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PACIFIC NORTHWEST LABORATORY
MONTHLY ACTIVITIES REPORT

JUNE 1973

Division of Production and Materials Management
and
Hanford Plant Assistance
Programs

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Staff of Battelle-Northwest
E. L. Alpen, Director

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PACIFIC NORTHWEST LABORATORY
MONTHLY ACTIVITIES REPORT
DIVISION OF PRODUCTION AND MATERIALS MANAGEMENT
AND HANFORD PLANT ASSISTANCE PROGRAMS

ASSISTANCE TO ATLANTIC RICHFIELD HANFORD COMPANY

Summary

Program I

In studies on actinides present on soil from the 216-Z-9 enclosed trench, the presence of a ligand which limits the solubility of Pu in HNO_3 was indicated. Autoradiographic examinations of soil samples from the trench were completed; electron microscope probe examination of the same soil samples is in progress.

Two tests of a process for solubilizing refractory PuO_2 present in incinerator ashes by fusion in a $\text{NaOH-Na}_2\text{O}_2$ mixture were completed. Of the Pu initially present in the ashes, 98.5 and 96% dissolved in HNO_3 following the $\text{Na}_2\text{O}_2 - \text{NaOH}$ fusion in the two tests.

Program II

Summary reports on "Barium-Strontium Separation During Fluoride Precipitation" and "Waste Volume Reduction by Sodium Removal" are in preparation.

Program III

Work on documentation of plutonium aerosols studies continued.

Scheduled sampling of the 234-5Z Building stack gases was completed and documentation covering the results is in progress.

Work was started on determining the transmissivity from historical well hydrographs.

Successful runs were obtained with the variable thickness transient model using the CDC computer on a synthetic test problem.

A new well location map for the Hanford Reservation was completed and distributed this month.

Distribution lists for offsite recipients of Radionuclide Transport Model documentation were assembled.

Documentation of the soil reactions portion of the transport model was continued.

Process Technology

Program I

Instrumentation development in support of Separations, Waste Management and Plutonium Reclamation included evaluation of a sensor design for Pu monitoring in the PRF canyon, optimization of Ce-activated glass alpha sensors, evaluation of radiation resistance of pH probes and evaluation of commercially available signal processing equipment.

Earlier studies on the Pu(IV) absorption and elution kinetics of recently available anion exchanger resins indicated the resin Amberlite IRA-458 should perform well in plutonium processing. In current column loading studies performance of this resin is poorer than expected due to poor absorption equilibria.

Program V

Development and evaluation was continued on solid state relay control systems for use in radioactivity resuspension studies. No detectable amounts of ^{137}Cs were made airborne during burning of contaminated materials in gasoline fires in an air stream moving at 2.5 mph. Some transport of contaminated soil from the residue following a gasoline fire occurred when the residue was subjected to air moving at 20 mph.

The first high-volume rate air sampling resuspension experiment at BC-trench area was completed and the second resuspension experiment was completed at U-pond.

Objective wind and trajectory calculations using the operational wind data obtained from the Hanford Reservation wind measuring equipment is still in progress.

A computer simulation was also run to examine the spread of water from a four-inch pipe set five inches into the bottom of the 216-Z-9 enclosed trench.

Soil chemical parameters were estimated for a high-level waste tank leak and used in a preliminary calculation of the motion of waste and soil ions through the soil.

Computer simulation of the 106-T tank leak has been started using the Partially Saturated Transient model.

Studies were initiated on the formation of soil hydrophobic seals in Hanford soils as a possible means of controlling liquid flow in soils. A quaternary amine and a cationic asphalt emulsion have been tested to date.

Autoradiographs of soils contaminated with actinide elements as nitrate, organic acid or chelating agent solutions showed that not all of the soil particles are radioactive. Shoot uptake of Cf by tumbleweed and cheatgrass was less than for Am and Cm but more than for Pu from soils contaminated with nitrate solutions of these elements.

