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DEPARTMENT OF MINES

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C H E M I C A L E N G I N E E R I N G S E C T I O N

Report No. RD3

"OPTIMUM ADDITION OF REAGENT S.3000 FOR THICKENING LEACHED PULP FROM RADIUM HILL CONCENTRATE".

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I N D E X.

SUMMARY:

This report covers laboratory experiments to determine the optimum addition of Reagent S.3000 during the thickening operation of pulp leached from Radium Hill concentrates. Use of this reagent as a 1% solution up to 0.6 lbs. per short ton of dry solids has been investigated, and it is recommended that 0.15 lbs. per short ton of dry solids, equivalent to 0.12 lbs. per short ton of concentrate should prove satisfactory.

INTRODUCTION:

Glue solution has been used at the Chemical Pilot Plant, Thebarton, as a flocculent to assist thickening operations, and the design of the thickeners at the Uranium Treatment Plant, Port Pirie, has been based on these results. A new flocculating reagent, S.3000, is now available from the Cyanmid Co., and the possibility of using it at Port Pirie has been foreseen. This investigation has been carried out to determine its suitability and to recommend the usage required. All test work was performed on pulp from Radium Hill concentrates leached for 10 hours with 750 lbs. sulphuric acid per ton of ore, and diluted to 15% solids.

EXPERIMENTAL:

Method of Sampling: After dilution and neutralisation in the holding tank, the pulp was stirred vigorously until all solids were in suspension. Samples were taken with a scoop and collected in a 2 gallon rubber bucket and stirred to provide a common head sample. Each test sample was dipped from the bucket into 500 ccs. measuring cylinders. Temperature and pH of liquors were recorded.

Measurement of Settling rates: The required amount of reagent was added to the cylinder which was then hand shaken for

30 seconds and the time noted. Each cylinder was similarly handled in turn. At 10 minute intervals the depth of supernatent liquor above the settled solids was measured in inches over a minimum period of 2 hours. Free settling appeared to be complete after 2 to 3 hours.

Fresh reagent was prepared for each test, unless otherwise stated.

On completion of settling in the cylinders, the liquors were pipetted, and the settled solids were weighed, filtered and dried. From the dry weight of solids, the pulp densities and use in lbs. per short ton of dry solids were calculated.

RESULTS:

TABLE I.
Series 5

Reagent: S.3000 0.25 lbs. per short ton dry solids.
Figures refer to inches of supernatent liquor.

Conditioning period (mins.)		0.5	1	2	4	8	16
Settling period (mins.)	30	5.0	4.9	5.1	5.2	4.8	4.2
	60	5.85	5.8	5.9	6.1	5.8	5.5
	90	6.3	6.3	6.3	6.6	6.3	6.0
	120	6.6	6.6	6.7	6.9	6.6	6.4
	150	6.9	6.9	6.95	7.2	6.9	6.7

Temperature and pH of pulp 34°C. and 1.65 respectively.

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TABLE II.
Series 7

Reagents: Glue 4.2 lbs./short ton dry solids.
S.3000 .42 " " "

Reagent	Glue					S.3000				
AGE	FRESH	8 hrs.	24 hrs.	45 hrs.	5 days	FRESH	8 hrs.	24 hrs.	45 hrs.	5 days
Minutes 10	0.8	0.8	0.9	0.8	0.8	1.5	1.5	1.5	1.5	1.4
20	1.4	1.5	1.7	1.5	1.5	3.1	2.9	3.1	3.2	2.8
30	2.1	2.2	2.4	2.1	2.2	4.2	3.9	4.4	4.4	3.9
40	2.8	2.7	3.1	2.8	2.9	5.2	4.8	5.2	5.3	4.8
50	3.3	3.4	3.8	3.4	3.4	5.8	5.5	6.0	6.0	5.5
60	3.9	4.0	4.4	3.9	4.2	6.3	6.1	6.5	6.4	6.1
90	5.4	5.6	6.0	5.4	5.6	7.0	7.0	7.2	7.1	7.0
120	6.7	6.9	7.1	6.7	6.7	7.4	7.3	7.6	7.4	7.4
240	8.1	8.1	8.2	8.0	7.9	8.1	8.1	8.3	8.1	8.1
480	8.9	8.8	9.0	8.7	8.6	8.7	8.8	9.0	8.8	8.9

Temperature and pH of pulp 35°C. and 1.63 respectively.

