WATER FILTRATION – ADVANTAGES OF FABRIC MEDIA

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69th Annual Water Industry Engineers and Operators' Conference
Bendigo Exhibition Centre
5 to 7 September, 2006

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KEYWORDS
Fabric media filtration, contaminant removal, Class A recycled water

ABSTRACT

Several attractive filtration performance attributes are provided when active washable fibres are incorporated into a water filtering media, such as the Fabric Media water filtration technology. There are process and economic advantages compared to the more traditional media bed filtration techniques, such as sand filters, and surface filters such as micro membrane filtration. These attractions are

- A fibre surface chemistry can be selected to optimize the adsorption of the contaminant, its wash ability and resilience to disinfection chemicals.

- Fibres are much smaller in diameter than sand particles. Hence, Fabric Media filtration provides:
    - A much greater surface area per unit volume of media, thus greater capture capacity between backwash events or similar capture in much less media bed depth.

    - A much greater density of openings, or open area to cross sectional area, thus much smaller equipment footprint is required.

- With the smaller footprint, lower lift height and smaller pressure drop, Fabric Media filtration presents a much lower operating energy requirement than alternative filtration techniques and thus a lower energy cost is encountered.

- The Fabric Media is not abrasive to itself nor to the filter tank. The filtration performance remains constant and predictable and equipment life is much longer.

- Fibres are extremely mechanically robust and chemically inert and can be repetitively exposed to a rapid mechanical washing event, thus providing high wash efficiency with minimum equipment off line time.

- With the superior chemical adsorption attribute the Fabric Media filtration technology can provide performances expected of micro membrane filters, but at a fraction of the cost of a sand filter.

- With a mechanical agitated backwash mud balls which can foul sand filters and contaminants that can adhere and block membrane apertures are no longer a concern.

With the qualities mentioned above, the Fabric Media water filtration technology can be designed for applications ranging from raw sewage filtration to high quality drinking water. It is simply a matter of selecting an appropriate fibre and fabric weave pattern for the contaminant and filtrate quality objective.

1.0 THE FABRIC MEDIA INNOVATION

Figure 1: ***Typical Fabric Media*** **Figure 2:** ***Filter Tank***

An example of a fabric media that is applicable for municipal waste water is depicted in Figure 1. A fabric media water filter tank will literally contain millions of fabric wads cut from a proprietory non woven textile. Fibres of the textile are selected primarily for their affinity to strongly adsorb the contaminant particles from the raw water.

Typical fibres in a Fabric Media range between 1 and 10 micron in diameter, whereas a typical sand filter media bed has a nominal 500 micron dimension of grit. Thus a much greater proportion of the filter tanks cross sectional area is open to water passage and a much smaller tank can be applied for the same task. An example of this is displayed in Figure 2. Each filter processes 2,500m^3/day of tertiary alum treated waste water. The Fabric Media filter on the right has a 1.6 metre diameter with the sand filter being 5.0 metres. This means the Fabric Media filter with a 2.0 m^2 tank cross section must have a filtration flux roughly ten fold that of the sand filter which has a cross sectional tank area of 19.6m^2. This installation is at the Nanbu Waste Water Treatment Plant located in the Kyushu district of Kagoshima prefecture, Japan.

From an economic perspective, the significantly smaller footprint of the Fabric Media water filter enables an attractive purchase price proposition and significantly reduces several associated installation costs. For example, the Fabric Media filter has an operating weight of 11 tonnes whereas the sand filter is 116 tonnes. The Fabric Media filter does not require an overhead crane for media replacement purposes as the fabric media weighs 16 kilogram in a 200 litre box. In addition, Fabric Media filters do not require compressed air to assist the washing, nor high quality water for the back rinse, nor oxidant or surfactant chemicals which can be applied to provide routine disinfection of a sand filters media bed.

Fabric Media provides a surface area typically in the 8,000 to 12,000 m^2/m^3 region, with a clean flow backpressure of about 6 kPa per metre of media depth at a filtration flux of 70m^3/m^2/hr. To put this in perspective, a typical 500 micron sand media would provide a surface area of 1,250 m^2/m^3 and has a nominal clean flow backpressure of 60 kPa per half metre of media depth at a filtration flux of 7m^3/m^2/hr.

Fabric Media floats on water. Therefore, the direction of flow during filtration is from bottom to top, opposite to a sand filter. During operation the Fabric Media is restrained by screens built into the filter tank.

Similar to all other media type filters the flow direction is reversed during the backwash rinse. The wash cycle is akin to a household laundry washing machine, except the degree of physical agitation is maximised to utilise the highest possible washing efficiency without the need for chemical additives.

When the process logic computer receives a backwash required signal, the pump is stopped and the agitator is activated for several minutes thereby dislodging all captured contaminants from the Fabric Media. With continued agitation, the pump restarts to enable dislodged contaminants to be rinsed from the filter tank. Once the rinse is complete, full flow is reverted in the upward filtering direction. A typical backwash event lasts 15 minutes.

