HDS Water Treatment Plant at Cominco's Sullivan Operation

by

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HDS WATER TREATMENT PLANT AT COMINCO'S SULLIVAN OPERATION

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- Cominco operates a Drainage Water Treatment Plant in Kimberley, B.C. to deal with AMD and Tailings water that are generated in the Sullivan Mine/Mill operation.

- I can answer questions relating to plant equipment and operating strategy, but for the moment I'll confine my remarks to what I'll call "Operating Nuggets" that we've learned over the past 15 years of operation. As well, I was asked to reiterate some comments made by Lorne Ball at a similar gathering last year.

- From the Plant flowsheet, you can see that the process relies on High Density Sludge Recirculation.

- Our primary control parameter is the RECYCLE RATIO
  - Calculated as the ratio of recycled solids to the solids in the feed water which are generated when treated.

$$\frac{\text{Recycle Flowrate (lpm)} \times \text{Density (g/L)}}{\text{Feedrate (lpm)} \times \text{Sludge Production (g/l)}}$$

  - Ratio is determined at least once per day by measuring plant flowrates and densities, and by doing a Sludge Production Test.

- Sludge Production Test
  - This is a laboratory beaker test
  - Stir & aerate 1 L of raw water for about 45 mins
  - pH is kept at 9.5 for duration by adding slaked lime slurry
  - Resulting solids are flocced, filtered, dried & weighed
  - The Sludge Production is then expressed as Grams/Liter.

- The Recycle Ratio is generally maintained at about 20:1
  - Noted that the plant is more stable if this ratio is changed seasonally
  - Raised to 30:1 during Winter months
  - Dropped to about 15:1 during Summer months.

This effect is thought to be related to either temperature dependent reaction rates or flocculant activity. We have noted a drop in flocculant efficiency in the cold weather but we don't know if it's due to mixing in cold water or its application to a relatively cold process.

- Iron content of raw water also changes seasonally
  - Climbs dramatically in Spring as snow melt leaches metals in tailings (200 --> 3000 ppm)
  - First plant indication is greenish tinge in Reactor froth
  - If unchecked, plant throughput is limited by poorly settling sludge
  - Must increase aeration
  - May increase Recycle Ratio

- Stabilized the Recycle Ratio somewhat with a controller
  - Integrate the Sludge Flowmeter and Densometer signals to generate a Sludge Massflow value
  - This is controlled to a setpoint by using a controller to vary the Recycle Pump VSD.
  - This eliminates the variations in flow that previously accompanied changes in underflow density.
  - Stabilizes other process variables too (lime demand, floc demand)

- Mechanically, the single biggest problem that we have is gypsum scale buildups.
  - Most of our process piping and vessels are fine
  - Both the Clarifier and our Effluent Discharge System have experienced significant buildups.
  - In the case of the Clarifier, even though the concrete was sulphate resistant, we've noted fairly severe pitting and deterioration of the walls where the buildups were the greatest.

- I've appended some notes from Lorne Ball. Some of the issues he emphasized were:

- The Iron in the feed is beneficial due to the co-precipitation that results. Kimberley benefits from this in that our iron is much higher that any of the other metals.

- HDS treatment relies on the premixing of the fresh lime with the Recycled Sludge, in a separate vessel, prior to the introduction of the raw feed.

- It is critical that any new plant be designed on the basis of adequate testwork.

- Start with using beaker tests to evaluate:
  - Operating pH (dependant on metals to be removed)
  - Effluent Quality

- Use Pilot Scale work to evaluate:
  - Sludge production
  - Establish Recycle Ratio - Generally low sludge production water need high Recycle Ratio, and vice versa
  - Confirm effluent quality under steady state conditions
  - Sludge quality (density, settling, --> clarifier & impoundment requirements)
  - Flocculant Selection
  - Neutralizing Reagent (Lime?) requirements (g/L & tpd)

