INSTALLATION & COMMISSIONING OF A PRE-FILTRATION SKID FOR OUYEN WATER TREATMENT PLANT'S MEMBRANE FILTRATION UNIT

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ABSTRACT

The Ouyen Water Treatment Plant, first commissioned in May 2000, utilised high pressure type Polypropylene microfiltration membranes. These membranes reached the end of their life and were replaced in October 2007 with new technology membrane material PVdF which requires significantly less amounts of air and air pressure to perform the backwash (down from 600 kPa to 35 kPa). The PVdF membranes were expected to last for 7 to 11 years however needed to be replaced in October 2013 after 6 years.

In preparation for the membrane replacement GWMWater carried out a detailed review of the plant set up to identify the reasons behind their early failure. The initial assessment identified a limited ability of the inline screen filter to remove sharp items as a major cause for membrane rupture. GWMWater therefore initiated investigations into installing a better pre-filtration system.

The following things were identified as important features for the new pre-filtration unit:

1. Size of filtration screen = 130 micron
2. Flow rate capability of the unit = 1.5 times the plant flow rate
3. Pressure rating = 6 bar or more.
4. Type of backwash = Automatic based on operator adjustable pressure differential
5. Automation: Backwash and head loss to be monitored on SCADA

With the help of the Amiad design team, GWMWater identified that an Arkal Disc Filtration Spin-Klin unit would tick all the boxes for an ideal pre filtration unit at the plant.

The new unit was procured, installed and commissioned in less than 12 weeks, with the help of local contractors, at a total cost of $50,000.

1.0 INTRODUCTION

The Ouyen Water Treatment Plant uses Memcor membrane modules to filter the raw water to 0.04 micron. The plant receives its raw water from the Murray River system into the two storages on the south side of the plant. Raw water is pushed into the plant with the help of duty / stand by 45 kW KSB Ajax E150- 40 pump sets.

2.0 DISCUSSION

The 3.0 ML/day Memcor® Microfiltration plant (90M10C) at Ouyen was built in 2000 and was upgraded to an Ultrafiltration (UF) PVdF (90L10) low pressure backwash in October 2007. Within a couple of years of installation 9 modules needed to be replaced as pinning didn't fix the problem. When the Polypropylene membranes were upgraded to low pressure PVdF membranes in 2007 GWMWater was advised that the life expectancy of the new membranes will be between 7 to 11 years. However, the new membranes started to fail after 5 years, with pressure decay test failures meaning the membrane modules had to be replaced before the summer of 2013.

Early replacement raised concerns about the full life expectancy and as a result further

investigation was carried out to determine what was leading to premature failure of the membranes.