A single set speed raw water pump is most commonly installed for the Fabric Media water filtering operation and during the back rinse a set valve acts as a flow restriction device thereby reducing the rinse water to between 15 and 35 percent of normal filtration flow. This significantly reduces the wash water volume compared to equivalent sand filter filtration performance.

Fabric Media will not chemically dissolve or abrade, rather degradation occurs through unravelling and the loose lint reports with the backwash water. A Fabric Media can endure between 2,000 and 5,000 backwash events before degradation. A typical application for treated waste water filtering 90% of the suspended solids at 10mg/l filterable solids will require one back wash event per day. This means the media will last somewhere between 6 and 15 years before full replacement is attained.

The replacement of fabric media involves simply opening the filter tank and poring new fabric in. Unlike sand filters where it is essential that the media must be carefully positioned and correctly layered, replacing Fabric Media is a non skilled task. The volume of Fabric Media within a filter tank can be simply topped up when convenient in an exercise that is generally completed within one hour, whereas placing new media into a sand filter can consume days or even weeks with the larger volume sand filters.

2.0 CASE STUDY - SECONDARY TREATED WASTEWATER

A side by side performance assessment comparing the Fabric Media water filtration technology directly against a sand filter installation was conducted by the Water Corporation, at the Subiaco WWTP on secondary treated waste water. Picture 3 shows a transportable Fabric Media demonstration unit on the right hand side of the array of pressure sand filters. Raw water intake to the Fabric Media was via the grey hose connected to the purple coloured sand filter inflow main.

Figure 3: ***Transportable Fabric Media Demonstration Unit***.

Each sand filter operates at 38m^3/m^2/hr filtration flux with backpressure ranging between 50 to 70 kPa. For the comparison, the Fabric Media filter operated with a much lower energy requirement at 10 to 15 kPa with a flux of 107.5m^3/m^2/hr. The Fabric Media filter produced significantly better capture of suspended matter as shown in graph 1. The Water Corporation plant operators stated that the nominal 20% removal rate performance by the sand filters was as true representation of the sand filters expected capability. The Fabric Media filter performed with an average suspended solids removal rate of 74% for the same suspended organic matter.

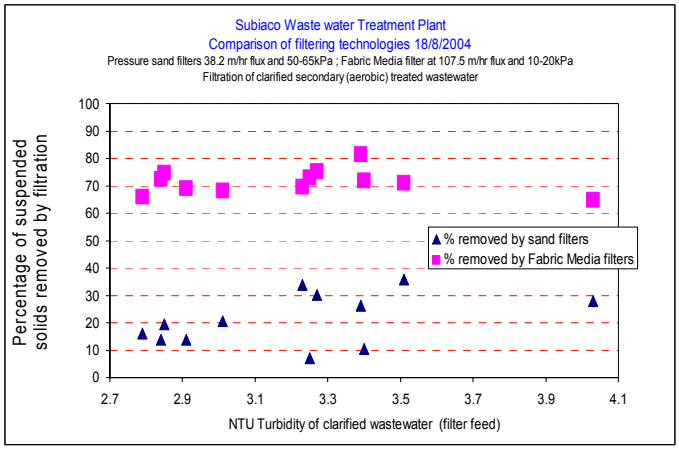

Figure 4: ***Comparison of Sand and Fabric Media Filtering Technologies***

This comparison has shown that a Fabric Media water filtration technology can generate a higher quality recycled water product. Higher filtrate quality means less chlorine is consumed to attain the same residual disinfectant and greater disinfection confidence.

2.1 Case Study - Control of Algae in a WWTP Pond

Algae in WWTP ponds presents an array of problematic issues. Process route examples for the separation of high algal concentrations invariably apply a two stage separation process. For example, a Dissolved Air Flotation followed by sand media filtration is a common practise. The preliminary separation being required to overcome the concentration related limitations of sand filters. The Fabric Media technology is applicable to higher solids concentrations than sand filters and can perform suitable algae removal in a more cost attractive single step unit operation.

The DAF separation requires application of a coagulant, flocculant polymer and pH control chemicals. Depending on the conditions, Fabric Media can filter algae from such water without chemical addition providing further potential cost savings for a WWTP. The potential benefits from Fabric Media filtration at WWTP ponds includes removal of algae from discharge treated water and total process security.

The Water Corporation has conducted a technology development campaign at the Mundaring WWTP, where the water overflowing the maturation wetland pond can contain in excess of 200mg/L of algae with a background level of other matter generally in the 10-20mg/l range.

Figure 5 shows the concentration of total suspended solids (TSS = filterable matter at 0.45micron) contained in the wetland overflow throughout an eight day campaign of continuous filtration. Wetland overflow was feed water to the Fabric Media filter.

