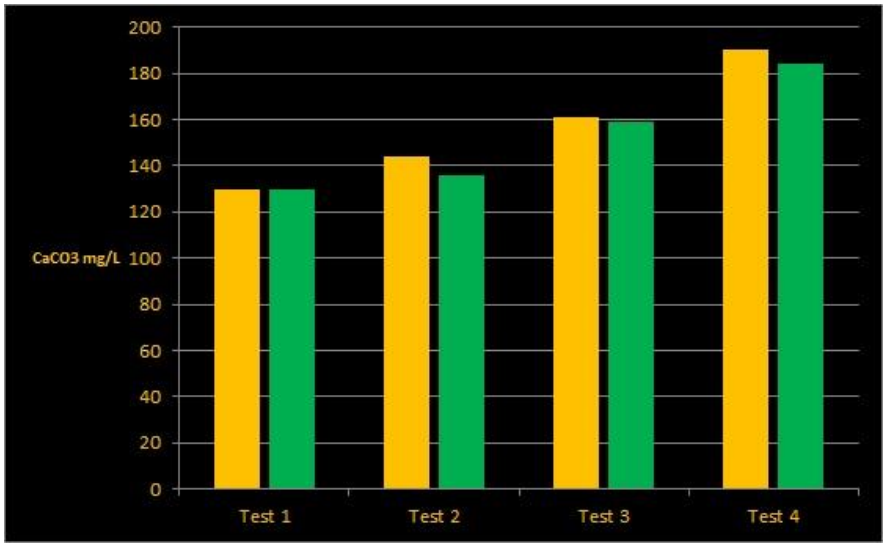
Alkalinity Test Showdown:
Hanna Checker versus Hach Titration Method

By Dana Riddle



Alkalinity is an important parameter in reef aquarium and should be routinely monitored. Alkalinity can help prevent downward shifts in pH and can be used as a carbon source in photosynthesis. Various testing methods exist and I will compare results obtained by titration and colorimetric procedures over a range of alkalinities commonly seen in reef aquaria. These were the alkalinity concentrations measured and compared (Alkalinity, milligrams per liter as $CaCO_3$ degrees Carbonate Hardness (dKH), respectively: 130 mg/L $CaCO_3$ =7.28 dKH; 136 and 7.62; 162 and 9.072; 190 and 10.64.

Before presenting results, I'll describe methods (and costs!)

Colorimetric Method: Hanna Checker

This device is a colorimeter and estimates alkalinity concentrations by adding a reagent that produces a color, which is then determined in accordance with Beer's Law (which states the concentration of a dissolved substance is proportional to its absorptive capacity of light.) At one time, devices (spectrometers) used to determine absorptive capacities were expensive, sometimes costing thousands of dollars. The advent of using narrow bandwidth LEDs and microprocessors has dramatically reduced costs of colorimeters – the Hanna Checker for alkalinity can be purchased for less than $50, and this includes all hardware and regents for 25 tests. Hanna offers two colorimeter models, one reports alkalinity as calcium carbonate (CaCO3) in *milligrams per liter* (more or less equivalent to parts per million) and *degrees carbonate hardness* (dKH) – I chose the model that reports in millligrams per liter in order to compare results determined by the titration method without relying upon conversion factors. See Figure One.

Figure One. The Hanna Checker colorimeter for determination of alkalinities typically found in reef aquaria. Everything is included for these determinations, including reagents sufficient for 25 tests.

Titration Method: Hach Digital Titrator

Titration is the determination of a dissolved substance by measuring the amount of a known concentration of a reagent to a desired endpoint. In the procedure I used, 100 milliliters of sample was titrated (through use of Hach's digital titrator) with a reagent (5.25N H_2SO_4) to a pH endpoint of 4.2. The titrator and reagent set costs about $300. In addition to the sulfuric acid cartridge, this set also provides a reagent (bromcresol green-methyl red) that changes color from green to red when the endpoint is reached. Since this involves visual determination of the color shift (which can be difficult when making comparisons of multiple samples), I chose to determine the titration's endpoint through use of a calibrated pH meter. Also used was a magnetic stirrer and stir bar to rapidly mix reagents in the sample. All told, cost of equipment used in this procedure amounts to about $1,500. See Figure Two.

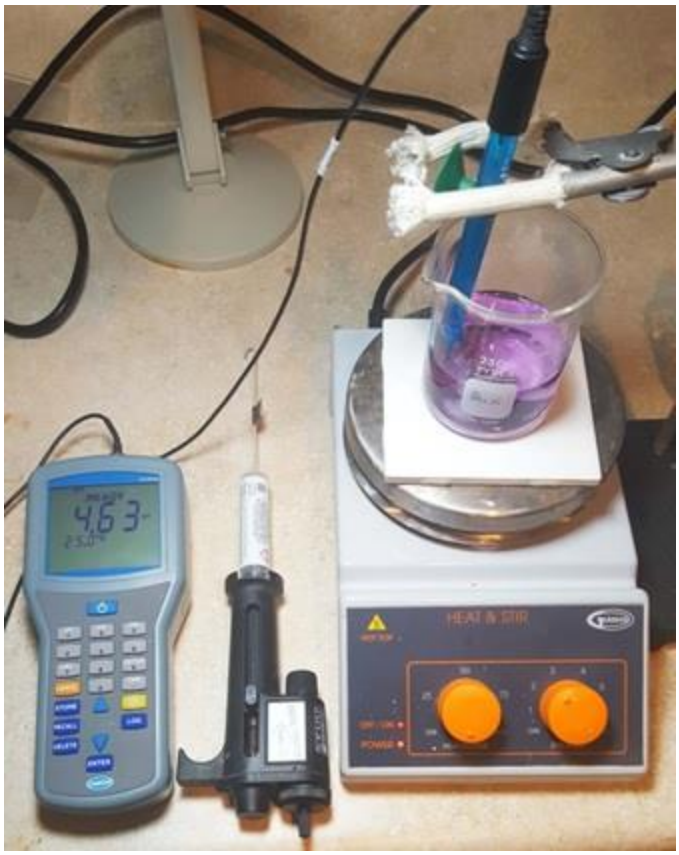


Figure Two. 'Laboratory-grade' equipment used in determining alkalinity for this report.

