PROCESS OPTIMISATION OF BIOSOLIDS DEWATERING

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ABSTRACT

The Black Rock Water Reclamation Plant was upgraded to secondary treatment in 1996. The upgrade included the construction of a sludge dewatering process. Until March 2001 the dewatered sludge was stored onsite at Black Rock in clay lined lagoons. Due to restrictions at the site it became necessary to find alternative storage sites.

Since March 2001 the dewatered sludge has been stored at Western Treatment Plant in Werribee approximately 62 kilometres away. In February 2004 a treatment process commenced to dry and stabilise the sludge into biosolids. The biosolids are now being reused beneficially as a soil improver on agricultural land. This process is an interim step toward Barwon Water's long term biosolids management project.

The costs for transport and processing of the biosolids are based on the wet tonnage of the dewatered sludge produced. It is very important to ensure that the sludge dewatering operation produces the driest possible sludge cake. The paper discusses the problems faced by the operators of the plant, the solutions that were applied and the outcomes achieved.

KEYWORDS

Water reclamation plant, biosolids, sludge dewatering, efficiency, moisture content, economic benefit.

1.0 INTRODUCTION

The Black Rock Water Reclamation Plant treats domestic and industrial wastewater from the City of Geelong and surrounding townships including Torquay, Ocean Grove and Queenscliff. The plant serves an E.P. of 220,000 people.

Following the upgrade of the Black Rock Water Reclamation Plant to secondary treatment in May 1996, the sludge dewatering process was commissioned in September 1996. Up until March 2001 the dewatered sludge was stored in specially constructed clay lined lagoons on site at Black Rock.

From March 2001 until February 2004 the dewatered sludge has been transported to and stored at the Western Treatment Plant in Werribee. In February 2004 a treatment process commenced to dry and stabilise the sludge into biosolids. The biosolids are being reused beneficially as a soil improver on agricultural land. This process is an interim step toward Barwon Water's long term biosolids management project.

2.0 THE PROBLEM

The plant utilises the Intermittently Decanted Extended Aeration (IDEA) process. IDEA plants are often designed with an assumed sludge yield factor lower than will actually occur. As a consequence, there is considerably more sludge produced than was anticipated at the design stage. This puts pressure on operators and machinery to dispose of the waste activated sludge.

The dewatering plant consists of four dewatering trains each 3 metres wide. Each train consists of polymer dosing equipment, floc mixing tank, gravity deck and belt press which discharge dewatered sludge to a spiral conveyor system that fills the waiting trucks. Each truck transports 27 tonnes of sludge.

The costs for the transport and processing of the biosolids are based on the wet tonnage of dewatered sludge produced at Black Rock. Therefore it is very important that the sludge dewatering operation produces the driest possible sludge cake to minimise these costs. The opportunity to increase cake dryness was identified as a worthy Continuous Improvement Project.

3.0 OPPORTUNITIES FOR IMPROVEMENT

From the time of commissioning it was identified that the equipment supplied had potential to be fine tuned and its performance improved. Early results of sludge cake dryness indicated that the cake coming off the belt presses was wetter than anticipated. The percentage moisture content was in the range of 86.5%-88%. If these results were improved by even a small margin they would provide a significant economic benefit.

4.0 ANALYSIS OF THE PROBLEM

Greater understanding of the operation and function of the equipment has been gained as experience with the equipment grows. Analysis of the shortcomings of the equipment concluded that the factors affecting sludge cake dryness could be grouped into three categories:

Reliability – the dewatering trains were stopping up to 8 times a day each. The stoppages were caused by false alarms communicated to the control system. It was identified that the ingress of moisture to connections in the communication wiring was the cause. This required almost constant attention from the operator and led to frequent downtime of the plant.

Inefficient polymer dosage and mixing – a polyelectrolyte solution is added to the waste activated sludge to assist in the flocculation process prior to discharging onto the gravity deck and belt press. If not made up to the correct dilution and dosed at the correct rate this problem led to wetter than optimum sludge and the overuse of polymer.

Ineffective filter belt backwashing devices – each drainage belt on the gravity decks and belt presses has a back washing sparge that is designed to remove solid material adhering to the belts. If solid material is allowed to accumulate in the fabric apertures the belts do not drain the sludge efficiently.

Each of these factors was then studied to try to find a solution to minimise the impact caused.

5.0 SOLUTIONS

An assessment of the cause of these problems helped determine the most appropriate solutions. The solutions determined to be most effective are described below.

5.1 Reliability

To allow the dewatering trains to operate reliably it was necessary to eliminate the ingress of moisture into the communication wiring. A decision was therefore made to rewire instrumentation to I.P.56 standard as required in Australian Standard AS 1939-1990.

<u>**Figure 1:**</u> ***Rewired Conductivity Probe***

5.2 Polymer Dosing

In order to make more efficient use of polymer and to produce the best performance (driest sludge cake) it was decided to seek assistance from the polymer supplier CIBA. CIBA has a very good understanding of both the performance of their product and also the type of makeup and dosing equipment. It was considered crucial to keep the polymer dosing system at or near its optimum performance at all times.

