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Department of Energy
Albuquerque Operations Office
Los Alamos Area Office
Los Alamos, New Mexico 87544

JUL 24 1996

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Benito J. Garcia, Bureau Chief
Hazardous and Radioactive Waste Bureau
New Mexico Environment Department
2044 Galisteo St., Bldg. A
P. O. Box 26110
Santa Fe, NM 87505

JUL 1996 RECEIVED

Dear Mr. Garcia:

Subject: Treatability Study Notification

The purpose of this letter is to provide notification of intent to conduct nine mixed waste treatability studies at the Los Alamos National Laboratory (LANL). The studies will be conducted by the Advanced Technology Group (NMT-6). The waste samples to be studied are transuranic mixed waste. However, these waste streams are currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

These treatability studies are intended to determine the effectiveness of a high temperature, high pressure aqueous oxidation method known as Hydrothermal Processing (HTP) on mixed wastes. HTP destroys hazardous organic constituents and facilitates the recovery of radionuclides present in the waste. The studies will be conducted at the TA-55 Plutonium Facility.

The waste samples to be treated were generated during solvent extraction experiments and from analytical procedures. Initially, solvent extraction uses tributyl phosphate and carbon tetrachloride to separate plutonium from acid solutions. Later, experiments to improve the process were conducted that resulted in solutions that also contain acetone; chlorobenzene; chloroform; trichloroethylene; 1,1,2-trichloroethane; 1,1,2,2-tetrachloroethane; and xylene. Also to be studied is a 1,1,1,-trichloroethane and mineral spirits solution used in the polishing of mettalography samples. These experiments generated nine different mixed wastes. Because LANL wants to evaluate all nine waste types, a treatability study project description has been prepared for each waste stream. These descriptions begin on Page 2 of the enclosed treatability study write-ups. This technology is being studied for possible use throughout the DOE complex for

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treatment of these waste streams. A total of 41.5 kilograms of waste samples will be treated in the studies.

If you have any questions, please contact me at (505) 665-5042.

Sincerely,

H. L. "Jody" Plum
Office of Environment and Projects

LAAMEP:8JP-002

Enclosure:
Process Description for Treatability Studies using Hydrothermal Processing

ENCLOSURE

PROCESS DESCRIPTION FOR TREATABILITY STUDIES USING HYDROTHERMAL PROCESSING

Los Alamos
NATIONAL LABORATORY

Hazardous & Solid Waste Group
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Facility Name:	**Los Alamos National Laboratory (LANL)** **Nuclear Materials Technology Division** **Advanced Technology Group (NMT-6)**
Facility EPA ID Number:	**NM0890010515**
Project Title:	**Hydrothermal Processing**
Location of Project:	**TA-55, Building PF-4, Room 208**
Project Contact:	**Laura Worl, Ph.D.** **NMT-6, Mail Stop E510** **(505) 665-7149**
Other Contacts:	**Steve Buelow, Ph.D.** **CST-6, Mail Stop J567** **(505) 667-1178** **Kirk Veirs, Ph.D.** **NMT-6, Mail Stop E510** **(505) 667-9291**

Project Description:

This project consists of <u>nine</u> separate treatability studies involving nine different mixed wastes that were generated at Los Alamos National Laboratory's Plutonium Facility, located at TA-55. This project is intended to determine the effectiveness of a high temperature, high pressure aqueous oxidation method know as Hydrothermal Processing (HTP) on mixed wastes, i.e., wastes that contain both hazardous constituents and radioactive constituents. HTP destroys the hazardous organic constituents in the mixed waste and facilitates the recovery of radionuclides.

Project Goals and Objectives:

Evaluate HTP on solvents used for analytical procedures, on solvents used in solvent extraction processes, and on solvents used for bench scale fundamental research. This project seeks to demonstrate the feasibility of HTP for a safe, economical, and effective treatment of mixed waste.

Project Tasks:

Obtain sample from identified source.
Conduct hydrothermal processing on the sample.
Determine the destruction efficiency of hazardous organic components and identify treatment products.

