By Neil McAdams & Christian Cabral

Treating Food & Beverage Wastewater

Membranes combined with phased biological treatment bring high-performance MBR technology

Food and beverage processors typically consume high volumes of water and generate high organic-strength wastewater in batch mode. These high-pollutant loads increase the cost of treatment and may require significant storage volume for equalization at the head of the treatment system. Major pollutant loadings often include biological oxygen demand (BOD) and chemical oxygen demand (COD), total suspended solids (TSS), fats/oils/greases (FOGs) and nutrients in varying concentrations

Wastewater plants at food and beverage manufacturing facilities are constantly challenged by changes in influent conditions caused by load shocks; temperature changes; increases in production; changes in manufacturing operations; spills; washwater surges; operation malfunction; and limited equalization capacity. Effectively treating this wastewater is often difficult, for reasons numerous and varied. In many cases, conventional activated sludge treatment systems are not capable of handling large, sudden variations in BOD, COD and nutrients.

Immersed MBR

The immersed membrane bioreactor (MBR) is proving to be a key emerging technology for eliminating the typical problems when treating high-strength wastewater generated in food and beverage processing. It also shows significant potential in helping many facilities meet their growing commitments to sustainable water development and reuse, as well as their need for exceptional water quality.

MBR combines—in one stage—biological

ARTICLE SUMMARY

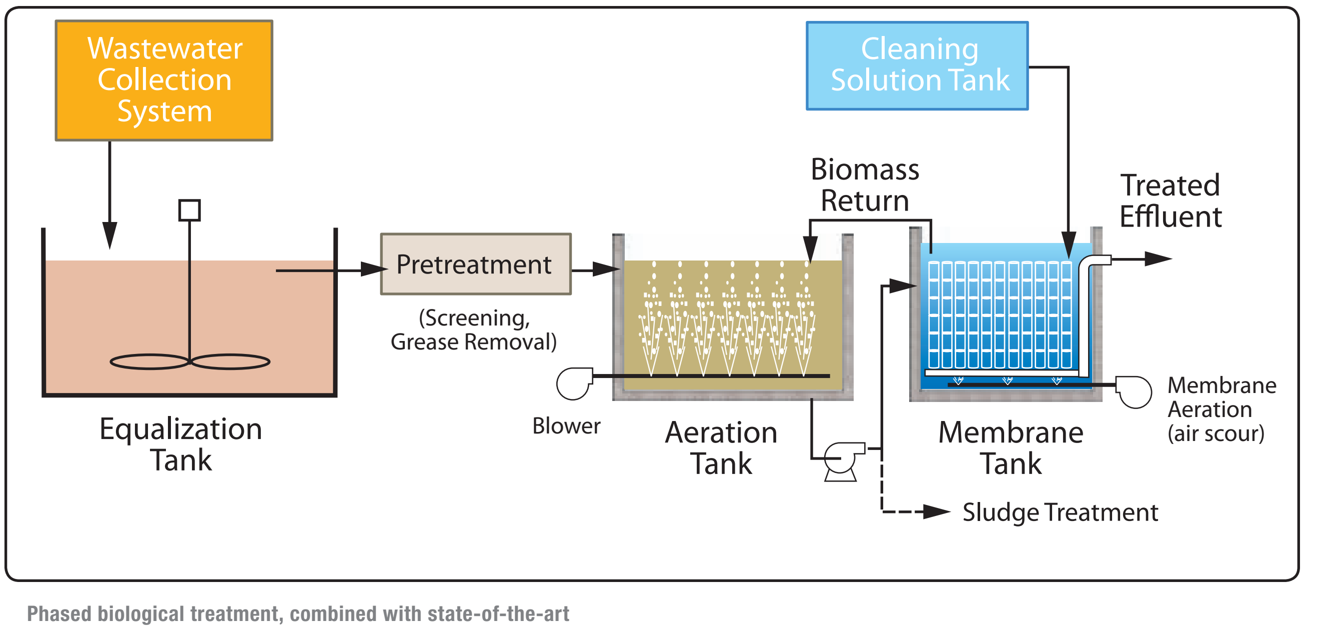
Challenge: Wastewater at food and beverage manufacturing facilities plants faces constantly changing influent conditions, complicating the treatment process.

Solution: An immersed MBR NEOSEP at a brewery has successfully treated high concentrations of BOD and suspended solids, while showing adaptability and exceeding its guaranteed performance criteria.

Conclusion: Immersed MBRs are highly efficient at treating COD, BOD, TSS, FOGs and nutrients in high-strength wastewater, while promoting benefits such as space savings, sustainability and high-quality water.

A pilot-scale NEOSEP MBR system is transported to food and beverage processor sites to test the effectiveness of the technology on the site's specific wastewater characteristics.

