

The Importance of Monitoring Alkalinity and Calcium in Coral Reef Aquariums

Description:

Alkalinity and calcium are important parameters in all marine ecosystems, but are especially important in marine ecosystems where coral is present. Alkalinity is the ability of a system to buffer the pH from changing when acids or bases are introduced. Salt water aquariums are usually buffered at a stable pH ranging from 7.8 to 8.4 and the ocean has a stable pH of approximately 8.1. A stable pH is very important for coral and fish life; small fluctuations in pH can cause stress which can result in death to the organisms. In small scales systems, such as aquariums, keeping the pH stable is difficult and requires frequent testing and adjustments. Alkalinity in aquariums ensures that the waste from fish is in the form of ammonium (NH_4^+). If the pH of the aquarium is too high, ammonium will convert to ammonia (NH_3) which is toxic to fish at very low levels. Alkalinity in salt water systems is primarily in the form of the bicarbonate ion, HCO_3^- , and the carbonate ion, CO_3^{2-} . If acid (H^+) is introduced into the system, the bicarbonate ion reacts with the acid to form water and carbon dioxide, as in the following equation: $\text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2$. If a base (OH^-) is introduced into the system, bicarbonate will react with the base to form carbonate and water, as in the following equation: $\text{HCO}_3^- + \text{OH}^- \rightarrow \text{CO}_3^{2-} + \text{H}_2\text{O}$. In both cases, the result is an unchanged, buffered pH. A number of dissolved ions can contribute to alkalinity, so for the sake of consistency, alkalinity measurements are expressed as units of CaCO_3 . In coral reef aquariums, bicarbonate, as well as dissolved calcium ions, is consumed by the coral to form the calcium carbonate (CaCO_3) exoskeleton of the coral. The ratio of alkalinity to calcium is important for coral reef health and growth, and these ions need to be closely monitored so that the aquarium owner can make additions of bicarbonate and calcium ions as they are consumed. The alkalinity of oceans is 125 ppm CaCO_3 with a recommended concentration of 125 - 200 ppm CaCO_3 in salt water aquariums and the calcium concentration of oceans is 420 ppm Ca^{+2} with a recommended concentration in aquariums of 380 - 450 ppm Ca^{+2} .



Application:

The owner of a fish store specializing in coral reef aquariums approached Hanna Instruments for a fast and reliable way to monitor alkalinity and calcium in their aquarium tanks. They were currently using a chemical test kit for alkalinity. This chemical test kit utilized a drop wise titration method, which was timely to perform and often yielded incorrect results due to over-titration of the water sample, and therefore, overestimation of the concentration of alkalinity present in the aquarium. For calcium, the customer was utilizing a test strip. The test strip was easy to use, but the customer wanted to improve the resolution of their calcium measurements to better maintain a consistent calcium: alkalinity ratio over time. Hanna Instruments offered the HI 755 Alkalinity Checker and HI 758 Calcium Checker. Both the HI 755 and HI 758 are part of the Checker Marine series, meaning they have been specifically designed for use with salt water, and will yield better results than a test intended

for fresh water. The customer appreciated that these single parameter colorimeters were small and easy to store and transport around the store, and were easy to use. The Alkalinity Checker has a range of 0 - 300 ppm, which encompassed their ideal range of 125 - 200 ppm, and the Calcium Checker has a range of 0 - 600 ppm, which encompassed their ideal range of 380 - 450 ppm. The increased resolution of 1 ppm for each test and the increased accuracy (+/-5% of reading +/- 5 ppm for alkalinity and +/- 6% for calcium) allowed the customer to more precisely adjust the alkalinities and calcium concentrations of the tanks to ideal levels. The Alkalinity and Calcium Marine Checkers provided an easy, affordable solution for the aquarium store to maintain optimal levels for growth of their corals.

