REPLACING FILTER MEDIA, "DUST FREE" AND WITH SIGNIFICANTLY REDUCED OH&S RISKS

Paper Presented by:

Wayne Shaw

Author:

Wayne Shaw, *Water Treatment Technician Operator,*

Gippsland Water

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ABSTRACT

Replacement of filter media over the years has proven to be a dirty and labour intensive exercise. Dust problems are magnified by fully enclosing filter cells at treatment plants to minimize the growth of algae and contamination by wildlife and debris. Apart from the dust hazard, manual handling of 25kg bags of anthracite up stairs was also a major OH&S concern. The manual handling was usually done when a top up of anthracite was required at the smaller plants, and on those occasions it seemed OK to lug the bags up the stairs. Be that as it may, those practices had to be stopped, and the hazards involved with the process removed. A cleaner, safer and more cost-effective method of topping up the filters using vacuum technology was trialled. Using this method the media is sucked out of bulky bags and mixed with water. The beauty of the system is that it eliminates the dust and manual handling issues very effectively, and is a locally designed and manufactured product with technical support close by. The purchase of specialized pumps to drive the vacuum unit was a one-off expense. The only ongoing costs will be routine maintenance of these pumps as they are used on subsequent jobs.

This paper shows how effective, safe and clean the vacuum system of replacing filter media has proven to be.

KEY WORDS

Gippsland Water (GW), Water Treatment Plant (WTP), Occupational Health & Safety (OH&S), Confined Space Entry (CSE), Surface Loading Rate (SLR).

1.0 INTRODUCTION

Gippsland Water (GW) has 17 Water Treatment Plants (WTP's) of various capacities, supplying treated water to consumers. Across the WTP's there are a total of 51 filter cells, ranging from small self-contained freestanding units at the package plants, to the large concrete units, which are integral to the building structure at larger plants. Over the years, the older plants had very little maintenance focused on the filter beds. The Safe Water Drinking Act has brought about greater regulation and compliance requirements regarding the standard of water supplied to consumers. With filters being the last physical barrier in the removal of turbidity particulates the treatment group started a program of filter inspections to ascertain the state of repair of the beds at the WTP's. It was through the data collection of this program, that a number of filter beds were identified as being in need of further investigation, which ultimately led to some rebuilds. Design and historical information about the filters was gathered by the treatment group. This was a challenging process that identified many knowledge gaps that had to be filled by further research. It was discovered that some filters had incorrect backwash rates, which contributed to media loss. These filters needed to be topped up with anthracite. Adding the anthracite, and working in the cells spreading and levelling the coal was physically difficult due to confined spaces, hot and humid due to the environment, and the filthy nature of the materials used. A safer, cleaner method had to be found!

Figure 1: ***Manual handling of bagged anthracite***

2.0 DISCUSSION

2.1 Maffra WTP trial for adding activated carbon

During an algal bloom event on the Macalister river, activated carbon dosing was put into place to aid in the treatment of the raw water. Gippsland water already had a containerized transportable activated carbon powder dosing system which had been used during TOC reduction trials at our Seaspray WTP. This was repositioned to Maffra WTP. The unit consisted of a bag splitter and loading device, a mixing vat and dosing pump. A method for loading the activated carbon into the mixing vat to form a slurry and to reduce the dust and manual handling issues was set up on our existing activated carbon system. The device chosen for this was the 25mm model Hydro De Wetter unit from Melbourne Controls. This proved to be ideal for the job at Maffra. As an extension to the use of this technology we thought that we could try the same unit to install the anthracite during the next filter upgrade at the Tyers WTP.

2.2 Tyers trial

Up to this time filters were loaded manually with all the attendant dust and manual handling issues. A safer and cleaner method of loading media into the filter cells had to be found. Improving the loading of the anthracite was the main driver, due to the excessive dust and manual handling issues.

Tyers WTP is one of our medium sized plants with three freestanding stainless steel units. Each unit comprises of an "Absorption Clarifier" (primary filter) with a surface area of 3.4m^2 and a secondary polishing filter with a surface area of 5.76m$^{2.}$ The units stand about 3 and 4 meters high respectively.