Project Milestones:

1.	Begin treating wastes	Aug. 10, 1996
2.	Complete testing of solvent extraction solutions	Oct. 1, 1996
3.	Complete testing of Scintillation Cocktails	Dec. 1, 1996
4.	Complete testing of Analytical waste	March. 1, 1997

Qualifications:

Experience: Out team has over eighteen years cumulative experience with either hydrothermal processing or with plutonium handling. Each team member has a different background with many years of experience in his/her relevant field of research. We have experience in waste minimization and waste treatment technologies for both hazardous and mixed wastes. In addition, members of our team received the LANL Waste Minimization Award for 1995 titled "Magnetic Separation for Treatment of TA-55 Caustic Waste."

Key Staff: Laura Worl: Ph.D. in Inorganic Chemistry, University of North Carolina, 1989. Current position LANL technical staff member in NMT-6. 4 years experience in research and development of technologies for treatment of radioactive materials and wastes.

Steve Buelow: Ph.D. in Chemical Physics, Harvard University, 1983. Project leader for Hydrothermal Process of Wastes at LANL since 1991.

Kirk Veirs: Ph.D. in Physical Chemistry, Pennsylvania State University, 1981. Current position Team Leader of the Research Team of the Advanced Technology Group of the Nuclear Materials Technology Group. Over ten years experience working with radioactive materials including actinides.

Equipment and Facilities:

This project will be conducted within LANL's radiologically controlled Plutonium Facility. The demonstration equipment will be installed within a glove box in Room 208.

Project Discussion Treatability Study 1

Description of Waste to Be Treated: The waste to be treated was generated during solvent extraction experiments and from analytical procedures. These solvent extraction experiments used tributyl phosphate to separate plutonium (Pu) from acid solutions.

Sample Waste Amounts to be Treated: 2.0 kg

RCRA Waste Code(s): Mixed D002

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor.

The mixture is further cooled in a heat exchanger and then depressurized. In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide. Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-550°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts. Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revision of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the treatment process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management: Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste treatment residues and effluents will be analyzed for proper characterization. If the residues/effluents do <u>not</u> exhibit the characteristics of a hazardous waste then they will be managed as radioactive waste.

Project Discussion Treatability Study 2:

Description of Waste to Be Treated: The waste to be treated was generated during solvent extraction experiments where xylene in an acidic solution was used to separate americium from plutonium (Pu).

Sample Waste Amounts to be Treated: 0.5 kg

RCRA Waste Code(s): Mixed F003

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor. The mixture is further cooled in a heat exchanger and then depressurized.

In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide. Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-500°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts. Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revision of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management:

Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste treatment residues and effluents will be analyzed for proper characterization. Waste residue, regardless of whether any VOC's are detected, will be managed as a mixed waste based on the Derived-From Rule and placed in TA-55's mixed waste interim status storage unit (actinide concentrations in this residue are expected to be low).

The effluent from the treated waste sample is not expected to exhibit the characteristic of ignitability. However, if the effluent from the treatment unit exhibits a characteristic of ignitability, it will be rerun through the treatment unit or managed as a mixed waste. Effluent that does not exhibit the characteristic of ignitability will retain the listing (F003) due to the Derived-From-Rule. However, LANL proposes to discharge this effluent into the TA-55 acid waste line that flows to the TA-50 Radioactive Waste Treatment Plant. As the treatment process, by necessity, combines the effluent with a solid waste (liquid in the acid waste line) the resulting mixture would loose its Derived-From listing pursuant to the mixture rule exemption described in 20 NMAC 4.1, 40 CFR 261.3(a)(ii)(3). This exemption allows that a mixture of a solid waste and a waste listed in Subpart D for characteristics (described in Subpart C) that no longer exhibits such characteristics is not a hazardous waste. Because this effluent is not expected to retain any characteristics for which it may have been listed, it would no longer be a hazardous waste. The effluents from the treatment process will be profiled and submitted with analysis to the Chemistry and Mixed Waste Science Group (CST-5) for approval prior to discharge.

Project Discussion Treatability Study 3

Description of Waste to Be Treated: The waste to be treated was generated by using a product called Hyprez OS Lubricant for polishing metallography samples. The Hyprez OS Lubricant contains mineral spirits and 1,1,1-Trichloroethane.

Sample Waste Amounts to be Treated: 15 kg.

RCRA Waste Code(s): Mixed F002, D001

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor. The mixture is further cooled in a heat exchanger and then depressurized. In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide. Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-550°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts. Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revision of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management: Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste residues and effluents will be analyzed for proper characterization. Waste residues, regardless of whether any VOC's are detected, will be managed as a mixed waste and placed in TA-55's mixed waste interim status storage unit.

