BE CAREFULL WHAT YOU WISH FOR - IMPLEMENTING A FILTER INSPECTION PROGRAM

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3rd Annual WIOA NSW Water Industry Engineers & Operators Conference
Tamworth Regional Entertainment & Conference Centre
31 March to 2 April, 2009

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ABSTRACT

As stated in the publication of *A Practical Guide to the Operation and Optimisation of Media Filters* "filtration is arguably the key process unit in a Water Treatment Plant"

In recognising the truth of this statement and to improve the reliability and water quality out of our filters at Goulburn Valley Water (GVW), Peter Mosse was engaged to develop a regular inspection program and to train operators to undertake this program. This paper will cover the implementation, results and ongoing outcomes of setting up the system of inspection. The paper will also address, putting together an Action plan, and will cover some of the actions that were implemented.

1.0 INTRODUCTION

The Central Water Treatment (CWT) team operates and maintains seventeen of the thirty seven water treatment plants within the GVW area. Of the seventeen plants five have common media filters, four have Dissolved Air Floatation Filter (DAFF) filter systems, and two include in ground pressure media filters. It was identified under HACCP and a Water Quality Action List that the introduction of regular filter inspections was required and that a procedure needed to be introduced to guarantee effective operation of the CWT media filters. Dr Peter Mosse was employed to run a two day training session based on the Filter Assessment Practical Guide published by WIOA. Coinciding with the training, inspection of all filters would be undertaken with the trained operators and Dr Mosse with a written report to follow.

The parameters investigated and reported on were:

- Float removal time
- Drain down time
- Air scour intensity and progression
- Up-wash rate and duration
- Turbidity profile
- Media depths
- Texture and odour of the media
- Media layers and inspection for mud balls
- Filter scrape (if required).

From the report, an action plan was developed and followed (Table1). Several issues were identified from filters the operators believed were in excellent operational order.

The following action items were decided in order of risk to be investigated first:

1. Plant four at the Shepparton WTP,
2. The plenum floor of the Kyabram DAFF
3. OH&S improvements to the Rushworth plant to improve entry and stop wind from disturbing the filter.

For the purpose of this paper we will concentrate on the Shepparton, Kyabram and Rushworth Filters and the work that was undertaken.

2.0 ACTION PLAN

The action plan for Shepparton, Kyabram and Rushworth filters developed in response to the inspection report from Peter Mosse is detailed in Table 1. The highlighted items are actions that are discussed in more detail in this paper. If inspections are not carried out regularly, the list can be very daunting and possibly unable to achieve with budgets already set from the previous year. The approach that CWT took was it was like eating an elephant, you had to take it one chunk at a time to finish the meal. As can be seen it only took a two year plan to complete all of the items raised in the action plan.

Table 1: *Filter Inspection Action Plan*

Plant	Issue	Action	By When and Who
Shepparton	Foreign material building up in rose nozzles causing blockages	Clean and inspect all backwash tanks and install intake guard around backwash pump intakes	Completed
	Lack of online turbidity analyzers resulting in late response to high turbidity's	Reinstate analyzers on plant 3 (never connected after installation), Purchase meters for plant 4, and install second meter on plant 1.	Completed
	No portable data logger equipment to spot check and trend pH, Turbidity and Cl2	Price portable data logger with pH Cl2 and Turbidity similar to South West unit. For trending of separate plant lines to help identify problems. Will be used by new water quality position within CWT when filled	Completed
	Plants stopping and starting causing operational issues of carryover and excess chemical and power use.	Have Grad engineer undertake plant optimization investigation to look at the correlation between temperature vs demand and power vs plant.	Completed
	Over and under dosing of Alum for common plants	Replace existing alum pumps with digital pumps to stop the manual adjustment required by present system for better flocculation and reduce overdosing.	Completed
	Plant 3 has mud zone above air distribution pipe on all filters.	Air sparge area and plunge to break up mud zone to return area back to even distribution of media	Completed
	Backwash water volumes at times of blocked filters requires more water than is in separate storages	Raise as a project identification to investigate the possibility of connecting CWS to backwash water supply	JD to raise by June 09
	Over backwashing,	Reduce a combination of either Air times, water backwash or filter run times and carryout backwash profiles and filters trend profiles to back up changes	Completed
	Plant 4 filter 2	Remove media and inspect nozzles and condition of filter.	Completed
	Draw down levels on plant 4 not going down to recommended heights	Investigate and remedy, Look at replacing level indicators	Completed
	Air comes on to violently in Plant 3 and 4	Investigate air relief valves to have soft starts or equivalent	Completed
	Plant 4 Air distribution not even	Find out from WTA reason for split air distribution pipes and if adjustable valves would help better distribution of air	Underway