ASSISTANCE TO ATLANTIC RICHFIELD HANFORD COMPANY

Program I - Plutonium Scrap Processing

Actinides on Sediments

(J. L. Swanson, Chemical Development Section and L. L. Ames, Water and Waste Management Section)

This study seeks to understand the manner in which contaminants, particularly actinide elements, are held on soils and the changes which have occurred in the soils because of exposure to the solutions and slurries which have been discharged to them. Such studies will aid in understanding how contaminants migrate through soils and in developing effective procedures for removing contaminants from soils. Current studies concern soil samples taken from and near the Hanford 216-Z-9 enclosed trench.

Recent results in leaching studies of 216-Z-9 enclosed trench soils indicate the presence of a ligand which limits the solubility of Pu in HNO_3 leaches of the soil. This effect is more pronounced with soil from Sample 4-11 than with soil from Sample 4-5. Since Sample 4-11 contains much more tributylphosphate (TBP) and/or dibutylbutylphosphonate (DBBP) than Sample 4-5, it is tempting to conclude that the ligand in question is a solvent degradation product.

Observations which have been made relative to this effect using soil from Sample 4-11 at the 12-18 in. depth are:

- The same concentration of Pu was found in solution when different weights of soil were contacted with a given volume of 5M HNO_3 . The concentration of Pu was low ($\sim 5 \text{ mg/l}$) and did not increase with time of contact.
- The amount of Pu removed from the soil was substantially increased by the presence of TBP. The Pu which extracted into the TBP phase was not readily stripped with water.
- The ligand can be removed from the soil (at least partially) by washing the soil with ethanol or KOH solution. This may explain the previously reported observation that HNO_3 removed Pu from soil more rapidly if the soil had been washed with a carbonate solution.
- Addition of fluoride to the HNO_3 leach solution increased the solubility of Pu in the solution.

These results do not necessarily mean that the Pu is present on the soil as a precipitate with the ligand. It is also possible that the Pu and the ligand are separately present in the soil and that prior removal of the ligand will permit better characterization of Pu behavior during leaching.

In an earlier study it was found that Pu was removed from soil samples about equally readily by 5M HNO₃ and 5M HBr. Since HBr reportedly dissolves refractory PuO₂ more rapidly than does HNO₃, this observation cast doubt on the presence of refractory PuO₂ in the soil. Further studies with these leachants showed that boiling 9M HBr is significantly more effective in removing Pu from soil (Sample 4-5) than boiling 16M HNO₃ (97% versus 70% at six hours contact using 15 ml reagent per gram of soil). Thus, the presence of some refractory PuO₂ is indicated.

The process used in obtaining matching sets of optical and autoradiographic photos of plastic-impregnated 216-Z-9 trench soil mounts was described in the May report. After obtaining autoradiographs, with film exposure times ranging from fifteen minutes to sixteen hours, the same areas were located optically and photos taken at the same magnification. The resulting set enables the reader to directly compare the two photos.

Approximately 87% of the autoradiograph film exposure was due to ²³⁹Pu alpha emissions; most of the remaining exposure was due to ²⁴¹Am alpha emissions. The alpha emitters were nonhomogeneously distributed in the autoradiographs; they were present chiefly as high activity spots and areas. Toward the top of the soil column, the bulk of the alpha emitters occurred surrounding soil grain rock fragments and in areas between them. Soil sample 4-11 was overlaid by about half an inch of sludge, presumably added during crib operation, while soil sample 4-5 was not overlaid by such a sludge. The highest alpha activity occurred in bands within the 4-11 sludge. Evidence for accelerated chemical attack of soil rock fragments occurred throughout both soil samples. In the lower extremities of these two-foot samples, the amount of alpha emitters, relative to the total amount present, increased within the chemically-corroded soil rock fragments. However, because film exposure times were different for soil taken from different positions in a sample, the absolute concentrations of alpha emitters within the corroded soil rock fragments may have been the same in all cases.

