BIOSOLIDS BELT PRESSING – THE TRIALS AND TRIBULATIONS OF SEEKING BETTER PERFORMANCE

Paper Presented by:

David Greaves

Author:

David Greaves, *Coordinator Black Rock Water Reclamation Plant,*

Barwon Water

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1.0 INTRODUCTION

Black Rock water reclamation plant is the largest plant of its type operated by Barwon Water in Geelong, Victoria and services approximately 250,000 customers. The plant is an Intermittently Decanted Extended Aeration (IDEA) plant, with an average dry weather capacity of 70 ML/day and a peak wet weather capacity of 210 ML/day. The treatment process consists of coarse screening to 65mm followed by fine screening down to 3mm. From here the influent goes to four 25 ML biological treatment tanks which operate on a four hour treatment cycle consisting of two hours of aeration followed by one and a half hours of settling and 30 minutes of decanting. From this process we have two outputs:

- Class C recycled water for use by connected customers or discharge from a 1.2 kilometre outfall to the ocean.
- Biosolids. During aeration cycles 'mixed liquor' (MLSS) is removed from the treatment tanks and belt pressed onsite. We currently produce 120 tonnes per day of dewatered biosolids from four Warman Belt filter press trains each with a 3 metre width. Biosolids are then taken offsite via semi trailers for further drying and processing at Melbourne Water's Western treatment plant as part of the short term biosolids management plan. Barwon Water's long term biosolids management strategy, an onsite thermal drying process at Black Rock, is currently under construction and is anticipated to be commissioned in early 2010.

Good maintenance ensures that the biosolids plant runs properly for the maximum amount of available time, however the question we kept asking ourselves was, 'is the plant running at its most efficient?'

By way of a few mechanical failures in the belt filter press plant we have embarked on a series of trials involving recycled water, belt material, polymer choice and online monitoring equipment across the plant with the aim of producing the best possible final biosolids product. Additionally, with a new thermal biosolids drying plant presently being constructed onsite and commissioned next year, it is more important than ever that our dewatered biosolids have the best possible moisture content, consistency, and quality. Some of the trials provided improvement, some confirmed that what we were doing was the best possible, but the most important thing we achieved from the process was a far greater understanding of our plant and the belt filter press process.

2.0 POLYMER BATCHING

As with nearly all water industry biosolids belt filter press operations, we use a flocculant to aid in the consolidation of mixed liquor prior to belt pressing. In total, we use 3 tonnes/month of powdered polymer at Black Rock from which we currently batch 35000 litres of polymer per day at strength of 0.38%. As part of our belt filter press operations we ran a small 2 l/s microfiltration unit to treat Class C recycled water for general hose down and cleaning use in the belt filter press plant. After over a decade of service the microfiltration unit failed and it was at this stage that we looked at what other possible uses we had for microfiltrated Class C water.

Almost immediately we flagged the potential to batch polymer with this microfiltrated recycled water and after many onsite tests decided that we should be able to carry out batching using recycled water with little operational problems. Based on the trials and as part of the microfiltration replacement, we ordered a new unit with an increased capacity of 4 l/s to accommodate polymer batching supply requirements.

2.1 Plenty of positives, but not all smooth sailing

Once the new membrane unit was installed and commissioned, pipe work was then modified so that Class C microfiltrated water was supplied to the polymer mixing tank and polymer batching using this water started.

Almost immediately we encountered a problem that interfered and shut the batching process down. This problem was foam! Batching polymer with recycled water was creating a thin layer of sparse foam on top of the mixing tank. This was not something we had encountered in the small trials we had done, but was now creating an issue as it was interfering with the ultrasonic level sensors in our batching and day storage tanks. The ultrasonic level sensors could not read through the foam and constantly failed to zero, at which point the plant would start batching again. Due to this we converted the level measurement to pressure transducers which have worked well since.

The significant benefits of batching polymer with recycled water at Black Rock are a 10 ML saving in potable water use per year. Not only does this make great sense environmentally, but also from an economic point of view. With potable water costing $1.63 KL that's a saving of $16,300 a year which equates to a good return on investment. This conversion has been made at other smaller plants in our system with potable water savings of 95% being achieved.