The effluent from the treatment process will be profiled and submitted with analyses to the Chemistry and Mixed Waste Science Group prior to discharge to LANL's Radioactive Wastewater Treatment Plant. The F002 Derived-From effluent would loose its listing and would no longer be a hazardous waste if the effluent met the New Mexico Hazardous Waste Management Regulations 20 NMAC 4.1, 40 CFR 261.3(a)(2)(iv)(A&B) wastewater exemption.

Project Discussion Treatability Study 4:

Description of Waste to Be Treated: The waste to be treated was generated during solvent extraction experiments and from analytical procedures. These solvent extraction experiments used tributyl phosphate and carbon tetrachloride to separate plutonium (PU) from acid solutions.

Sample Waste Amounts to be Treated: 12.0 kg

RCRA Waste Code(s): Mixed D019, D002

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor. The mixture is further cooled in a heat exchanger and then depressurized. In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide. Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-550°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts. Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revision of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management: Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste treatment residues and effluents will be analyzed for proper characterization. If the residues/effluents do not exhibit the characteristics of a hazardous waste then they will be managed as only a radioactive waste.

Project Discussion Treatability Study 5:

Description of Waste to Be Treated: The waste to be treated was generated during solvent extraction experiments and from analytical procedures. These solvent extraction experiments used acetone to separate plutonium (PU) from an acid solution.

Sample Waste Amounts to be Treated: 2.0 kg

RCRA Waste Code(s): Mixed F003, D002

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor. The mixture is further cooled in a heat exchanger and then depressurized. In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide. Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-550°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts. Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revisions of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management:

Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste treatment residues and effluents will be analyzed for proper characterization. Waste residue, regardless of whether any VOC's are detected, will be managed as a mixed waste based on the Derived-From-Rule and placed in TA-55's mixed waste interim status storage unit (actinide concentrations in this residue are expected to be low).

The effluent from the treated waste sample is not expected to exhibit the characteristic of ignitability. However, if the effluent from the treatment unit exhibits a characteristic of ignitability, it will be rerun through the treatment unit or managed as a mixed waste. Effluent that does not exhibit the characteristic of ignitability will retain the listing (F003) due to the Derived-From-Rule. However, LANL proposes to discharge this effluent into the TA-55 acid waste line that flows to the TA-50 Radioactive Waste Treatment Plant. As the treatment process, by necessity, combines the effluent with a solid waste (liquid in the acid waste line) the resulting mixture would loose its Derived-From listing pursuant to the mixture rule exemption described in 20 NMAC 4.1, 40 CFR 261.3(a)(ii)(3). This exemption allows that a mixture of a solid waste and a waste listed in Subpart D for characteristics (described in Subpart C) that no longer exhibits such characteristics is not a hazardous waste. Because this effluent is not expected to retain any characteristics for which it may have been listed, it would no longer be a hazardous waste. The effluents from the treatment process will be profiled and submitted with analysis to the Chemistry and Mixed Waste Science Group (CST-5) for approval prior to discharge.

Project Discussion Treatability Study 6:

Description of Waste to Be Treated: The waste to be treated was generated during solvent extraction experiments and from analytical procedures. These solvent extraction experiments used tributyl phosphate, carbon tetrachloride, and acetone to separate plutonium (Pu) from acid solutions.

Sample Waste Amounts to be Treated: 4.0 kg

RCRA Waste Code(s): Mixed F003, D019, D002

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor. The mixture is further cooled in a heat exchanger and then depressurized. In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide. Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-550°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts.

Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revision of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management:

Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste treatment residues and effluents will be analyzed for proper characterization. Waste residue, regardless of whether any VOC's are detected, will be managed as a mixed waste based on the Derived-From-Rule and placed in TA-55's mixed waste interim status storage unit (actinide concentrations in this residue are expected to be low).