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TABLE III.
Series 11

REAGENT	Nil			Glue			S.3000		
lbs./ton	A	B	C	2.8 A	3.4 B	2.8 C	.48 A	.35 B	.25 C
Minutes 10	0.4	0.3	0.3	0.4	0.3	0.2	2.5	3.1	1.6
20	0.7	0.6	0.6	0.8	0.7	0.6	4.0	5.0	3.6
30	1.0	0.9	0.8	1.3	1.0	0.8	4.6	5.5	4.5
40	1.3	1.2	1.1	1.7	1.4	1.3	5.0	5.9	5.0
50	1.6	1.55	1.35	2.1	1.7	1.6	5.3	6.1	5.4
60	1.9	1.85	1.6	2.5	2.1	2.0	5.5	6.3	5.6
90	2.75	2.8	2.5	3.8	3.2	3.1	6.1	6.8	6.2
120	5.5	5.5	4.9	5.9	6.3	6.2	7.0	7.6	7.1

Column A - fresh pulp. Temperature 34 C. pH 1.7
Column B - 24 hours aged pulp. Temperature 21°C. pH 1.6
Column C - 48 " " " " " " "

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TABLE IV.
Series 8

Reagent	Glue 2.5 lbs./ton					S.3000 0.25 lbs./ton					Series 6 S.3000 30lb./ton
pH	1.5	1.6	1.7	1.8	.9	1.5	1.6	1.7	1.8	1.9	1.9
Minutes 10	0.4	0.4	0.4	0.4	.5	2.3	2.8	3.3	1.5	0.5	0.5
20	.9	.9	.9	.9	1.0	3.6	4.1	5.0	3.1	1.0	1.0
30	1.5	1.4	1.4	1.4	1.5	4.2	5.3	5.5	4.4	1.5	1.6
40	2.0	1.8	1.9	1.9	2.0	4.7	5.6	5.9	5.1	2.0	2.0
50	2.5	2.3	2.4	2.4	2.5	5.1	5.9	6.2	5.5	2.4	2.4
60	3.0	2.8	2.8	2.8	2.9	5.4	6.1	6.4	5.7	2.8	2.8
70	3.5	3.2	3.2	3.3	3.5	5.6	6.3	6.6	6.0	3.3	3.3
80	4.1	3.7	3.7	3.8	3.8	5.8	6.5	6.7	6.1	3.6	3.6
90	4.6	4.2	4.2	4.4	4.7	6.0	6.6	6.9	6.3	4.0	4.0
120	6.0	5.7	5.8	5.7	5.6	6.4	6.9	7.2	6.6	5.3	5.2
150	6.4	6.1	6.3	6.1	6.0	6.7	7.1	7.4	6.9	6.2	6.2

Temperature of pulp - 34°C.

TABLE V.

Series	Time	Glue Nil	Glue 2.5	S.3000 lbs./ton. 0.05	0.10	0.25	0.3	0.4	0.5	0.6
9	60 mins.	2.4	3.3	5.95	5.9	6.2	5.8	6.1	5.4	5.3
10	60 "	2.3	3.1	5.6	6.2	5.4	5.5	5.5	5.7	5.8
9	90 "	3.5	5.0	6.5	6.4	6.7	6.2	6.7	6.2	6.0
10	90 "	3.3	4.6	6.3	6.7	6.1	6.2	6.2	6.3	6.4

Temperature and pH of pulp 35°C. and 1.6

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TABLE V (Series 12)

Reagent		Glue	S.3000						
lbs./ton	Nil	2.8	.03	.04	.06	.08	.09	.10	.11	.13
Minutes 10	0.4	0.5	.6	1.0	1.5	1.5	2.1	2.2	2.3	1.8
20	0.7	1.0	1.1	2.0	3.0	2.9	4.0	4.3	4.3	3.8
30	1.1	1.4	1.6	2.3	4.3	4.0	4.9	5.3	5.1	5.0
40	1.5	1.9	2.1	3.6	5.0	4.9	5.4	5.7	5.6	5.5
50	1.8	2.3	2.5	4.2	5.4	5.3	5.7	6.1	5.8	5.8
60	2.2	2.8	2.9	4.9	5.7	5.7	6.0	6.3	6.1	6.1
70	2.5	3.2	3.3	5.5	5.9	6.0	6.1	6.5	6.3	6.3
80	2.8	3.6	3.7	5.9	6.1	6.1	6.3	6.7	6.5	6.5
90	3.2	4.1	4.0	6.2	6.2	6.3	6.5	6.8	6.6	6.6
120	4.0	5.6	5.1	6.6	6.6	6.7	6.8	7.1	6.9	6.9

Temperature and pH of pulp 35°C. and 1.6

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TABLE VI.

