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SUBJECT: Run Summary of HRT-CP-7A and 8

TO: W. D. Burch

FROM: R. H. Winget

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To: W. D. Burch
From: R. H. Winget
Date: December 17, 1956
Subject: Run Summary of HRT-CP-7A and 8

Purpose

Run 7A was made to determine how effectively the hydroclone removed solids of low concentrations. Run No. 8 was the first of a series of three runs to determine if the underflow pot could be drained after several hundred grams of solids were removed from the system.

Summary

In run 7A, 10.1 grams of solids were injected into the system and the solids removal rate by the hydroclone followed by sampling every 4 hours for 48 hours. Solids concentrations decreased from a calculated initial value of 0.4 mg/ml to an apparent equilibrium concentration of about 0.003 mg/ml with a half life of about 1.7 hours.

Sixty-eight per cent of a total of 222 grams of solids injected was recovered at the conclusion of run CP-8. A total of 10.5 liters of UO_2SO_4 solution containing 74 grams of solids (32% of the solids injected) was drained from the chemical plant without difficulty. The concentration factor was 662.

Procedure

At the beginning of run HRT-CP 7A a total of 35 liters of newly prepared UO_2SO_4 (7.45 mg/ml of U in 0.02 M H_2SO_4) containing no solids was charged to the shakedown loop and chemical plant. The system was brought up to 280°C and 1350 psi with a flow of 0.75 gpm through the hydroclone. At 1145 on 11/18/56, 10.1 grams of solids were added to the shakedown loop by means of a sample bomb. These solids contained 40% Fe_2O_3 , 45% ZrO_2 , 13% Cr_2O_3 and 0.2% CuO by weight. A sample was pulled 15 minutes later and every four hours thereafter without any further addition of solids for the next 48 hours. At the end of this period, 75 grams of solids were added in one bomb to begin CP-8. Two more batches of solids (approximately 75 grams each) were injected at 3-1/2-hr intervals and samples were pulled two hours after each of the three additions. The loop and the chemical plant inventory was kept constant by charging the sample bomb with a volume of UO_2SO_4 equivalent to that removed as the sample. The chemical plant and the loop were each drained and rinsed once separately. Then the entire system was rinsed twice to improve the material balance of solids and uranium.

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Results of CP-7A

The sample pulled before the addition of solids contained 0.015 mg/ml of solids which indicated that approximately 0.5 grams of solids was circulating in the loop and chemical plant. Since the entire system had been rinsed twice before the start of the run and only clean solution was added, this amount of solids was either descaled from the system or left from the previous run. The data for the runs are shown in Table 1. The first sample pulled 15 minutes after the solids were added contained 0.195 mg/ml of solids compared to a calculated value of 0.4 mg/ml. The calculation assumed that no solids were removed during this 15 minutes of hydroclone operation. At a flow rate of 0.75 gpm through the clone, the entire solution inventory is circulated through the hydroclone one time in 12 minutes. In approximately three hours, the concentration dropped by a factor of 33. The samples pulled during the final 31 hours of operation averaged 0.003 mg/ml of solids compared to 0.004 mg/ml at the conclusion of run CP-7.

The results show that the hydroclone in the chemical plant effectively removed solids of low concentrations. A plot of concentration of solids in mg/ml in the circulating system plotted against time is shown in Fig. 1. By drawing a line (see broken line on Fig. 1) through several points to obtain the slope, a half life of 1.7 hours was found. The remaining samples gave concentrations in such a low range that half lives obtained from a similar curve through these points would be meaningless.