Electron microprobe examination of the soil mounts is now underway. Data obtained will be used to determine the distribution of elements within the soil mounts and to determine the chemical compositions of remaining corrosion products and refractory minerals associated with the alpha emitters.

Recovery of Pu from Incinerator Ash
(J. A. Partridge, Chemical Development Section)

Prior work has shown that highly refractory PuO_2 present in incinerator ashes can be made more soluble in HNO_3 by exposing the ashes to fused $\text{NaOH-Na}_2\text{O}_2$. A process for recovering Pu from incinerator ashes which utilizes this observation is being developed. The fusion operation will be done in a mild steel can. Subsequently, both the mild steel container and the fusion mixture will be dissolved in HNO_3 to provide a feed solution for Pu recovery and purification.

Two tests of the process were completed. Twenty grams of incinerator ash, 70 g of Na_2O_2 and 70 g of NaOH contained in a mild steel can were held at 600-650°C for one hour. Air was bubbled through the melts to provide mixing. After cooling, each melt and container was dissolved in HNO_3 (4 x 2M and 800 ml 15.7M). Each solution contained about 1.2 g undissolved solids. Of the plutonium initially present in the ashes, 98.5% was in solution in one test and 90% in the other.

Program II - Waste Solidification and Encapsulation

Separation of Ba from Sr During Fluoride Precipitation
(J. A. Partridge, Chemical Development Section)

Results obtained in this study will be reported in a document now in preparation, BNWL-B-286, "Barium-Strontium Separation During Fluoride Precipitation".

Salt Cake Volume Reduction
(L. L. Burger, Applied Chemistry Section)

Results obtained in this study will be reported in a document now in preparation, BNWL-B-293, "Waste Volume Reduction by Sodium Removal". This report summarizes past work on chlorination of waste salt cakes, calcination of salt cakes, carbon reduction of sodium compounds and distillation of sodium metal.

Program III - Public Protection Assurance

Airborne Release from Postulated Accidents
(J. Mishima, Atmospheric Analysis Section)

Several additional sections and illustrations were prepared for the document, "Information Useful in Assessing the Consequences of Airborne Plutonium in Potential Accidents".

Characterization of Radioactive Particles in the 234-5Z Building Gaseous Effluent
(L. C. Schwendiman and J. Mishima, Atmospheric Analysis Section)

The sampling program to measure the concentration and size distribution of alpha-active particles in the 234-5Z Building stack gases was completed. Seven (instead of the scheduled six) samples were taken continuously during the period October 12, 1972 to May 31, 1973. Analyses are not yet completed on the final sample. Data are being accumulated and analyzed for a report covering this topic.

Radionuclide Transport Model

Generation of an Improved Transmissivity Distribution
(K. L. Kipp, Water Resources Systems Section)

Work was started on determining the transmissivity distribution from historical well hydrographs. A sufficiently frequent series of measurements is available for the year 1972. October 1972 appears to be the best potential map to use for the new transmissivity calculation. This is because the slopes can be obtained with reasonable accuracy for this point in time for the hydrographs.

Conversion of the Variable Thickness Transient Programs to the CDC Computer
(W. V. DeMier, Water Resources Systems Section)

Successful runs of the synthetic test problem were obtained this month. Implementation of a variable grid spacing capability is in progress. Preliminary conversion work is being done on a multiple aquifer program that will be the starting point for a program to take into account the vertical variation of permeability (hydraulic conductivity).

Field Monitoring and Measuring Assistance
(K. L. Kipp, Water Resources Systems Section)

A new well location map for the Hanford Reservation was completed and distributed this month. A revision of the water table measurement schedule was made and a new base map showing wells added in the past 1-1/2 years is being prepared.

