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REDOX INTERNAL CAPACITY IMPROVEMENT

The following review indicates the present limiting capacities within the Redox plant and presents courses of action necessary to realize an instantaneous rate of 12 T/D. The changes contemplated to reach this goal are time cycle reductions, procedural changes, and equipment changes which can be undertaken and achieved by the Redox optimization presumably without recourse to project funds or special authorizations.

The review proceeds systematically from the dissolvers, through head-end, the extraction columns, concentrators, tail end equipment, and auxiliary equipment. Table I summarizes the critical points covered in the discussion.

Dissolvers

The instantaneous capacity of the three dissolvers is presently at something in excess of 10 T/D. The following data list a value of 10.2 T/D and show how it is anticipated that an increase to 13.1 T/D may be achieved.

Step	Current Cycle 5 T chgs.	6T Chgs.	Residual Acid Increase	Jacket Removal Changes	Faster Dissolving
Charge	3 hrs.	3 hrs.	3 hrs.	3 hrs.	3 hrs.
Jackets off	8.5	9	9	6.2	6
1st Cut	11.5	13	12.5	12.5	11.5
2nd Cut	12.5	14	13.4	13.4	12.4
Total	35.5 (1)	39 (2)	37.9 (3)	35.1 (4)	32.9 (5)
T/D	10.2	11.1	11.4	12.3	13.1

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- (1) The current cycle as listed may be a little long. However, the dissolver time cycles fluctuate more in response to variables. A conservative value is therefore listed. The truer value may be somewhere between 10.2 and 10.8 T/D.
- (2) It appears possible that the dissolvers can be charged with 6 T and the dissolving batches increased to 3 T each. This will decrease the dissolver freeboard at the end of the dissolution from approximately 27" to 21.5". The storage tanks (3-8,9) would no longer be able to hold both cuts, so single batches would have to be routed through these tanks to H-7 thus increasing the sampling load and reducing the metal solution inventory, but otherwise creating an increase of ~10% in dissolver capacity.
- (3) At the end of the dissolution period the dissolving rate is very slow. It is anticipated that by cutting short the tail end of the dissolution period and by neutralizing the excess acidity in subsequent processing that a small capacity increase can be achieved at a nominal increase in cost of around \$10/ton.
- (4) Reduction of the jacket removal time requirement is possible and efforts to achieve this reduction have already started. Three items are being considered; charging to hotter nitrate solution which will shorten the heating period, addition of ematic at a faster rate during the latter part of the addition, and elimination of over an hour of the digestion and rinse periods. The time cycle would be as follows:
	Present	Proposed
Heat to boiling	.75 hrs.	.50 hrs.
Add ematic	3.16	2.20
Digest	3	2
Cool and transfer	.7	.7
Rinse	1.38	1.80
	<u>8.99</u>	<u>6.20</u>
- (5) The time for dissolution was previously stated as a conservative value. As better control of iodine emission is attained, it will be possible to force the dissolution rate within reasonable limits to attain shorter dissolution periods. The values quoted are not considered non-realistic and can therefore be set as a goal to be attained if not surpassed. The demonstrated slower dissolution rates of low MFC uranium as compared to high MFC uranium is a variable that will have to be met.

The order of presentation of the above changes does not necessarily indicate the order in which the changes will occur. The rate of 13.1 T/D however, appears feasible and efforts to achieve it will be made.

Head-End

Present procedures in the head-end oxidation, concentration and centrifugation steps are limiting in the H-4 and H-2 vessels at approximately 13 and 15 T/D respectively. Further improvements in time cycle appear to be possible and will be attempted to provide a good factor of assurance at this point. The following tabulation reviews present and proposed time cycles for the H-4 oxidizer.

	Present Permanganate Procedure	Proposed Permanganate Procedure	Proposed Dichromate Procedure	Proposed Dichromate Thiosulfate Procedure
Transfer in	1.0	1.0	1	1
Butt and oxidize	.5	.5	4.5	5
Digest	1	1		
2nd oxidation	2	1		
Recycle and Diss.	1.5	1.5		
Cool and transfer	1.5	1.5	1.5	1.5
Total Time	7.5	6.5	7 (1)	7.5 (2)
T/D	12.8	14.8	13.8	12.8

(1) The dichromate oxidation procedure is very simple and straightforward. Some reduction over this original time cycle proposal may be possible. This procedure is contemplated for concurrent use with caustization and recycle.

(2) The dichromate thiosulfate time cycle covers the latest revision of the proposed procedure for achieving plutonium decontamination by conditioning with thiosulfate. Time cycle requirements have not been demonstrated but they would undoubtedly be in excess of those of the straight dichromate procedure. Under this procedure the centrifuge might become limiting at something less than the 15 T/D quoted above due to the need for more frequent bowl cleanout.

