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HANFORD ATOMIC PRODUCTS OPERATION

• PRODUCTION TEST 221-T-18

SCAVENGING OF FIRST-CYCLE WASTE

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PRODUCTION TEST 221-T-18
SCAVENGING OF FIRST-CYCLE WASTE

I. OBJECTIVE

To establish that scavenging of first-cycle wastes in the Bismuth Phosphate Plant will give a supernatant liquor, after the precipitate settles, that may be routinely cribbed. This test will also perform the functions: a) establish an effective scavenging procedure, b) shakedown the pH monitor, and c) train operational personnel.

II. BASIS

In order to make the most economical use of the underground waste storage space, several methods have been used, in the past, to reduce the volume of waste to be stored. The latest method used has been the disposal of large volumes of first-cycle waste supernatant to open ditches. This waste has contained low concentrations but relatively large quantities of long-lived fission products (Cs-137 and Sr-90). Over the past several months, the Applied Research Sub-Section, Chemistry Unit has developed, in the laboratory, a method by which Cs-137 and Sr-90 may be removed from the first-cycle waste solutions on a precipitate of nickel ferrocyanide.

Since it is essential to minimize the quantities of long-lived fission products being discharged to ground and at the same time make the most economical use of the underground waste storage space, it is desirable to conduct this test to determine if the plant will reproduce the decontamination performance obtained in the laboratory, permitting the cribbing of the supernatant. Although the cost of scavenging vs. the use of the waste evaporator are comparable, scavenging will greatly reduce the complexity of scheduling the storage of all Separations plant radioactive waste. (See Table I).

III. PROCEDURE

During scavenging, the following first-cycle waste treatment procedure is recommended: (See Figure I for Chemical Flowsheet.)

For First-Cycle Waste.

- a. Receive the product and by-product wastes into 15-8.
- b. Add $K_4Fe(CN)_6$ solution to make the final waste solution 0.005 M in $Fe(CN)_6^{4-}$. (57.5 pounds of $K_4Fe(CN)_6 \cdot 3H_2O$ per run.)
- c. Neutralize the waste with NaOH to a pH of 8 to 10. (A pH range of 8 to 9 is more desirable.)

- d. Add NiSO_4 solution to make the solution 0.005 M in Ni^{++} (36 pounds of $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ per run.)
- e. Agitate for at least 10 minutes and then jet to underground storage. (Storage Tank 101-TT is suggested.) Keep agitator in operation as long as possible during transfer.

For Coating Waste (when required).

- a. Receive the coating removal waste into 15-8 and combine with the neutralized scavenged first-cycle waste, without adding additional scavenging chemicals or further pH adjustment. If scavenged first-cycle waste is not available in 15-8 at the time it is necessary to transfer coating waste into 15-8, the coating waste should be transferred into 15-8 and on to underground storage without scavenger treatment before the next batch of first-cycle waste is received. (In no case should the coating waste and first-cycle waste be mixed before scavenging has been completed on the first-cycle waste.)
- b. Repeat Item "c" above.

If preliminary data from the test or additional laboratory data indicate a need for altering the proposed procedure, authority is granted to make minor deviations from this procedure, with the concurrence of the T Plant Process Engineering Unit and Separations Technology Sub-Section.

pH control in the range of 8 to 10 is required to insure that the scavenger will give satisfactory removal of the long-lived fission products. Laboratory data indicate that the decontamination factors for Cs-137 and Sr-90 decrease if the pH is below 8 or above 10. In the BiPO_4 Plant, the installation of a pH instrument will be required to insure that satisfactory pH control can be maintained.

Method of Addition

Laboratory studies indicate that the addition of the potassium ferrocyanide to the acidic solution prior to neutralization, with the addition of nickel sulfate afterward, does not hinder the formation of nickel ferrocyanide or the decontamination of cesium or strontium. The reverse method of addition (i.e. add NiSO_4 , neutralize, add $\text{K}_4\text{Fe}(\text{CN})_6$) appears to delay the formation of nickel ferrocyanide and will result in a lower cesium and strontium decontamination.

IV. SPECIAL DATA

Special samples on a non-routine basis, from tank 15-8, or the underground receiver tank will be requested by Technical Section personnel for

determination and evaluation of the Cs-137 and Sr-90 removal. Operating procedures should be completed for each run.

V. EQUIPMENT AND PROCESS CHEMICALS

A new pH monitor will be required for the 15-8 tank to insure that the proper pH (8 to 10) is maintained. A unit similar to the pH monitor in the UR Plant waste neutralizer should be satisfactory for this operation. (A spare Beckman pH amplifier is available in the UR Plant.)

About 35 pounds of $K_4Fe(CN)_6 \cdot 3H_2O$ and 22 pounds of $NiSO_4 \cdot 6H_2O$ will be required for each ton of uranium processed under the test.

VI. RESPONSIBILITY

Run books for handling the waste covered in this production test will be prepared by the Manufacturing Separations Section personnel.

Summation and evaluation of test data will be the joint responsibility of Separations Section, Separations Technology Sub-Section, and Radiological Engineering Section personnel.

VII. ESTIMATED COMPLETION

Completion of this test is dependent upon production scheduling in T-Plant, but is scheduled for the production of approximately 750,000 gallons of scavenged waste.

VIII. FUTURE WORK

Following completion of test scavenging of an initial 750,000 gallons of first-cycle wastes, additional tanks in the Waste Cascade may be scheduled for further operational testing.

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FIGURE 1

FLUORIDE SCAVENGING OF FIRST-CYCLE WASTE

Processing 15-8 batches

(1) Coating-removal solution and first-cycle waste flows based on 1.65 T of U batch size. Actual dissolver charge is 3.3 T U, batch size for first cycle is 1.65 T U.

TABLE I

Estimated Operating Costs of T Facility (In-line PH system) 2 makeups

Basis: Costs are calculated assuming an annual production of 1800 tons of 215 MW/T uranium.

Cost	221-f Scavenging	242-T Evaporation
Annual chemical cost	\$26,000	\$ 0
Annual amortization cost	25,000(1)	0
Annual equipment cost	\$50,000(1)	0
Annual operating cost	22,000(2)	96,000(2)
Annual crib cost	20,000(4)	0
TOTAL Annual treatment cost	93,000	\$96,000
		Gallons/year
Total volume of waste to storage	3,770,000	3,710,000
Total volume of cribbed waste	2,430,000	2,370,000
Volume of permanently stored waste	1,340,000	1,340,000
Permanent waste storage cost at \$0.22 gal.	295,000	295,000
TOTAL Annual Cost	\$ 388,000	\$ 391,000

(1) Based on estimated piping and equipment needed in T Facility (In-line PH system) 2 makeups tanks, 2 agitators and piping.) Two year amortization period.

(2) Based on estimate of two man-years needed for cribbing the waste.

(3) EM-31769 - Estimated Operating Costs for Disposal of TWP Wastes (Scavenging), R. H. Silletto, April 27, 1974.

(4) Based on project estimate in EM-31731 for covered-type crib for TWP scavenged waste.

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