A second 25mm Melbourne Controls unit had been purchased for a permanent powder activated powder dosing system at Seaspray WTP. This unit was trialled at Tyers with 5 to 6m^3 of anthracite loaded into the filter with no dust or sore backs. However, a few issues had to be overcome along the way.

Limited room in the cells meant that the backwash outlet launders had to be boarded up to stop media going into them.

Problems with local availability of smooth bore flexible vacuum hose made choosing the suction line difficult. The translucent braided type that was initially used proved to be too soft and collapsed where it bent over edges, causing loss of suction.

Having to draw the material to a height of 3 and 4 metres respectively made progress very slow. It took 3 hrs to empty 1 bag of anthracite using the 25mm vacuum.

A trial with a 50mm vacuum unit proved unsuccessful due to not being able to keep enough water supply to the pump. There was insufficient head on the filter to push the water through the media fast enough.

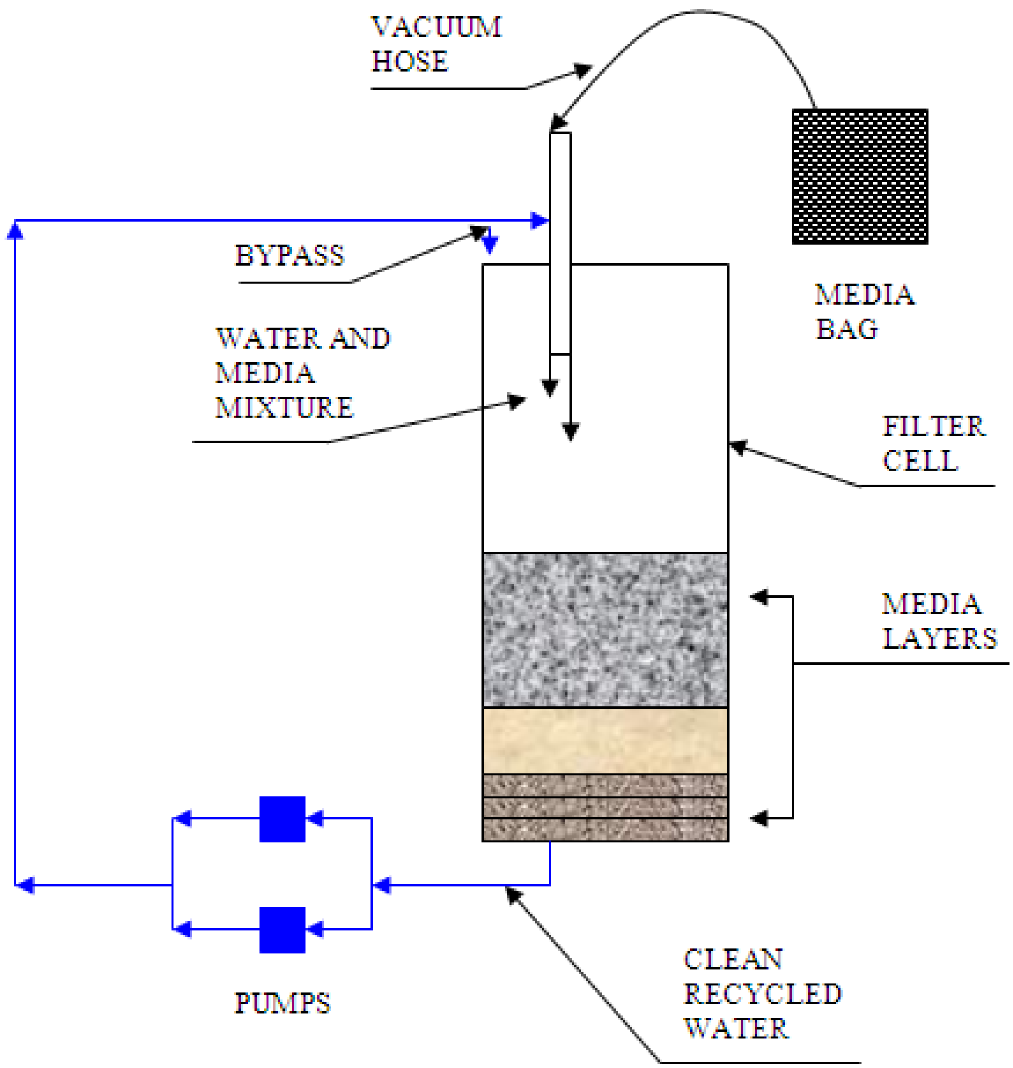
Figure 2: ***Dealing with anthracite is a dirty job***

