CHEMICAL OPTIMISATION & COST SAVINGS

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37th Annual Qld Water Industry Operations Workshop
Parklands, Gold Coast
5 June to 7 June, 2012

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ABSTRACT

The Moura Water Treatment Plant (WTP) is a conventional water treatment plant comprising chemical dosing, clarifiers and media filters. There were some extensions made to the original plant in 1974 to accommodate increased population in the town, but no major works have been undertaken since.

The raw water is sourced from the Dawson River and the raw water quality can be extremely variable, particularly in times of flooding. This puts extra strain on the treatment plant to continually provide good quality treated water.

This paper covers the investigation into the chemical dosing configuration and chemicals used at the Moura and other WTPs. It discusses a variety of trials which confirmed the benefits of changing and outlines the cost savings in both chemical and labour resulting from this work.

1.0 INTRODUCTION

The Moura Water Treatment Plant (WTP) treats water from the Dawson River and supplies it to the Moura Township as well as the town of Banana. The population serviced is Moura 2000 and Banana around 300 people.

The WTP was built in 1970 and consisted of a flash mixing tank coupled with a flocculation tank, a clarifier, two sand filters and a treated water reservoir. In 1974, to meet population growth, two more filters were added making a total of four, along with an additional clarifier and reservoir. With no further changes being made to the plant is effectively still a 1974 model.

Figure 1: ***Aerial View of Moura WTP***

Raw water quality can vary considerably with turbidity ranging from 20 NTU in drought conditions to 7,000 NTU in flood conditions. The colour can also go as high as 15,000 HU and water quality can change from day to day, a big challenge for the operators.

The existing treatment process consisting of pre-lime addition, Alum dosing, LT 25 and LT 35 addition and post lime addition was constantly being challenged by the widely variable raw water quality. It meant that the process was very difficult to manage, particularly using Alum as the coagulant along with pre/post limiling and LT 25 & LT 35.

To treat the poorer quality raw water, up to 360mg/L of Alum was being applied on occassions, just to make the coagulation process work. The plant was very expensive to run from both a chemical and labour perspective. The labour costs for mixing and dosing chemicals was very high and time consuming. From a close inspection of the plant equipment, it appeared the chemical dosing system was not very well configured with coagulant being dosed over the top of the flash mixer and there was a high potential that much of the chemicals were being wasted.

Around this time (2004), the time of the first trials, there was some publicity about the potential link betwenn Aluminium and Alzheimers Disease and given our high Alum dose rates during poor quality events, this was a concern for operators. All thses issues combined were the driver for us to investigate other coagulants and dosing configurations.

2.0 REVIEW OF PLANT OPERATION

A step by step review of the whole plant and its operation were undertaken.

2.1 Past Results

The first step was to look through all the old log sheets to determine the results from the past. At the start of the review, the chemicals being used included Alum, LT 35, and LT 25 also pre & post lime for pH correction & pre & post chlorine for disinfection.

In the past, operators had trialled various products and chemicals but none provided results better than the current plant configuration, with many bringing the colour down but leaving a hazey look in the treated water. Ultimately, we were trying to find an alternative to Alum that would give better results and not be as costly.

It appeared we would be stuck with Aluminium based products so we moved over to the plant to see if we could make it run better.

2.2 Chemical Dosing Configuration

The next step was to go back to the basic principles of coagulation, flocculation and sedimentation and check how the plant was setup and being operated according to these principles.

This investigation indicated that the chemical dosing point should be changed to give the chemicals more appropriate mixing time. At the time, the Alum, LT25, lime, and the Chlorine were being dosed over the top of the flash mixing tank allowing the natural

turbulence of the inflow to mix the chemicals.
The LT35 was added at the bottom of the mixing tank so that flocculation could take place. With observation of where the chemicals were being dosed, it appeared that there was not enough detention time for the process to work effectively and we believed we had to change dosing points and compare the results from different scenarios.

2.3 Jar Testing and Laboratory Investigations

Our first action was to try to work out where the dosing points should be for the best results. We undertook a series of jar tests to mimic the plant configuration and then to try and determine the best setup to suit the plant.

Changing dose points is something that takes time when you are dealing with raw water that is always changing – even on a daily or hourly basis.

After many frustrating hours and days changing the dosing points and many times believing we had the best plant setup, we were introduced to a new product. A product called ULTRON R 44560, formally called DVS 1C001 (but it was born into this world as D245).

According to the salesman, it was the best thing since sliced bread. In the middle of him telling me how great the product was, I asked for a 20L sample for a trial. That stopped the conversation dead in its tracks, and he looked at me with those eyes sales people seem to get when you ask for a freebie. After what seemed like forever, I did manage to get a 20L sample to trial.

More time was spent in the lab doing jar tests to see what the chemical could do. The chemicals currently in use were compared to the results using D245 to replace the alum, but still using LT35 & LT25. Then the LT35 was dropped and just the D245 and LT25 were used, and the results compared.

The jar tests were giving good results on the raw water that was coming into the plant. The conclusion was that we could use D245 + LT25 and only post lime for pH correction, as D245 does not change the pH in raw water that much.