3.0 BELT FILTER PRESS MATERIAL TRIAL

The belt filter press material trial started due to a perforated press roller that had broken (shattered) in the middle. It was decided that the only way to get this 600kg roller out was to remove the belts and dismantle the top of the press to gain access. Within a week and while a replacement roller was being made we found that the same perforated rollers on each belt press were in some state of significant failure and needed to be repaired.

It was coincidentally opportune that at this time we had four or five filter belt manufacturers approach us within a few weeks trying to sell us their product. We decided, seeing as we were removing the existing belts to facilitate the roller repairs, that we should run a trial to see if we could improve our final moisture content and find the best belt fabric for our process.

To allow for a proper and fair trial we decided that we would also replace the gravity deck belts so that each manufacturer had a full set of belts on each train. Three suppliers visited the site and where asked to supply a set of belts that they thought would give us the best results based on our process. On the fourth train we used a set of new existing belts as a control.

It was decided that that our final preferred supplier would be based on moisture content, lifespan, cleaning requirements, price, pressed biosolids consistency and operator feedback.

Over the course of the trial more than 500 moisture tests were conducted on dewatered biosolids from both the gravity and press belts to allow us to get an accurate picture of what was happening across the four belt filter press trains.

Prior to the trial we were running at an average of 15% solids (85% water) off our belt presses, and had large amounts of data to show that this 15% solids was consistently achieved over many years. Any improvement in solids content from using new belts would have a positive financial impact. A 1% improvement would mean 1.2 tonnes less water transported off site each day. Based on this our expectations going into the trial were quite high and we hoped that we could find 1% to 2% improvement at the very least.

3.1 Moisture content, lifespan, price and cleaning results

Our expectations were dashed quite early in the trial as it became evident that there was no holy grail for us in terms of solids percentage gains from different manufacturer's belts and weaves. Some belts provided equal performance at 15%, some provided reduced performance at 13% and some were inconsistent in that they would vary between 13% and 16% over the course of the trial. Having proved to ourselves very early on that there was to be no significant gains in moisture content we moved our focus onto the other elements of the trial.

Of the four sets of belts, one press set failed very early on in the trial, after about six months. These belts were found to wear poorly around the zipper/connector area. It was decided that due to these failures these belts would be removed from the trial. The other three sets of belts have been in service for nearly two years now with our first gravity deck failure in the last month. From past experience we would consider normal life spans for gravity belts to be about 18 months and press belts to be around 2 years.

Overall purchase price was very even. Three sets were priced within 6% of each other. The other set was 20% cheaper than the rest however this was also the set that failed within 6 months of the trial starting. With this in mind the price became almost irrelevant in the final decision as there was very little cost difference over the three remaining sets of belts.

Like all belt filter presses, ours contain several sets of sparge cleaning bars that spray high pressure water onto the belts for cleaning purposes. In addition to this we also clean every belt once per week using very high pressure gernies. At the front of the press we have two sets of doctor blades (top and bottom belts) that aid in the removal of the biosolids from the belts and into the conveyor system. One of the most significant issues we found with three of the four sets of belts was an accumulation of fibre and hair on the doctor blades. It appears that this fibre and hair becomes caught in the weave of the belts rather than sitting on top of the belt. Once caught this fibre and hair appears to hook itself around the leading edge of the doctor blades. Over a very short period of time this raises the doctor blade a few millimetres off the belt and results in some biosolids material not being removed. This also causes the creation of sludge balls on top of the press that need to be removed. This hair and fibre needs to be removed from these doctor blades several times per day. The other set of belts trialled has not shown any signs of this problem, and does not appear to allow this material to be caught in the weave with all biosolids falling freely from the doctor blades and cleaning of these blades required infrequently.