1st Cycle 1A, 1B, 1C

No difficulty in achieving the 12 T/D rate at this point. However, continued operation of 1A and 1B in parallel will be required. The battery will be limiting at around 12 T/D.

2nd and 3rd Plutonium

These two batteries have been found to be limiting at 11 T/D at one point, the 2B column. Its replacement is recommended. This would permit the plutonium cycles to handle anything that the 1st cycle could produce.

A recommended method of replacing the 2B column with a larger unit is as follows:

1. Take original 2A (now in capsule and supposedly in storage) and hold as a 3A spare.
2. Take cold 2A spare and enlarge as a 2B replacement.
3. Take 2B spare and enlarge to 4" as new 2B spare.¹ A need for greater capacity in the 2nd Pu cycle over the first cycle is present in order to control critical mass and plutonium concentration.

2nd and 3rd Uranium

The second and third uranium cycles are limiting first at 10 T/D or slightly more due to the F-6 condenser and second at ~11 T/D due to limitations of the 2B and 3B columns.

¹See O.D. Erlanson's letter to K.K. Campbell (cc to RT Jessen) date 6-6-55 for an inventory of spare columns.

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The F-6 condition can be remedied by moving the present D-11 condenser to the F-3 position and the F-3 condenser to the F-6 position. Approximately five jumpers will be needed. The D-11 condenser will become available upon installation of the new D-12 pot.

Phase II 23 and 38 columns have never been installed. Completion of this item would remove this second limitation and provide a combined capacity across the second and third uranium cycle of 12 T/D limited by the E-10, E-11 system. Flowsheet changes appear feasible which would make 12 T/D possible at this point also.

Demineralized Water

Present demineraliser capacity will handle a 10 T/D rate but reserve capacity will be negligible. Temporary relief can be afforded by using filtered water. Chloride corrosion under these conditions is increased. Since the 12 T/D rate is not a final goal, expansion of the demineraliser capacity should be seriously considered.

Coagulation, Silica Gel, etc.

These units are tentatively considered adequate for a 10 T/D rate. Since they have not been demonstrated, no firm statement of ultimate capacity can be made. However, there is optimism concerning their ability to handle 10 T/D and further improvement should be possible. Furthermore it may not be necessary to process 100% of the stream flow through the units to meet specifications.

Waste System

No difficulty is anticipated in the process waste section in achieving a 12 T/D rate. D-12 will be replaced shortly and the use of one or two stage back-cycle gives a comfortable margin of freedom in handling process waste.

The condensate waste system however, may become critical at 12 T/D due largely to the organic content of the condensate which is somewhat unpredictable. I am informed that a design is available for converting the old K-8 condenser to a D-6 condenser was prepared in 1954 and should be still available.

Organic System

The organic still (O-3) has been tested for a short period at a rate equivalent to 13-14 T/D. The transfer rate from O-1 to the organic recovery building, however, is limiting at 10-11 T/D. An attempt will be made to improve this item in the near future by replacing a limiting valve in the O-1 to O-1 pump transfer line.

Miscellaneous

It should be anticipated that minor equipment pieces may be found to be limiting as experience with higher rates is accumulated. Items such as rotameters and valves can be taken in stride and efforts made to locate these small limiting items before their replacement becomes necessary.

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Two stage backcycle will not materially effect the limiting values as listed. It will present the possibility of altering the flowsheet in an advantageous manner to gain greater economics and to reduce the load at some of the critical points. This is made possible by the automatic rework of the waste losses from both the second and third cycles.

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Limiting Area	Item	Present Capacity	Proposed Capacity	New Attained
Dissolvers	A2, B2, C2	10.2	13.1	Time cycle reductions
Head end	B-4, B-2	12.8	14.3 (13)	Time cycle reduction (Chromate Oxidation)
1st Extraction	1A or 1B	9	>12	Parallel Operation must be investigated
2nd Plutonium and 3rd Plutonium	2B	11	>12	Install new larger 2B
2nd Uranium and 3rd Uranium	7-6	10	>12	P-11 to P-3 P-3 to P-6
	2E	11	>12	Install phase II 2E
	3E	11	>12	Advantage can be taken of total backcycle to lessen the burden at these points.
	P-11	11	>12	Limitation depends upon the need for this equipment and time cycles which can be demonstrated.
Tail end	P-13	10	12	Install a third unit.
	Silica Gel	10	12	Install compacted P-3
Desimer. Water	Desimeralizer	10	>12	Install new P-12
Waste System	D-6	10	>12	Replace valve in P-1 to P-11
Organic System	O-1 to O-7	11	>12	

Present figures have not been listed in the proposed capacity column since further study is required to determine ultimate limits. The goal is to reach 12 T/D. Equipment should be made to provide 15 T/D as feasible whenever revisions are made since 15 T/D is the next goal to be established.

The new B-4 tank of larger diameter will make the centrifuge system limiting.

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