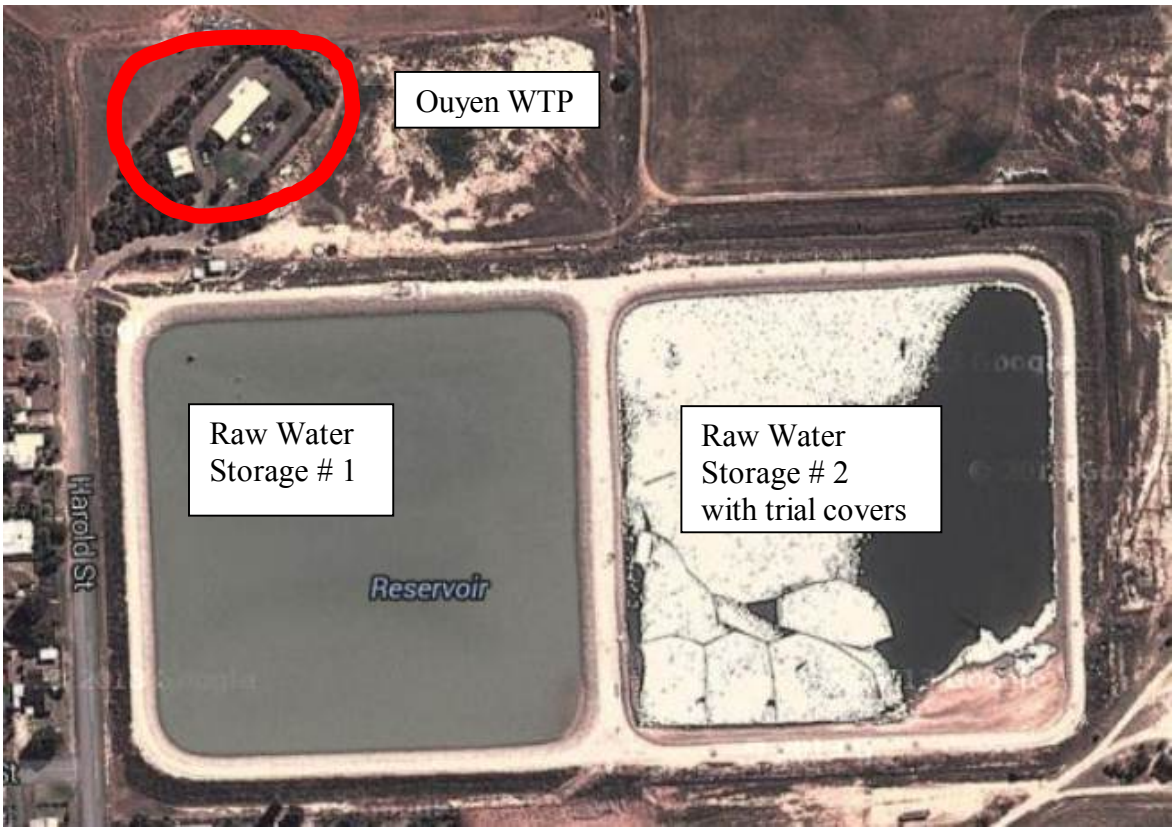

Figure 1: ***Ouyen Raw water storages and Water Treatment Plant***

The following things were identified from the investigations:

1. The plant had a single 400 micron inline automatic backwashing type screen filter.
2. Whenever the inline filter was out of service for maintenance the operator would only have the option of using the bypass line that sent raw water straight onto the membranes without any pre-filtration.
3. Initial assessment of the inline screen pre-filter identified that shells can be forced through the screens when broken down into finer particles
4. It was also found that the screen filter allowed other particles, such as grit and algae, to flow through at inspections.
5. At the time of upgrading from high pressure to low pressure modules the raw water pump's operation was left as is which meant they still delivered around 360 kPa pressure through the membranes when required operating pressure was less than 200 kPa.
6. The backwash was still carried out using compressed air and not blowers.

2.1 UPGRADING THE PREFILTRATION SYSTEM

Investigations into selecting a right pre-filtration unit commenced in September 2013 which resulted in identifying the following necessary features for the new pre-filtration skid:

1. Size of filtration = 130 micron
2. Flow rate capability of the unit = 1.5 times the plant flow rate
3. Pressure rating = minimum 600 kPa.
4. Type of backwash = Automatic based on operator adjustable pressure differential

5. Automation: Backwash and head loss to be monitored on SCADA
6. The raw water storages are known to have algae infestations along with being a breeding ground for fish and shellfish, meaning pre-filtration skids should be capable of handling these types of organic loads.

After detailed discussions with suppliers and manufacturers of pre-filtration units GWMWater identified that AMIAD's Spin-Klin disc filtration unit would be able to meet all the requirements.

The procurement, supply and installation of a new disc filtration skid were completed in 12 weeks with the help of local fabrication contractors and Aquamange.

Observations post commissioning of the disc pre-filtration system:

1. While the water consumed by the town in May 2013 (485 KL) was almost similar to that consumed in May 2014 (467 KL);
    a) Considerable savings in wash water volumes was witnessed, reducing the run time of wash water pumps from 70 hours in May 2013 to 40 hours in May 2014
    b) A 32% reduction in the number of clean in place cycles between January and June 2013 and 2014 was also experienced

