IMAS Newsletter

THE IMPORTANCE OF WATER PARAMETERS

Editor's Comments:

Seeing as Kim Gross is covering the importance of water parameters for this months subject. I figured that I would also cover this important area. I know sometimes I find myself very interested in what is covered in the meetings and the find myself forgetting a lot of the information. I hope that making this info available in one place for all of us will make it easier for us to remember. I will try cover as thoroughly as I can the 4 parameters that I feel are very important to the health of your saltwater aquarium

ALKALINITY

Alkalinity is one of the most important parameters of a reef tank. Alkalinity is a property of water. It's not as straight forward as adding, say, Calcium. Calcium is low, so we add calcium to the tank. That's easy. With alkalinity it's just a bit different. In fact it's a property of water, which we measure incidentally. Usually people add a mixture of three different things to raise alkalinity, but there are several different chemicals in seawater that contribute to this.

HCO3- (bicarbonate) 89.8 %
CO3-- (carbonate) 6.7 %
B(OH)4- (borate) 2.9 %
SiO(OH)3- (silicate) 0.2 %
MgOH+ (magnesium mono hydroxylate) 0.1 %
OH- (hydroxide) 0.1 %
HPO4-- and PO4--- (phosphate) 0.1 %

You'll notice that bicarbonate and carbonate make up the bulk of the chemical species that contribute to alkalinity. These are what we, as reef aquarists, are interested in. These are what corals use to produce their aragonite skeleton. Corals take up actually mainly bicarbonate, but carbonate and bicarbonate can inter convert in seawater depending on pH/CO2. They are also used during photosynthesis by both symbiotic algae in corals and micro and macro algae in the tank as a carbon source.

Though there are all these things that make up the total alkalinity of the tank, obviously it's the coral building of the bicarbonate and carbonate that we are interested in. One definition for alkalinity is that it's a chemical property of the water to resist pH change upon the addition of acid. Even though resistance to pH drop is important we measure alkalinity to ensure that there is enough bicarbonate and carbonate in the water. But there may be a problem. You'll also notice that borate is third on the list. This is important because unlike bicarbonate and carbonate, borate is not used in calcification, but it may play a significant role in total alkalinity. Remember these numbers are for natural seawater. The numbers in artificial seawater can vary dramatically. Many salts have elevated borate levels which helps to maintain pH. It's obviously helpful for fish only tanks where there is no emphasis on calcification, but in our reef tanks we don't really want any more of it than necessary. Keep an eye on the ingredients in the alkalinity buffers you use.

Alkalinity is closely tied to pH. In fact there is a direct linear rise in pH with a rise in alkalinity. Other than alkalinity the only major contributor to the pH of the tank is the amount of CO2 in the water. So basically maintaining adequate alkalinity and keeping good gas exchange to the tank will ensure that the pH is within acceptable range. This is also the reason why one should not try to control the pH with the use of buffers. This is common advice that is frequently given to new aquarist. Doing this does raise the pH, but in doing so it elevates the alkalinity too high. Low pH is almost always a gas exchange issue. So again don't try to control pH with the use of buffers.

Edited by: Kevin Adler

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Test kits measure alkalinity in three different units, ppm CaCO3 equivalents, meq/l and dKH.

50 ppm = 1 meq/l = 2.8 dKH.

Reef tank recommendations being

125-200 ppm , 2.5-4 meq/L, 7-11 dKH

An important thing to consider is the amount of alkalinity in the water compared to Calcium. During calcification 50 ppm of alkalinity are consumed for every 20 ppm of calcium. So more than twice the amount of bicarbonate is used compared to calcium. Since recommended reef tank levels of bicarbonate are only 175 ppm alkalinity can drop extremely fast in relation to calcium. For this reason it is extremely important to test for and maintain adequate alkalinity in our tanks.

CALCIUM

Many corals use calcium to form their skeletons, which are composed primarily of calcium carbonate. The corals get most of the calcium for this process from the water surrounding them. Consequently, calcium often becomes depleted in aquaria housing rapidly growing corals, calcareous red algae, Tridacnids and Halimeda. As the calcium level drops below 360 ppm, it becomes progressively more difficult for the corals to collect enough calcium, thus stunting their growth.

Maintaining the calcium level is one of the most important aspects of coral reef aquarium husbandry. Most reef aquarists try

to maintain approximately natural levels of calcium in their aquarium (~420 ppm). It does not appear that boosting the calcium concentration above natural levels enhances calcification (i.e., skeletal growth) in most corals. Experiments on Stylophora pistillata, for example, show that low calcium levels limit calcification, but that levels above about 360 ppm do not increase calcification.

For these reasons, it is suggested that you maintain a calcium level between about 380 and 450 ppm. It also suggested using a balanced calcium and alkalinity supplement for routine maintenance. The most popular of these balanced methods include limewater (kalkwasser), calcium carbonate/carbon dioxide reactors, and the two-part additive systems.

If calcium is depleted and needs to be raised significantly, however, such a balanced additive is not a good choice since it will raise alkalinity too much. In that case, adding calcium chloride is a good method for raising calcium.

SALINITY

With salinity (like temperature), while it's important to be in the right range, it's more important to maintain as close to a constant value as possible. Salinity's importance in your system, without going into a lot of scientific detail, is related to osmosis and each critter's ability to regulate ions. Keeping the tank outside of that range creates stress on your tank's inhabitants, which as previously stated, leads to illness, infections, or even death.