2.3 Traralgon trial

At the Traralgon WTP one filter cell unit had been cleaned and was ready to have new media installed. The larger 50mm unit was set up to load the anthracite into this cell. This unit required a 600 litres/min delivery rate at 600kPa for best performance. To provide this water supply, two pumps were connected to the common filter outlet drain. This drain is only used to totally drain the filter cell.

Recycling the water in this way meant a constant water supply that wouldn't increase the water level in the filter cell, and reduced the need to drain off excess water as media was added. The process involved pumping the water ten meters vertically from the basement of the plant and then a further 20 meters across the filter gallery to the Hydro De Wetter at the filter cell being loaded.

A 90^{o} bend was removed from the drain, and a purpose built twin outlet flange, to which both pump suctions were connected, was bolted to the 300mm-outlet drain. Both pump discharges were brought together into a common 80mm line that carried the water ten metres vertically to the filter gallery above, then a further 20 meters horizontally to the filter cell.



<u>Figure 3:</u> ***Vacuum system schematic***

The design maximum flow rate of the filter cell is 80 L/s. This gives a Surface Loading Rate (SLR) of 2.9 L/m^2/s. A recycle rate of 10 l/s to the Hydro De Wetter gave us a filter SLR of around 0.36 L/m^2/s. This enabled the sand layer in the filter to cope with the increased turbidity as the anthracite was being loaded, ensuring that the water returning to the pumps for reuse was nice and clean. Each pump has a built in control panel that allows individual control over the speed of the pump while in service.

Table 1: ***Equipment specifications***

		Small Pump	Large Pump (X2)
Pump type		*ITT Lowara*	*ITT Hydrovar*
Q (m^3/h)		6 - 14	9 – 24
H (m H/min)		7.45 - 40	98 – 43
N (l/min)		2900	2900
Vacuum Device	*Melbourne Hydro De Wetter*		
Nozzle size (mm)	25	38	50
Flow (l/min)	100	300	600
Product transfer rate (m^3/hr)	6	18	36
Pressure (kPa)	600		
Delivery	~10% material weight/100L carrier water volume/min @ 1 – 1.5m lift		

Figure 4: ***Hydro De Wetter unit discharging anthracite from bulky bag***

3.0 CONCLUSION

Using the vacuum method developed at Traralgon WTP, there is now no need to do a CSE into the filter cell to load the product. This also reduces labour inputs/costs as there is no need to draw key personal in to assist, as one person can position, open and empty the media from the bag.

Each job does need to be properly assessed to make sure the correct Hydro De Wetter is selected for task. Multiple units could be used in larger filters if desired and larger units are available. Using the Hydro De Wetter, the process of loading the anthracite into the cell can be done with less people involved. The process using the Hydro De Wetter system is much safer and cleaner when loading the anthracite. The process could also be started and then left so other tasks could be attended to. Changing over media bags doesn't require shutting down the pump system, as once started, it runs until loading is complete. The media tends to level out quite well and only needs a little amount of work using a high-pressure hose to push it around. Once it has been roughly levelled a low rate wash does the rest. Once the ancillary equipment had been obtained it is pretty simple to set up the system at most plants.

In summary, using the Hydro De Wetter method has the following advantages over traditional media top up methods;

- No need for CSE (safer)
- Labour costs reduced (can complete job faster)
- Labour inputs reduced (fewer staff required)
- Cleaner (no dust)
- Process can continue unattended (convenient)
- Media is easily levelled (no manual handling)
- Simple to use.

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5.0 REFERENCES

JS Melbourne Controls Pty Ltd, www.melbourneflow.com