ACHIEVING THE BIOSOLIDS STRATEGY AT SANDGATE SEWAGE TREATMENT PLANT

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ABSTRACT

Queensland Urban Utilities (QUU) operates 28 sewage treatment plants which combine to produce approximately 150,000 wet tonnes of biosolids per year. To manage this product QUU developed the Biosolids Strategy in 2012. One of the key goals of the strategy is to identify and implement operational cost saving initiatives. Sandgate Sewage Treatment Plant (STP) is one of the 28 plants under QUU's operation and it produces approximately 8,000 wet tonnes of biosolids per year. This paper will be looking at biosolids management at Sandgate STP and its role in meeting the Biosolids Strategy.

1.0 INTRODUCTION

The QUU Biosolids Strategy has identified opportunities within the business to optimize de-watering facilities, create high value products and reduce haulage costs. By 2031 QUU has projected that biosolids disposal costs could double or even triple depending on population growth. Reducing the costs of biosolids disposal and re-routing biosolids streams will help to achieve the biosolids strategy. The following topics will be discussed in order to gain a better understanding of the Biosolids Strategy and how its goals are being achieved: biosolids handling within QUU, optimization of the Sandgate STP de-watering equipment and recommendations for improved de-watering.

2.0 BACKGROUND: BIOSOLIDS MANAGEMENT

To achieve the Biosolids Strategy, QUU developed the Sludge Management Centre (SMC) at the Oxley Creek STP. Oxley Creek STP is operated by QUU and is one of the major treatment plants under its control. The SMC is a thermal hydrolysis treatment plant. Thermal hydrolysis is a 2-step process of high-pressure treatment and then rapid de-compression (Barber, Kleiven and Lancaster 2004). This treatment process tears apart organics such as cellulose and makes micronutrients that are easily metabolized by the microorganisms within the SMC's anaerobic digesters. Theoretically, this process can reduce biosolids tonnage production by one third and increase methane gas production by three times. The SMC receives approximately 100 tonnes of biosolids from regional QUU plants every day. One of the limiting factors at the SMC is the biosolids feed pumps. Biosolids, also known as cake, must be wet enough for the pumps to move it into a feed hopper. Thus, cake solids percentages coming from regional plants must be lower than 14%.

Traditionally Sandgate STP has produced a cake between 14% and 15% solids or better. This cake was transported to Cecil Plains for the enhancement of non-food crop industry agricultural land known as beneficial reuse. When the SMC was developed it was decided that Sandgate's cake would be used in the thermal hydrolysis process instead of beneficial re-use. This decision was based on trucking costs to Cecil Plains and cake availability under previous contractual agreements. The de-watering system at Sandgate STP had to be adjusted to produce solids lower than 14% to the meet the SMC requirements. The changes resulted in operational difficulties and an increased total tonnage of biosolids produced because of the excess water left in the solids (see Table 1).

Table 1: ***% Solids and Production Volume Comparison.***

Daily Production (tonnes)	32.88	27.1
% Solids of Cake	14%	17%

In March 2016 the haulage contract was re-negotiated allowing for more flexibility in the movement of biosolids to Cecil Plains and the SMC. QUU identified 5 treatment plants in the Ipswich region that are more suited to the thermal hydrolysis plant due to their cake solids % and geographical location. The Wacol, Fairfield, Bundamba, Carol Park and Goodna STPs are now having their biosolids delivered to the SMC. Once again Sandgate's biosolids are going to beneficial re-use in Cecil Plains; therefore, it is very important to make the cake as dry as possible. In keeping with the QUU Biosolids Strategy the de-watering system must be optimized to reduce biosolids wet tonne volumes. Haulage fees are charged per tonne, therefore reducing the total tonnage per day will save QUU a substantial amount of money per annum.

3.0 SANDGATE SEWAGE TREATMENT PLANT

Sandgate STP is located within the Boondall Wetlands, which is in north Brisbane. The facility receives domestic wastewater from Boondall, Sandgate and Brighton totalling in approximately 16 million litres per day. The wastewater is treated using the biological nutrient removal process. Excess microorganisms known as wasted activated sludge (WAS) are removed from the process and pumped onto 2 belt filter presses (BPF) for de-watering. The presses are a French design, consisting of the Andritz PowerPress S models SAS 3000s combined with an Andritz PowerDrain gravity drainage deck (GDD). WAS is pumped onto the gravity drainage deck's belt which provides a large porous surface area for rapid de-watering and uniform sludge distribution. The thickened WAS is then further de-watered into cake through the belt filter press. The sludge falls off of the GDD and enters a long belt that is looped and doubles back over itself. The belt is tensioned along the 11 rolls using pneumatic rams and forms an "S" shape. As the sludge travels past the rolls pressure increases as the roller's size decreases resulting in a high compression force.