One common mistake/oversight made early on in this hobby relates to evaporation and it's affect on the tank's salinity. Water evaporates from the system. But that's it. Only the water (pure H_20) is evaporating. When this happens, the amount of salt (and other chemicals) in the tank remains the same. Only now the volume of water is smaller, which means their concentrations are higher.

This means, to maintain a stable salinity value, this evaporate water needs to be replaced in the system. This is referred to as topping off. The idea is, if your tank evaporates about a gallon a day, then a gallon of fresh (preferably RO/DI water) needs added to the tank to keep the salinity (as well as other parameters) at the same value. The more frequent the topping off, the more STABLE the salinity will be. With the example I just gave, if you topped off once a week, you would need to add 7 gallons of freshwater. If you did this all at once, this would more than likely be a huge shock to the system, causing major stress on the inhabitants. Topping off once a day is a common practice and for most critters/system sizes, this is sufficient. However this can still be a little shocking to some of the critters in the tank, and more frequent top-offs may be necessary depending on the types of animals you have in your system. Some people even install top off systems that constantly replace evaporated water throughout the day. This type of topping off is the most ideal, and provides the most stability when it comes to salinity.

The salinity in the natural reefs can vary from region to region. But the most common value found is about 35ppt (1.026 sg). Again, there are arguments for higher as well as lower salinities. Most seem to recommend aiming for the same levels as the reefs. If you're wondering why most LFS keep their tanks at much lower salinities, it's mainly cost. Much less salt is required to keep large volumes of water at a lower salinity. As with temperature, more important than which actual value you choose to aim for, is that you keep the salinity as constant as possible. Anything in the range of 1.023-1.027 sg should do just fine for most critters. Again, research the specimens you're planning on keeping, and find out what their preferred salinity is, and aim for that.

The 35 ppt value simply means 35 parts per thousand. If you broke down the water into all its parts, out of a thousand of those parts, 35 would be salt (sodium chloride). Another way to think of it is simply 3.5%. The 1.026 sg value is a little trickier. The sg stands for Specific Gravity. Specific gravity is not so much a measure in units, as it is a measure of density as compared against pure water. Pure water has a Specific Gravity (density) of 1.0. SG is a quick way to guestimate the salt content of your water. It is not always the most accurate way, however.

In practice, either value is intended to give you a measure of the concentration of the salt content of the water. One common mistake made early on, is not taking into consideration the affect temperature has on salinity. Since temperature will make the water expand/contract, as a result, this will affect the density of the saltwater.

There are two common ways to test for salinity. The first is a hydrometer. The concept behind the hydrometer is that they have some item float in a solution, and based on how high it floats, or how deep it partially sinks, you can determine the specific gravity (density) of that solution. Commonly sold hydrometers have a floating arm with pre-marked values on the side. You fill them with saltwater, and based on where the arm comes to rest, you can determine the specific gravity of your water.

The other common device to test for salinity is a refractometer. This device uses a few drops of a solution on a prism, and the tester looks through the prism and based on the way the light is refracted (bends), you can determine the salt content of the water based on preset hash marks in the viewer.

As stated, pH is the measurement of how acidic or base a solution is, relative to pure water. pH values greater than 7 mean that the solution is more base than pure water, while pH values lower than 7 mean that it's more acidic than water. The farther away from neutral (ph of 7) the value is, the more acidic or base that solution is.

It is important to note that the pH scale is logarithmic. This means that each whole number difference in pH represents in increase in the acidic/baseness by 10 times as much. (i.e. A solution with a pH of 9.0 is ten times more base than a solution with a pH of 8.0. Conversely, a solution with a pH of 4.0 is ten times more acidic than a solution with a pH of 5.0). Worse yet, that means a pH of 5.0 is 100 times more acidic that a solution with a pH of 7.0! The main thing to note here is that as the pH gets farther away from your goal, the intensity of the pH increases very quickly. pH that's just a little off (~0.2 units) isn't that big of a deal. But a pH that's off by 1 can mean a MAJOR difference.

Most of the time, during normal tank operation, it's not a single test result that's valuable. Instead, what's important is the range of the tank's pH (over the course of the day) that's important.

For the values to really give any insight into your tank's condition, at least two tests a day over a period of at least 2 or 3 days is needed. As stated above, pH should increase over the course of the day. So telling someone you tested your pH and it was 8.0 doesn't really tell you much. Was that the pH at the beginning of your photoperiod (the time your lights are on), in the middle of the day, or was it at the end? Without knowing that, and also having other test results you can't really know the range the pH is.

So that said, pH should be tested in the morning, and in the evening right before the lights go off. Once you put critters in the tank, these tests really should be done daily or every other day until you're confident in the consistency of your tank's pH.

Any change in your tank's lighting cycle should prompt another series of pH tests. Changes in ventilation, water chemistry, etc should also prompt pH testing.

pH really is a great indicator of the tank's health. As you'll learn later, when the pH is off, it can be the result of other parameters not being in line, or a symptom of potentially serious system problems.

Consider getting a pH probe that gives a constant readout of the tank's pH. They are much more accurate than test kits, and can save you lots of time doing tests. They also help you figure out much quicker when something's not right with your tank. Knowing your tank's pH values and the normal range your tank's pH covers all the time is very valuable information and will be of considerable help in maintaining good tank health.