World Aquaculture 2010, San Diego, California, March 1-5, 2010.

WATER TREATMENT PROCESS EFFICIENCIES IN REPLICATED RECIRCULATING SYSTEMS OPERATED WITH AND WITHOUT OZONATION

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In the Americas, a number of Atlantic salmon (*Salmo salar*) smolt and rainbow trout (*Oncorhynchus mykiss*) growout systems use a type of water recirculating system (WRAS) that includes the following common components: dual-drain circular culture tanks, radial flow settlers (to treat the tank bottom-drain flow), microscreen drum filters, fluidized-sand biofilters, forced ventilated cascade aeration columns, and low head oxygenation (LHO) units. These salmonid production systems are often operated with a makeup water supply that flushes the WRAS volume completely on a daily basis. These WRAS could be operated at much lower water exchange rates if heat accumulation did not create temperature problems or performance of the water treatment processes was not compromised. Ozonation is a process that can improve water quality and reduce bacterial gill disease mortalities in rainbow trout cultured in WRAS at relatively low, non-disinfecting dosages. The objective of the present study was to compare the water treatment process performance measured in six replicated WRAS, three systems per treatment, that were operated with or without ozonation of the recirculating flow and at relatively low makeup water flushing rates during growout of rainbow trout.

All systems were operated at a low water exchange rate, i.e., at a mean system volume exchange rate of once every 6.7day; makeup flow was 0.26% of the total recycled flow. Each identical 9.5 m^3 system recycled 380 L/min of water, which provided a 15min exchange rate of the 5.3 m^3 culture tank. A 24-hr photoperiod was provided and fish were fed every 2-hrs, twelve times daily. Rainbow trout were randomly stocked, 1000 fish/system. During a one week period when fish were at maximum feed levels (6.6kg/day/tank) and densities (80kg/m^3), water samples were collected across all unit processes to compare water quality and process removal efficiencies. Feed loading rates for all systems were approximately 4.6 kg/d per m^3 make-up water flow. All tanks were fed equal portions during the water sampling event.

Total ammonia nitrogen (TAN), nitrite nitrogen, nitrate nitrogen, dissolved oxygen, and carbon dioxide concentrations exiting the culture tank sidewall drain were similar between treatments. TAN removal efficiencies across the fluidized sand biofilters were significantly different between the O_3 and no O_3 treatments, i.e., 66±3% and 51±2%, respectively. The biofilters, however, maintained relatively low TAN concentrations at 0.53±0.02 and 0.59±0.03mg/L and nitrite nitrogen concentrations at very low levels, i.e., 0.05±0.01 and 0.06±0.01 mg/L in the O_3 and no O_3 treatments, respectively. TSS removal efficiencies across the radial flow clarifier and drum filter were also better in the O_3 treatment than in the no O_3 treatment, i.e., 72±2% and 50±10% across the radial flow settling units and 25±1% and 7±3% across the microscreen filter, respectively. Dissolved CO_2 removal efficiency across the stripping column was better in the O_3 treatment than in the no O_3 treatment, i.e., 49±5% and 40±1%, respectively, which was impressive considering the inlet CO2 concentration averaged 11-12mg/L. Dissolved oxygen transfer efficiency across the LHO was approximately 90% in both treatments.