Food & drink

New technologies in feed water and effluent treatment

With ever increasing water costs to, and pressures on, food and drinks production, and tightening water extraction, discharge limitations and developments in treatment technology, water recycling has become a high priority subject. This article examines technologies for feed water treatment and effluent treatment and shows how implementing those processes can lead to cost savings and environmental benefits.

Water scarcity continues to be an issue facing many global communities, with the risk of losing business continuity moving up both the corporate and public agendas. As a major importer and exporter of water, industrial sites in the food beverage and brewing industries are facing a serious challenge to work towards a better way of balancing the need for clean water and the need for clean emissions from their processes. According to Pentair, on average 70% of the fresh water intake to a food/beverage plant ends up as effluent. Hence, advanced technologies are required to reduce the water footprint.

"However," Colin Reith UK sales manager at Pentair said, "in a growing number of geographic regions these industrial water requirements are in direct conflict with the interests of municipalities or farmers. Law-makers are responsive to those pressures, resulting in more stringent legislative requirements on the industrial users". Mr Reith added: "In the brewing industry, where historically water management and waste disposal were already a significant cost factor and critical to business continuity, the need for adoption of sophisticated reuse technologies is evident."

Specified water

Mr Reith explained that the production of high quality 'specified water' in the brewing industry is an important factor, due to its influence on the produced beer. For example, yeast needs specified minerals in exact proportions, like potassium, sodium and calcium for an optimum fermentation process. Also, the produced water must be free from odor to avoid a negative influence on the taste.

In recent years, membrane filtration has become much more an accepted technology for the successful production of drinking water, polishing of water, and treating of both municipal and industrial waste water. In addition, pressure driven membrane processes ranging from open to tight separation efficiency are classified as microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) membranes as compared in Figure 1 (see below) by Pentair. The membrane processes use permeable membranes for the filtration of liquid or gaseous streams.

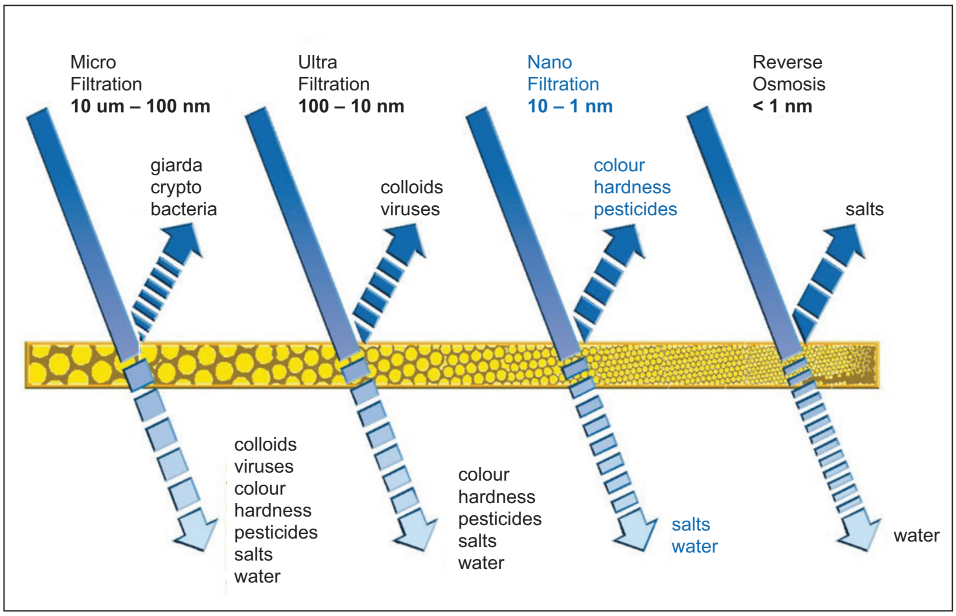

Figure 1: Membrane filtration and separation characteristics.

