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Decomtamination Study for Mixed Waste Storage Tanks RCRA Closure (U)

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DECONTAMINATION STUDY FOR MIXED WASTE STORAGE TANKS RCRA CLOSURE

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ABSTRACT

The Savannah River Site (SRS) plans to close six underground tanks storing mixed waste under RCRA regulations. In support of this closure effort, a study was performed to determine the optimal method of decontaminating these tanks to meet the closure requirements.. Items considered in the evaluation of the decontamination methods included effectiveness, compatibility with existing waste residues, possible cleaning solution disposal methods, and cost.

To support the evaluation of decontamination methods, tests were performed to evaluate the ability of various solutions (detergents, chemicals, and water) to remove both the hazardous and radioactive contamination. These tests involved metal specimens meant to simulate the walls of the tanks and non-radioactive and radioactive solvent meant to simulate the waste in the tanks. The non-radioactive tests indicated that all of the solutions evaluated should be effective in removing the hazardous contamination. The radioactive tests indicated that all of the solutions should be effective in removing the radioactive contamination if used in conjunction with a mechanical application technique, such as a tank washer.

INTRODUCTION

The United States Department of Energy, in the production of nuclear materials at the Savannah River Site, created various waste byproducts which required storage and handling. Spent solvent from separations operations is one of these byproducts. This solvent is primarily a mixture of tributyl phosphate and n-paraffin. Although not a listed waste as defined by the Resource Conservation and Recovery Act (RCRA), the solvent does contain levels of benzene, trichloroethylene, lead, mercury, and silver in concentrations above regulatory limits. Due to the radioactive contaminants present in the solvent, the waste is classified as a mixed waste.

This solvent is currently stored in eight underground storage tanks (S23-S30) located in the northern corner of the Burial Ground Complex. These cylindrical carbon steel

tanks have a 25,000 gallon capacity, with dimensions of approximately 10 1/2 feet in diameter and 39 feet long. These tanks were installed prior to current legislation requiring secondary containment and leak detection features, and tanks S23 through S28 are in excess of fifteen years old. RCRA regulations require that the integrity of all tanks be demonstrated and that all tanks over fifteen years old must meet the secondary containment requirements, or the tanks must be closed. Due to problems associated with testing the integrity of mixed waste tanks, tanks S29 and S30 will be used for interim storage of the waste from tanks S23 through S28 until new tanks meeting secondary containment requirements can be provided.

A closure plan for tanks S23 through S30 was submitted to South Carolina Department of Health and Environmental Control (SCDHEC) in August of 1992. This plan detailed the criteria to perform a clean closure in place. In essence, the waste was to be removed from the tanks and the tanks rinsed with a cleaning agent until the hazardous constituents in the rinsate were below Toxicity Characteristic Leaching Procedure (TCLP) limits and the level of radioactivity within guidelines established by the SRS Health Protection Department.

A study was performed to determine what cleaning agent would be most effective in meeting the standards set forth by the closure plan. Items considered in the evaluation of the decontamination agents included effectiveness of the cleaning solution, waste minimization, compatibility with existing waste residues and possible cleaning solution disposal methods, and cost. To support the evaluation of the decontamination agents, non-radioactive scoping tests were conducted to investigate the ability of two degreasing cleansers, Iradecon 210® and Nova Clean® to remove solvent from metal specimens meant to simulate the tanks walls. Water adjusted with 10 percent sodium hydroxide (NaOH) solution to a pH of approximately 9 was also evaluated in the non-radioactive scoping tests and the radioactive scoping tests. This paper describes the methodology used in the evaluation and the rationale for the final decontamination and closure strategy.

CLEANING MATERIALS EVALUATED

Iradecon 210® is a biodegradable cleanser formulated from natural organic solvents. It is manufactured by Decon Laboratories, Inc., Bryn Mawr, PA, 800-332-6647. This product has performed well in other lab-scale coupon tests and is relatively inexpensive at a cost of approximately $25.00 per gallon. Based on manufacturer's literature and the chemical analysis of the wastes in tanks S23 through S30, this cleaning solution would not react adversely with the wastes or the waste residues. However, questions arose regarding the flash point temperature of this cleanser.