No reagent addition: 2.2 inches per hour for first 1 hr.
2.15 " " " " " 2 hrs.

Glue solution: 3 lbs./ton; 3.35 ins. per hr. for first 1 hr.
3.3 " " " " 2 "

S.3000 reagent									
lbs. per ton	0.03	0.05	.07	.09	.12	.20	.30	.40	.50
Rate A	2.6	3.7	5.7	6.0	6.1	5.7	5.5	5.1	5.6
" B	2.6	2.9	3.4	3.5	3.6	3.3	3.3	3.3	3.3

Rate A represents inches per hour for first 1 hour.
" B " " " " " " 2 "

DISCUSSION:

1. Conditioning time of reagent with pulp.

Results obtained from Series 1 to 4 were disappointing, and it was believed that the conditioning time of reagent with pulp (30 seconds) was insufficient. Series 5 was then

carried out to determine the optimum mixing time. Results of this series Table I indicate that no advantage could be obtained by extending the conditioning period for longer than 30 seconds. The mixing technique used in the earlier series was considered faulty, and was amended. The mixing time was then maintained at 30 seconds for all tests.

2. Age of reagent solution.

Table II, series 7, indicates that the age of the reagent solution, either glue or S.3000, has no effect on the settling rate of solids, but it is to be noted that the consumption of reagents is above the optimum and this may have a bearing on the results obtained. This was the only series in which aged reagents were used.

3. Age of pulp.

Results on testing the effect on settling rates of aged pulps proved inconclusive. The weights of the dry pulp recovered at the conclusion of the tests were not constant, and the settling rates using fresh pulp are below average rates. The results obtained are given in Table III, series 11, and indicate that S.3000 reagent may be more effective than glue when thickening aged pulps. The rate holds for aged pulp with S.3000, but falls away with glue.

4. pH of pulp.

Series 6 and 8 were performed to determine rate of settling for pulps within the pH range 1.5 to 1.9. Results of series 6 may be unreliable due to poor sampling, but series 8 is reported in table IV. The rates are similar after the first 30 minutes up to pH 1.8. For pulp of pH 1.9, settling rates for series 6 and 8 are of the same order. On these results it appears that for satisfactory thickening, neutralisation should not proceed beyond pH 1.8, when using S.3000 as a flocculent. A similar effect is not observed when using glue.

5. Optimum S.3000 addition.

Series 9 and 10 are similar tests using S.3000 reagent up to 0.6 lbs. per ton, and indicate the optimum reagent addition in less than 0.25 lbs. per short ton of solids. Results are reported in Table V.

The range 0.03-0.13 lbs. reagent per ton has been investigated in Series 12. With the addition of S.3000 as low as 0.03 lbs. per ton, the settling rate obtained is comparable to the rate when using almost 3 lbs. of glue per ton, but tests have indicated unreliable results below 0.06 lbs. per ton. The rate of settling increases with reagent usage up to 0.10 lbs. per short ton of dry solids and then remains steady. For operating a large scale plant on a continuous basis, 0.15 lbs. per short ton of dry solids would be a reasonable reagent addition. This is equivalent to 0.12 lbs. per short ton of ore leached.

6. Settling Rates.

A summation of the settling rates obtained is reported in Table VI. These rates represent average figures for all reasonable results, and have been expressed as (a) inches settled per hour over the first hour and (b) inches settled per hour over the first 2 hours.

After a 2 hour period, free settling has been completed, and the rates per unit time interval are of a more uniform order.

7. Clarity of Supernatent liquors.

It was noted throughout the investigation that when using glue to assist settling, the surface liquor was always filmed with slime. The use of Reagent S.3000 would yield much clearer liquors during thickening operations.

S E C R E T

8. Ultimate Pulp Densities.

On completion of the settling tests, pulp densities on the settled solids were performed. With the use of either glue or S.3000, the average ultimate pulp density would be 35% after a settling time of approximately 12 hours.

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