# Methods for raising soluble calcium and hydrogen carbonate in sea water aquaria

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photo: AquaCare

## Why are calcium and hydrogen carbonate required?

Calcium and hydrogen carbonate are present in sea water as free ions (calcium to 88% and hydrogen carbonate to 64%, the rest is loosely bounded; TARDENT 1993) and are needed by chalk depending animals like hard corals, foraminifers, coralline algae and others for constructing their shells or skeletons. Calcium and hydrogen carbonate are incorporated by the animals and will be reformed to insoluble calcium carbonate (chalk) structures.

In particular quick-growing hard corals need a lot of soluble calcium and hydrogen carbonate (or $CO_2$)
photo: AquaCare

The disintegrating of solid calcium carbonate (chalk) to soluble calcium and hydrogen carbonate occurs only very slightly in the aquarium – quite the contrary in the oceans. So the forming of chalk prevails.

With the time in every sea water aquarium calcium and hydrogen carbonate will become a deficiency factor. To prevent problems both substances should be added by the methods described below.

## Why should be the magnesium concentration all right?

To rise the calcium concentration anyway the magnesium content of the water should be in the normal range of 1300 to 1350 mg/l (ppm). Below this span calcium cannot be enriched. As soon as you add soluble calcium it will disappear at once: calcium precipitates to calcium carbonate or others. If water contains magnesium in the right concentration the precipitation is blocked: magnesium is an inhibitor for calcium precipitation.

## $CO_2$ injection

This methods puts directly $CO_2$ at the corals' disposal without the "detour" of hydrogen carbonate (one part of the carbonate hardness – similar to alkalinity). The disadvantage of the method is the low pH value (7,5 or lower). If nitrate and phosphate are in the water, too, the risk of an mass growth can occur. For enriching the water with $CO_2$ a $CO_2$-reactor can be used. In our opinion this method is only for special coral breeding systems and should be used only by very skilled persons. Additionally calcium must be put to the system with one method listed below.

## Calcium chloride - sodium hydrogen carbonate (according to BALLING)

With this method you add both factors separately (for example AquaCare care product V1 and V2). It is made especially for small tanks or if only one value is falling - mostly hydrogen carbonate and the other - calcium – is in the optimum range of 400 to 450 mg/l (ppm). For larger aquariums this solution is too expensive.

The needs of soluble chalk is very tremendous if animals like this are in the aquarium. The method according to BALLING is too expensive.
photo: AquaCare

Some authors warn for an ional displacement if you use this method. AquaCare has never seen negative phenomenons provided that a regular water change of at least 1-5% per month is made. Prophylactic you can add with the BALLING chemicals simultaneously a mineral salt.

The pH value is stabilized with this method. With dosing pumps you can add the two chemicals easily – provided that the salts are dissolved in water or you use readily made fluids.

If the carbonate hardness (alkalinity) will fall down rapidly you can add other buffering substances (like

AquaCare Triple-Buffer), too. Or you take a chalk reactor into consideration.

## „Kalkwasser“ - Chalk Water (according to WILKENS)

A chalk mixer or chalk water reactor in combination with a level control is a practicable method to fill up chalk water to the aquarium automatically.
photo: AquaCare

With this method it is possible to add calcium in form of calcium hydroxide (hydrated lime) or calcium oxide unless you use a skimmer with a high air input or another $CO_2$ source as a chalk reactor or $CO_2$ injection method. Otherwise the pH can rise to incredible levels. The disadvantage is the high maintenance (or you use a chalk mixer) and the low stability of the solution. Advantages are the slight increasing pH in the aquarium (about 0.1-0.2), the ability of phosphate precipitation (hydroxyl apatit), and low costs. It is possible to automate with a chalk mixer, a level control and a dosing pump.

## Chalk reactor with $CO_2$ supply

This smart method dissolves carbon dioxide ($CO_2$) in a reaction chamber to get the pH of the water down (6.0 to 6.5). The acidified water allows calcium carbonate to dissolve into calcium and hydrogen carbonate. The advantage is the easily automation with a chalk reactor. The disadvantage is a high input of free $CO_2$ into the aquarium water, especially if the reactor is not adjusted carefully. With too much $CO_2$ the pH of the aquarium water is low and green algae can grow rapidly.

Giant clams need high quantities of soluble chalk, too.
photo: AquaCare

If a chalk reactor should run with high safety standards it is indispensable to use an internal pH control that regulates the $CO_2$ supply. But you must calibrate the pH probes regularly. After about 2 years the probe must be changed – it is an expendable item. The water input of some models is malfunctioning – so a dosing pumps is required. You cannot precipitate phosphate with a chalk reactor – on the contrary with some chalk granules you get phosphate into the aquarium.

You can rise the efficiency of every chalk reactor with highly soluble special calcite granules (see AquaCare *Turbo* granules)
photo: AquaCare

## The *Turbo* Chalk Reactor

The AquaCare *Turbo* Chalk Reactor is a further development of the conventional reactors. The efficiency of the dissolving process is dramatically increased by using highly soluble calcite granules and a very low internal pH value; any blocking of the material can occur because of the high water velocity inside the calcite tubes; the $CO_2$ input is realised without $CO_2$ probe; the $CO_2$ supply is seen in the integrated bubble counter that cannot dry out; the water outlet pH is about 7.0 to 7.3 so that the free $CO_2$ concentration is approximately 80% lower; the water inlet is very high so it is more easier to regulate it; the water inlet is shown in a sight glass.

## Combining the methods

Unfortunately you can hear again and again – most of the time it is ignorance or some mistakes in operation the units –that you cannot combine the methods. Basically you can combine all methods. But you must take care to separate the methods by time or by space (e.g. the outlet of the chalk reactor is ending at one side of the aquarium or filter sump and the outlet of the chalk water at the other end). So never bring the outlets of a chalk reactor and a chalk water reactor together. Otherwise insoluble chalk will develop and precipitates.

Our recommendation for the standard coral reef aquarium is the combination of the *Turbo* Chalk Reactor and a chalk water reactor (e.g. KWR). Both system eliminates the chemical and biological disadvantages of the single systems. The chalk reactor produces free $CO_2$ that can causes green algae – the chalk water reactor increments the pH and “adsorbs” the free $CO_2$. The chalk water reactor cannot generates hydrogen carbonate ions (carbonate hardness) – the chalk reactor does it.

If only one parameter is not in the optimum (e.g. the carbonate hardness is o.k. but calcium is too low) you can use one part of the BALLING method (use only the calcium component). But pay attention: sometimes another factor causes the sink of calcium: if magnesium is too low it is not possible to increase the calcium concentration in sea water.

Generally: every changing of a parameter should be done very slowly! It makes no sense to adjust a value after a along time of lack very quickly. The animals must acclimate to the new concentrations.

The AquaCare *Turbo* Chalk Reactor is probably the most efficient system on the market. The technical versions (see picture) works with 1 bar (15 psi) internal pressure.
photo: AquaCare