Documentation Reports
(D. B. Cearlock, Water Resources Systems Section)

Distribution lists for offsite recipients of report on the Radionuclide Transport Model were assembled. Copies of the reports are being sent to prominent workers in the fields of groundwater flow and associated mass transport.

Soil-Waste Reactions
(R. C. Routson and R. J. Serne, Water and Waste Management Section)

Documentation of the soil reactions portion of the transport model was continued through the reporting period. The documentation is divided into four parts which will be entitled: 1) One-Dimensional Model of the Movement of Solutes Through Soil Columns: The PERCOL Model; 2) PERCOL Model User's Manual; 3) Experimental Support Studies for the PERCOL and Transport Models; and 4) Laboratory and Computer Methods for the PERCOL Model Verification Effort during the month has been directed towards responding to internal review and preparation of final input figures for graphics. All four documents are in reproduction.

Process Technology

Program I - Plutonium Product Support

Instrumentation Studies in Support of Separations, Waste Management and Plutonium Reclamation
(O. H. Koski, Chemical Development Section)

Development of instrumentation for in situ monitoring of plutonium in the Plutonium Reclamation Facility Canyon was continued. Developing realistic performance criteria for the in-canyon monitor requires that the projected use of multichannel analysis be evaluated by simulation of in-canyon measurement conditions. In a laboratory simulation, count rates observed at energies from zero to 1 MeV were recorded as a function of (a) distances from source up to 6 feet, (b) sensor window sizes designed for 0, 12, 24, and 48 inches maximum

distance from source, (c) 6-inch diameter sources, (d) sample concentrations of 1, 20, and 80 g/Pu/l and (e) stainless steel tank wall thicknesses of 1/8, 1/4, and 1/2 inches. Preliminary analysis of the data indicates that the gamma signatures of the various Pu isotopes present is seriously obscured by Compton radiation. Also, the assumed directionality of the sensor is not considered adequate, count rate observations are taken in a complete 360° traverse and the location and size of sources are determined by computation. Other possible improvements include adding more shielding (lead) to the sensor or the use of a shield sensor and anticoincidence circuitry to reject counts not entering through the window. The use of more shielding would permit using larger sensor windows for a given source distance but would increase the weight of the sensor and the difficulty of positioning it in the canyon. A photometric device expected to be useful in determining sensor to source distances, is on order.

Twenty cerium activated glass alpha sensors were processed during the month to optimize their alpha response. There were no rejects. Five sensors with an alpha-sensitive layer thickness of less than 3 mils were selected for grinding to special diameter and edge profile specifications desired by ARHCO.

Testing of pH converters and associated equipment together with radiation testing of pH probes as candidates for use in the cesium and strontium recovery processes was continued. The pH probes being radiation-tested include three commercially available probes, two of which are pH-reference combinations, and a laboratory developed platinum differential oxidation-reduction potential (ORP) type. Current data suggest that a relationship exists between pH probe radiation-induced offset and pH probe impedance. The probes under test vary from 400 megohms to about 15 megohms, except for the lab probe which is about 5 kilohms and not of conventional glass construction. At a radiation exposure level of 9×10^5 R/hr and a total dosage of 6×10^7 R the high impedance probe had an observed offset of 2.5 pH unit while the low impedance probes showed about 0.3 pH units. Commercially made pH amplifiers and adapter modules have been investigated and appear to be an economical method for acquiring pH and ORP information from the low output impedance signal conditioning units tested. The low cost and rugged industrial housing make the units applicable and attractive for a variety of applications including pH and ORP measurement, electrolytic bath control and specific ion electrode readout.

Also tested were modules capable of converting voltage to frequency and frequency to voltage with a usable span of four decades. The possible uses

include wire telemetry, turbine flowmeter readout frequency, encoding and decoding of analog voltages and totalization of analog values such as flow rates. In particular the end point in the neutralization of cesium carbonate has been shown to be determinable by computing the slope of the pH change per unit of hydrochloric acid added. The acid rate assumed to be available as a voltage value is converted to a frequency and totalized over a selected count over which period the change in pH is determined. The pH change is computed by either analog or digital techniques.