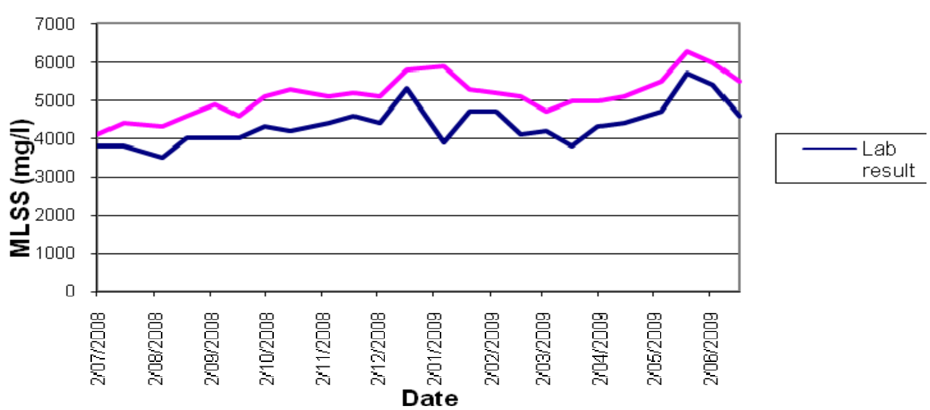
3.2 The Final Choice

Our final decision relating to which of the belt types were best for us came down to consistency. Some of this can be validated by lab tests, and some of it comes from operator feedback in relation to visual and perceived performance. In the end we did not achieve any better moisture content performance as was envisaged at the start of the trial, but we did see that we could do worse, and found overall we could become more consistent in what we do. So based on our test results we chose the belts that gave us the best average solids content (15%), lasted at least two years and were the easiest to clean and maintain. The good part about this final decision was that they were the belts the operators believed worked the best over the course of the trial.

4.0 MEASURING MLSS FOR ACCURATE POLYMER DOSING- THE DISCREPANCIES

There are several ways in which treatment plant operators measure their MLSS or solids loadings in the treatment process. They can be onsite filtering and drying, external laboratory analysis, handheld solids meters and halogen lamp dryers to name a few. At Black Rock we have the ability to use onsite filtering and drying, external laboratory analysis, handheld solids meter and an online solids meter.

We use our MLSS readings taken each day to select our polymer dosing rate for that period. At other plants we use handheld solids meters calibrated to MLSS results from external laboratory testing of site samples. One issue we always had with all these tests was that there was a significant level of disparity between results on the same sample, depending on the methods used. Some of these discrepancies can be explained by operator errors and some can be explained by the mis-calibration of handheld units. However the biggest discrepancy was the one between our onsite filtered and dried results and our external laboratory supplied results using the same method on the same sample. As can be seen in the graph below, our average variation was 15%, with the onsite measurements always being higher. Depending on which of these two figures you use for your solids concentration can have a significant impact on your belt filter press and polymer usage, sludge age and quantity determination and also have a compounding effect if being used to calibrate electronic solids meters.



<u>Figure 1:</u> ***MLSS – Site vs Lab Monitoring***

Following a review of our onsite sampling and testing procedures and confirmation that

they were exactly the same as our external laboratory procedures, we set about finding what caused this variation.
What we found at the end of our testing was a very simple and repeatable sample difference based simply on the time it takes you to test a sample. Simply put, MLSS contains a huge amount of biology that breaks down and treats sewerage. Because we put it in a sample bottle doesn't mean it stops working, and because of this continuing activity, the longer you leave a sample sitting before testing the lower the MLSS result will be. Below are test results for the same sample re-tested over a period of days. It shows that if you are using laboratory MLSS results that have taken several days to be delivered and tested, they will more than likely be largely different to actual readings.

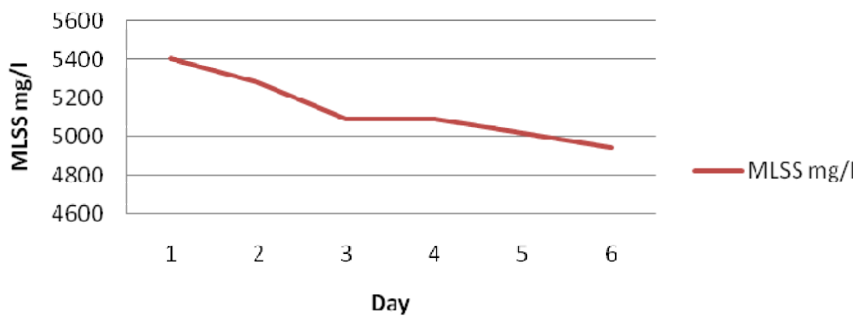


Figure 2: ***MLSS sample degredation***

4.1 Obtaining MLSS Accuracy

We have recently installed an online MLSS meter into one of our aeration tanks. Once installed it was calibrated using onsite laboratory MLSS results. The unit consists of a recycled water cleaning jet to keep the light source clean and to date has given us results within 4% of all onsite samples. These results have been obtained with little maintenance and monthly calibration checks. Because of these good results we are looking at reducing our onsite testing in the future, and have purchased another unit to measure the MLSS in our belt press solids storage tank.

