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COMPARING CARBON DIOXIDE STRIPPING COLUMN PERFORMANCE IN FRESHWATER AND SEAWATER

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Problems with dissolved CO_2 have been encountered in intensive aquaculture systems that supplement dissolved oxygen levels using pure oxygen injection technologies, because these systems support higher fish loading rates and the oxygen transfer processes that are used provide insufficient gas exchange to strip the quantities of CO_2 produced. Previous research in freshwater systems has demonstrated that as much as 5-10 volumes of air per volume of water must be contacted for the most effective CO_2 stripping. However, anecdotal evidence from commercial marine fish farmers indicates that dissolved CO_2 stripping across forced-ventilated cascade columns is more difficult in seawater than in freshwater. Therefore, we conducted empirical studies to determine how air:water loading levels, and packing height affect dissolved CO_2 removal in freshwater and seawater. CO_2 stripping was studied using two force-ventilated cascade columns, each 38.6 cm (15.2 inch) diameter and randomly packed with either 1 m or 2 m of 5-cm diameter tubular NORPAC media. The counter-current ventilated cascade columns were located on a side-stream within a recirculating aquaculture system containing a 150 m^3 culture tank at the Conservation Fund Freshwater Institute. Water flow rates were controlled with valves so that each cascade column received 119, 238, 357, or 476 L/min of water flow, producing hydraulic loading rates of 1.03, 2.05, 3.07 , and 4.1 m^3/min per m^2 plan area (25, 50, 75, and 100 gpm/ft^2). Volumetric air flow rates were adjusted so that each column received ½, 1, 2, 5, 10, or 20 times the volumetric water flow rate. The combination of airflow and water flow rates resulted in 48 different trials for each column, i.e., four HLR's were tested at six air:water ratios and at two salinities. Each of these trials was conducted at a water temperature of 15.5 ± 0.5°C and repeated at least six times. Salinity levels in the recirculating system were 0.1 ppt, (freshwater) and 33 ppt, produced by adding NaCl and other salts to create a synthetic seawater solution in the recycle system. Inlet CO_2 concentration was held at 20 mg/L by regulating the amount of CO_2 gas that was diffused into the water. Results of the mean CO_2 removal efficiencies measured at a HLR of 2.05 m^3/min/m^2 are plotted below.