Recovery of Plutonium from the 216-Z-9 Enclosed Trench
(J. L. Ryan, Applied Chemistry Section)

The objective of this study is to adapt anion exchange processing to the recovery and purification of Pu from solutions produced by leaching soil from the 216-Z-9 enclosed trench. It is hoped that a fluidized bed contactor can be used in order to minimize problems due to solids expected to be present in the solutions. Exchanger properties such as exchange kinetics and resin density are more important when using such a contactor than in packed bed systems.

In earlier work a series of commercially available anion exchange resins was evaluated with respect to kinetics of absorption of Pu(IV) from 7.5M HNO_3 solution and elution of Pu(IV) from the resin with 1M HNO_3 .

Emphasis was placed on evaluating anion exchange resins which have become available since 1957-1958 and comparing them to resins which have been used for plutonium processing. Of the resins studied, Amberlite IRA-458 showed most promise for the desired use based on exchange capacity, loading and elution kinetics, and density.

Current studies involving loading of columns of Amberlite IRA-458 resin with Pu(IV) have not borne out the predicted good performance of this resin. For a 0.55 g Pu(IV)/l feed at 25°C and at a given flow rate, the capacity of IRA-458 to 10% breakthrough was only 23% of that for Permutit SK (a resin widely used for Pu processing) at 60°C. Although this is better loading than would be obtained with Permutit SK at 25°C, it indicates that the difference between Permutit SK and IRA-458 involves factors other than kinetics. The breakthrough performance was improved somewhat with decrease in flow rate at 25°C, but for the same flow rate the performance was poorer at 60°C than at 25°C. Since increased temperature causes decreased equilibrium absorption and increased

absorption rates (in terms of rate of approach to equilibrium), it was concluded that the absorption equilibrium is much less favorable with IRA-458 than with Permutit SK. This was further verified by loading at 1.0 g Pu(IV)/l at the same Pu mass flow rate, 4.9 mg Pu/min cu² at 25°C. The breakthrough capacity was increased almost exactly proportional to the increase in feed concentration. Such behavior does not occur in the case of Permutit SK or Dowex 1, X-4, both of which show negligible change in breakthrough capacity over this Pu concentration range since the equilibrium capacity for these resins approaches the total exchange capacity over this range.

In addition to the poorer column loadings for IRA-458 than had been hoped for, the resin is definitely less stable than Dowex 1, X-4 or Permutit SK to nitric acid attack. Thus, column gassing due to resin attack is rather severe at 60°C and is moderate even at 25°C.

Program V - Prevention of Accidental Releases

Environmental and Meteorological Survey Instrumentation Studies (O. H. Koski, Chemical Development Section)

Effort toward the design and construction of solid state instrumentation systems to be used in resuspension experimentation was continued. Integral to the data selection and powering of the conventional system is an electromechanical relay control system which will be replaced by solid state relays. Testing of the selected solid state relay system showed that successful control of the sampler motors can be accomplished while maintaining isolation of the control circuit from the power circuit. This allows remote placement of the control system and increased safety due to the use of the low voltage control cables. A similar relay system was demonstrated to be capable of switching 240 volts at 40 amperes to power a transformer. Therefore, the switching of a number of sampler motors simultaneously appears possible.

A data acquisition system consisting of a 16-channel multiplexer, an analog-to-digital converter and a digital tape recorder and control is being evaluated. This unit is designed to minimize consumption of power from the required 12-volt DC supply. The unit is expected to be of value in both remote monitoring with radio or wire telemetry of data and with self-stored data systems.

Potential for Airborne Release of ^{137}Cs During a Range Fire in the B-C Enclosed Trench Contamination Zone
(J. Mishima, Atmospheric Analysis Section)

No measurable amounts of ^{137}Cs present on various materials collected from the B-C Enclosed Trench Contamination Zone 1 was made airborne during burning of the materials in gasoline fires in the 242-B wind tunnel facility. Small amounts of ^{137}Cs were entrained during periods after the burning.