The flash point temperature was listed as 145 degrees F in the manufacturer's literature and 140 degrees F on the Material Safety Data Sheet (MSDS). Further investigation revealed that the manufacturer had used the open cup method for determining the flash point, whereas RCRA specifies that the ignitability must be determined using a Pensky-Martins closed cup tester. The manufacturer retested the product for ignitability using Pensky-Martins closed cup method, and results showed a flash point of 128 degrees F. A flash point of less than 140 degrees F classifies the material as hazardous due to the ignitability factor.

In cleaning applications Iradecon 210® is placed in a container in which contaminated items are immersed. During use the flash point of the material increases because volatiles disperse into the atmosphere. By the time the bath becomes ineffective for degreasing, the flash point has increased above 140 degrees F and is no longer considered hazardous due to ignitability. Placing Iradecon 210® in solution with water would cause the same effect.

Nova Clean® is a biodegradable, non-hazardous detergent designed for use in cleanrooms. It is manufactured by Micronova, Inc., Torrance, CA, (310)378-6854. Based on the manufacturer's literature and the chemical analysis of the wastes in tanks S23 through S30, this cleaner would not react adversely with the waste or the waste residues. This product is slightly more expensive than Iradecon 210® at approximately $39.00 per gallon. However, it may be safer and more environmentally acceptable to use based on the data provided in the MSDS.

Caustic water, a water solution adjusted to a pH of approximately 9 using a 10 percent solution of sodium hydroxide (NaOH), was suggested for use by a prospective closure subcontractor. Caustic solutions are commonly used in various concentrations at many facilities at the Savannah River Site without incident. Based on the chemical analysis of the wastes in tanks S23 through S30, this solution would not react adversely with the waste or the waste residues. This solution would be the least costly since sodium hydroxide itself costs approximately $ 21.77 per gallon, and only a minimal amount of sodium hydroxide would be required to adjust the pH of water to approximately 9.

As detergents, Iradecon 210® and Nova Clean® posed the greatest difficulties for disposal. Several of the treatment facilities on site, including the Effluent Treatment Facility, the 211-F Evaporator, and Rinsate Recycle Trailer, could not accept these agents. The detergents could cause excessive "bubbling" in the Evaporator and could adversely affect the ion exchange columns in the Effluent Treatment Facility and the Rinsate Recycle Trailer. The caustic water could potentially be treated at any of these facilities.

EXPERIMENTAL TECHNIQUES AND RESULTS

Scoping tests were conducted to evaluate effectiveness of the cleaning materials described in the previous section in removing non-radioactive solvent from metal coupons. Cleaning tests were conducted to evaluate the ability of Iradecon 210® to remove solvent from metal coupons. The coupons used in these tests were 1 inch by 3 inch pieces approximately 1/16 inch thick corroded and noncorroded carbon steel. Solvent was applied to the faces of the coupons. The coupons were then immersed in a beaker containing a 50 volume percent solution of Iradecon 210® at room temperature for 24 hours with constant stirring. Three 24 hour water rinses at room temperature with constant stirring followed. Results of the tests indicated that Iradecon 210® was effective in removing the solvent. Total Petroleum Hydrocarbon (TPH) analysis of the final rinse water indicated no hydrocarbons were present.

Further cleaning tests were conducted to evaluate the ability of Iradecon 210® and Nova Clean® to remove non-radioactive solvent from metal specimens and to obtain a rough indication of the cleaning rate. Metal specimens identical to those used in the first cleaning test were dipped into the solvent and placed in separate beakers. A 50 volume percent solution of each cleaning agent was added to a set of beakers. Cleaning was allowed to proceed up to 24 hours. Samples of the solvents were taken periodically for TPH analysis. The cleaning solutions were replaced with water. Rinsing was allowed to proceed for up to 24 hours. Samples of the rinse water were taken periodically for TPH analysis. Results of these tests indicated that both Iradecon 210® and Nova Clean® were effective in cleaning the specimens. There seemed to be no advantage in cleaning or rinsing times in excess of one hour. There was some scatter in the test data. Investigation revealed that both Iradecon 210® and Nova Clean® contain hydrocarbons (Iradecon 210® - 16.6 percent and Nova Clean® - 10.4 percent).