The volume wasted to the belts is calculated through the control system. It uses a sludge age of 20 days and a manual input of mixed liquor suspended solids (MLSS) concentration to determine the wasting volume. Once the volume is determined the operator can adjust the GDD, BFP and WAS to optimize the quality of the cake being produced. Polymer is used to coagulate the WAS which allows for water separation. Polymer concentration and dosage can be selected on the control system. Dosage volume is determined by selecting a dry tonnes per kg wasted ratio such as 6.0 kg/tonne. Increasing the ratio increases the volume of polymer dosed into the WAS.

4.0 BELT FILTER PRESS OPTIMIZATION AND RECOMMENDATIONS

The operational steps taken to increase the cake solids % and reduce the over biosolids tonne production per day are listed in Table 2. Using the Andritz PowerPress operational manual as a guideline the WAS feed rate was reduced, polymer dosage was increased and GDD/BFP running speeds were reduced. These changes did not make significant improvements on cake dryness. After the operational changes failed to produce results the GDD/BFP equipment itself was considered as the limiting factor. Arrangements were made to have the belts on BFP 1 and 2 high pressure cleaned to increase their permeability. This was the only successful alteration that was made that increased de-watering capability and resulted in a higher cake solids % level.

Table 2: ***Belt Filter Press Optimization.***

DATE	Operational Change	WAS Feed Rate (L/S)	GDD Speed %	BFP Speed %	Polymer Dosage (kg/tonne)	BFP 1 %	BFP 2 %
Initial Settings	None	40	60	60	4.0	13.3	13.0
4/04/2016	As suggested in the operational manual reducing feed rate to increase dryness	35	60	60	4.0	13.0	13.3
5/04/2016	As suggested in the operational manual reducing feed rate to increase dryness	30	50	50	4.0	13.8	13.1
6/04/2016	Continuing to reduce feed rate and decreasing speeds of the BFP/GDD increasing time that the cake is being pressed	25	50	50	4.0	13.5	13.5
7/04/2016	Original settings before sludge was being taken to the SMC	40	100	50	6.0	13.3	13.8
12/04/2016	High pressure water cleaning on BFP 1 and 2 belts	40	100	50	6.0	14.2	14.3

Further consideration has been given to the current operational state of the BFP and recommendations have been made to the maintenance supervisor from QUU that the following mechanical improvements are made to the BFP:

1) Sandgate’s Andritz PowerPress is supplied with an optional de-watering improvement kit called a “nip”. The nip is composed of a pneumatic ram and roller attached to the bottom side of the BFP. Just before the cake exits the BFP the last roller receives extra compression from the nip’s roller increasing de-watering capabilities. The nips are not currently functioning as recommended in the operational manual. On BFP 1 the nip is too low and is pressing on the outer belt after de-watering has been completed. On BFP 2 the nip does not move or come into contact with the last roller. It has been recommended to the mechanical maintenance team that the nips be adjusted to function as designed. (See Figure 1)
2) Repeated tracking faults on BFP 1 and 2 have damaged their belts. Both belts have significate stretching, warping and tears resulting in poor de-watering. It has been recommended to the mechanical maintenance team that the belts are replaced to improve belt tensioning and increase permeability.
3) The BFPs have 2 wash boxes per press which use high pressure water sprayed through nozzles to clean the belts. The nozzles often become clogged with debris reducing their ability to clean the belts. It has been recommended to the mechanical maintenance team that the wash boxes are dismantled and cleaned during the belt replacement.

4) Correct belt tension is critical in optimizing de-watering because it ensures good belt alignment and maintains an even pressure throughout the rolling process. The current air regulators feeding the tension control panel are in disrepair. It has been recommended to the mechanical maintenance team that these regulators are replaced with new equipment to ensure the correct air pressure is being received to the BFP's air control panel.
5) A high pressure water blaster should be purchased for use by the operator to clean the BPF's belts daily. Keeping the belts clean will maintain good permeability and is proven to increase solids % levels in the cake.

