ROYCE TECHNOLOGIES

APPLICATION BULLETIN

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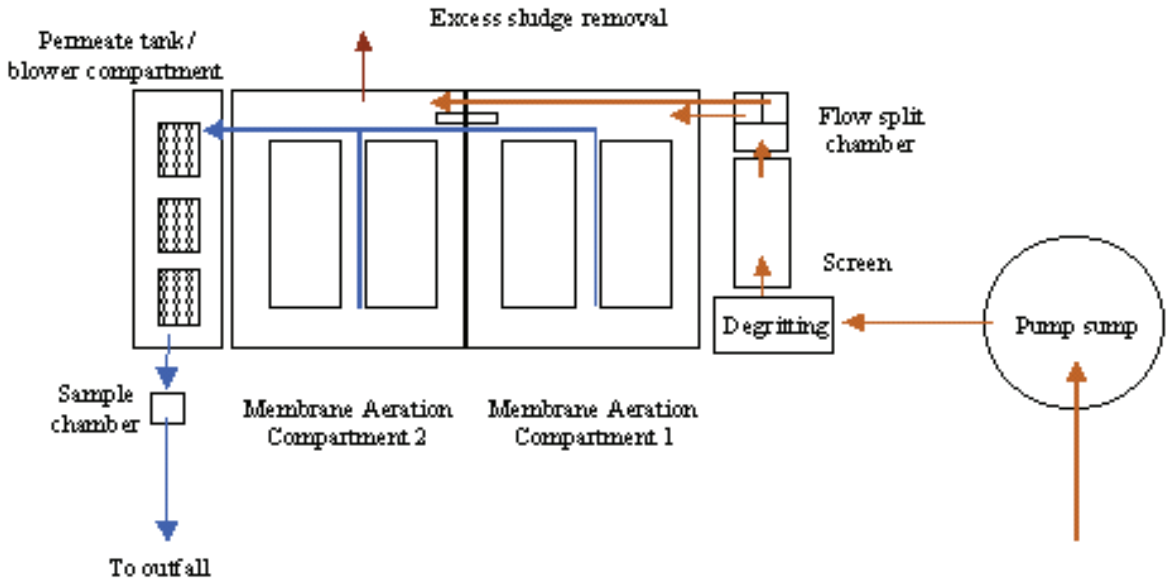
ABSS.11

TSS Measurement in Membrane (MBR) WWT Plants

Membranes have been used for many years to process a variety of liquids and gases. Until acceptable costs of membrane materials and improvements in flow rates were achieved, membranes were not often seen in the municipal wastewater treatment market. This changed when the flat sheet submerged membrane process was developed some 12 years ago in Japan (Kubota system).
The primary benefit of MBR plants is that sludge production is half that achieved in traditional activated sludge plants. As disposing of sludge is already very expensive, and set to become more so, the MBR plant clearly has a major advantage over other systems. Nutrient and particulate removal capability is also extremely good and better than more traditional process's. Legislative requirements around the world are continually restricting sludge taken to landfill and ever tighter effluent consent limits are being applied. These factors will ensure MBR plant construction increases ever more rapidly and the demand for robust instrument and control systems will follow.

A drawing of a typical modern MBR plant is provided below.



Worldwide there are now some 6-700 membrane plants installed treating municipal sewage and a variety of industrial waste waters. The process has demonstrated an amazing capability to treat wastes of widely different strengths and compositions to remarkably high standards when operated correctly.

Royce- MBR Process Optimization & Cost Saving

All plants and process's achieve their best when operated within their capabilities, and as close to the optimum design settings as possible. MBR plants are no exception other than the operating bandwidth is narrower than for a traditional treatment plant so a committed & skilled operating team or online automation are required.

Failure to control MBR MLSS correctly can give rise to increased maintenance, more frequent back-flushing or even more serious, plant shut downs. Clearly, a reliable and accurate continuously on line MLSS Analyzer is an essential element of the MBR control philosophy.

The real life example below gives some idea of just what a typical MBR plant can achieve and the challenges facing any instrumentation used for monitoring and control.

The plant identified was designed to treat effluent generated from 5 dewatering and dryer lanes, capable of processing the design maximum dry solids load, with 1 membrane tank off line.

The MLSS value had been calculated to run at a nominal maximum value of 20,000mg/l, for maximum flows. Each tank volume is nominally 2,357m³ and a sludge age (SRT) of 20 to 24 days ensures proper nitrification.
Each membrane tank has a dedicated blower providing air to the membrane unit with a separate blower arrangement to provide aeration to the fine bubble diffusers. The blowers for the membrane diffusers are nominally rated at 3,840 m³/hr@0.55bar.

Plant Flow Data
450m³/hr maximum flow rate
366m³/hr average flow rate
295m³/hr minimum flow rate
537m³/hr maximum flow rate with
six dryers running and no standby

As can be seen, very high MLSS concentrations combined with long SRT's and powerful fine bubble aeration systems set the MBR plant apart from the more traditional WWT plants most of us are familiar with. Note also that flow rates vary widely between minimum and maximum.

MLSS Concentration.

In an MBR the 'biomass' that breaks down the pollutants in the waste water, operates at MLSS concentrations some five to six times higher than in a conventional plant.

Most commercially available MLSS Analyzers & Probes are optimized in the 2-10,000 mg/l range. The Royce Model 73B operates up to 30,000 mg/l, exceeding the requirements of even the most demanding MBR plant. The Royce Model 73B

incorporates Royce's award winning Tri-color phased array color compensation system for even better accuracy, repeatability and reliability.

Sludge Retention Time & Aeration.

Long SRT's allow the development of slow growing micro organisms such as nitrifying bacteria that contribute to the excellent nutrient removal characteristics provided by MBR technology. Combining long SRT's with high volumetric loadings requires excellent Aeration capability and control. High rate Fine Bubble diffusion is almost always used. A quick peek in any MBR Bioreactor will give an indication of just how powerful the aeration systems used can be, the MLSS often looks like it is boiling or fizzing there are so many bubbles to be seen. Any TSS sensor installed in an MBR must be highly immune to errors caused by bubbles. The Royce Model 73B uses a Tri-Color phased array technique based on the light absorption principle rather than the more common but inferior Nephlometric technique used by many of Royce's competitors. This technique combined with Royce's unique user selectable WWT optimized linearity curves found in the Model 70011A TSS Analyzer totally eliminates errors due to bubbles. The Royce Model 73B has as standard the facility for self-cleaning (air or water) that is essential for any sensor installed into such high MLSS applications.

Conclusion

MBR plants are coming on line at an ever increasing rate due to their ability to reduce sludge production by a half combined with excellent quality effluent capability. However, if it is to operate correctly the MBR plant requires a highly accurate, reliable and low maintenance suspended solids analyzer. Only Royce is able to satisfy these criteria. Royce, innovative designs, reliable results.