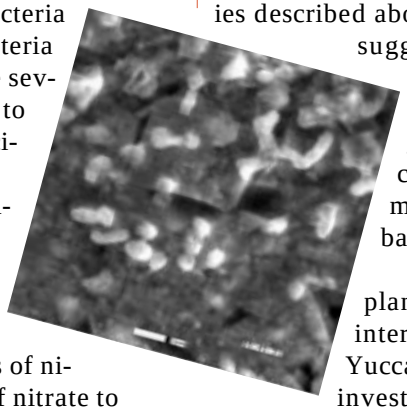
Bacteria in Radioactive Environments Can Affect Waste Storage *(continued)*

This article was contributed by **Lisa Pansoy-Hjelvik,** NMT-9, and **Betty Strietelmeier,** CST-7.

A quantity of the original material from the WIPP site (from which the mixed BAB culture was obtained) was added as an inoculum to all of the test containers. The growth of the bacteria in the containers was followed for approximately one year. The overall result of these studies showed a decrease in cell numbers with time.

Recently, in order to investigate the microbial processes in the test containers, Los Alamos investigators (Pansoy-Hjelvik and P. A. Leonard, CST-7) conducted research to determine the viability of the bacteria in selected STTP containers. Bacteria were expected to be viable since several of the containers continued to evolve gases that could be associated specifically with anaerobic bacterial processes (i.e., denitrification) that reduce nitrate to produce gaseous nitrogen oxides, primarily nitrous oxide, and nitrogen gas. Those test containers contained high levels of nitrate, and microbial reduction of nitrate to form these gases commonly occurs under environmental conditions. Therefore, the viability studies focused on identifying metabolically active denitrifying bacteria.



We were unable to demonstrate viability of denitrifying bacteria under the growth conditions used in the studies. However, further studies are needed to determine whether live bacteria, perhaps having been removed from the sampled test solution by sorption or aggregation, are attached to the solids or surfaces within the test container. Additionally, studies are in process to test an alternate gas-generation process (a process that involves nitrate reduction to form nitrous oxide by radiolysis). Low levels of hydrogen, detected in the same containers with the nitrous oxide, suggest that nitrate could be acting as an electron scavenger during the radiolysis of water to form hydrogen.

Use of a multibarrier approach to containment of wastes has been considered for WIPP, and magnesium oxide has been proposed as a backfill. If brine were to seep into the repository, the magnesium oxide would not only serve as an absorbent, but it would increase the pH of the brine to levels where hydrolysis of the actinides would cause insolubilization and precipitation. Other microbial studies investigated the toxic effects of MgO on the WIPP bacteria. They were conducted in the same manner as the Pu and Am toxicity studies described above. The MgO toxicity studies suggested that MgO has an inhibitory effect on the bacteria either by interfering with their growth, by cell lysis, or by increases in the pH beyond the metabolic range of the specific bacteria studied.

Several other studies are planned to investigate microbial interactions with actinides. The Yucca Mountain Project (YMP) investigators (Hersman and Strietelmeier) will investigate possible microbially mediated transport under unsaturated groundwater-flow conditions. These particular studies are relevant not only to YMP, but to other potential repositories that currently are planned for placement in vadose (unsaturated) zones. Additional STTP investigations will include an analysis of the solids in the waste containers to detect viable bacteria, along with other studies involving the MgO backfill material.

Although Not Magic, "WAND" Helps Manage Waste

"WAND," which stands for Waste Acceptance for Nonradioactive Disposal, is a very ambitious, four-year developmental project in radioactive waste management. The WAND project has developed an ultrasensitive survey system for low-density wastes generated at the Los Alamos Plutonium Facility. The system now allows us to separate nonradioactive wastes from radioactive wastes to the satisfaction of regulatory agencies. As of October 1997, it has finally resulted in approvals from a number of offices of the DOE, the NM State Environmental Division, and Los Alamos County.

About 60%–70% of the regular low-density waste generated at the plutonium facility is innocuous, nonradioactive waste. Until now, all the waste from the plutonium facility was labeled and handled as radioactive and disposed of according to applicable regulations. Although the associated costs were prohibitive, until now there was no reliable technology to prove conclusively that most of this waste was nonradioactive.

A team of experts from technology divisions NMT, NIS, and CST, and operations group EM/SWO took on the challenge to develop technologies and demonstrate to the satisfaction of all applicable bureaucracies and regulatory agencies that most of the waste stream from Los Alamos Plutonium Facility is nonradioactive and that it could be disposed of at a municipal site.

We would like to congratulate our colleagues who, in spite of enormous difficulties, persevered and succeeded. This technology could be transferred easily to other DOE sites, where it would lead to major savings in waste management costs.