The effluent from the treated waste sample is not expected to exhibit the characteristic of ignitability. However, if the effluent from the treatment unit exhibits a characteristic of ignitability, it will be rerun through the treatment unit or managed as a mixed waste. Effluent that does not exhibit the characteristic of ignitability will retain the listing (F003) due to the Derived-From-Rule. However, LANL proposes to discharge this effluent into the TA-55 acid waste line that flows to the TA-50 Radioactive Waste Treatment Plant. As the treatment process, by necessity, combines the effluent with a solid waste (liquid in the acid waste line) the resulting mixture would loose its Derived-From listing pursuant to the mixture rule exemption described in 20 NMAC 4.1, 40 CFR 261.3(a)(ii)(3). This exemption allows that a mixture of a solid waste and a waste listed in Subpart D for characteristics (described in Subpart C) that no longer exhibits such characteristics is not a hazardous waste. Because this effluent is not expected to retain any characteristics for which it may have been listed, it would no longer be a hazardous waste. The effluents from the treatment process will be profiled and submitted with analysis to the Chemistry and Mixed Waste Science Group (CST-5) for approval prior to discharge.

Project Discussion Treatability Study 7:

Description of Waste to Be Treated: The waste to be treated was generated during solvent extraction experiments and from analytical procedures. These solvent extraction experiments used carbon tetrachloride and acetone to separate plutonium (Pu) from acid solutions.

Sample Waste Amounts to be Treated: 2.0 kg

RCRA Waste Code(s): Mixed F003, D019, D002

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor. The mixture is further cooled in a heat exchanger and then depressurized. In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide. Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-550°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts. Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revision of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management:

Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste treatment residues and effluents will be analyzed for proper characterization. Waste residue, regardless of whether any VOC's are detected, will be managed as a mixed waste based on the Derived-From-Rule and placed in TA-55's mixed waste interim status storage unit (actinide concentrations in this residue is expected to be low).

The effluent from the treated waste sample is not expected to exhibit the characteristic of ignitability. However, if the effluent from the treatment unit exhibits a characteristic of ignitability, it will be rerun through the treatment unit or managed as a mixed waste. Effluent that does not exhibit the characteristic of ignitability will retain the listing (F003) due to the Derived-From-Rule. However, LANL proposes to discharge this effluent into the TA-55 acid waste line that flows to the TA-50 Radioactive Waste Treatment Plant. As the treatment process, by necessity, combines the effluent with a solid waste (liquid in the acid waste line) the resulting mixture would loose its Derived-From listing pursuant to the mixture rule exemption described in 20 NMAC 4.1, 40 CFR 261.3(a)(ii)(3). This exemption allows that a mixture of a solid waste and a waste listed in Subpart D for characteristics (described in Subpart C) that no longer exhibits such characteristics is not a hazardous waste.

Because this effluent is not expected to retain any characteristics for which it may have been listed, it would no longer be a hazardous waste. The effluents from the treatment process will be profiled and submitted with analysis to the Chemistry and Mixed Waste Science Group (CST-5) for approval prior to discharge.

Project Discussion Treatability Study 8:

Description of Waste to Be Treated: The waste to be treated was generated during solvent extraction experiments and from analytical procedures. These solvent extraction experiments used carbon tetrachloride, chlorobenzene, and acetone to separate plutonium (Pu) from an acid solution.

Sample Waste Amounts to be Treated: 2.0 kg

RCRA Waste Code(s): Mixed F002, F003, D019, D002

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor. The mixture is further cooled in a heat exchanger and then depressurized. In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide. Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-550°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts. Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revision of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management:

Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste treatment residues and effluents will be analyzed for proper characterization. Waste residue, regardless of whether any VOC's are detected, will be managed as a mixed waste based on the Derived-From-Rule and placed in TA-55's mixed waste interim status storage unit (actinide concentrations in this residue are expected to be low).

The effluent from the treatability study would retain the listings of (F002 and F003) due to the Derived-From-Rule. Regarding the F002 listing; effluent from the treatment process will be sent, pending approval, to LANL's Radioactive Waste Treatment Plant. The F002 Derived-From effluent would loose its listing and would no longer be a hazardous waste if the effluent met the New Mexico Hazardous Waste Management Regulations 20 NMAC 4.1, 40 CFR 261.3(a)(2)(iv)(A&B) wastewater exemption.

