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A Report on the Filtration of Pitchblende Digest Slurry on
an Oliver Continuous Vacuum Rotary Precoat Filter.

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Letter from Declassification Branch

by

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Introduction:

These experiments were performed in order to determine the feasibility of using an Oliver type continuous rotary vacuum precoat filter for the filtration of pitchblende digest slurries of the type produced at M.C.W. For this purpose the 3' x 1' Oliver filter in the M.C.W. pilot plant was equipped with a precoat scraper feed mechanism, according to Oliver United Filters, Inc. drawing no. LF 3390. The internal vacuum valving system was changed to permit a constant suction to be applied to the entire drum throughout its revolution in order to prevent the precoat from sliding off the filter face.

As specified by Mr. Riker, a system for water washing the cake was installed on the filter. This consisted of 4-3/4" pipes having 1/8" holes drilled on 1" centers. The pipes were spaced at the top of the filter to provide a distribution of the water. Two drag cloths of Vinyon 114N aided in the water distribution.

Results and Conclusions:

Average cake rates for each run varied from 3.1 to 14.5#/ft²-hr and slurry rates from 1.1 to 4.8 gal/ft²-hr.

Depth of the doctor cut affected filtration rates; the 0.0012-0.002 inch cut average cake rate was 9.5#/ft²-hr, while the 0.004 inch cut gave 12.3#/ft²-hr. average, a 30% increase. Tests were done at 2.3 M.P.R. Average cake and slurry rates for the first 12 hours of operation were the same as the overall average rates.

Results of washing the X from the cake were not good. The "% Water soluble x wet basis" varied from 0.62% to 6.5%. It was realized that the drag blanket method of washing used in these tests was inadequate, however, time did not permit tests of other washing methods. It is thought that the problem can be overcome with spray jets or a blanket and compression roll system for the washing. We have had considerable experience with the latter on our Plant FEinc filters.

Total X contents of the filter cakes were from 0.78% to 6.5%, while moisture was from 20.6% to 42.0%.

Settling of the "sand" in the bottom of the filter bowl presented difficulties in the fact that it caused stoppage of the filter bowl agitator, caused thick globs of sand to appear on the drum (thereby contributing to bad washing and high X in the cakes), and also caused blockage of the bowl drain lines.

The filter would have to be shielded or confined in a cell block and a remote control operating system installed for protection of the operators.

A filtrate clarification system with a small solids capacity could be used since the wet solids in the filtrate were less than 0.01#/gal.

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Experimental Procedure:

In each of the runs the precoat material was slurried at room temperature at 0.1#/precoat per gallon of water. The filter was operated at 0.74 MPR at 20" Hg vacuum until the desired precoat thickness was obtained. With the vacuum still on the filter to prevent the precoat from slipping, the precoat slurry was dropped from the filter bowl and the slurry to be filtered was pumped into the bowl.

The temperature of the slurry in the bowl was maintained at 200°F $\pm 10^\circ$ and the washing water likewise. Speed of rotation of the drum was maintained constant throughout each run, as was the depth of the cut of the doctor blade. Hourly checks were taken on the cake and slurry rates. The washing water was regulated so as to provide maximum washing with a minimum of spillage into the slurry in the bowl.

The slurries filtered in these experiments were obtained from M-298 and consisted of pitchblende digest slurry mixed with other slurries entering M-298, i.e., recovery slurry, M-289 slurry and boildown liquors from M-1 and M-4. Wet unwashed solids in the slurries varied from 3.6 to 6#/gal. Checks on the excess nitric acid in the slurries were taken about every 4 hours and the acidity maintained at 0.4 to 0.7#/gal. by additions of 57% nitric. No evidence could be found in the data that variances in acidity or solids, within these limits, affected the filtration rates.

Discussion of Data:Table I: General Operational Data

The overall cake rates varied from 3.1 to 14.5#/ft²-hr and the slurry rates from 1.1 to 4.8 gal./ft²-hr. Averages were also figured for the first 12 hours of operation so that the shorter runs could be compared with the longer ones over the same time period. There is very little variation in the 12 hour rates and the overall rates, indicating that the filtration characteristics would not change much during an exceptionally long run,---after installing a proper top cover.

The abnormally low rate in Run 1 has been attributed to the fact that Standard filter cel was used. Low filtration rates using Standard filter cel have also been encountered in pilot plant Oliver precoat filtrations of TBP slurrex raffinate,---on one comparison run slurry filtration rate with Hy-flo was 67% faster than with Standard.

Depth of the doctor cut affected filtration rates. Disregarding the bad result of Run 1, the average of the 0.0012-0.002 inch cuts was 9.5#/ft²-hr while that for the 0.004 cut was 12.3, a 30% difference in cake rate.

Standard super cel was used on the first run,---this was changed on the remainder of the runs to Hy-flo filter cel. It was thought that the porosity of the Hy-flo precoat cake would be greater and that a higher filtration rate would be obtained.

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The cloth used on Run 8 was 120 x 120 mesh stainless steel square weave, which had been previously used on several pilot plant FEinc filtrations of digest slurry and MgX.

Blinding of the filter cloth cannot be altogether eliminated. Runs 1 and 7 blinded badly at the end of the run. The cloth on Run 7 showed a definite scale when examined under a microscope. Cloths would have to be removed and washed, or else washed in place. It is thought that the time of use of the cloth would be longer than the 2 days now employed on the FEinc filters for a similar cloth, but would not exceed 100 hours.