Contributed by Sam Pillay, NMT-DO

LANL Establishes Seaborg Institute and Names Director

David L. Clark, a chemist who has been with Los Alamos National Laboratory nearly 10 years, was recently named as director for the Los Alamos branch of the Glenn T. Seaborg Institute for Transactinium Science.

The main purpose of the Seaborg Institute is to educate and train the future generations of actinide scientists and engineers. This goal addresses a pressing national concern that the supply of researchers and technicians in transactinium science and related disciplines is seriously dwindling.

The Seaborg Institute was chartered by the Department of Energy and the University of California to serve as a focal point for actinide science, promote laboratory collaborations and train the next generation of actinide scientists. Branches of the institute were established in 1991 at Lawrence Berkeley National Laboratory, where Nobel laureate Seaborg continues a long affiliation, and at Lawrence Livermore National Laboratory.

The Los Alamos branch will help integrate research programs in actinide science with a special emphasis on plutonium. Maintaining research capabilities and expertise for studying plutonium and other actinides will play a critical role in Los Alamos' ongoing mission. Another aspect central to the institute is to foster closer ties with the outside community through extensive visitors programs, workshops, and conferences and to encourage graduate students, postdoctoral research associates, university faculty, and collaborators to perform research at LANL facilities.

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Invited Talks

E. Garcia, J. A. McNeese, W. J. Griego, and V. R. Dole, "The Chemistry of Plutonium in Molten Chloride Salts," Chemistry Department, University of California, Davis, CA, October 23, 1997.

R. B. Matthews, "Plutonium Futures-The Science" at the Nuclear Science Center, The University of Florida, Gainesville, Florida, on October 28, 1997.

Reports and Memos

K. K. S. Pillay, "Food Safety and Food Irradiation," a letter to the editor, *Nuclear News*, **40** (11), pp. 12, (October 1997).

K. K. S. Pillay, "Multi-Generational Stewardship of Plutonium," in *Proceedings of the International Conference on Future Nuclear Systems*, Vol. 1, pp. 716-719 (LA-UR-97-1563, October1997).

A. Toupadakis, "Evaluation of the Loss-on-Ignition Measurement for Storage of Legacy Plutonium-Bearing Materials, LA-UR-97-3753, November 1997 (http://lib-www.lanl.gov/la-pubs/00326374.pdf).

A. Toupadakis, T. Allen, Q. Appert, C. Davis, L. Foster, D. Horrell, R. Mason, L. Morales, M. Ramos,
J. Telford, and J. Trujillo, "Materials Identification and Surveillance Project Team Evaluation, Item: Impure Plutonium Oxide (PPSL-365)," LA-UR-97-4436, November 1997.

Conference Presentations

D. R. Horrell, T. H. Allen, Q. D. Appert, L. Morales, A.S. Toupadakis, R. E. Mason, "Long-Term Storage of Plutonium Metal and Oxides,"American Nuclear Society 1997 Winter Meeting, Albuquerque, New Mexico, November 16–20, 1997.

J. M. Macdonald, "Implementation of an Intranet for Industrial Control," Industrial Society of America (ISA), Anaheim, CA, October 1997.

K. K. S. Pillay, "Back End of an Enduring Nuclear Fuel Cycle," presented at a panel discussion on "Enduring Nuclear Fuel Cycle," in *Transactions of the American Nuclear Society*, **77**, P.74, American Nuclear Society, La Grange Park, IL, (November 1997) (see also LA-UR-97-4335).

N. G. Pope, Robin Holt, and S. Taylor (Wunderlich-Malec/Engineering/Systems), "Acceptance Testing and Start-Up of an Upgraded Facility Control System at the Los Alamos Plutonium Facility," Plant Life Management & Plant Life Extension in Nuclear Facilities, Prague, Czech Republic, December 8–10, 1997.

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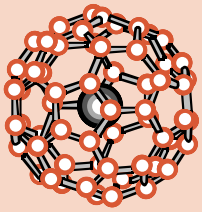
Editorial

Actinide Research Quarterly Looks Back



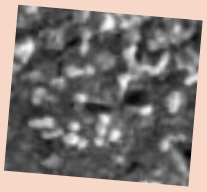
This issue marks the third anniversary of the *Actinide Research Quarterly*. During these past three years the publication has grown both in scope and in circulation. Departing from the original scope of reporting activities strictly within the division, we have reached out to external sources for our editorial pages and contributed technical articles. The newsletter's circulation has almost doubled over this same period. In addition, all current and back issues of the *Actinide Research Quarterly* are now available electronically on our World Wide Web page for our international readership.*

For technical articles, because of the limited space and the nature of this newsletter, we do not expect to present a significant part of all actinide research and related activities. Instead, we summarize all publications and reports that occurred during the reporting quarter within the Nuclear Materials Technology Division, and we report only a selected few articles that we view as being of general and current interest to a broader audience. For those readers who seek further information, we provide the names of the authors and other information sources that our readers can contact directly. While the actinide science community is small, it is increasingly more important for us to communicate more effectively among its practitioners and with the general scientific community as well. It is with this goal in mind that we have reached out for contributed articles from other organizations within the Los Alamos National Laboratory, with marginal success so far.

