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MEMBRANE BIOLOGICAL REACTOR TREATMENT OF A SALINE BACKWASH FLOW FROM A RECIRCULATING AQUACULTURE SYSTEM

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A recirculating aquaculture system (RAS) can minimize water use, allowing fish production in regions where water is scarce and also placing the waterborne wastes into a concentrated and relatively small volume of effluent. The RAS effluent generated during clarifier backwash is usually small in volume (possibly 0.2–0.5% of the total recirculating flow when microscreen filters are used) but contains high levels of concentrated organic solids and nutrients. When a RAS is operated at high salinities for culture of marine species, recovering the saltwater contained in the backwash effluent could allow for its reuse within the RAS and also reduce salt discharge to the environment. Membrane biological reactors (MBRs) combine activated sludge type treatment with membrane filtration. Therefore, in addition to removing biodegradable organics, suspended solids, and nutrients such as nitrogen and phosphorus, MBRs retain high concentrations of microorganisms and, when operated with membrane pore sizes <1 mm, exclude microorganisms from their discharge.

In this research, an Enviroquip (Austin, TX) MBR pilot-plant was installed and evaluated over a range of salinities to determine its effectiveness at removing bacteria, turbidity, suspended solids, nitrogen, phosphorus and $cBOD_5$ content from the approximately 22 m^3/day concentrated biosolids backwash flow discharged from the RASs at The Conservation Fund Freshwater Institute. The MBR system was managed at a hydraulic retention time of 40.8 h, a solids retention time of 64 ± 8 days, resulting in a Food: Microorganism ratio of 0.029 day^{-1}. Results indicated excellent removal efficiency (%) of TSS (99.65 ± 0.10 to 99.98 ± 0.01) and TVS (99.96 ± 0.01 to 99.99 ± 0.00) at all salinity levels. Similarly, a 3–4 $\log_{10}$ removal of total heterotrophic microbes and total coliform was seen at all treatment conditions. Total nitrogen removal efficiency (%) ranged from 91.8 ± 2.9 to 95.5 ± 0.6 at the treatment levels and was consistent, provided a sufficient acclimation period to each new condition was given. Conversely, total phosphorus removal efficiencies (%) at 0 ppt, 8 ppt, 16 ppt and 32 ppt salinity were 96.1 ± 1.0, 72.7 ± 3.5, 70.4 ± 2.3, and 65.2 ± 5.4, respectively, indicating reduced phosphorus removal at higher salinities.