	No backwash tank level indication causing pumps to run dry	Install backwash tank level indicators	JD Raise in 08-09 Budget
Kyabram	Plenum floor leaking suspect failure of grout between floor and walls	Pressure gauges to be installed linked to SCADA	Completed
		Investigate possible on the run grout fix	JD Jan 08
		Raise as Cyclic maintenance in Hansen to investigate plenum floor annually	Completed
	Blocked cutting sprays	Raise in Hansen as cyclic maintenance schedule	Completed
	Over backwashing	Reduce air scour to 1 minute	Completed
		Investigate Backing off air flow or install air relief or soft starter, also look into changing pulley size to slow down rate of air flow.	Completed
		Reduce backwash water time to 4 mins and carryout profiles to check	Completed
	Changes made to plant operation without notification	Investigate option to record changes and plant settings to stop unauthorized changes to set points	Completed
	Prevent nozzles from blockages	Install shroud around backwash inlet	Completed
	Filter boil in centre of filter #2	Monitor and report also check new pressure gauges	Completed
	pH control	Run training session CWT on how to interpolate trends correctly and when to run to a target or a band	Completed
	pH target not set	Carry out Jar tests to identify best pH for pretreatment dose	Completed
	Media in cell 1 lower than cell 2	Top up to recommended depth	Filter coal purchased
	Access to filter not safe	Install gates and investigate ladder system, but not permanent in DAFF due to disturbance caused by ladder to operation	JD Budget 08-09
	Drawings not available	Chase up with Graeme Eadie drawings for Kyabram	JD Dec 07
Rushworth	DAFF float not being removed due to wind disturbance	Encase building to stop wind.	Completed
	Coagulation not the best	Carry out jar tests to find best coagulant	Completed
	Incoming water very variable	Reduce issue by improving dam to use as buffer	Completed
	Entry and access to filters unsafe	Investigate gates and walkway between filters	Completed
	PLC not working correctly	Have D.Cox, Jason and Jamie check PLC against backwash sequence	Completed
	No operation manual	Find from Aqua Tech	Unavailable
	Draw down level before backwash sequence too high	Change to 150 mm	Completed
	Air to violent	Look at changing by changing pulley size. Speak to CAPS	Completed
	Backwash storage to small to carry out repetitive backwashes	Price for extra storage and raise as budget item	Not considered
	Mixer full of sludge	Remove sludge and investigate options to improve	Yearly maintenance

2.1 Kyabram Plenum Floor

Air and backwash water were escaping around the sides of the filter floor at the Kyabram DAFF plant in backwash mode (Fig 1). It was unclear if there was structural damage to the plant or whether this has been the case since construction. We decided to inspect the plenum floor for any signs of filter damage or media pass. On inspection, it was assessed that there was little sign of media pass and that the leaks were occurring between the seal of the base and the wall. Plenum floor pressure indicators were installed to monitor any pressure drop in case of floor failure (Fig 2), or worsting of the seal and pressure rise caused by filter nozzle heads blocking. So far no signs of pressure differentials have been noted and yearly inspections have shown no signs of media pass to the plenum floor.

Figure 1: ***Kyabram filter in air scour***

Figure 2: ***Pressure indicator***

2.2 Shepparton WTP Filter Four

The Mosse report indicated filter two was of most concern as it was thought that if filter two was passing media it could be causing even further damage to the other three filters by passing on media to the filter nozzles via the backwash tank. It was decided that the media from filter two would be removed to check the following:

1. The condition of the nozzles for blockages and breakage
2. Inspection of the filter floor for scouring
3. Inspection of the backwash tank for media build-up
4. Provide access to the plenum floor to inspect build-up of media

After media was removed using a vacuum truck, it was visually clear that a high proportion of nozzles were partially broken or in need of repair. Next was a determination of how much media had made its way through the rest of the system.