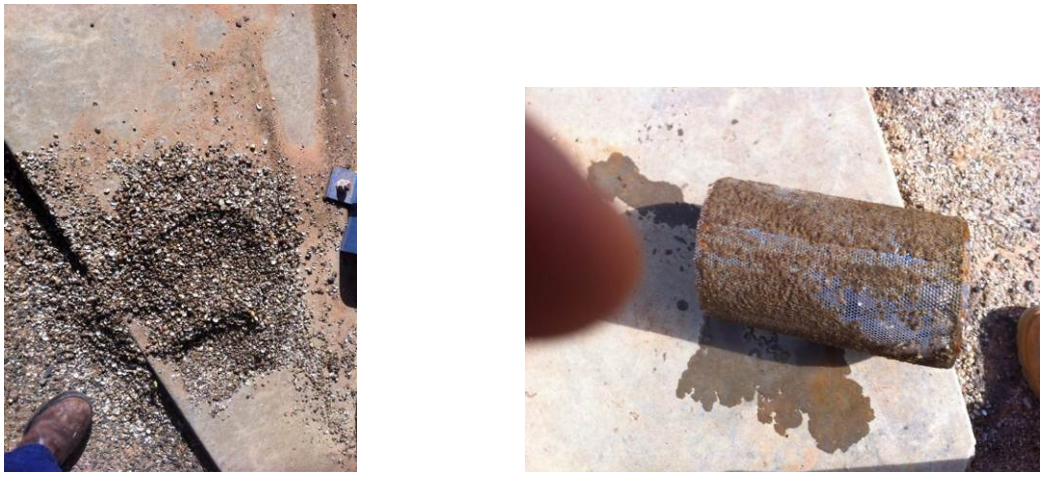

Figure 2: ***Shells and an Algae that usually clogs up the raw water pump's prefilter***

Figure 3: ***Pre-filtration system prior to upgrades between storages and water treatment plant***

Figure 4: ***Pre-filtration system post upgrades***

Figure 5: ***Disc filters doing their job before backwash***

2.2 UPGRADING THE RAW WATER PUMPS

The existing raw water pumps on the site are capable of delivering 370 kPa pressure. However the new low pressure membranes can produce filtered water at less than 200 kPa pressure. The peak summer and winter demand of the town varies considerably meaning the plant needs to operate at 35L/s in summer and at around 20L/s for the remainder of the year. Therefore to meet the pressure requirements and supply capacity in the short term the 45kw KSB Ajax 150-40 raw water pumps now remain throttled manually on the upstream of the membrane unit to avoid putting high pressure through the membranes and by a modulating valve on the downstream to regulate the flow. GWMWater intends to resolve this situation in the near future by installing variable speed drives (VSD's) on these pumps.