	MBR Type	Normal operating MLSS range (gTSS/l)	Sustainable normalized flux, litres/ m^2/h(lmh)	Energy use on biomass separation, kWh/m^2 permeate produced	Energy management, membrane area & replacement
Viledon® Systems	AMBR™ 'Dry', out of tank	10 to 25 (air) >25 if pure oxygen enhanced	80 to 250	1.8 to 3.5	Yes But limited to automatic flushing and shutdown on low/no flow. High flux means less capital cost, installed membrane area and replacement costs.
	AMBR LE™ 'Dry', out of tank	10 to 18 (air) >25 if pure oxygen enhanced	40 to 120	0.25 to 0.7 Higher energy is temporary only for extreme peak hydraulic conditions (which cannot be dealt with using air flush/lift or submerged membrane systems)	Yes Permeate flow is automatically regulated and banks can still be automatically shut down on low/no flow. Peaking capability means significantly reduced installed membrane area and replacement costs compared to other 'low energy' technologies.
Other MBRs	Air flush/lift crossflow 'Dry', out of tank	8 to 15	25 to 60	0.25 to 0.7	Yes But limited to automatic flushing and shutdown on low/no flow. No significant peaking capability meaning more membrane area than AMBR™ and AMBR LE™ is required.
	Submerged HF/flat sheet	8 to 15	8 to 25	0.5 to 1.5 Field experience in various industrial applications	NO Membranes submerged in biomass and must be regularly 'scoured'. Energy > 1.5 kWh/m^2 during flow/no flow. Low flux means very large membrane area is required.

Figure 2. Comparison of Aquabio MBR systems.

RO membranes are widely applied for desalination of seawater while UF and MF processes are typically used as a pre-treatment or polishing step to remove particles including bacteria and viruses. Membrane applications have recently been developed for a broad range of industries including the food, beverage and brewing industries.

Reuse

"In the brewing industry for example," Mr Reith explained, "membranes are applied to processes ranging from beer clarification to caustic recovery and, of course, process and waste water treatment. Membrane systems have become widely and steadily less and less expensive in recent years, available for all kinds of applications in the beverage industry. The uniqueness of all membranes is the very fine level of filtration that can be achieved, and thus the high level of control over the filtration process."

Because of those factors the 'effluent' from the membrane processes can also be viewed as an on-site 'resource' to be reused in processes such as bottle and kegs cleaning and service water production for further treatment by ion exchange technology for utilisation as boiler feed water. According to Pentair, a re-use ratio of up to 50% is typically achievable.

The work of companies like Pentair and Aquabio (part of the Freudenberg Group) over the last decade has helped to boost confidence in safe reuse on industrial sites and reduced the 'stigma' of recycling 'effluent' water in food factories so the 'resource' benefit of reuse can be realised. Steve Goodwin director at Aquabio said: "The driving issues are now linked to the economics of recycling water in times of rising incoming water charges and outgoing effluent disposal costs, plus the limitations on borehole and surface water extraction or final discharge constraints."

In the UK, users with an incoming mains supply from the local water company are charged for both potable water entering the factory and trade effluent leaving it. Recycling is, therefore, an increasingly attractive option. Mr Goodwin explained, "With recent developments in treatment technology the payback on capital investment has reduced significantly, in many cases to below two years. These motivating factors are exacerbated by business growth, factory expansion, and corporate pressure from customers to reduce carbon footprint or improve environmental credentials."

Global concerns

Abstraction of water from boreholes as an alternative to mains supplies is also affected by more global concerns such as decreasing ground water levels caused by a higher general demand for water, as well as changes in climate. "Companies who already have an existing wastewater pretreatment infrastructure in place," Goodwin added, "may well find the option of investment in potable recycling more attractive."

The UK government is offering an Enhanced Capital Allowance tax incentive scheme for water reuse investments where 100% of capital expenditure is fully allowable in the year following start-up of an 'eligible' efficient membrane based plant reusing more than 40% of the factory wastewater.

MBR systems

Another application of membranes that can decrease the amount of fresh water required and the amount of waste generated on an industrial site is a combination of process technologies. Mr Reith explained that, "a membrane bioreactor, or MBR, combines biological treatment, dealing with the dissolved 'organics' using micro-organisms and membranes to separate the clean water from the suspended solids."

"After treatment by an MBR," Mr Reith added, "the water can be reused and utilized for activities such as flushing and CIP. In some cases the water can be treated to drinking water quality. And in certain situations in the food industry MBR treated water is used directly in the production process." To avoid excessive concentrations of dissolved solids a secondary treatment, following the MBR, is required and can be NF or RO (Figure 2). "The UF membranes in the MBR system," Mr Reith explained, "are of a similar pore size as