A CREEPY SOLUTION TO SLUDGE THICKENING

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71st Annual Water Industry Engineers and Operators' Conference
Bendigo Exhibition Centre
2 to 4 September, 2008

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ABSTRACT

The intention of this paper is to relay the issues encountered by Gippsland water at a number of it's smaller water treatment plants with the thickening and removal of treatment sludge. The paper will outline the trials and tribulations of trying to find a cost effective and simple solution to the issues we were/are having, including sludge thickening, storage and removal.

The positives and negatives of such solutions will be discussed and an indication of where we are now and where we intend to be in the future will be provided.

The main theme of the paper is to highlight the use of current technology in different applications. (Pool cleaners, Grain silos).

1.0 INTRODUCTION

In the late 1990's Gippsland water built a number of small Water Treatment Plants (WTP). The capacity of these WTPs range from 1 to 5ML/D. The location of these plants where all on small parcels of land with limited or no area for sludge disposal. As such the plants were designed to thicken the alum or ferric sludge and store it on site.

Once the storage was full they were then emptied and the sludge transported to Gippsland Water's Dutson Downs Waste Handling Facility.

The design of the sludge handling system consisted of a primary concrete sludge tank with a flat bottom floor. In this tank there was a supernatant return pump suspended from a floating pontoon which returned supernatant to the inlet of the plant, and a fixed in place submersible sludge pump at the base of the tank.

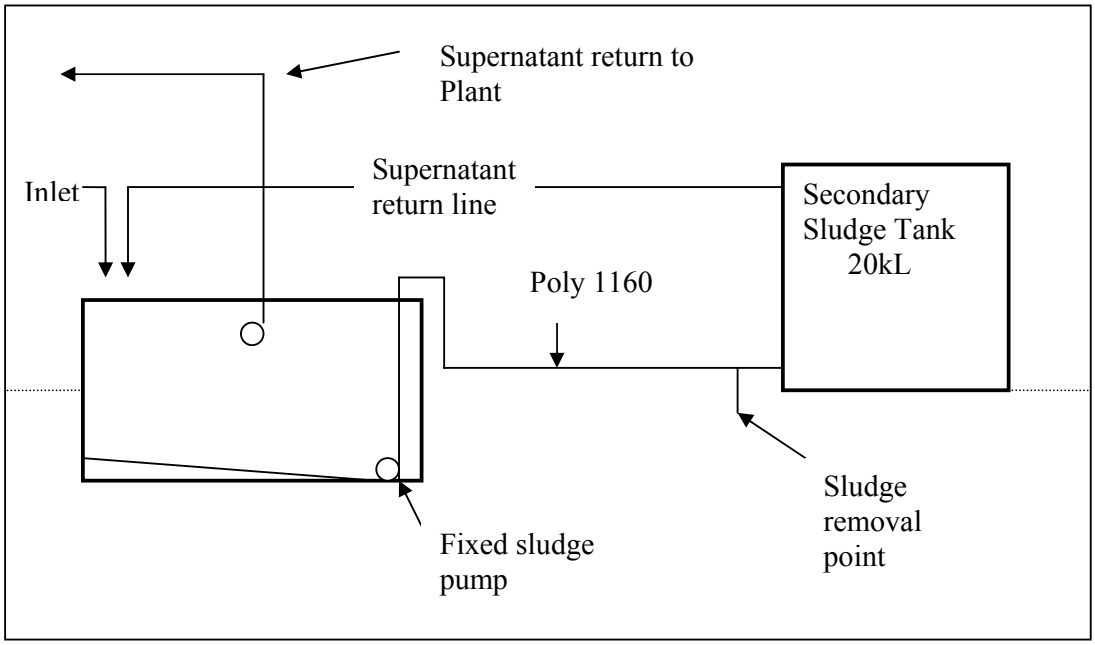

Figure 1: ***Original Sludge Set Up***

The sludge pump transferred the settled sludge into the secondary flat bottom sludge tank for thickening, with the thickening process aided with the dosing of polymer 1160. Supernatant from the secondary sludge tank then fed back to the primary sludge tank.