Table II: Cake Washing Results

The majority of the results on "% Water Soluble X wet basis" are too high for successful operation of the present C-3 system,---high end slurries would result. However, it should be pointed out that the washing system employed in these pilot plant tests was not adequate and these results were not obtained under the best possible washing conditions. The two low "% water soluble X wet basis" results in Runs 5 and 6 of 0.88% and 0.62% should be noted; also, the corresponding high moisture contents of 35.2% and 42.0%. These results indicate that if the washing water and cake can be contacted sufficiently the water soluble X will be low. Mr. Riker suggested the use of atomizing sprays. One of these was obtained, but was not given a test in cake washing.

The drag blanket washing used in these experiments resulted in channeling of the water over the cake and in Runs 5 and 7 more than 1/3 of the precoat was washed off of the drum toward the end of the run. A FEinc type blanket washing mechanism might be used. Adoption of atomizing sprays would necessitate hooding of the filter to prevent the spray from getting into the atmosphere,---also a good dust collector for the K-65 carried off by the spray.

Table I: General Operational Data

Run No.	Inches Depth of Cut	MPR of Drum	Duration of Run Hours	Rate Averages		Rate Averages over first 12 hours		Type Cloth Used on Filter	Type Precoat Material
				Slurry gal/ft ² -hr	Cake #/ft ² -hr	Slurry gal/ft ² -hr	Cake #/ft ² -hr		
1	.002	3	13	1.1	3.1	1.2	3.3	Vin102N	Standard
2	.002	2.3	12	3.2	11.6	4.2	11.3	Vin111N	Hyflo
3	.0012	2.5	22	2.2	5.1	2.0	4.4	Vin111N	"
4	.004	2.3	17	3.2	14.1	3.4	13.9	"	"
5	.004	2.3	15.5	3.0	9.1	2.7	8.5	"	"
6	.004	2.3	11.8	4.8	14.5	4.8	14.5	"	"
7	.002	2.3	13	2.4	9.8	2.5	10.0	"	"
8	.002	2.3	34	3.5	12.1	2.9	12.1	S.S.	"

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Table II: Cake Washing Results

Run No.	% Water Soluble X wet basis	% Water Soluble X dry basis	% Total X	% Moisture
2	2.18	- -	- -	27.7
2	1.58	- -	- -	23.9
2	1.14	- -	- -	32.2
3	1.50	- -	2.15	- -
4	2.35	3.50	2.64	32.8
4	4.00	5.05	4.00	20.6
5	6.55	9.2	6.50	28.8
5	0.88	1.35	1.32	35.2
6	0.62	1.07	0.78	42.0
6	5.50	7.34	5.25	25.0
8	3.90	- -	- -	- -
8	1.73	- -	- -	- -
8	3.58	- -	- -	- -
8	1.13	- -	- -	- -
8	0.40	- -	- -	- -

Some Other Considerations:

Particular trouble was encountered by sand settling in the filter bowl. In general after about 8 hours the sand was approximately 4-5 inches deep and had stopped the cradle type bowl agitator. This resulted in the drum cutting a path thru the sand buildup. In many instances thick globs of sand adhered to the filtering surface, thereby contributing to non-uniformity in the cake thickness and hence to bad washing results. Inability to pick up sand during filtration is an inherent characteristic of Oliver type filters. The Oliver precoat filter was not designed to pick up sand, and it will not do so as well as some other filters. During one revolution the filter will first pick up the slime and fines at the top of the filter bowl just as the filtering section enters the slurry. This layer of fines forms a cake which reduces the suction drop across the filter face. It is after this fines cake has formed that the filter surface approaches the bottom of the filter where the sand lays. This makes it extremely difficult to pick up sand, especially in a large bowl of this type wherein the agitation in the filter bowl cannot be adequate, i.e.; a cradle type agitator must be used because of the small clearance between the bowl and the filter. It should be pointed out that during these runs the agitation of the slurry in the slurry tank was not altogether adequate. This caused some classification of the sand before it reached the filter. Hence, when the heel in the tank was pumped out a large slug of sand entered the filter bowl. Actually the agitation in a large plant tank would be sufficient to prevent such pronounced classification. However, even with slurry from the uniformly agitated feed tank in our present plant there has been classification of the sand in the FEinc filter bowl, causing considerable trouble with sand buildup in the bowl. A solution to the sand problem might be to put a sand classifier before the filter. Mr. Riker has presented some considerations along this line in a letter to Dr. Harrington. This, however, would mean the installation of additional costly equipment, and also some method for washing the X from the sand collected in such a classifier.

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A wet screen analysis of some of the settled sand taken from the bottom of the filter bowl at the conclusion of Run 8 showed the following;

	<u>% Sample Basis</u>
on 50	3.52
on 100	25.07
on 200	34.90
on 325	4.12
thru 325	32.39

Adequate shielding, or confinement of the filter and related equipment in a cell block would be required for radiation protection. This would mean installing a system for remote control operation.

Precoat leaf tests indicated that a slurry rate of approximately 6 gal/ft²-hr might be expected; actually the rates attained in these experiments were nearer to 3 gal/ft²-hr. The wide variation may be attributed to the fact that in the filtration the K-65 penetrated the precoat to a greater depth than the depth of the doctor blade cut. This caused the doctor blade to cut thru the K-65 layer and chip particles from the surface of the precoat. Naturally more wear will occur to the blade when this occurs than when the blade is cutting thru the precoat material alone. Also, such chipping causes a reduced filtration rate since an unclean precoat surface is presented to the slurry. This problem could be eliminated by taking a deeper cut so that all of the K-65 would be removed. Of course, this means greater precoat material consumption, more precoat material entering the K-65, increase in shipping and material costs, and a shorter filtration cycle before a new precoat must be applied, thereby increasing the down time of the filter.

Solids contents in the filtrates were very low, in most cases less than 0.01#/gallon. The highest recorded wet solids was 0.045#/gallon. A clarification step would be necessary to have adequate control of radium losses in the filtrate, but a clarification system with a small solids capacity could be used.

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