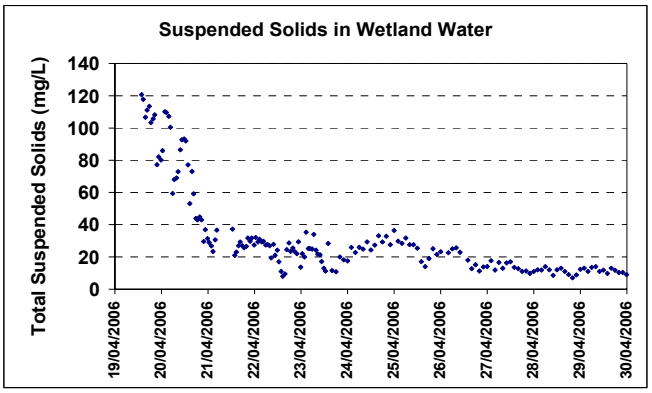

Figure 5: ***Suspended Solids in Wetland Water***

The filtration at Mundaring was designed to process in a recycling mode with 4 m^3/hr being returned to the maturation pond. Backwash water at about 5 gram per litre concentration can be returned to the head of the plant and does not recycle to the maturation pond.

After chlorine disinfection, the discharge filtrate would easily attain a "Class A" rating having an NTU of less than 2, BOD less than 10mg/L, SS less than 5mg/L and less than 10 coliform counts per 100mL.

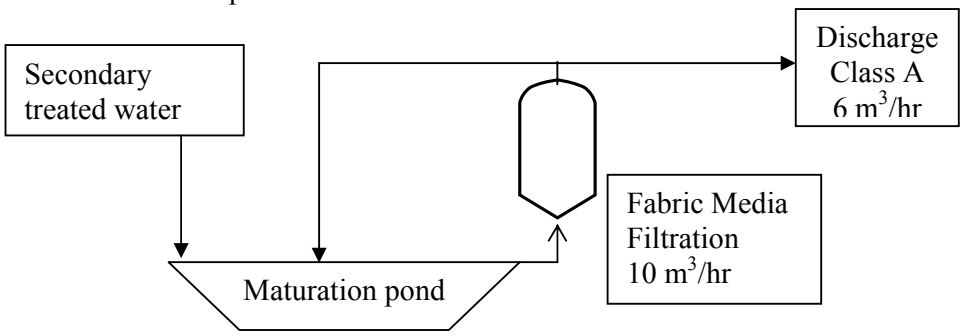

Figure 6: ***Water Quality After Fabric Media Filtration***

As depicted Figure 5, continuous application of the Fabric Media water filtration technology reduces the suspended solids to background levels meaning that algae in the pond are reduced to virtually zero, without the requirement for chemicals.

The advantage of the Fabric Media technology is that it provides a cost effective treatment strategy for algae control in the maturation pond and not just a post treatment step. It enables the root cause to be addressed rather than treating the resultant problem, when the quality of algae contaminated water has to be addressed.

3.0 SUMMARY

The Fabric Media water filtration technology enables filtration to be applied to a much wider window of concentrations than sand media or membrane type filters and provides design engineers with a serious incentive to positively address capital cost and performance for new infrastructure projects.

The Fabric Media technology provides an ability to enhance the chemical adsorption of microscopic particles and does not present a purely physical size barrier.

The higher surface area provided by the Fabric Media, the selected chemistry of the fibre surface and the open highly permeable weave structure enables the benefit of a logarithmic increase in adsorption capacity and adsorption strength for contaminants to be applied at a much faster filtration flux. These advantageous parameters can clearly result in superior filtration at considerably increased filtration flux velocity and this provides the water plant with the double win of significantly lower operational energy costs and lower capital compared to alternative water treatment processes of similar performance potential.

Compared to all known media and membrane filtering techniques, the Fabric Media innovation provides the most highly flexible application design potential. For example, it can be considered as alternatives for water clarifiers for turbid untreated wastewater to substitutes for micro membrane filtration of pre treated wastewater or drinking water.

Operators of Fabric Media water filters describe the technology as operator friendly and process forgiving. It is operator friendly because media replenishment can be completed in a very short time and does not require skilled contract labour. It is process forgiving because full filtration performance is automatically restored by the backwash operation if the filter is deluged with high solids concentration or with oversize particles.

4.0 CONCLUSION

The case studies provided above are some of many examples that highlight a range of possible applications and potential benefits associated with Fabric Media water filtration technology.

The Fabric Media innovation presents opportunities for operators of municipal water facilities, be it drinking water or wastewater to improve process efficiency, lower capital cost of future projects and reduce operating costs. Whilst also reducing exposure to operational and environmental risks.

Further information on this technology can obtained from SLS Technology Pty Ltd.

5.0 ACKNOWLEDGEMENTS

The author wishes to acknowledge the assistance of Water Corporation of Western Australia for sponsorhip of the waste water development projects.

There are a limited number of water treatment consultants in Australia with experience relating to Fabric Media water filtration technology. Readers are invited to obtain further information on the technology from the author and the web site www.watertechnology.com.au.