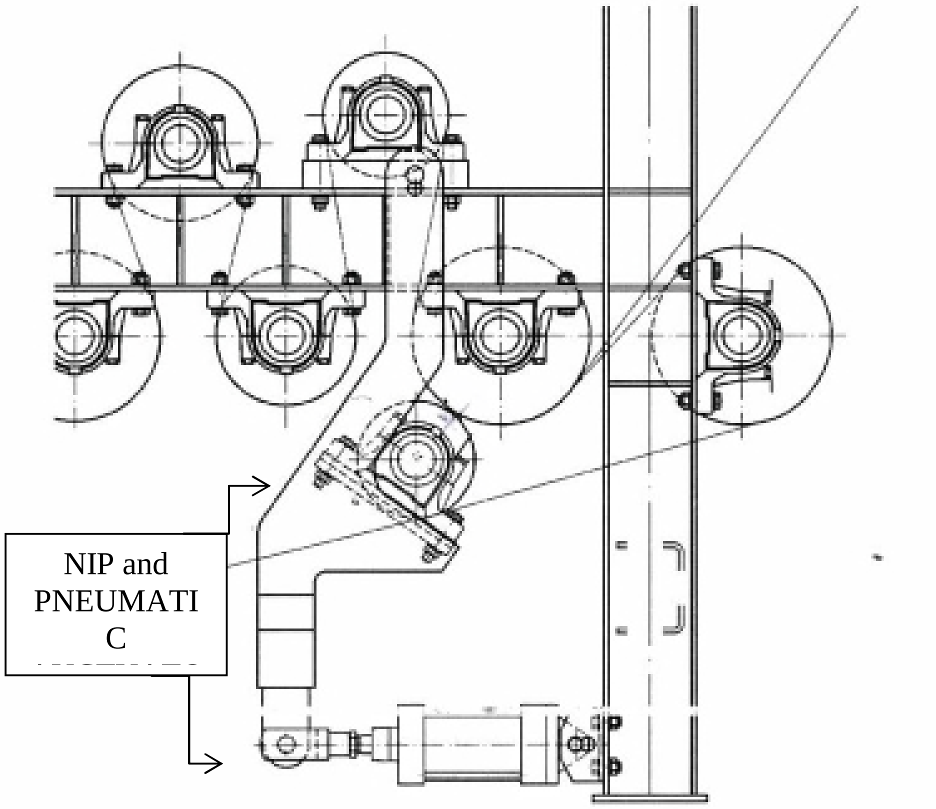

Figure 1: ***Belt Filter Press Nip.***

5.0 MIXED LIQUOR SUSPENDED SOLIDS

Historical information located within the QUU Scientific Analytical Services archives demonstrates that the BFPs have the ability to create dry cake (see Table 3). The BFPs were commissioned in 2006 and had initial cake dryness of about 18%. Production ability then dropped off dramatically and has since wavered between 13% and 15%. Interestingly the cake dryness seems to improve when the MLSS concentration is reduced from 3000 mg/L to 2200 mg/L. As described earlier the current MLSS concentration is the result of a 20 day sludge age calculation determined by the control system's wasting rate and typically results in a concentration of about 3000 mg/L. Further investigations and trials will need to be conducted to see whether a process change could be used to improve de-watering.

Table 3: ***De-watering Capabilities and MLSS Concentrations.***

	MLSS (mg/L)		**BFP % Solids**	
DATE	Bioreactor 1	Bioreactor 2	BFP 1	BFP 2
0/02/2006	3010	2790	18.9	18.1
10/03/2008	2290	2230	15.2	15.3

6.0 CONCLUSION

To achieve the Biosolids Strategy at Sandgate STP the de-watering system must produce dry cake in order to reduce the overall tonnage of biosolids currently being hauled to Cecil Plains. To produce dry cake the recommended mechanical improvements need to occur and the effects of MLSS concentrations on de-watering need to be investigated. If operations can procure a high pressure water blaster and clean the belts daily a cake dryness of 14% solids can be constantly achieved. When all of the improvements are completed a cake dryness of up to 17% may be produced which would reduce the annual biosolids production by 1400 tonnes. At a removal cost of between $50 and $70 per tonne the dryer cake % would result in almost $84,000 in savings per annum.

7.0 REFERENCES

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