

WATER QUALITY IN REPLICATED RECIRCULATING AQUACULTURE SYSTEMS OPERATED AT HIGH, LOW, AND NEAR-ZERO WATER EXCHANGE WITH AND WITHOUT OZONE

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A series of studies have been conducted to identify potential water quality parameters that could limit rainbow trout performance within recirculating aquaculture systems (RAS) operated at low and near-zero water exchange with and without ozone. Six identical 9.5 m³ WRAS, containing a single 5.3 m³ tank and operated at a total recirculating flow of 380 L/min were used in each study. Three studies were conducted: 1) RAS operated with low water exchange rates with and without ozone; 2) RAS operated with low water exchange rates with ozone versus high exchange without ozone; and 3) all RAS operated at near-zero exchange with and without ozone. A primary objective of these studies was to determine ozone's impact on water quality.

Ozone dramatically reduced true color during each study, creating very clear water. Ozone also reduced total suspended solids, carbonaceous biochemical oxygen demand, and dissolved heavy metals (copper and zinc), and increased ultraviolet transmittance. Reduction of copper through ozonation appears to be extremely valuable since copper bordered toxic levels without ozone. TAN and nitrite concentrations were also generally lower in RAS operated with ozone. It is important to note dramatic differences in water quality weren't apparent within the ozonated RAS during Study 2 due to ten times greater flushing of the non-ozonated RAS. Despite the difference in dilution between treatments water quality within the ozonated RAS was still comparable during Study 2. Ozone effectively reduced potentially harmful water quality constituents that accumulate in RAS and thus appears to be an important component for creating an optimal culture environment in systems operated at low and near-zero water exchange.

TABLE 1. Mean water quality when RAS were operated at maximum feed loading and density.

Treatment Parameter	Study 1		Study 2		Study 3	
	Low Exchange No Ozone	Low Exchange Ozone	High Exchange No Ozone	Low Exchange Ozone	Near-Zero Exchange No Ozone	Near-Zero Exchange Ozone
TAN (mg/L)	0.59 ± 0.03	0.53 ± 0.02	0.55 ± 0.06	0.71 ± 0.02	1.14 ± 0.19	1.01 ± 0.14
Nitrite (mg/L)	0.06 ± 0.01	0.05 ± 0.01	0.17 ± 0.12	0.12 ± 0.04	0.20 ± 0.05	0.27 ± 0.16
True Color (Pt-Co units)	53 ± 2	4 ± 0	12 ± 0	5 ± 1	157 ± 25	5 ± 1
cBOD ₅ (mg/L)	5 ± 1	2 ± 0	4 ± 1	5 ± 0	12 ± 0	4 ± 0
UV Trans %	60 ± 1	82 ± 0	89 ± 0	77 ± 2	30 ± 2	66 ± 4
TSS (mg/L)	9.7 ± 1.4	4.7 ± 0.6	2.8 ± 0.2	5.1 ± 0.3	20.2 ± 7.8	3.7 ± 0.2
Copper (mg/L)	0.064 ± 0.001	0.021 ± 0.008	0.014 ± 0.002	0.038 ± 0.004	0.169 ± 0.031	0.047 ± 0.002
Zinc (mg/L)	0.005 ± 0.003	0.001 ± 0.001	0.011 ± 0.003	0.007 ± 0.002	0.067 ± 0.010	0.038 ± 0.019

Note: True color and UV transmittance values are means for the duration of each study.