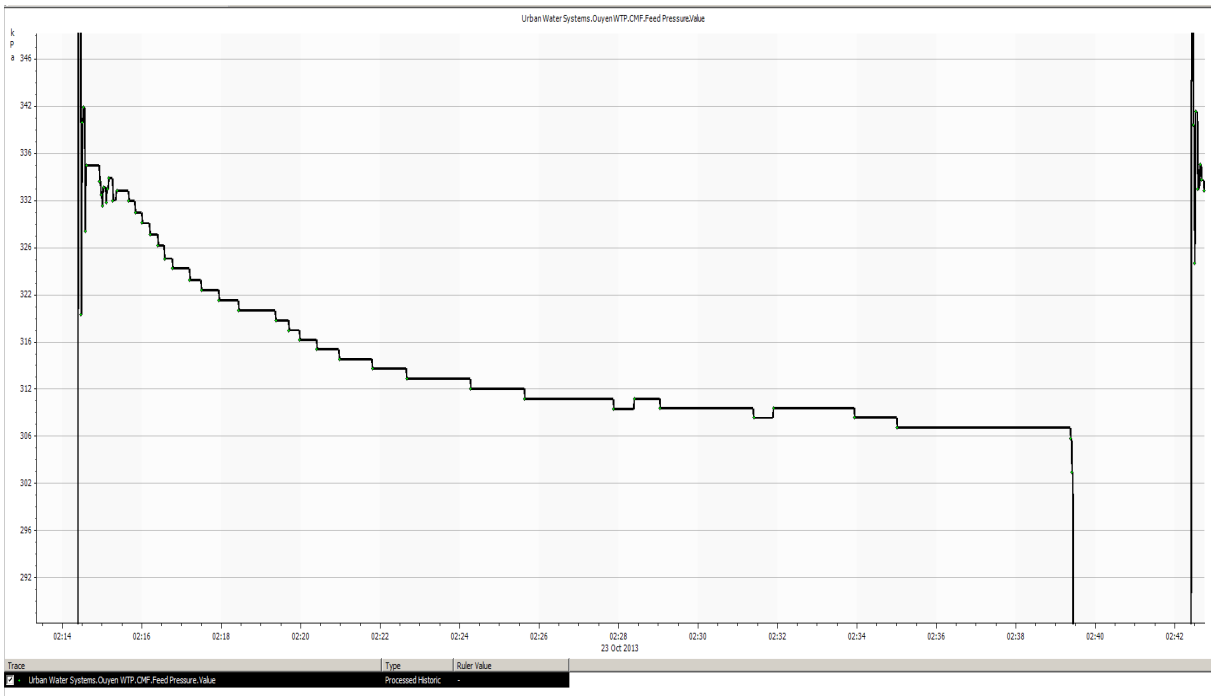

Figure 6: ***Membrane Feed Pressure > 300 kPa prior to October 2013***

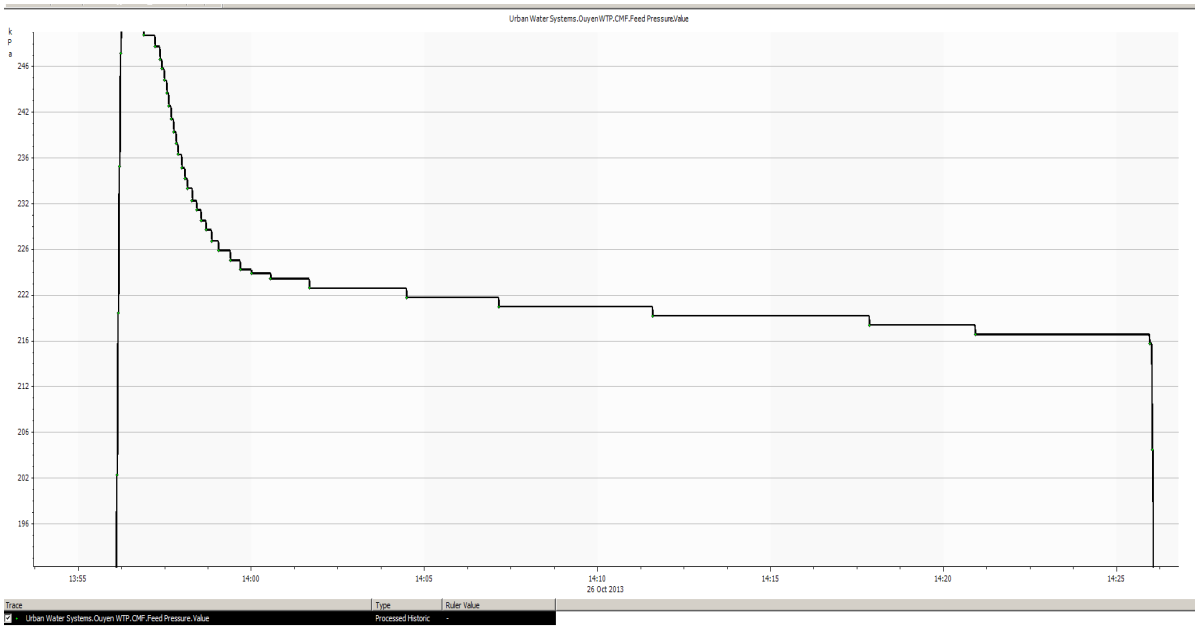

Figure 7: ***Membrane Feed Pressure < 220 kPa post October 2013***

2.3 UPGRADING THE AIR SCOUR SYSTEM

The new low pressure membrane modules can be air scoured at a pressure of around 35kpa and GWMWater has therefore decided to install a blower at this plant. The new blower will lower the operating hours of the compressors and remove the need for having pressure reducing valves to generate low pressure air supply for air scouring.

GWMWater believes that lowering the operating and backwash pressures, along with the efficient and guaranteed removal of sharp items from the raw water stream, will limit the rupture of membranes considerably and therefore achieve optimum life expectancy from the membranes at this plant.

Figure 8: ***Blower installed at Willaura Membrane Filtration Unit for low pressure backwash***

3.0 CONCLUSION

Initially it was thought that more than 6 months would be needed for the installation of the new pre-filtration skid, however with active support from the contractors and supplier, along with little bit of planning, we delivered the job in less than 3 months.

The lessons learnt on this project included:

1. The initial intent was to use consultants and contractors from Melbourne/ Horsham to deliver this job on a turnkey basis. However due to time and money limitations the project was managed and delivered using in-house expertise along with active support from suppliers and contractors. This resulted in the best outcomes for the organisation in time and costs.
2. Maximising the use of local contractors for site works meant we could deliver more works at less cost as the local contractor did not have to worry about travel time or accommodation
3. GWMWater has highly experienced and capable operators and more effort should be put into utilising in-house skills. Using in-house expertise also made trouble shooting and commissioning faster and easier.
4. The unavailability of specialised plumbing or electrical supplies in the town meant we had to do lot of planning and scoping to help reduce the number of trips to nearby town centres.

4.0 ACKNOWLEDGEMENTS

I acknowledge the support provided by the Water Quality team and the contractors in installation and commissioning of the skid.