5.0 POLYMER TRIAL

As a continuation of our belt filter press trial, and following discussions with our flocculant supplier, a trial validating optimum powder flocculant was carried out in combination with evaluation of the alternative bead flocculant technology. Bead flocculants have been reported to increase free drainage during dewatering. This trial evaluated Zetag 8160, Zetag 8180 ("powder flocculant") and the equivalent Zetag 7557, Zetag 7587 ("bead flocculant"). For the purposes of the trial, Ciba supplied a 3000 litre/hour fully self contained batching unit. This unit was setup to supply flocculant to belt filter press train #1, while the other three trains continued to run on the existing system as controls. The self contained batching unit was connected to the existing flocculant dosing pump No.1. Both the onsite batching plant and the self contained batching plant were calibrated to deliver identical batch strengths (0.36%). All other aspects of the dosing system were the same - including the use of recycled water for flocculant batching. Current use Zetag 8180 polymer was put through the system for two weeks to collect background data and ensure the standalone batching unit was working within the parameters of the onsite unit. With the calibration complete we started the trial of the different polymer products across belt filter press #1. Each flocculent trial ran for two weeks, and moisture content and overall operation were monitored on a daily basis.

At the end of each trail the performance of the test product was measured against an average of the other three belt presses.
Overall we found the Zetag 8180 treatment had a drier cake than Zetag 8160 and Zetag 7557. Zetag 8180 and Zetag 7587 cake moisture values were not significantly different. From the trial we determined that the bead flocculants did not record improved final cake moisture content and confirmed that the Zetag 8180 was the most appropriate flocculant.

From this trial however we found some very interesting results in relation to moisture content across the length of a filter belt. It appears that we have a repeatable 1% variation in moisture content from the left side to the right side of our belt presses. So if moisture content was sampled on the left side it could return a result of 84% and if sampled on the right hand side could give a result of 85%. Because this is repeatable, we now need to look at what aspects of our process can influence this. Areas that may possibly influence these variations are inconsistent belt or bellows pressures from one side to the other and inlet mixing chamber flow patterns where the MLSS is directed onto the gravity belts.

6.0 FUTURE TRIALS - ONLINE SOLIDS SETTLING TRIAL

We are currently trialling an Alcotech TC Micro™ supplied by Ciba. This unit takes a sample of flocculated water at set intervals and then measures the time to settle out in a cylinder using a solids sensor. Based on this settlement time you should be able to identify under/over dosing of polymer. As this unit is normally used in quarries, there is a chance that it will not work in our situation as we do not have the same solids settlement characteristics as the quarry and thus get differing results. We do believe however that with some modifications we will be able to get the unit to work with our solids. Stay tuned for further information.

7.0 CONCLUSION

With most water authorities suffering from water restrictions and dwindling storages, pressure on the community to be water wise and a real need for water companies to be seen to be taking a proactive approach to water conservation there is no easier solution at water reclamation plants than to use recycled water to batch polymer. As we are a large plant we can produce significant volume savings, but as we have proven even small plants can save up to 95% of their potable water use onsite.

To some extent it may appear that for all the time and effort put into the above trails we have not achieved any better results than what we started with. It is very evident that there is no Holy Grail or easy option when it comes to us producing a better biosolids end product from our belt filter press operations. This fact is almost irrelevant though considering how much we have actually learned about what we do, how we do it and how we can do it better. These trials have highlighted to us that consistency is one of the most important aspects of what we do, and if you do nothing more than become more consistent then you have achieved quite a substantial gain.

8.0 ACKNOWLEDGEMENTS

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