Figure 1.



Phased biological treatment, combined with state-of-the-art membrane technology, creates a compact system that produces high-quality effluent for nonpotable reuse.

treatment with membrane separation that, in concept, is simply an activated sludge plant with the final clarification stage replaced by a membrane filtration system. Since 1993, research efforts on the NEOSEP MBR, an immersed-configuration MBR process, have focused on further optimizing both biological treatment and the separation unit (membrane) to enhance permeability, improve treated water quality, and minimize sludge production and overall treatment costs.

One main advantage of the NEOSEP process is its compactness. The separation of sludge from the treated effluent is implemented directly in the aerated biological reactor rather than by gravity using large final and secondary clarifier tanks. The solids removal efficiency of the membrane means that the sludge can be contained in the system at mixed liquor suspended solids (MLSS) concentrations up to five times higher than is possible in conventional activated sludge plants. This results in more efficient BOD and COD removal because higher MLSS concentration results in lower food to microorganism ratios, which is particularly important in the case of high-strength food and beverage processing effluents that would otherwise need an aeration tank with three or four times the volume.

The NEOSEP immersed MBR system operates under low negative pressure (less pumping), relying on the membrane scour air to reduce fouling. The technology also incorporates a phased aeration control scheme on the biological side of the process, providing for significant reduction of buffering needs/equalization volume as compared to many other treatment systems. The phased biological treatment, combined with state-of-the-art membrane technology, creates a compact system that produces effluent that replaces final clarification and tertiary filtration for nonpotable reuse (see Figure 1). The sequenced aeration also reduces the need for equalization, allowing the biological treatment cycle to be adjusted depending on the wastewater characteristics (nitrogen and organic loadings).

System Overview

After screening, raw water flows into the system's biological tanks, where carbon-, nitrogen- and phosphorus-containing pollution is removed. The immersed MBR system can be configured with nitrification and denitrification zones for nitrogen removal. Here, a proprietary sequenced aeration technology control scheme provides flexible anoxic/oxic phases to achieve nitrification and denitrification without the need for the pumped recirculation of nitrified mixed liquor from the aeration to the anoxic reactors. Anoxic and oxic phase hydraulic retention times (HRTs) can be changed easily to accommodate influent water quality variations caused by manufacturing operations with minimal equalization volume needed.

Following biological treatment, membrane filtration then separates the purified water from the activated sludge and the treated water is drawn off using a low-pressure pump or by gravity. Excess sludge is directly removed from the biological tank for dewatering. Maintaining filtration performance is the key point to the process, and this is based on different automated functions: backwash, scour air and chemical cleaning, all monitored and controlled by a PLC-based control system or SCADA system.

The membrane elements, which have an average pore size of 0.08µ, separate the mixed liquor solids from the treated effluent. The treated effluent is drawn through the membrane, typically by a low-pressure suction pump (<3 psi). The tight pore structure of the membrane ensures the removal of suspended solids without the formation of a cake layer across the surface. In the backwash phase, fouling is controlled by returning some of the permeate countercurrent through the membranes with specific cleaning agents.

A Proven Technology

The proprietary immersed MBR technology has proven to be an effective solution for a variety of wastewater treatment applications. NEOSEP systems have been installed in more than 75 locations worldwide. Many food and beverage processing facilities, including champagne and beer production plants and vegetable, fish and meat processing plants, now use this system.

For example, a brewery was dealing with high load variations, strict effluent limits and space limitations. Effluent from the brewery was very difficult to treat, with oxidizable chemicals and biological compounds in much higher concentration than typical domestic sewage. A recently installed NEOSEP unit there can now treat 240,000 gal per day with design influent concentrations of 3,000 mg/L of COD, 1,650 mg/L of BOD and 650 mg/L of suspended solids. The MBR system has demonstrated strong adaptability to shock organics loading and has exceeded its guaranteed performance criteria of <100 mg/L COD, <25 mg/L BOD_5 and <30 mg/L total suspended solids.

Testing for Effectiveness

Immersed MBR technology allows for a significant reduction of biological reactor volume with relatively low additional costs for membrane filtration, due to the small membrane surface required for most food and beverage producers.

Compactness and ease of operation help make these systems an ideal process for treating and recycling wastewater in space-limited environments, providing effective control of biological activity and high-quality effluent while allowing for higher organic loading rates.

In 2007, Veolia Water Solutions & Technologies launched a mobile wastewater treatment unit for its NEOSEP immersed MBR technology. The pilot-scale treatment system is self-contained on a 48-ft truck trailer that can be transported to any food and beverage processor site to test the effectiveness of the technology on the site's specific wastewater characteristics. WWD

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