BASIC WATER QUALITY PARAMETERS FOR AQUACULTURE

Measured Parameter	Definition	Recommendations	Problem	Solution	Comments	References
Alkalinity ($CaC0_3$)	Water property that resists or buffers against changes in pH upon addition of acid or base	110-140 [1] or <140 mg/l [2]; >200 ppm, few adverse consequences [1]; Also measured as dKh (norm 6-7, tolerable to 11) and meq/l (2.1-2.5) [1]	Too low	Addition of alkaline buffers used to adjust pH usually provides adequate alkalinity; if buffers contain calcium, adds to hardness	Varies with calcium, magnesium, and pH; can be altered by several common solutes (i.e., soda ash dissolved in water)	[1] Shellfish [2] Shrimp
Calcium Hardness ($CaCO_3$)	Calcium and magne-sium ions in water; expressed as mg/L $CaCO_3$ equivalent	>20 ppm as $CaCo_3$ [3] 20 – 200 ppm [4]	Too low	Addition of calcium chloride to water supply	Important aspect of water chemistry in saltwater systems; closely related to pH	[3] Catfish [4] Finfish
Carbon dioxide (CO_2)	Clear gas; end product of cellular respiration	<20 mg/l (ppm) [2] <10 ppm [3] 1.5-3 ppm [4] normal range 1-10 mg/l [2]	Too high	Vigorous aeration (degassing) of incoming water; supplemental aeration in tanks	Primary greenhouse gas	[2] Shrimp [3] Catfish [4] Finfish
Dissolved Oxygen (O_2)	Amount of oxygen dissolved in water; higher amounts in colder waters than warmer waters	>5.0 mg/L [1] <5% over saturation [2] 5 ppm to 90% of saturation level [3]	Too low	Vigorous aeration of incoming water; supple-mental aeration in tanks	Range may vary with species and life stage; varies depending upon temperature	[1] Shellfish [2] Shrimp [3] Catfish
Hydrogen Sulfide (H_2S)	Colorless gas with strong odor of rotten eggs, exists as ionized and unionized	<0.005 ppm [3] <0.002 ppm [4] <0.1 mg/l [2]	Too high	Vigorous aeration (degassing) of incoming water	Unionized form toxic to aquatic organisms; dependent on pH, temperature, salinity	[2] Shrimp [3] Catfish [4] Finfish
Hypochlorite ($Ca(ClO)_2$)	Chemical compound widely used for water treatment and as a bleaching agent	Non detectable [1]	Detectable	Commercial sodium thiosulfate used as a neutralizer; 1.5 grams required to neutralize each liter of 200 ppm chlorine solution	Disinfectant used in cleaning tanks; any detectible level can cause mortality to shellfish	[1] Shellfish
Iron (Fe)	Chemical element, a metal; by mass, the most common element on Earth	<0.5 ppm total iron [3]	Too high	Aeration (oxidation) followed by filtration (i.e., activated carbon) and/or precipitation	Saltwater from wells often contains high levels of iron and other minerals	[3] Catfish [4] Finfish

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Nitrogenous compound: Ammonia (NH_3)	By-product of metabolic process (i.e., food digestion and decomposition of uneaten food and organic matter)	<0.1 ppm generally safe [1] 0–0.1 mg/l [2] <0.05 ppm [3] <0.02 ppm [4]	Too high	Avoid accumulation by decreasing stocking density, increasing water flow or exchange; biofiltration	Most toxic of nitrogenous compounds; varies with salinity, pH, and temperature; adult bivalves hardier than larvae [1]	[1] Shellfish [2] Shrimp [3] Catfish [4] Finfish
Nitrogenous compound: Nitrite (NO_2)	Formed by the oxidation of wastes containing ammonia, converted by Nitrosomonas bacteria	<0.2 ppm should generally be safe [1] 0–0.5 mg/l [2] <0.1 ppm [4]	Too high	Reduced or blocked by chloride ions; biofiltration	Toxicity increased by higher pH, 10-100 times less toxic than ammonia [1]	[1] Shellfish [2] Shrimp [4] Finfish
Nitrogenous compound: Nitrate (NO_{3-})	Final product of conversion in N cycle; converted by nitrifying bacteria	16 ppm in salt water [1] 400–800 µg/l [2] <1.0 ppm [4]	Too high	Marine organisms tolerate high nitrate levels, but should be kept as low as possible	10-100 times less toxic than nitrite [1]	[1] Shellfish [2] Shrimp [4] Finfish
Oxidation reduction potential (ORP)	Extent to which a material will lose or gain electrons, causing them to be oxidized or reduced	150-250 [1] 500-700mV [2] Range is highly variable, stability more important than exact values [1]	-	-	High values associated with high oxygen and pH values present in water; affected by temperature and pH	[1] Shellfish [2] Shrimp
pH	Negative logarithm of hydrogen ion concentration, used to define acidity (values <7) and alkalinity (values >7)	7.8 to 8.4 [1] 6.5 – 9.5 [2] 6.7 – 8.6 [4]	Too low	Maintained by adding alkaline buffers (i.e., soda ash, sodium bicarbonate)	Range may vary with species and life stage	[1] Shellfish [2] Shrimp [4] Finfish
Salinity	Degree of salt dissolved in water	20-35 ppt (psu), clams [5] 10–30 ppt (psu), oysters	Too low Too high	Use artificial sea salt Blend with fresh water	Monitoring based on variability, depends on species and life stage [1]	[1] Shellfish [5] Clam
Temperature	Degree of hotness or coldness measured by a thermometer with a numerical scale – Fahrenheit (°F) or Celsius (°C)	18-20°C for conditioning, 22-23°C for rapid conditioning and prespawn priming, 24-28°C optimal, 20-30°C for larvae and post-set rearing [5]	Too low Too high	Use electric immersion heaters, gas or electric heating units, heat exchangers or pumps Blend with cooler water or use chiller unit	Should be monitored on continuous basis, depends on species and life stage [1]	[1] Shellfish [5] Clam

REFERENCES

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[3] Tucker, C.S. (1991) Water Quantity and Quality Requirements for Channel Catfish Hatcheries. USDA Southern Regional Aquaculture Center, SRAC Publication No. 461: 8 pp. file:///C:/Users/lnst/Downloads/SRAC_0461.pdf

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