OPTIMISING SLUDGE DEWATERING - BENEFITS FROM SHARED WATER SERVICES

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ABSTRACT

The Porirua Wastewater Treatment Plant was commissioned in 1989 and had been operated in-house by Porirua City Council. A number of upgrade works had been made to the plant since commissioning, however by late 2013 the performance of the dewatering system had dropped to around 14% dry solids which was constraining the solids disposal to landfill.

Following the merger of Capacity Infrastructure Services and Greater Wellington Bulk Water into Wellington Water in 2014 the combined operation teams were able to work to improve dewatering performance at the site. Trials identified that an emulsion polymer was optimal and resulted in an increase to 20% dry solids being achieved. The additional chemical cost was assessed against the reduction in disposal costs and has proven to be good value for money.

These improvements have allowed the treatment plant to effectively manage the solids inventory in the treatment process, optimise landfill disposal costs and improve effluent consent compliance.

KEYWORDS

Sludge dewatering, optimising, operations, shared services

1 INTRODUCTION

Wellington Water is a shared service, council-controlled organisation jointly owned by the Hutt, Porirua, Upper Hutt and Wellington City Councils, and Greater Wellington Regional Council. It manages the three water networks (drinking water, stormwater and wastewater) on behalf of client councils and provides advice on how best to deliver the three water services with client councils owning and funding the assets. Wellington Water is implementing a regional approach to planning, operating and managing these water networks. As part of this regional approach, knowledge sharing is actively encouraged.

Wellington Water Ltd (then Capacity Infrastructure Services) took over management and operation of the Porirua Wastewater Treatment Plant in November 2013. Prior to that time, the plant, which had been commissioned in 1989, had been operated in-house by Porirua City Council (PCC) staff. PCC currently has a population of around 50,000 but the plant treats wastewater from northern Wellington City Council under a "Joint Venture" arrangement. The total catchment is approximately 80,000 population and is growing steadily.

A number of upgrade works have been made to the solids thickening system in the past decade, including replacement of the original belt filter presses with centrifuges in 2006 and a third clarifier in 2012. The centrifuges had been commissioned at an initial performance of around 18% dry solids but by late 2013 the dry solids being achieved had dropped to around 14% on average and as low as 11% at times. This poor dewatering was associated with a poor solids capture.

The dewatered sludge has been disposed at Spicers landfill since 1989. Despite the population growing over time the waste volumes at the landfill had been declining in recent years. The landfill acceptance of the dewatered sludge is constrained by minimum mixing ratios. With reduced overall waste to landfill, the volume of sludge that could be accepted was becoming less than what the treatment plant was generating. This in turn was leading to accumulation of solids in the treatment plant beyond design levels. The treatment plant had been

non-compliant with consent conditions as the clarifier sludge blankets were regularly over-topping during high flow events.

2 CONSIDERATIONS FOR DISPOSAL TO LANDFILL

2.1 ODOUR ISSUES

As noted above, dewatered sludge from the plant had been disposed to Spicer Landfill since 1989. Landfill odour complaints increased significantly in early 2015 and by June 2015 GWRC issued an abatement notice to PCC to cease discharge of objectionable odour to air from the Spicer Landfill.

The landfill operator expressed a view that the dewatered sludge was a major contributor to the odour at the landfill. While Wellington Water did not agree that the odour issues were directly related to the sludge disposal, efforts to cooperate and assist with the landfill operation were given priority. Improvements to dewatering were the key area of focus.

A subsequent independent review found no correlation between the landfill odour complaints and sludge dry solids content.

2.2 MIXING RATIOS

The Spicer Landfill resource consent requires dewatered sludge to have a minimum of 11% dry solids content and requires minimum mixing ratios of 5 parts general refuse to 1 part biosolids. The dry solids requirement is relatively low compared to other sites, however that figure had provided the baseline requirement target. The volume of general waste received by Spicer Landfill had been declining in the past few years. There are currently three operational landfills in the Greater Wellington area and there had been some reduction in waste received at the site, particularly following price increases in July 2013. In 2010 total refuse (excluding green waste and sludge) was just over 4,000 tonnes per month. By 2015 the total refuse had reduced to approximately 3,000 tonnes per month.

With the gradually increasing population and improvements in effluent quality resulting in more sludge, by mid 2015 the treatment plant was struggling to maintain the target solids retention time in the aeration basin.

2.3 WORKING WITH THE LANDFILL

The practical requirements of achieving mixing ratios at the landfill meant that by 2015 the WWTP was restricted to sending six bins of sludge per day on week days (each bin up to 5 tonnes) and three bins on Saturday by agreement. There is also a limited time window for deliveries to site in order for the landfill to dispose the sludge.

A monthly liaison meeting was instituted in late 2015 to help both parties better understand the others pressures and lead to a more collaborative working arrangement. These discussions have led to other improvements by coordinating the treatment plant operation to the landfill operation, particularly around centrifuge processing times and truck movement times.