So after looking into the performance of the D245 in the lab trials, a quick calculation indicated that there was a strong chance money could be saved in both chemicals and labour costs.

2.4 Plant Trials of D245

The next challenge was to see how D245 would work in the actual plant and having only 20L, there was none to be wasted.

With a few trials and on different dosing points, we eventually determined what we believed to be the best dosing points to provide the best performance from the plant. So with about 10L left and feeding the chemical through a sight glass to the dosing pump, we ran the plant to see what would be the result.

The results were very promising with a better quality of treated water being delivered out of the plant – the tubidity was extrmemly low, the sludge in the clarifer was settling much quicker than when alum was used, the treated water was clearer and there was no calcium taste in the water as the prelime was not required.

After the trial, an order for a tote box (1,000L) of D245 was made and a series of trials at the Moura water plant were undertaken as we had more chemical to play with.

At the end of this exercise the overall cost of chemicals and labour for mixing them was greatly reduced.

2.5 Cost of the Chemicals for the Treatment Plant

The calculated average cost of chemicals for the year 2004 is shown in Table 1. Keep in mind this is only the cost of chemicals.

Table 1: **Chemcial Costs Moura WTP 2004**

Chemical	Cost per unit	Usage 2004	Cost
Alum	$420.00 t	101 t	$ 42,420.00
Lime	$260.00 t	39 t	$ 10,140.00
LT 35	$3.00 L	4000 L	$ 12,000.00
LT 25	$6.00 Kg	222Kg	$ 1,332.00
		Total Cost	**$ 65,892.00**

The volume of water produced was 597.206ML giving a cost of $154.08ML.

As a result of the trials and by changing the chemicals and dosing points, the cost of treating water in 2005 is provided below for the same amount of water treated.

Table 2: **Chemcial Costs Moura WTP 2005**

Chemical	Cost per unit	Usage 2005	Cost
DVS1C001 (D245)	$ 2.90 L1	6,000 L	$ 17,400.00
Lime	$ 260.00 t	6.14 t	$ 1,597.00
LT 25	$ 6.00 Kg	111 Kg	$ 666.00
		Total Cost	**$ 19,663.00**

The annual saving for chemicals between 2004 and 2005 is $46,228.00

By changing the Alum to DVSIC001 (D245) we reduced the Aluminium residue in the water and also eliminated the use of LT35. The lime consumption has reduced to under a third. As D245 has very little effect on the raw water pH, we have now eliminated the need to use pre-lime. There is still a need to post-lime for pH correction to ensure the treated water meets ADWG requirements.

Since 2005, the only increase in cost are the CPI increase and wage rises. The chemical handles flood conditions very well and in fact, the dirtier the raw water, the better the plant now works. The plant is also able to be run 24/7 when the River is in flood and still produces excellent treated water. The greatest test so far has been the floods of 2011 and

the plant handled the water quality with no problems.
After a period of time to make sure that the chemical changes were working well we confirmed the change to the new chemicals and way of operating the plant.

2.6 Labour Costs for Chemical Mixing and Addition

The average time taken to mix chemicals was 4 hours per day that was seven days per week as chemicals were mixed twice a day the cost were as follows:
Monday to Friday 4 hours @ $18.00 per hour = $72.00 per day
5 day week = $360.00
Saturday 2 hours at time and half @ $27.00 = $54.00
Saturday 2 hours double time @ $36.00 = $72.00
Sunday 4 hours @ double time @ $36.00 = $144.00
So the cost of mixing chemicals for a week = $702.00 per week
The yearly cost of mixing chemicals = $ 36,504.00 (2004)

The labour cost have been reduced
Mixing time now is at between one and three hours a week
That is equal to $120.00 per week.
That is equal to $6.240.00 per year.
The savings are $30.000.00 per year.
That would change with the increase of wages and chemical cost.

2.7 Trials of D245 at other Banana Shire WTP's

As a result of the success at Moura, the D245 was trialled at two other WTP's that also draw their raw water from the Dawson River to see if the results would be the same. After the trial at Baralaba and Theodore, the chemical provided the same results as Moura. The only change made was to trial LT25 instead of LT20, as Baralaba & Theodore were using LT20 and Moura was using LT25.

The results from Baralaba and Theodore were comparable with Moura the cost of saving is different as these plant produce smaller amounts of water. The costs in those plants have been reduced by simi8lar percentages aliong witrh water quality improvoments.

3.0 CONCLUSION

The investigation into the chemical dosing process at the Moura WTP provided the opportunity for Banana Shire Council to change the chemical that we can deliver a better product at a cheaper rate to the consumer.

By changing the Alum to DVSIC001 (D245) we have reduced the Aluminium residue in the water and eliminated the use of LT35. The lime consumption has been reduced to under a third. As D245 has very little effect on the pH in raw water, we have now eliminated the need to pre-lime but there is still a need to post-lime for pH correction to bring the treated water within the ADWG specified levels.

Additionally, we now have three water treatment plants using the same chemicals which in itself provide a cost saving to Council.