Regarding the F003 listing; effluent from the treated waste sample is not expected to exhibit the characteristic of ignitability. However, if the effluent from the treatment unit exhibits a characteristic of ignitability, it will be rerun through the treatment unit or managed as a mixed waste. Effluent that does not exhibit the characteristic of ignitability will retain the listing (F003) due to the Derived-From-Rule. However, LANL proposes to discharge this effluent into the TA-55 acid waste line that flows to the TA-50 Radioactive Waste Treatment Plant. As the treatment process, by necessity, combines the effluent with a solid waste (liquid in the acid waste line) the resulting mixture would loose its Derived-From listing pursuant to the mixture rule exemption described in 20 NMAC 4.1, 40 CFR 261.3(a)(ii)(3). This exemption allows that a mixture of a solid waste and a waste listed in Subpart D for characteristics (described in Subpart C) that no longer exhibits such characteristics is not a hazardous waste. Because this effluent is not expected to retain any characteristics for which it may have been listed, it would no longer be a hazardous waste.

Effluent from the treatment process will be profiled and submitted with analysis to the Chemistry and Mixed Waste Science Group (CST-5) for approval prior to discharge.

Project Discussion Treatability Study 9:

Description of Waste to Be Treated: The waste to be treated was generated during solvent extraction experiments and from analytical procedures. These solvent extraction experiments used carbon tetrachloride, chloroform, acetone, trichloroethylene, 1,1,2-tricholorethane, and 1,1,2,2-tetrachloroethane to separate plutonium (Pu) from acid solutions.

Sample Waste Amounts to be Treated: 2.0 kg

RCRA Waste Code(s): Mixed F002, F003, D022, D019, D002

Site Treatment Plan Information: This waste stream is currently not included in the Compliance Plan Volume of LANL's Federal Facility Compliance Order Site Treatment Plan.

Description of The Waste Treatment Technology: HTP is an environmentally benign oxidation process for the destruction of the organic component of hazardous and mixed waste. The waste is pressurized and mixed with pressurized hydrogen peroxide (30 wt.%). Solids can also be treated. For pumping solids, the solids are first reduced in size by cryogenic grinding, then mixed with water. The reaction mixture is fed into a high temperature, high pressure reactor and allowed to react for 20 to 60 seconds. At the end of the reactor, cold water is added to help cool the mixture and to facilitate transport of any insoluble solid material that may have been formed in the reactor. The mixture is further cooled in a heat exchanger and then depressurized. In the reactor, the organic components of the wastes are oxidized to carbon dioxide by reaction with the water and hydrogen peroxide.

Nitrate contaminants also react with the organic material and are converted to nitrogen gas and some nitrous oxide. Heteroatoms such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts depending on the pH of the solution. At temperatures above 500°C, reactions are rapid, and greater than 99% conversion can be achieved in seconds. The reactions are carried out entirely in an enclosed pressure vessel and in dilute concentration so that the heat of reaction is absorbed by the water and the temperature can be maintained at any desired level, typically in the range 400-550°C. The reactor is fitted with a titanium liner to protect the pressure vessel from corrosion. The speciation of the actinides in the hydrothermal reactor is not yet certain; they most likely will be converted to either small insoluble oxide particles that can be separated by filtration or to water soluble carbonate salts. Since the reactions are rapid, the volume of the reactor is small (200 ml). Consequently, the amount of radioactive material and their stored energy are small. These reactions and the treatment of a wide variety of organic wastes have been studied using non-radioactive simulants.

LANL is in the process of evaluating several different treatment technologies, including this technology, for possible submittal to NMED as a new regulated treatment unit. This would involve revision of the TA-55 Part B permit application. If this treatment technology is permitted, the treatment unit will be connected to the TA-55 acid waste line as part of the process. The acid waste line would discharge the treatment unit's effluent to the TA-50 Radioactive Waste Treatment Plant. Actinide residues from the permitted unit that are of sufficient concentration would be managed as a commodity and sent to the TA-55 actinide recovery line for retrieval. If the actinide residues from the treatment unit are not of sufficient concentration, then the residues would be managed as mixed waste.

Surrogate Waste Treatment Results: A large number of surrogate waste studies have been carried out. All components of the hydrothermal process are included in the surrogate studies except the radionuclide. The results of studies on non-radioactive simulants are given in Table I.

Waste Management:

Any untreated waste sample will be returned to TA-55's mixed waste interim status storage unit. All waste treatment residues and effluents will be analyzed for proper characterization. Waste residue, regardless of whether any VOC's are detected, will be managed as a mixed waste based on the Derived-From-Rule and placed in TA-55's mixed waste interim status storage unit (actinide concentrations in this residue are expected to be low).