3 RETURN ACTIVATED SLUDGE SYSTEM UPGRADE

In order to improve plant effluent compliance PCC commissioned a third clarifier in 2012 to cater for a growing catchment population and increasing peak flows from network upgrades to reduce wet weather overflows. While this third clarifier provided some benefit to the effluent quality and plant hydraulic capacity, the new clarifier had not integrated with the existing plant as well as planned. In particular, the new clarifier was deeper than the two existing clarifiers. The manual valve provided for balancing of the return activated sludge (RAS) from the three clarifiers to the existing RAS/WAS pump station had proved insufficient for operators to maintain a consistent sludge blanket between the clarifiers. This had resulted in sludge blanket overtopping in

high flow events and was also hindering the operation of the dewatering system with inconsistent waste activated sludge (WAS) feed.

An upgrade of the RAS/WAS system was undertaken in 2014/15. This upgrade provided independent RAS pump stations to each clarifier to provide a stable WAS feed to the sludge thickening system and further improve effluent compliance.

4 DEWATERING IMPROVEMENTS

As part of the merger between the former Greater Wellington Bulk Water Team and Capacity Infrastructure Services, Wellington Water inherited the technical expertise from Greater Wellington's team of in-house water treatment plant operations.

The new Treatment Plants manager visited the site with the Chief Advisor Treatment Optimisation and quickly identified a number of potential improvements, in particular the opportunity to substantially improve dewatering performance with an alternative polymer product. The steps undertaken are outlined below.

4.1 EMULSION POLYMER

The former GWRC staff had extensive experience with emulsion and powder polymer systems for the dewatering of water treatment solids at the three plants they operated and therefore had considerable experience and some expertise in this matter.

With the assistance of Cardno Consultants, two polymer suppliers were invited to provide both powdered and emulsion polymers for jar testing and full scale testing. On the basis of the independent review of those trials, the IXOM EJ 12 emulsion polymer was selected for use. One of the significant factors favoring emulsion over powder was the limited ability of the existing powder polymer batching plant to keep up with demand.

The change to a more effective polymer system produced a step change in the dewatering performance. Figure 1 below shows the improvement from an average 14% dry solids to an average just under 20% dry solids in the last quarter of the year. The improvement in capture rate also allowed the hydraulic loading rate on the centrifuges to be reduced.

Further optimization work has been undertaken by IXOM since the initial set-up to accommodate changes in sludge. Due to the constraints on sludge removal, the Mixed Liquor Suspended Solids in the aeration basin had been around 5,700 mg/L in the first half of 2015. This was able to be reduced to the target level of 3,500 mg/L following the first few months of emulsion polymer operation and also improved the effluent quality with reduced solids loading on the clarifiers.

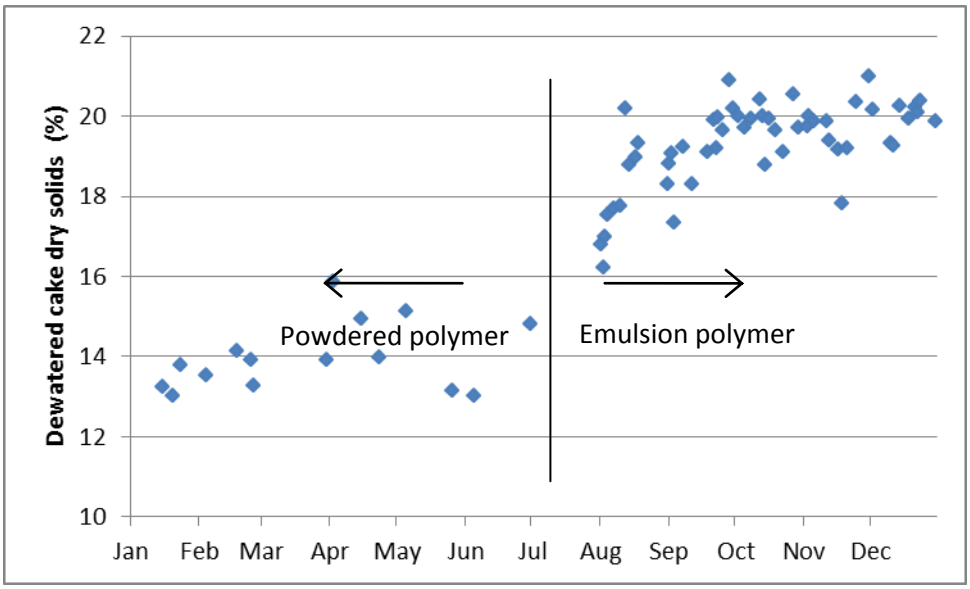

Figure 1: Dewatering performance during 2015

4.2 OTHER OPERATIONAL IMPROVEMENTS

In addition to the emulsion polymer dosing the sludge handling system was comprehensively reviewed to seek other improvements. The actions undertaken are outlined below.

4.2.1 CHANGES TO SLUDGE BIN HANDLING

The dewatered sludge bins are modified skip bins, operating on a "train track" system. The weight of the bins and the limited access to the bin area had previously meant that the operators were reliant on the waste disposal contractor to move the bins.