So, how do these different approaches to the determination of alkalinity compare? Does an inexpensive colorimeter deliver results comparable to those obtained with expensive equipment?

Results

The results obtained through these procedures involving two different reagent sets compared favorably. See Figure Three.

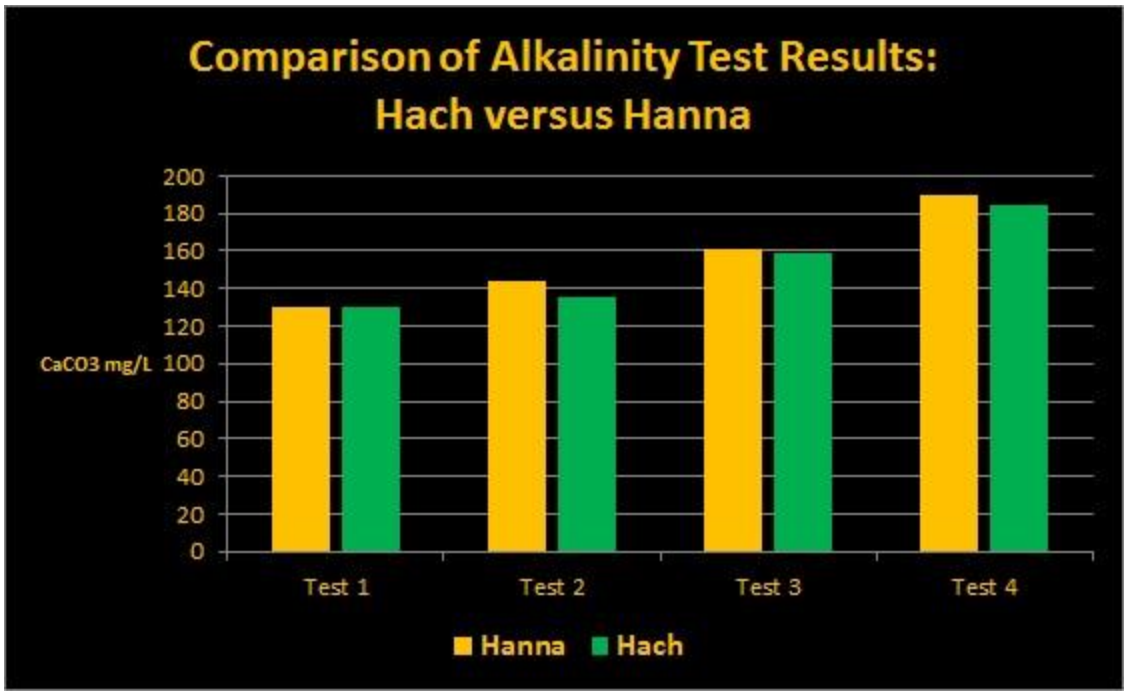


Figure Three. Results compared favorably between the two alkalinity reagents/approaches.

Discussion

No attempt was made to compare results of either result sets to a known standard. Since Hach's method for alkalinity determination conforms to that described in the 14th edition of *Standard Methods for the Examination of Water and Wastewater*, I am operating under the assumption that it generates accurate results. A later edition of *Standard Methods* could mention the chemistry used by Hanna. Whatever the case, due diligence should be exercised when executing either test procedures – good laboratory technique is a must. Follow directions explicitly!

Four criteria were used in evaluating suitability of these procedures for reef aquarists:

1. **Cost.** When considering costs associated with the equipment I used with the Hach method, it is clear Hanna's Checker is the winner in this category. While it is true that the pH meter could be considered a luxury, I felt that it was necessary when making comparisons of multiple samples, especially in the case of the slow response of the gel-filled pH probe. The same rationale applies to the use of the magnetic stirrer/stir bar.
2. **Ease of Analysis.** There is an old saying among the line of '*the more difficult the task, the less likely it will be done.*' Again, Hanna is the winner. Adding the reagent to the sample is easily done, and analysis is completed by pressing a button 3 times. The other method I used involved use of various devices.
3. **Time Required.** The Hanna test can be completed in less than 5 minutes. If I'm performing the 'Hach' test procedure employing a pH meter, the test takes about the sample amount of time – once the pH meter is calibrated. If I have to mix pH standards using dry reagents (my preference in any case), the setup time can be 15 to 20 minutes.

4. **Results – Most Importantly Results!** Test results differed by only a few milligrams per liter. It should be noted that Hach offers a reagent for alkalinity testing that is the same (or very similar) to that used by Hanna, but requires the use of an expensive spectrometer. I also performed some repeatability comparisons. I was able to obtain the exact same results with both procedures.

Both test procedures delivered results that compared favorably. Which is best for you? If you have access to a wet lab, there is little reason to purchase Hanna's colorimeter. I suspect in most cases this is not the case and the Hanna Marine Alkalinity Checker is worthy of consideration for purchase.

All equipment and reagents were obtained through normal retail channels.