SOLIDS REMOVAL FROM THE FLUME WATER SYSTEM PHASE V

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ABSTRACT

Historically solids in the flume water system were removed by settling the clarifier underflow in a pond and returning the clarified water for reuse. In 2006 an infection occurred in the pond which did not allow solids to settle thus returning muddy water back to the flume water system. Since 2006 removal of solids from the flume water system has been an ongoing experiment to see what process will result in the most reduction of solids at the lowest cost. Phase I split the clarifier underflow stream and sent a portion of the flow to rented belt presses and one centrifuge, this reduced solids being sent to the mud pond. Phase II sent a portion of the flow to two hydroclones that removed solids mechanically before being sent to rented centrifuges. Phase III additional hydroclones and two belt presses were installed to reduce solids along with a polymer make down system that lowered costs. Phase IV added two belt presses to the system to increase solids removal capacity. Phase V installed a solids thickener for conditioning of the solids before the belt presses, lime addition after the clarifier, and new inflow settling rings in the clarifier. The belt press operation is optimized when the solids are consistent, thickened and at a pH of 6.5 to 9 before polymer addition. Before the thickener, solids withdrawal rate from the clarifier was reduced to increase the solids content to the hydroclones and the belt presses. This resulted in a dirty overflow from the clarifier and on one occasion a plugged clarifier underflow line. Lime addition after the clarifier allowed a higher pH in the flume system without adversely affecting polymer efficiency and belt longevity. The new clarifier settling rings increased the effectiveness of the clarifier at varying solids loads and flow rates, shortcutting of solids was eliminated.

Since 2006, the Mini-Cassia Factory has been struggling to finish the beet campaign in 185 days without the influence of a poor settling mud pond shutting the factory down.

At the last ASSBT (2009) meeting, Amalgamated reported the efforts that were done to remove dirt from flume water by mechanical means. While successful in part, the mud pond still did not behave in a way that kept the factory completely from risk. The mud pond was still receiving too many solids and water to settle properly; additional solids and water had to be removed. Since 2009 several things have been done to improve the mud removal system. These efforts include:

1. Two additional belt presses installed in 2009 (total of 4).
2. Mud Thickener installed in 2010.
3. pH of flume water stability in 2010 campaign.
4. Modification of the center well of the Primary Clarifier 2010.
5. Lime addition to the mud pond.

Two additional belt presses were installed in 2009 to remove a greater quantity of solids. However, operating conditions were difficult to control and the dirt removal was not as expected. One issue was the wash water from the four belt press, laden with dirt, and spillage still had to be sent to the mud pond, approximately 500 gpm, when all four belt presses were operating. In addition, to help belt press performance, it was desired to increase the density of the mud flow to the belt presses to reduce the hydraulic flow. To achieve this, the primary clarifier was used as a thickener to increase the density of the underflow feeding the hydroclones and belt presses. While the intent was good, this operating condition resulted in an overloaded clarifier. Mud built up in the clarifier and resulted in the failure of the gearbox of that clarifier. After repairing the clarifier drive, the density of the underflow was reduced and the belt presses became hydraulically overloaded again. At the beginning of this beet campaign, the clarity of the clarifier overflow was very dirty, sg 1.05+. The mud carryover affected beet handling and diffuser operations and increased wear and tear on pumps and machinery.

This year (2010-2011) it was determined to improve performance of the clarifier as much as practicable and not use the clarifier as a thickener. To accomplish this, the center well of the clarifier was redesigned, the underflow density was not allowed to increase above a certain level, and the pH of the flume water was increased. Also a separate thickener was installed to take the clarifier underflow and thicken it before going to the belt presses. There were numerous piping configurations installed to determine the best operating configuration of the mud removal equipment with the advent of the thickener.

As of this date the most reliable, and operator friendly configuration is as follows: First, the pH of the flume system has been raised to 12+. This has improved the clarifier overflow clarity (sg 1.01-1.02). The clarifier is now settling as it should. The clarifier underflow is pumped aggressively to the six hydroclone separation units. Here, the heavy solids are removed as much as possible without the use of polymer. The resulting mud laden flow then passes through two of the four belt presses. Polymer is added to aid in the dirt removal. Any surplus mud flow that these two belt presses can not take along with the wash water and spillage from the belt presses is sent to the thickener (garbage can). The thickener separates the solids from the water. The clear overflow is returned to the primary clarifier outer ring. The underflow of the thickener is currently being sent to the other two belt presses with the surplus going to the mud pond. It was originally intended that the thickener underflow be sent to all four belt presses. This has not been successful because the thickener is not able to handle the total solids loading from the underflow of the clarifier. The two belt presses (from the underflow of the clarifier) reduce enough of the load to the thickener to make the thickener successful. A centrifuge was used on the underflow of the thickener as a test and was successful. This final step, however, is quite costly although effective.

The mud system will be continually evaluated as to the most cost effective method to handle the mud at this point, either mechanically or send to the mud pond and clean the pond on an as needs basis. What has become evident is the value of the high flume pH, and the modifications made to the clarifier both mechanically and operationally. It was feared that the clarifier would have to be replaced, but now the clarifier has become a functioning part of the flume system even in very muddy conditions.

The development of the mud removal project has shown the mud pond can be eliminated but at a cost. At this writing the mud pond is settling. Mud pond return water is clear and flume water at beet handling is performing as desired, and the factory is not at risk as in the past. Solids removal will always require attention to keep costs as low as possible.