In one experiment, ^{137}Cs contaminated materials (1.67 μCi on soil and organic debris) were placed on sandy soil and burned with gasoline in an air stream moving at 2.5 mph. The fire lasted 54 min. No measurable amount of activity was found in air filter and cascade impactor samples taken during the fire and for 60 min afterwards. Also, activity was below detection limits on aluminum foil placed on the floor and one wall of the wind tunnel.

In another experiment rabbit droppings containing 9.38 μCi ^{137}Cs were burned in a gasoline fire lasting 52 min; air was drawn across the surface at 2.5 mph. Again, activity airborne during the fire was below detection limits. Following the fire, air was drawn over the residues at 20 mph. Measurable amounts of activity were found on air filter samples taken during this period and on aluminum foil taped to the floor and wall of the wind tunnel. Considerable amounts of activity were present on soil particles which moved along the floor of the duct. A similar experiment but with a post-burning air velocity of 2.5 mph was run; analysis of samples taken is in progress.

Particulate Resuspension Studies
(R. K. Woodruff and G. A. Sehmel, Atmospheric Physics Section)

Equipment installation was completed for the first high-volume rate air sampling resuspension experiment at B-C trench area. Eight cascade impactors and 44 high-volume air samplers were used for this first experiment. The second resuspension experiment was completed at the U-pond site using the sampling tower arrays. Radiochemical analysis of samples taken during the first U-pond run is continuing. Interpretation of these resuspension experiments will be made when the radiochemical analyses are complete.

Wind Trajectory Studies
(R. K. Woodruff and M. M. Orgill, Atmospheric Physics Section)

Data reduction of constant-volume balloon flights tracked near U-pond and B-C trench areas is complete and analysis of the data is nearly complete.

Operational wind data obtained from the Hanford Reservation wind measuring equipment during the same time as the constant-volume balloon flights were made have been processed by computer and trajectory calculations are now underway. Analysis of wind data as well as observed and calculated trajectory data will be the principal effort next month.

216-Z-9 Enclosed Trench Studies

(J. R. Eliason, Water Resources Systems Section)

A soil psychrometer is being used to measure the water potential versus moisture content in a sample of the soil taken from the 216-Z-9 enclosed trench.

A computer simulation was run to examine the spread of water from a four-inch pipe set five inches into the enclosed trench bottom. The soil used was a medium uniform sand with a permeability of 29.6 ft/day and a porosity of 0.373. Within the top five feet the 5% moisture line spread to a distance of 3.5 feet.

106-T Tank Leak Studies

(R. C. Routson and R. J. Serne, Water and Waste Management Section
A. E. Reisenauer, Water Resources Systems Section)

Work was initiated to estimate soil chemical and sorption parameters for input to the Radionuclide Transport Model for the estimation of the movement of radionuclides from a high level waste tank leak. All input parameters were estimated from measured parameter values for similar soils. Factorial design sorption equations were developed for the expected ranges of solution ion concentrations. A one-dimensional analysis, using the above estimated input parameters, indicated that the initial 5% of the high-Na waste would Na-saturate the soil ion exchange capacity, and that the solution Ca concentration would remain low as the remainder of the solution passed through the soil. The latter is due to the precipitation of CaCO_3 when the solution Ca reacts with the $\text{CO}_3^{=}$ in the waste. At the wetting front, the solution Ca concentration would increase to a high value after passing through a large amount of Ca-saturated soil. The leading edge of the solution essentially exhausts the waste's $\text{CO}_3^{=}$ and further exchange of Na for Ca causes the solution Ca concentration to rise to the high value.