In our editorial pages we reported diverse views on such topics as high-level policies impacting stewardship of excess plutonium, a social scientist's view of the institutional stewardship of nuclear materials and nuclear weapons, and plutonium disposal issues. The technical articles included mainly applied research and programmatic activities, although once in a while we presented the pure science aspect when it was timely. Three most notable topics reported during 1997 included the 1997 NMT Division Review in March (Spring 1997), the Plutonium Futures - The Science conference sponsored by the Los Alamos National Laboratory and held in Santa Fe (Summer 1997 and Fall 1997), and the guest article "Source of the Actinide Concept" by Glenn Seaborg, discoverer of the element plutonium as an introduction to the conference (Summer 1997). This newsletter's writer/editor Ann Mauzy summarized the conference activities in the fall issue, which included an excellent photo display of scenes from the conference and was produced by our designer/production member Susan Carlson (photos by Mick Greenbank, CST-15).

The Plutonium Futures - The Science conference was clearly the high point among the 1997 events reported. The conference hosted over 300 participants. Over 110 technical papers were presented in diverse, actinide-related fields. This conference was indeed a smorgasbord event for all actinide researchers worldwide,

and it achieved the stated objective of the conference: providing an opportunity for the international scientific community to exchange ideas, to discuss and assess current understanding of the chemical and physical properties of plutonium and other actinides, and to discuss the current and emerging science of plutonium and actinides. One article selected from the conference, "Bacteria in Radioactive Environments" by L. Pansoy-Hjelvik, appears in this issue. We strive to inform our readers of the most current research activities in all things nuclear and actinide.



In sum, the year 1997 was a good year for the division and the newsletter. As the NMT Division and the Los Alamos National Laboratory make progress toward achieving their goal of reducing the global nuclear danger, so does the newsletter prosper in reporting their success in doing so.

K. C. Kim

*http://www.lanl.gov/Internal/divisions/NMT/nmtdo/AQarchive/AQhome/AQhome.html

NewsMakers

■ **Gordon Jarvinen** and his coworkers were awarded U.S. Patent 5,670,550 in September for their invention "Ion Exchange Polymers for Anion Separations." Gordon's coinventors are **S. Fredric Marsh** of Los Alamos and **Richard A. Bartsch** of Texas Tech University.

■ **Gary Rinehart** (NMT-9) and **E. A. Franco-Ferreira** of the Oak Ridge National Laboratory have received the $5,000 Gold Award in the 1997 Professional Awards Program of the James F. Lincoln Arc Welding Foundation. The biennial national program recognizes excellence in arc welded design and engineering across the country. Rinehart's and Franco-Ferreira's entry describes the loading and welding of light weight radioisotope heater units that was done for the Cassini spacecraft and its probe Huygens, using an automated and digitally controlled welding system built specifically for the task.

Publications, Presentations, and Reports (continued)

D. E. Sanchez and D. W. Mullins, "Control of Instability in Nitric Acid Evaporators for Plutonium Processing," ISA Tech/97 Conference, Research Triangle Park, NC, Oct. 7–9, 1997.

M. A. Stroud, D. A. Swingle, J. M. Stewart, and S. Stewart, "Exploring Safety Systems with a Mouse," 21st Annual TRADE Conference, Denver, CO, December 3, 1997 (LA-UR-97-1697).

A. Toupadakis, Gregory J. Kubas, W. A. King, B. L. Scott, "Synthesis and Reaction of $[Mn(CO)_3(PCy_3)_2]+$ with Hydrogen and Crystal Structure of the $MnBr(CO)_3(PCy_3)_2$ Precursor," 214th American Chemical Society National Meeting, Las Vegas, Nevada, September 7–11, 1997.

The following were presented at Global '97, October 5–10, 1997, Yokohama, Japan: M. A. Williamson, F. Venneri, and N. Li, "Chemistry Technology Base and Fuel Cycles of the Los Alamos Accelerator Driven Transmutation System" and K. K. S. Pillay, "Multi-Generational Stewardship of Plutonium."

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