Inspection of the plenum trough, nozzle laterals and backwash tank reviled relatively small amounts of media pass, but it did however show other issues that needed repair to put the filter back online that were:

- The backwash foot valve was in need of replacement (Fig 3)
- The Plenum trough needed removal of rubbish (Fig 4)
- All nozzles needed replacing (Fig 5)
- New media required to return the filter to an operational state (Fig 6)

If the filter in number 4 plant had been allowed to continue to disintegrate over time, more media passing into the plenum floor would have occurred and may have caused all four filters to fail, by blocking up the filter nozzles beyond repair.

Figure 3: ***Back Wash foot valve***

Figure 4: ***Rubbish in the plenum trough***

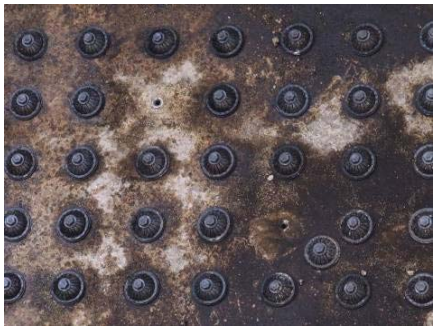

Figure 5: ***Broken filter nozzles***

Figure 6: ***Rebuilding the Filter***

Water Treatment Australia (WTA) were approached for some technical advice and to price the repairs. Carrying out the repair work using in-house staff was calculated as the cheaper option by approx $100,000, but the draw back would be the timeline. Carrying out all the work in-house using our own staff meant the work had to be completed in between undertaking normal duties. As the filter could be isolated from the rest of plant 4 it was decided that this was achievable and the work would be undertaken in-house.

The replacement nozzles were sought from WTA and filter media from River sands. The nozzles stayed with the original design but the media purchased was a change from the media removed from the filter. The following is a breakdown of the new media chosen:

- Filter Garnet – nominal size of 2.4-4.8mm
- Filter Gravel – nominal size of 1.5-3.0mm
- Filter Sand – nominal size of 0.56- 0.7mm
- Filter Coal – nominal size of 1.2-1.4mm

We changed from filter rock to filter garnet which has become a standard within GVW due to its effectiveness in staying in a settled layer due to its higher weight.

Peter Mosse was again approached to supply a rebuild summary sheet stepping us through the process of reinstating the filter. This step by step sheet mimics the WIOA Practical Guide book on filters. Rebuilding the filter was completed within the three months upon ordering the materials and has resulted in a rebuilt filter at a fraction of the cost of using contractors for the labour component of the job. Another positive of undertaking the rebuild in-house has been improving the skills of our own people to help with the filter examination process in the future. The choice of filter garnet over filter rock looks to be giving a better result, as lower turbidity's are being obtained from the

rebuilt filter.

2.3 Rushworth WTP

Rushworth's DAFF plant posed a problem that was not necessarily about condition of the filter but more about its design. No wind protection and a lack of access to the filter made inspections hard and unsafe to undertake (Fig 7). To remove these issues the roof over the filter was raised so a walkway could be installed, providing access to the filter. Extra cladding was attached to the sides and end of the DAFF to stop the wind from holding the float back from being removed, which had resulted in the float being dragged into the backwash stopping an effective backwash. This has now resulted in regular inspection being able to be undertaken and a cleaner float that is easily removed.

Figure 7: ***The low level of the roof and open end were retro fitted to improve entry to filters and wind holding back float.***

3.0 CONCLUSION

It is easy to become complacent that all your filters are in good shape because your results are within their limits, but without a system of inspection do you really know what is going on? It was quickly realised that a yearly investigation of the filters will allow the operational philosophy to be converted from reactive to proactive.

The key to GVW's filter inspections has been to employ outside knowledge to train our operators in correct technique and procedure. This doesn't stop here as we are again utilising Peter Mosse to run review session for our operators and new staff, this will enable those staff member to undertake inspections of their own plants, instead of using outside consultants to undertake this costly work. The report stage of the inspections is the most important step, and a yearly action plan from these reports is essential to keep on top of all issues, highlighting urgency in order of risk. Hopefully if you work through your action plan you should see a smaller list each following year and a steady improvement in water quality.

4.0 ACKNOWLEDGEMENTS

The author would like to thank Dr Peter Mosse, and the Central Water Treatment Team for carrying out the initial inspections and work as part of the Action Plan. WTA for helping with the sourcing and supply of filter nozzles and previous filter history. Also, Bruce Anderson, GVW Operations Manager for proof reading this paper.

5.0 REFERENCES