This system created two main issues which where:

- Sludge build up in the primary sludge tank
- Inability to remove all the sludge from the Secondary sludge tank

2.0 DISCUSSION

2.1 Sludge Build Up In Primary Sludge Tank

The build up of sludge in the primary sludge tanks was primarily considered to be an issue with having a flat bottom tank. A sloped concrete floor was poured onto the existing floor with a slope of about 30 degrees. This provided only minimal improvement so other ideas were sought. We were looking for a low cost solution which kept the sludge level to a minimum with the least capital out-lay, this would then minimize the need to clean out the primary sludge tank.

The idea of using a pool cleaner was raised and a "Genie Creepy Crawly" (Figure 2) was purchased from a local supplier. Adapters were made so the unit could be bolted onto the base of the submersible pumps that were originally in place. We found that that some of the existing pumps did not run at the required flow rate (40 l/min) to ensure correct operation.

Figure 2: ***Genie Creepy Crawley***

As we modified each plant we made improvements to the system we first installed. We tried different size pumps both submersible and externally mounted pumps (Figure 3) with solenoid valves to maintain prime. These pumps required modifications to suction pipe work which would allow easy access to the cleaner.

Figure 3: ***External pump configuration***

Some trials were conducted to get the right length of hose to allow the cleaner to reach the whole area of the tank floor. The cleaner proved quite successful at removing the sludge but however there was another issue! The cleaner managed to find every obstacle in its way and get caught up. While this was frustrating it was no worse then original fixed pump suction. To over come this we removed were possible those obstacles by shortening or removing pipes and smoothing off cast joints in the concrete tank. Where it was not possible to remove obstacles we installed deflectors, these were primarily plastic feed troughs bolted to the walls, bottom out. We ensured that the finish and quality any new sludge tanks that were aimed at reducing these issues.

Another problem for us has been the suction head blocking due to grass, leaves and other debris blowing into the primary sludge tanks. This requires the operating Technician to manually extract the cleaner and clear the blockage. This is an ongoing issue that we need to find an answer to.

2.2 Inability To Remove All Sludge From The Secondary Sludge Tank

The provision of flat bottom 20kL plastic tanks as secondary sludge tanks for storage, created an issue when it was time to empty the tank, the contractor that we used had only centrifugal pumps to remove the sludge via a 50mm Cam-Lok fitting in the base of the tank. As the tank lowered it would rattail through the sludge and draw out all the water, this would then vortex and suck in air which would put an end to the pumping process.

This left us with 40% of the sludge left in the tank and us paying full price for half a load of sludge. We decide to use vacuum trucks to empty the sludge tanks we found this to be a more effective way to remove the sludge, but we were still left with quite a build up of sludge away from the outlet. Access into the tanks was very restricted, so trying remove sludge from the top was hazardous and not cost effective.

Figure 4: ***Secondary Sludge Tank***

Figure 5: ***Secondary Sludge Silo***

Again some thinking outside the box threw up the suggestion of using a silo as a secondary sludge tank was raised. We investigated the possibility of using an existing design of silo that was used for grain storage. We had to ensure that they would be water tight and had the capacity to hold 16 tonnes of sludge. We purchased an 18 kL silo with a steeply coned base (45^{o}) and replaced the secondary sludge tank. The sludge from the primary sludge tank was pumped in from the bottom through the silo outlet and dosed with poly 1160 at this point. This provided some filtering through the sludge layer and with the help of gravity quicker settling of the sludge. The supernatant returns to the primary sludge tank via a fixed over flow. Visual inspections of the silo are carried out regularly to determine when emptying of the sludge is required.

Due to the shape of the silo the sludge is drawn from the base of the silo effectively by the vacuum truck. By accident we soon realized that by leaving a small amount of sludge in the cone it aided the settling in the initial filling process and minimized sludge return to the primary sludge tank. To maximize the amount of sludge removed we installed outlets on the silo at 300mm intervals down from the overflow this allowed us to decant off any supernatant. We have since designed a floating decant system which allows us to decant the supernatant from the top of the silo at any level. Sludge entry is now via a dedicated pipe with a dispersion cone on the end, this now gives us even distribution of the sludge into the silo.