Non-radioactive tests were conducted to demonstrate the effectiveness of caustic water in tank cleaning applications. The coupons used in these tests were identical to those used in previous tests. Solvent was applied to the faces of the coupons. The coupons were then immersed in the caustic water solution at room temperature for 24 hours with constant stirring. Three 24 hour water rinses at room temperature with constant stirring followed.. Results of the tests indicated that the caustic water solution was effective in cleaning the specimens. Again there is little advantage in cleaning or rinsing times in excess of one hour. Also, more than 98% of the cleaning occurs during the first rinse cycle. See Table 1 and Graphs 1, 2, and 3 for a tabular and graphical analysis of results of the caustic water tests.

Radioactive scoping tests were conducted using the caustic water solution to further evaluate the effectiveness of this solution in decontaminating the tanks. In these tests

six (6) planchetts were contaminated with equal amounts of a radioactive solvent similar to the solvent in tanks S23 through S28. The planchetts were placed at the face of a hood for five (5) days, during which time much of the volatile material in the solvent was removed by airflow. Three (3) of the planchetts were washed for 5 seconds with the caustic water solution using a squirt bottle and allowed to dry. All six planchetts were then submitted for scintillation counting to determine the amount of radioactivity on each planchet. Results of the radioactive cleaning tests indicated that little radioactive decontamination was accomplished by the caustic water solution. The level of alpha activity was reduced by six (6) percent. The level of beta activity was reduced by thirteen (13) percent.

FINAL DECONTAMINATION AND CLOSURE STRATEGY

Based on the results of the non-radioactive scoping tests, either Iradecon 210®, Nova Clean®, or the caustic water solution applied to the interior of the tanks with a mechanical washer should be effective in removing hazardous contamination from the tank. The caustic water solution would allow the most flexibility for waste disposal, even though the results from the radioactive tests were not very promising.

During the execution of this study, the closure strategy changed as a result of comments from SCDHEC. For a clean closure SCDHEC required that the tanks be cleaned to drinking water standards and that extensive soil sampling be performed in the area of the tanks, despite the fact that site records showed that no release has occurred in the operating life of the tanks. If drinking water standards were not met, SCDHEC required that the tanks be closed in accordance with the South Carolina Hazardous Waste Management Regulations (SCHWMR) R61-79.265 Subparts G (Closure and Post-Closure Plan) and N (Landfill).

Based upon the amount of time, effort, and cost associated with trying to decontaminate the tanks to drinking water standards, the clean closure plan was abandoned. Instead, the tanks will be decontaminated by triple rinsing with the caustic water solution and a final rinse with clean water. The tanks will then be filled with a consolidated low strength material. The tank area will then be regraded and prepared with a low permeability cover system.

