

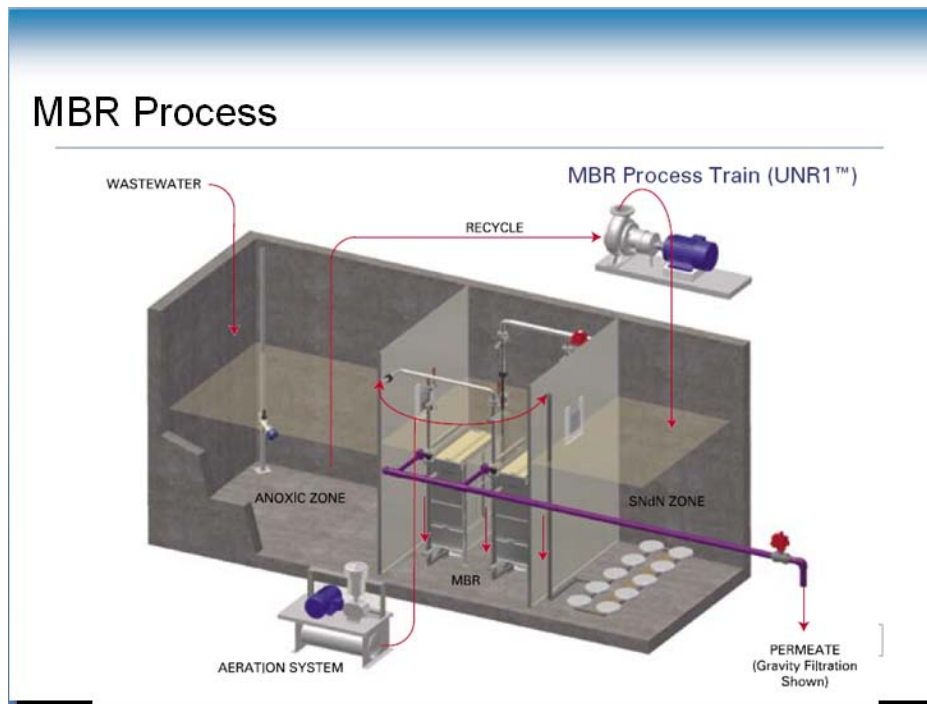
Information about the membrane treatment technology used in Barrow (based on information sent via email from Jesse Phillips and Brian Codianne of OVIVO on February 1, 2011).

The Barrow WWTP is an Enviroquip (Now called OVIVO) Membrane Treatment system.

MBR System is still a biological process with physical barrier filtration

System is essentially a paper filter mounted on plastic plates that are submerged in highly concentrated mixed liquor typically 8,000-18,000MLSS. Filter is 0.4 micron pore size and what comes out on the other side of the filter is clean, clear water.

A generic snapshot of the process:



Q: Does the system treat ammonia or metals?

A: Ammonia is treated through biological nitrification with aeration and denitrification. System has demonstrated excellent nutrient removal for nitrogen and phosphorus. TN levels < 3 and TP < 0.03

Q: What are the incoming ranges of concentrations and volumes of sewage treatment parameters as well as ammonia, copper, and zinc?

A: The nominal porosity of the membranes without the biological layer is 0.4 micron. With the proper biofilm the porosity is decreased to about 0.1 micron. This is the level they try to maintain. This porosity is typically greater than that required for good metals removal. However, activated sludge processes have been able to achieve fairly good metals removal capabilities, with MBR outperforming all the others in this category due to the much higher MLSS concentrations (15,000 ppm). Vendor does not have any quantitative data because the systems weren't designed specifically with metals removal in mind. But it usually requires

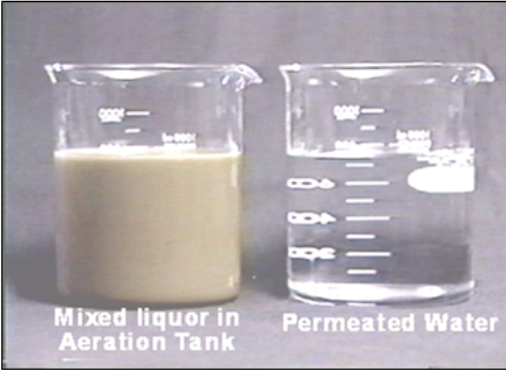
coagulant addition and very precise control of operating conditions, which could come at the expense of operational flexibility. Copper has proven to be the toughest of the metals to remove basically to it being a very small ion. So realistically, to provide consistent and reliable metals removal, the system should also include ion exchange or nano filtration as part of the package

Ammonia varies from plant to plant and the amount of incoming ammonia would determine what size aeration basin may be necessary.


Q: What standards can be met (outgoing concentrations)?

Achievable MBR Effluent Quality

- > Effluent BOD < 5 mg/L
- > Effluent TSS < 5 mg/L
- > Total Phosphorus < 0.13 mg/L
- > Total Nitrogen < 3 mg/L
- > Ammonia < 0.1 mg/L
- > Turbidity < 0.2 NTU
- > Up to 6 log removal of bacteria*
- > Up to 4 log removal of viruses*



* - prior to disinfection

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Q: What are the costs of treatment?

The total installed costs for this system generally falls in the \$7 to \$9/gal range. This can vary due to geographical location and the engineering firm involved, but the majority of OVIVO plants fall into that range. Operating costs can vary widely depending plant size, type of installed equipment, and operating philosophy.

Link to vendor website for more info.

www.ovivowater.com

Link to Kubota's website to see the membranes that Barrow uses.

<http://www.kubota-membrane.com/mbr.htm>