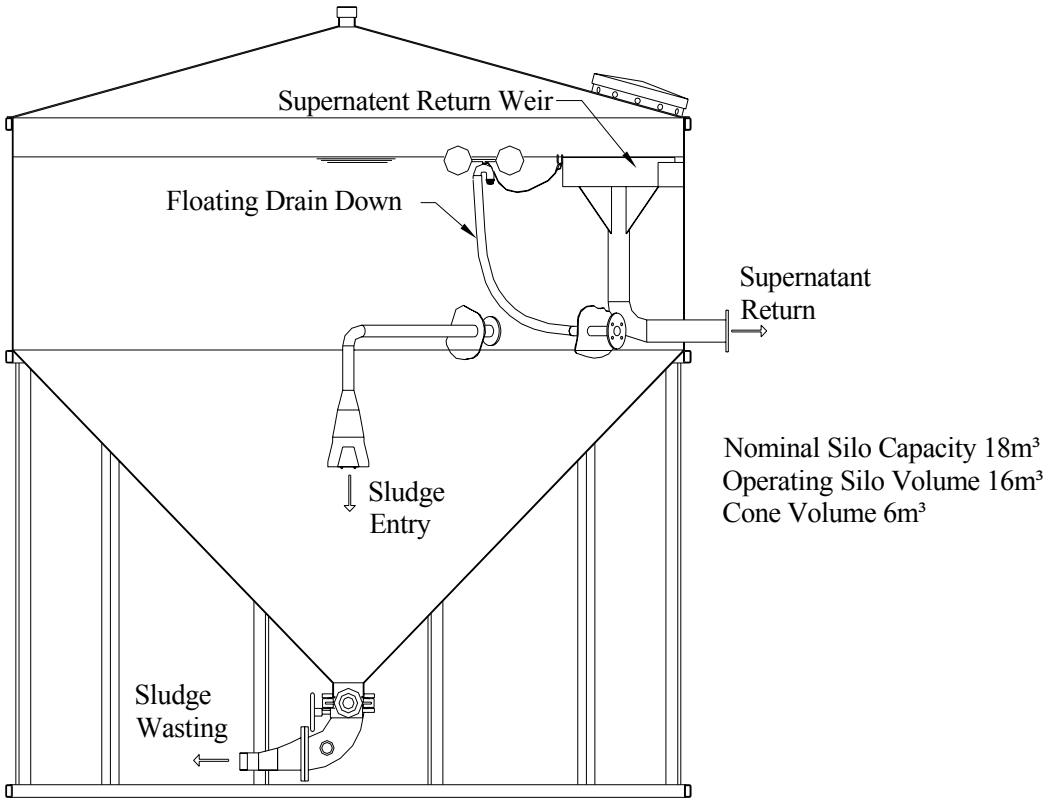

Figure 6: ***Latest design secondary sludge silo***

2.3 Positives And Not So Positives

Positives

- Increased thickening of sludge which has led to
- Reduced sludge cartage costs
- OH&S risks reduced, including
- Reduced manual handling issues

Not So Positive

- Increased operation time due to blockages of creepy crawly and tangling
- Maintenance costs increased due to more moving/wearing parts

3.0 CONCLUSIONS

Where to now? There is always room for improvement, and we are trying to be proactive in finding ways to minimize costs, improve reliability and make the life of the operating technician a bit more bearable.

In the future we need to address the issue of blocking of the suction heads due to foreign matter; possible solutions include covering of the primary sludge tanks modified suction heads on the cleaners or a different approach all together. Access to silos for inspections is another issue that we are dealing with.

Some of the projects in future include:

- Easily removed covers for primary sludge tanks
- The use of "geo-bags"
- Working with suppliers to redesign cleaners for industrial use
- Silo access and work platforms.
- Use of centrifuge thickening at central sites

The path we have taken with these systems has been very successful in reducing cartage costs, by having better control over the process.

The increase in operation hours and maintenance has been balanced out with reduced need for cleaning of tanks.

OH&S Risks have been reduced due to the fact we do not have to get in the primary or secondary sludge tanks or work at heights with awkward equipment. There still is however a problem with working at heights for inspection of the silos.

While these systems have been successful at some sites, it is not the answer to all our sludge handling issues. What it does highlight though is that with some innovative thinking and the use of existing technology and a lot of work the answers to most problems can be solved, without reinventing the wheel.

4.0 ACKNOWLEDGEMENTS

- Sandy McGregor – for the original ideas
- Bob Rowley – Engineering design
- Gippsland Operating Technicians – for their patience and input