The effluent from the treatability study would retain the listings (F002 and F003) due to the Derived-From-Rule. Regarding the F002 listing; effluent from the treatment process will be sent, pending approval, to LANL's Radioactive Waste Treatment Plant. The F002 Derived-From effluent would loose its listing and would no longer be a hazardous waste if the effluent met the New Mexico Hazardous Waste Management Regulations 20 NMAC 4.1, 40 CFR 261.3(a)(2)(iv)(A&B) wastewater exemption.

Regarding the F003 listing; effluent from the treated waste sample is not expected to exhibit the characteristic of ignitability. However, if the effluent from the treatment unit exhibits a characteristic of ignitability, it will be rerun through the treatment unit or managed as a mixed waste. Effluent that does not exhibit the characteristic of ignitability will retain the listing (F003) due to the Derived-From-Rule. However, LANL proposes to discharge this effluent into the TA-55 acid waste line that flows to the TA-50 Radioactive Waste Treatment Plant. As the treatment process, by necessity, combines the effluent with a solid waste (liquid in the acid waste line) the resulting mixture would loose its Derived-From listing pursuant to the mixture rule exemption described in 20 NMAC 4.1, 40 CFR 261.3(a)(ii)(3). This exemption allows that a mixture of a solid waste and a waste listed in Subpart D for characteristics (described in Subpart C) that no longer exhibits such characteristics is not a hazardous waste. Because this effluent is not expected to retain any characteristics for which it may have been listed, it would no longer be a hazardous waste.

The effluents from the treatment process will be profiled and submitted with analysis to the Chemistry and Mixed Waste Science Group (CST-5) for approval prior to discharge.

Table I: Summary of Surrogate Waste Treatment Studies

Waste Type	Composition	Reaction Conditions	Results*
Hydraulic jack oil	98% hydrocarbons, zinc, sulfur-related compounds, no silicone	550°C, 44 MPa, 60 seconds, 34 wt.% H_2O_2	25,000 ppm TOC reduced to less than 5 ppm, effluent contained 300 ppm sulfate, pH~2.3
Vacuum pump oil	Olefin: $(CH_2)_n$ where 20<n<40	550°C, 44 MPa, 60 seconds, 34 wt.% H_2O_2	40,000 ppm TOC reduced to less than 5 ppm
Heavy mineral oil	Paraffin C_nH_{2n+2} where n~34	550°C, 44 MPa, 60 seconds, 34 wt.% H_2O_2	40,000 ppm TOC reduced to less than 5 ppm
Tributyl phosphate	$(C_4H_9O)_3PO$	550°C, 44 MPa, 60 seconds, 34 wt.% H_2O_2	550°C, 44 MPa, 60 seconds, 34 wt.% H_2O_2, Effluent pH ~ 2
Diesel oil #2	Hydrocarbons: C_{15} to C_{25}	550°C, 44 MPa, 60 seconds, 34 wt.% H_2O_2	25,000 ppm TOC reduced to less than 5 ppm
Toluene	C_7H_8	550°C, 44 MPa, 60 seconds, 34 wt.% H_2O_2	30,000 ppm TOC reduced to less than 5 ppm
Carbon tetrachloride	CCl_4	450°C, 60 MPa, 80 seconds, titanium• lined reactor	CCl_4, 11,500 ppm reduced below 0.5 ppm (>99.995% destruction)
Trichloroacetic acid	CCl_3COOH	500°C, 60 MPa, 30 seconds, titanium• lined reactor	CCl_3COOH, 1000 ppm reduced below 1 ppm
Trichloroethylene	C_2Cl_3H	500°C, 60 MPa, 30 seconds, titanium• lined reactor	C_2Cl_3H, 1000 ppm reduced to below 1 ppm
1,1,1 Trichloroethane	CCl_3CH_3,	500°C, 60 MPa, 30 seconds, titanium• lined reactor	CCl_3CH_3, 1000 ppm reduced to below 1 ppm
Cation exchange resin	$(C_8H_8SO_3)_n$, 50 - 100 mesh, 50 wt.% water	550°C, 44 MPa, 60 seconds, 34 wt.% H_2O_2	Effluent TOC < 1 ppm

* For all waste types, the TOC levels were below detection limit.