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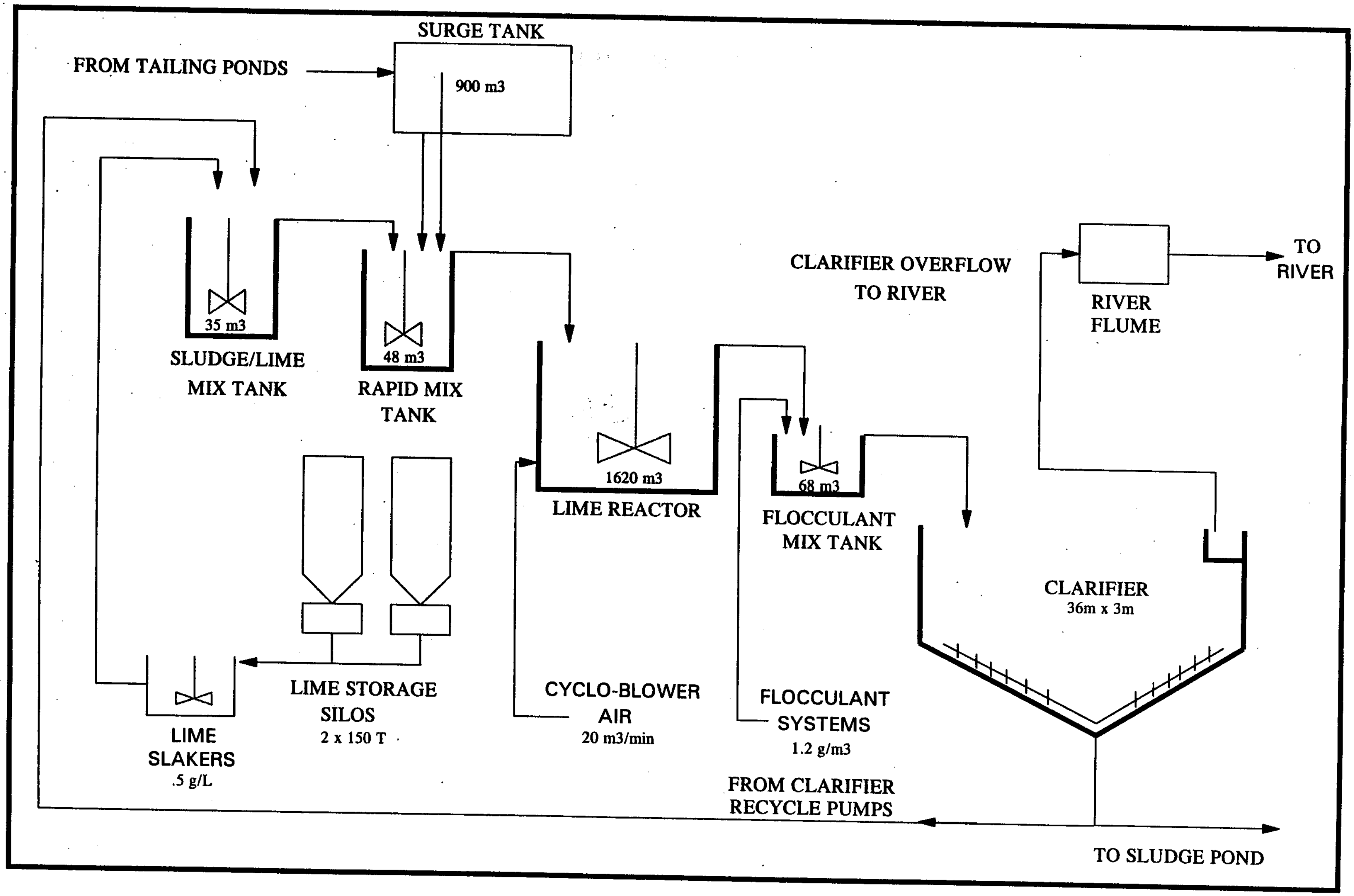
SULLIVAN CONCENTRATOR - DRAINAGE WATER TREATMENT PLANT



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DRAINAGE WATER TREATMENT PLANT

SLUDGE MASSFLOW – PLANT/LABORATORY WORKSHEET

If Laboratory Work Gives:

FEEDRATE	(L/Min)	=	20,000				
SLUDGE PRODUCTION	(gr/L)	=	0.67				
SLUDGE DENSITY	(gr/L)	=	325	=	40	x	________gr/L
SLUDGE FLOW	(L/Min)	=	850				

Then: **What is the Recycle Ratio ?**

Recycle Ratio = (Sludge Density x Sludge Flow) / (Feedrate x Sludge Prod'n)
(325 gr/L x 850 L/Min) / (20,000 L/Min x 0.67 gr/L)
20.6

(_____ x _____) / (_____ x _____) = _____

What is the Sludge Massflow?

Sludge Massflow = (Sludge Density x Sludge Flow)
(NOTE: This is just the top part of the Recycle Rate Formula)
(325 gr/L x 850 L/Min)
276,250 gr/L or 276.2 kg/min (divide by 1,000)
276.2 kg/Min

(______) x (______) = ______ Kg/Min

Since: A Recycle Ratio of 20.6 : 1 is low (should be 25 – 30), so Plant Operation must be changed to increase the Recycle Ratio. Therefore, either reduce Plant Feedrate, or increase the Sludge Massflow to improve the Recycle Ratio.

What Sludge Massflow is Required to acheive a Recycle Ratio = 30?
(Note: Use Lab numbers for Sludge Prod'n)

Sludge Massflow = (R/C Ratio x Feedrate x Sludge Prod'n) / 1,000
(30 x 20,000 L/Min x .67 gr/L) / 1000
402 Kg/Min

(_____ x _____ x _____) / 1,000 = ______ Kg/Min

However, a Sludge Massflow setpoint of 402 kg/min could cause the recycle pump to speed up to its maximum to attain this new setpoint if the Sludge Density is too low. Therefore, IS this calculated setpoint reasonable? Before entering it, check!!

What Sludge Flowrate is required to give the above Massflow?

Sludge Massflow = (Sludge Density x Sludge Flow)

Since we know that the Massflow would be 402 kg/min (402,000 gr/Min) and Sludge Density was 376 gr/L from the Labwork, then:

Sludge Flow = Sludge Massflow / Sludge Density
(402,000 gr/Min) / (325 gr/L)
1236.9 L/Min

Since this value is reasonable, go ahead and enter the new Massflow setpoint !

(______) / (______) = ______ L/Min