Computer simulation of the 106-T tank leak was started using the Partially Saturated Transient Model. The soil beneath the tank is being represented by

11 different layers. Assumed waste leakage is from a point source and the waste will be introduced into the model over a simulation period of 50 days at a rate of 1.6 gals/hr.

Results of the simulation for a period of 50 days show liquid spreading in the finer sand and silt lying above a caliche layer. Although the simulation shows that waste reached the ground water in about two weeks, the volume entering the water table has remained small due primarily to the caliche bed restricting downward flow.

Formation of Soil Hydrophobic Seals

(P. L. Koehmstedt, Corrosion Research and Engineering Section)

Hydrophobic seals in soil may be an effective means for preventing or controlling the movement of radioactively contaminated solutions in soils. A study was initiated to investigate the formation of such seals in Hanford soils and to evaluate their effectiveness in controlling liquid movement through the soils.

Surface soil from near the J. A. Jones 200 Area batch plant was used as test soil. About 90% of the soil is in the size range of from <20 to >200 mesh. Cation exchange capacity of the soil is 8 meg/100 g. Existing equipment was modified to allow pressurizing a 4-3/8 in. diameter by 6-1/2 in. long soil sample (ca., 2 Kg of soil) to up to 100 psi during sealant injection or seal test. Sealant solution injection or pressure test water flow rates up to 300 ml/min may be used. The test chamber can be heated to 175°F and it can be exposed to gamma radiation.

One wt% Aliquot H226 (dimethyldisterylammonium chloride) failed to form complete hydrophobic seals at any pressure above atmospheric or any soil sample although water flow rates were reduced greatly by the treatment. A 1.2 wt% Armah Pond Seal (cationic asphalt emulsion) produced an effective seal to water at atmospheric pressure. The behavior at increased pressures indicated bypass leakage. An admixture of 65 wt% of the Pond Seal with a <20 >40 mesh soil fraction produced a seal which did not leak at 100 psi. Further studies with this sealant are in progress.

Butylpyrocatechol is an interesting potential soil sealant because it forms extremely stable complexes with aluminum. Hydrophobic seals are formed with soils containing sufficient aluminum available for complexation.

Evaluation of this material is planned. A fourth material, a quaternary amine having higher water solubility than Aliquot H226, will also be evaluated.

Biological Interactions

(K. R. Price, Ecosystems Department)

The goal of these studies is to identify the ecological fate and behavior of important radionuclides, especially actinide elements, in soil-plant systems. Current studies concern the uptake and in-plant distribution of actinide elements by tumbleweed and cheatgrass plants grown on soil contaminated with these elements.

Tumbleweed and cheatgrass uptake of Cf from soils treated with Cf nitrate solutions was 0.006 (Cf = 0.0005) and 0.0005% (Cf = 0.00009), respectively. These values are less than those observed for Am and Cm but greater than for Pu. Californium (III) is chemically similar to Am(III) and Cm(III) but it is a neutron emitter (SF = 3%). Growth of the Cf treated plants was about one-half that of the Am or Cm treated plants.

An experiment designed to determine the effect of plant age on Pu uptake is in progress. Plants were harvested at 2, 4, and 6 weeks of age. They show a decrease in p Ci/g with time. However, uptake expressed as percent uptake or as a concentration factor increases with time due to an increase in total short tissue produced.

Autoradiographs of soil separates from a previously reported study were developed and photographed. They show that not all soil particles of a contaminated soil are radioactive. The chemical form of the transuranic element when added to the soil influenced the degree of soil sorption. However, for every radioelement (U, Np, Pu, Am, Cm, Bk, Es) and chemical form (NO_3^- , organic acid, ethylenediaminetetraacetic acid (EDTA), diethylenetriamine-pentaacetic acid (DTPA) not all particles $\leq 20 \mu\text{m}$ in size were contaminated. Soils treated with the radioelements as citrates, EDTA and DTPA showed very few contaminated particles. Alpha tracks from soil solutions passed through dialysis membranes appeared to be at random and not associated with particles $0.004 \mu\text{m}$ or smaller.

