Reef Aquarium pH and Alkalinity Balance

I have a problem balancing the alkalinity with the pH in my reef aquarium.

By J. Charles Delbeek

Q. I started a marine tank a year ago and have lost only two fish. I have now started a 10-gallon mini reef. I retrofitted the old light with a power strip recommended by my local retailer. I leave the light on for about 14 hours a day. I have a medium power filter (containing a small protein skimmer rated for 30 gallons) hanging on the back of the tank providing water movement over the live rock.

Water chemistry was fine during the first three weeks, and I purchased a small green star polyp colony and tiny yellow polyp colony. Six weeks later, I added a small tomato clown and four-striped damsel, along with a green emerald crab, to the two hermits and a red-collared turbo snail already there.

I have a problem balancing the carbonate hardness with the pH. I get them to preferred levels (8.0 to 8.2 pH, and 8 to 10 dKH), but I cannot get the two stabilized. Every time I turn around, pH is down to 7.8, and carbonate hardness is up to 12 to 15 dKH. On one hand, the marine buffer will raise the pH, but it also slightly raises the dKH. In addition, I recently noticed expansive algae growth, so I only ran the light for about six hours per day. Help!
Bruce Marat

A. Several things may be going on here. First, pH and dKH are only two components of a complicated system. Other factors include calcium and carbon dioxide. Other than the buffer you are using, you do not indicate if you are supplementing calcium - and the buffer does not supply it.

Are you using a test kit or a meter to measure pH? Sometimes, reported problems in pH are more a case of bad test kits or pH probes out of calibration. If you are using a test kit, you may want to get new reagents or a new kit, and measure again; if using a pH probe and meter, make sure you have calibrated the pH probe using the instructions provided with your unit.

Also, measure pH at the same time each day. The pH fluctuates during the day as organisms in the tank respire, giving off carbon dioxide (of course, they do this during the night, as well), which lowers pH. On the other end of the equation, coral zooxanthellae, as well as algae, use carbon dioxide in the presence of light, producing oxygen (photosynthesis). The net result is that the pH will rise as the day goes on and begin to fall once the lights are off.

To an extent, proper alkalinity (or buffer) helps mediate these types of swings, so the fluctuation is not too great. What is not commonly known, however, is that the amount of buffering in the normal pH seawater is not that great. The time of day you measure pH can have a great impact on your readings.

The very nature of a buffer will result in an increase in pH and alkalinity. However, the pH should only increase slightly, unless the buffer is not properly balanced and contains a higher proportion of carbonates as opposed to bicarbonates. Depending on the composition of the buffer, these changes can be great or small. Generally, the pH should fall to normal levels quickly because of the carbon dioxide in the water.

If your kit/probe reads accurately, and you are measuring pH at the same time each day, the explanation may be an excess of carbon dioxide in the water, with a couple possible reasons. The addition of fish increases the amount of carbon dioxide in the water, and the reduction in the light cycle and resulting reduction in algal photosynthesis also result in increased carbon dioxide levels.

Because you have a protein skimmer, excess carbon dioxide should be blown off, unless the skimmer is not working properly or efficiently. Although a protein skimmer helps oxygenate the water and release excess carbon dioxide, bringing the water into equilibrium with the surrounding air, unless that air is at normal levels, the skimmer will add carbon dioxide to the water. In today's more energy-efficient homes, air exchange with the outside is not as great as it used to be, and these homes often have higher-than-normal levels of carbon dioxide. Respiration by people and pets, cigarette smoking and the unvented appliances burning natural gas (e.g. ovens and stoves) can also lead to higher indoor carbon dioxide levels. This level can easily be more than twice that of exterior air, and thus lower the pH. If your tank is located in a confined space or a small room, you may have a carbon dioxide problem.

A simple test would be to add an airstone, and see if you get a rise or fall in the pH after a few hours. If the pH rises, you have excess carbon dioxide in the water and you need to increase aeration in the system. In some cases, simply opening the hood can help, but in others an aerator or larger protein skimmer is needed.

Another method is to use a calcium hydroxide solution (kalkwasser) for all your evaporative water needs. The calcium hydroxide will combine with carbon dioxide in the water to produce bicarbonates and combine with bicarbonates to form carbonates, thus boosting alkalinity. The removal of carbon dioxide will result in an increase in pH. An added benefit of kalkwasser is the precipitation of phosphate in the area where the kalkwasser is added, due to the high pH of kalkwasser, helping to reduce algal growth. Kalkwasser also adds calcium.

If, however, the pH falls further when you add an air stone, the carbon dioxide problem lies in the room with the tank. Solutions include opening a window, adding a fan to increase circulation with the rest of the house, moving the tank to another room or placing an air pump in an enclosure outside the house to pump outside air directly into the tank via an air stone. Again, the use of kalkwasser will help to reduce carbon dioxide levels.