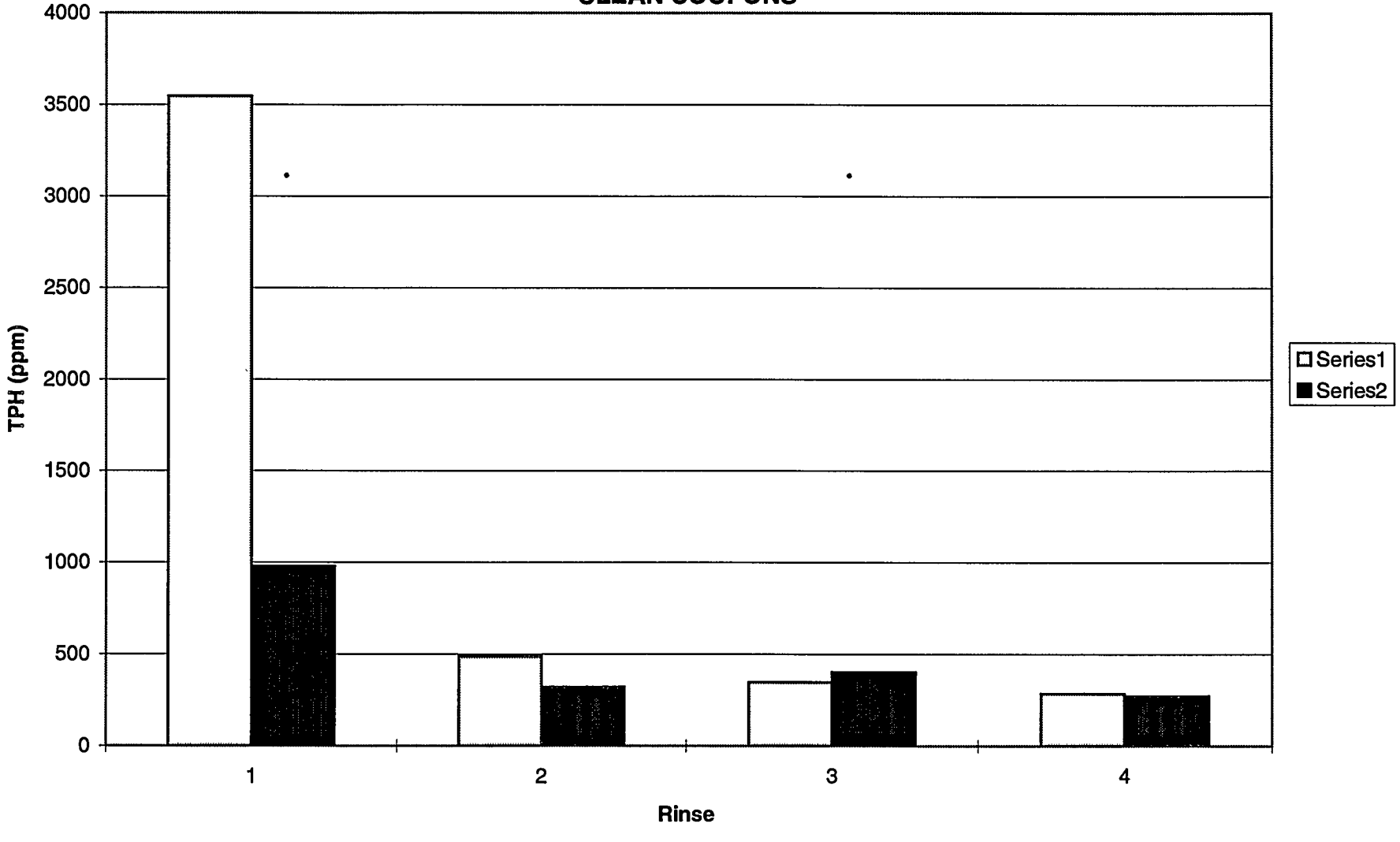
This final closure strategy does not require the more rigorous decontamination of the tanks that would have been required with the clean closure strategy. The levels of contamination in the tanks will be monitored prior to filling and covering for records required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), but there is no longer a level of decontamination that must be achieved for the closure.