Results of HRT-CP-8

The first sample pulled two hours after the addition of 75 grams of solids contained particles which were quite thin and plate-like, different than the solids which were added, indicating that some descaling of corrosion products from the pipe walls had taken place. The value of 5.92 mg/ml of solids found two hours after this initial large solid charge, compared to a calculated initial value of 3.0 mg/ml, verified the presence of these additional solids. The concentration of solids in the system steadily dropped even with two more large additions of solids. The last sample pulled six hours after the final addition contained 0.014 mg/ml compared to an average concentration of 0.003 mg/ml attained in the latter portion of run 7-A. However, this value in run 7-A was reached after twelve hours of hydroclone operation with only 10.1 grams added, compared to six hours operation after a total addition of 222 grams in run 8. A plot of concentration of solids in mg/ml vs time is shown in Fig. 2.

The half life of solids in run 8 (using the last calculated value plus the final two values by analysis) was 45 minutes compared to 1.7 hours in run 7-A. This 45 minute half life was found when the starting concentrations were approximately a factor of ten higher than those in run 7-A.

The initial draining of the chemical plant produced 74.3 grams of solids or 32% of the total solids added. One rinse of this system yielded an additional 24.1 grams for a total of 98.4 grams. Thus 42.4% of the solids charged to the system was found in the chemical plant. The concentration factor was 662. The over-all material balance for solids was 68.3%; a breakdown is shown below:

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	<u>Grams</u>	<u>% of Total</u>
Solids charged to the system	232.1	100.0
Solids drained from Chemical Plant	74.3	32.0
Solids rinsed from Chemical Plant	24.1	10.4
Solids drained from solids loop	3.0	1.3
Solids rinsed from solids loop	10.8	4.7
1st rinse of solids loop and chemical plant	31.4	13.5
2nd rinse of solids loop and chemical plant	11.4	4.9
Solids removed as samples	3.6	1.5
Total solids recovered	158.6	68.3

No difficulty was encountered in draining the underflow pot with about 100 grams of solids in the system. The uranium recovery was 96% compared to a solution recovery of 97%.

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Table I HRT-CP-7A and 8

Grams Solids Added	Concentration Suspended Solids mg/ml	Sample Code	Time Sample Taken After Hydroclone in Operation, hrs	Solution Temp, °C	Pressure in System psi	Time, Date Sample Taken
None	.015	CFH-7A-2	2	238	800	0745 11/18/56
10.1	.195	CFH-7A-3	2-1/3	280	1460	1200 11/18/56
None	.006	CFH-7A-5	6	278	1350	1540 11/18/56
None	.017	CFH-7A-7	10-1/3	274	1280	2000 11/18/56
None	.003	CFH-7A-9	14-1/3	282	1410	2400 11/18/56
None	.006	CFH-7A-11	18-1/3	278	1350	0400 11/19/56
None	.004	CFH-7A-13	22-1/3	281	1365	0800 11/19/56
None	.001	CFH-7A-15	26-1/3	283	1370	1200 11/19/56
None	.003	CFH-7A-17	31-1/3	278	1290	1700 11/19/56
None	.001	CFH-7A-19	37-1/2	275	1245	2315 11/19/56
None	.001	CFH-7A-21	41-1/2	279	1250	0315 11/20/56
None	.004	CFH-7A-23	45-1/2	280	1250	0715 11/20/56
75.0	3.0*	No Sample Pulled	50-1/4	279	1275	1200 11/20/56
None	5.92	CFH-8-1	52-1/4	279	1280	1400 11/20/56
75.0	3.0*	No Sample Pulled	54-3/4	276	1225	1530 11/20/56
None	1.59	CFH-8-3	57	279	1250	1745 11/20/56
72.0	3.0*	No Sample Pulled	58-1/4	280	1250	1900 11/20/56
None	0.87	CFH-8-5	60-1/4	280	1245	2100 11/20/56
None	0.014	CFH-8-7	64-1/4	278	1275	0100 11/21/56

*Calculated

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Fig. 1.. HRT-CP-7A SOLIDS CONCENTRATION vs OPERATING TIME OF HYDROCLONE

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Fig. 2. HRT-CP-8 SOLIDS CONCENTRATION vs OPERATING TIME OF HYDROCLONE

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