A study to determine the change in pH of a contaminated soil layer during the two-month growth period of an uptake experiment was initiated. Further experiments to determine the effect of pH on plant uptake are planned.

TECHNICAL ASSISTANCE TO THE HANFORD PLANT

Summary

Environmental Evaluations

No unusual results were observed from air and surface monitoring through the first part of June. Special monitoring was initiated in response to a foreign weapons test alert. Local changes were indicated to be occurring in groundwater contamination patterns near the WPN-2 site.

Radiation Protection

An order was placed for a computer terminal to be used at the Whole Body Counter facility. Responsibility for maintaining the TLD readout equipment was transferred to the U. S. Testing Company.

Radiation Standards and Engineering

A radiological instrumentation performance questionnaire has been distributed to all of our customers. The standard PuBe source was recently calibrated by the National Bureau of Standards.

TECHNICAL ASSISTANCE TO THE HANFORD PLANT

Environmental Evaluations

(J. P. Corley, Environmental Evaluations Section)

Along with special sampling procedures, a new low-level dose rate continuous monitor-recorder was placed in service during the last week in June in response to a foreign weapons test alert. No indication of fresh fallout had been detected through June 29.

Airborne particulate radioactivity continued at lower than expected seasonal contributions through the first half of June - generally less than 0.1 pCi/m^3 gross beta with all gross alpha and radioiodine concentrations less than the analytical detection limits.

Dose rates at river shoreline locations immediately downstream from 100-N area were somewhat lower than in recent months, with a maximum of $20 \text{ } \mu\text{R/hr}$ at 3 feet.

No contamination from plant sources was detected on routine control plot and road surveys.

Initial results on special groundwater samples obtained from wells being pumped at the WPN-2 site indicated a local extension of previously plotted groundwater concentration contours for tritium and nitrate ion. Further verification is in progress. Whether this reflects the influence of groundwater usage on rates of movement or simply better detail as a result of new sampling points has not been determined.

Radiation Protection

(K. R. Heid, Personnel Dosimetry Section)

An order has been placed for a computer terminal to be used at the Whole Body Counter facility. This computer will normally be used for storage of Whole Body Counter information for eventual transmittal to the computer. The terminal will also have capability for direct control of the computer when so desired.

Conversion of Personnel Dosimetry computer programs to the CYBER-70 computer is progressing on schedule.

Responsibility for the maintenance of the TLD readout equipment and for the procurement of additional dosimeter and dosimeter material was transferred to the U. S. Testing Company effective on the first of July.

Radiation Standards and Engineering
(H. V. Larson, Radiation Standards and Engineering Section)

Our standard PuBe neutron source has been returned from the National Bureau of Standards complete with a fresh calibration certificate. Preliminary analysis of the information indicates that the ingrowth rate over the last 11 years was significantly less than the value which we had been using for ingrowth prediction. A considerable amount of work must be completed before a new dose equivalent number can be established.

An irradiation cart has been designed and fabricated for use with the x-ray machine. This device will aid greatly in setting experiments using the x-ray.

A radiological instrumentation performance questionnaire has been distributed to all radiation monitors and specialists on plant. The purpose of the questionnaire is to provide information which will help us locate and evaluate problem areas and undesirable trends in instrument performance.

Meteorological Services
(E. H. Phinney, Synoptic Meteorology Section)

Meteorological services, viz., weather forecasts and observations and climatological services were provided to plant operations and management on a routine basis.

<u>Type</u>	<u>June 1973</u>	<u>No. Made</u>	<u>% Reliability</u>
Production Forecasts:		60	85.9
General Forecasts:		60	85.4
Special Forecasts:		264	88.3
Other Requests:		124	
Publications Distributed:		142	
Number of calls processed by Code-A-Phone:		3686	
TOTAL SERVICE ACTIONS		4336	