This could be achieved by arranging to have CIBA attend site on a monthly basis to optimise the polymer makeup and dosing operation and through the diligence of Barwon Water's Operators in monitoring performance. This would ensure the correct dilution of the polymer solution and the most effective dose rate into the waste activated sludge stream would be achieved as conditions in the biological treatment process vary.

Figure 2: ***Polymer Dosing Equipment***

5.3 Filter Belt Backwashing

The effectiveness of the gravity deck and belt press belts in dewatering the sludge is directly related to their ability to drain water from the waste activated solids while retaining the solids on top of the woven belts. As the belts drain water through the fabric, solids build up in the apertures of the belt and obstruct the drainage path of the water.

This reduces the permeability of the belts and results in wetter sludge cake. The gravity decks and belt presses have a number of sparge bars installed to clean the belts in order to remove the material blocking the apertures.

Figure 3: ***Additional Sparge Bar***

Figure 4: **High Pressure Cleaning**

It was agreed by the operators that the process would be improved by –

1. Installing a number of additional sparge bars to improve the continuous belt cleaning function.

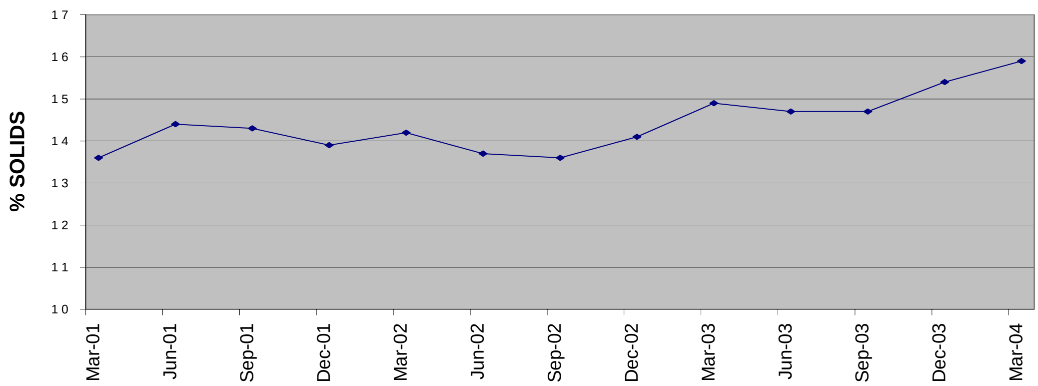
2. The use of a high pressure cleaner to clean the belts on a weekly basis to remove the most persistent material from the belts.

6.0 RESULTS

Over the past 3 years the operators have progressively improved the performance of the sludge dewatering operation through the steps identified. A number of smaller initiatives such as the addition of in-line filters on the wash water have also contributed to this improvement in performance but are not detailed.

The % solids in the dry sludge cake has increased from 14.21% (average result for the 3 years prior) to 15.62% (average result over the past 6 months). This is an increase of 1.41% or 9.92% real improvement.

Figure 5: ***Sludge Dewatering Performance***



7.0 IMPLEMENTATION COSTS (per annum)

Solution 1 Rewiring of the dewatering trains to I.P. 56 standard. Cost of rewiring $22,000 spread over 10 years	$2,200
Solution 2 CIBA supply polymer to Black Rock and are able to provide this service at no additional charge	Nil
Solution 3 Additional sparge bars - Cost $6521 spread over 10 years Supply high pressure cleaner - Cost $4500 spread over 3 years	$652 $1500
Total per annum	**$4352**

8.0 BENEFITS

8.1 Environmental

The reduction in the volume of sludge produced at the end of the sludge dewatering process has the effect of requiring less sludge to be transported to Werribee. The reduction of 4,396 tonnes requires 163 less truck loads to Western Treatment Plant per annum. This has an effect of reducing the greenhouse gas emissions from the diesel powered trucks used for transport.

8.2 Social

The reduction in truckloads to Western Treatment Plant has the effect of reducing traffic in and out of the Black Rock plant. As the local community has concerns about traffic movements it should be recognised that this reduction of traffic has a direct social benefit for the local area as well as for the greater Geelong region.

Figure 7: ***Sludge Transport Truck***

8.3 Economic

Dewatered sludge produced per annum (4 year average in tonnes)	**9.92% reduction in mass (tonnes)**	**Savings per annum (transport & processing) @ $50 per tonne**
44,310	4,396	$219,800.00
	Less costs	- $4352.00
	Net benefit	$215,448.00

9.0 CONCLUSION

In conclusion the team effort of the operators and contractors at the Black Rock plant to improve a process that was performing poorly have succeeded in producing results that can be acknowledged as making significant savings to the water authority together with benefits to the local community. The operators are continuing to review performance and identify opportunities to further improve the dewatering process at the Black Rock plant.

10.0 ACKNOWLEDGEMENTS

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