The new Wellington Water management team identified that this reliance on the waste disposal contractor was a constraint on plant operational flexibility. The operations team arranged a leased forklift for the site, improving operational capability to maximize the centrifuges output in order to meet the delivery time window limitations for the landfill.

4.2.2 CHANGES TO CONTROL SYSTEM AUTOMATION

One of the key requests from the landfill operators was to provide dewatered sludge as "fresh" as possible. Although the treatment plant has a relatively long sludge age (typically 20 days), there is still some potential for odour generation.

Previous operational practice had been to produce the first two bins of the next days sludge the previous afternoon. In order to maximize both the "freshness" of the sludge and the daily time window available for processing some modifications were made to the control system to automate the centrifuge start time. This had the additional benefit of reducing the hours required for the operator to attend site on Saturday for processing the three sludge bins permitted.

4.2.3 IMPROVEMENTS TO SITE DOCUMENTATION AND OPERATING PROCEDURES

Improvements have also been made to site documentation to support the ongoing operation.

Wellington Water is progressively introducing practices from operating four water treatment plants. Process and Instrumentation Diagrams have been created to provide a basis for a detailed understanding of where equipment fits in the process train, an asset list, and this is now being developed into a structured asset maintenance schedule.

5 VALUE FOR MONEY

One of the key objectives for Wellington Water is creation of "Value for Money". While the dewatering improvements at Porirua WWTP were initially triggered by the landfill odour concerns there was also a value for money proposition with the increased chemical cost being more than offset but the saving in disposal cost.

Figure 2 below shows the monthly costs for these two factors.

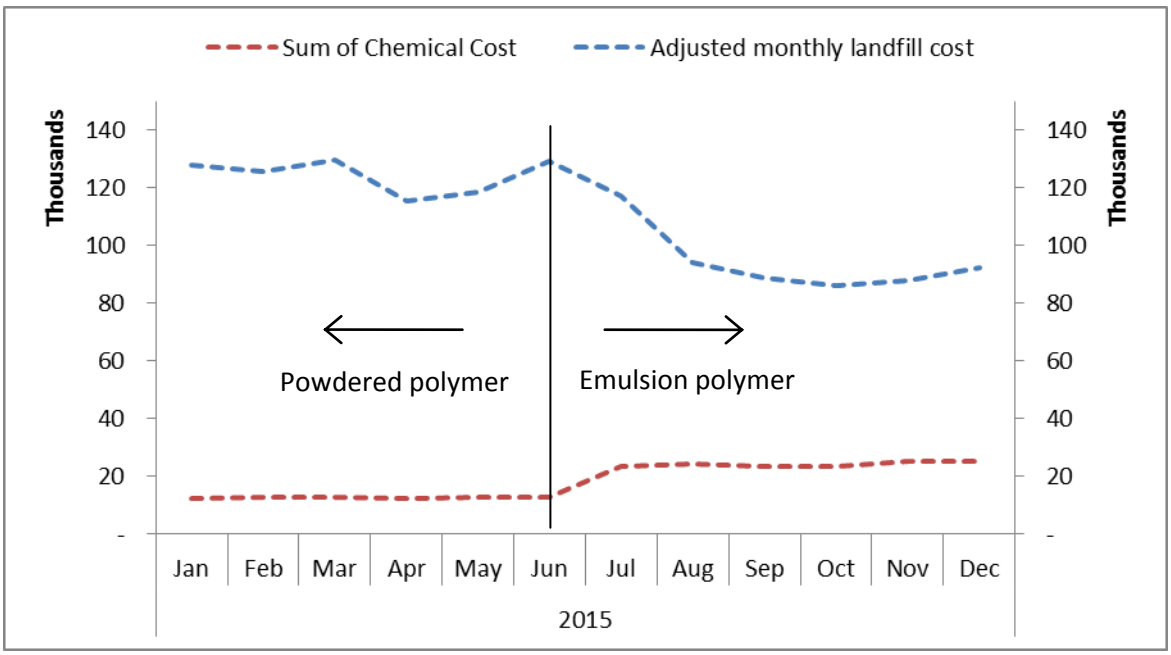

Figure 2: Monthly chemical costs and disposal costs during 2015

6 NEXT STEPS

A number of future improvement works are also being planned for the dewatering system. Further optimization of the gravity thickeners is the next priority, followed by a pilot trial of the Aquen floc former conditioning system.

A thermal dryer is being investigated to minimize solids production and provide the opportunity for beneficial use of the biosolids. Discussions are also underway with TERAX to consider that process for application to the Porirua situation.

Ongoing review of the emulsion polymer will be undertaken to check whether return to powder polymer would be appropriate.

7 CONCLUSIONS

With decreasing landfill waste volumes there was an increasing requirement for co-ordination between landfill operations and the disposal of dewatered sludge from the Porirua wastewater treatment plant.

The increased pool of technically skilled operations staff that the new shared services model provided was valuable in providing alternative approaches or options.
In this case the changing to an emulsion polymer provided both a positive improvement in the dewatering plant performance and also value for money by reducing landfill disposal costs.

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REFERENCES

Beca (2015), Spicer Landfill Odour Report, for Porirua City Council