TABLE 1

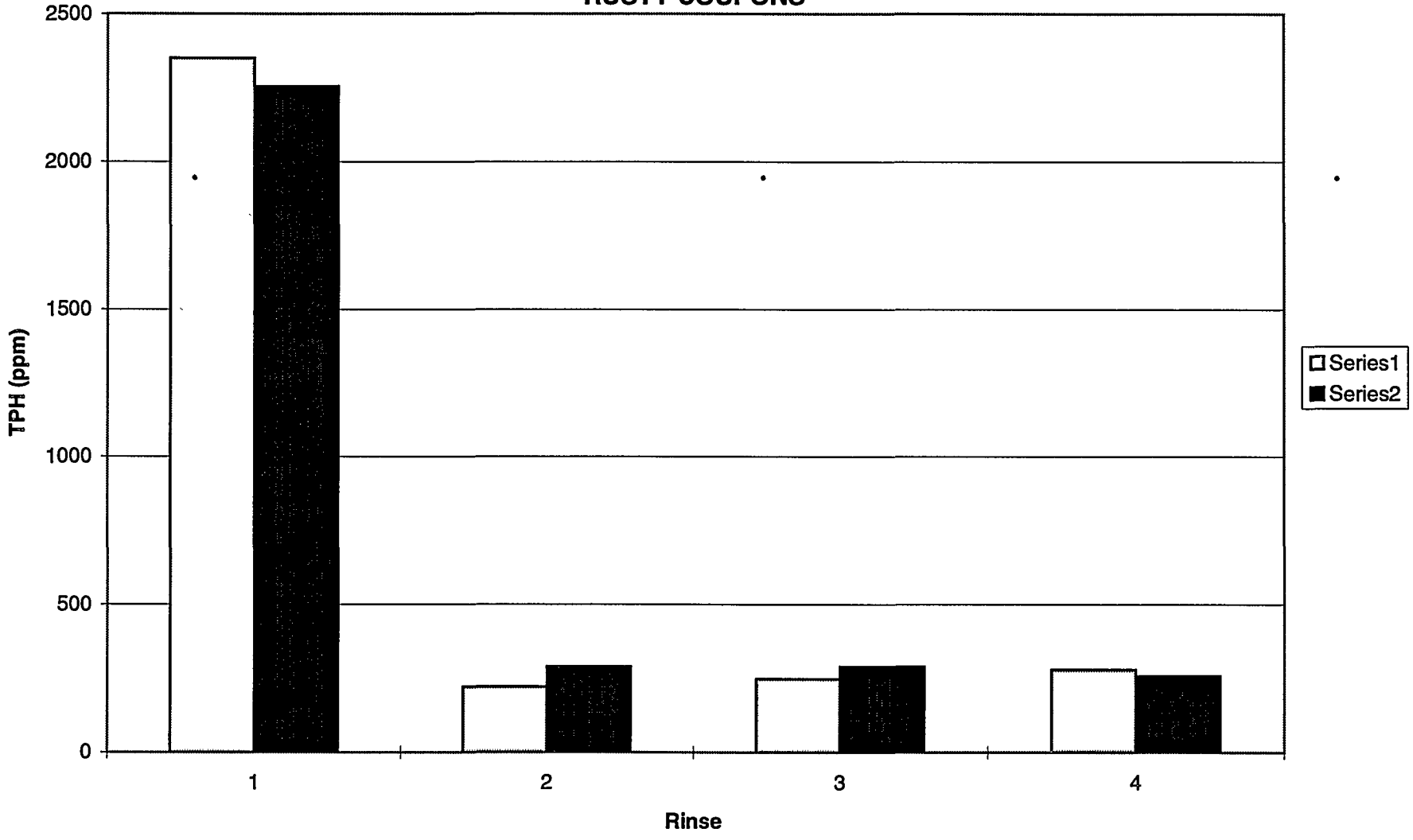
CAUSTIC WATER NON-RADIOACTIVE SCOPING TEST RESULTS

	TOTAL PETROLEUM HYDROCARBON ANALYSIS (ppm)					
	CLEAN COUPONS		RUSTY COUPONS		AVERAGE VALUES	
RINSE	Series 1	Series 2	Series 1	Series 2	CLEAN	RUSTY
1	3546	980	2350	2255	2263	2302.5
2	487	321	221	289	404	255
3	347	402	248	289	375	268.5
4	284	272	279	258	278	268.5

GRAPH 1
CAUSTIC WATER NON-RADIOACTIVE TEST RESULTS
CLEAN COUPONS



GRAPH 2
CAUSTIC WATER NON-RADIOACTIVE TEST RESULTS
RUSTY COUPONS



GRAPH 3
CAUSTIC WATER NON-RADIOACTIVE TEST RESULTS
AVERAGE VALUES