AquaCalculator reef aquarium Compendium – Part 2 Dosing of Major and Trace Elements in Reef Aquariums (Balling Method)



Dosing (balling method) is the best way to control the consumption of calcium, carbonates and magnesium in reef aquariums which is typically caused by stony coral growth. In addition, you can also add other trace elements as needed.

This compendium, together with our Aqua-Calculator, will make you a dosing professional. All this without any prior knowledge of chemistry and time-consuming calculations.

We wish you good luck with your reef aquarium (Martin Kuhn and the AquaCalculator team).

AquaCalculator

....the software for your reef aquarium Info and download: <u>www.aquacalculator.com</u> / <u>www.acalc.de</u>



AquaCalculator is supported by: www.faunamarin.de/en/home-engl/

FAUNA MARIN REEF POWER

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Liability exclusion

The information and recommendations made in this compendium represent the author's state of knowledge at the time of the last update. No guarantee can be given for the topicality and correctness of the contents! Any liability resulting from correct or incorrect application is rejected.

Symbolism



About us

We are a team of 3 software developers and have been striving for several years to support reef aquarists worldwide in their hobby in the best possible way. We are enthusiastic marine aquarists ourselves, not dealers or manufacturers of aquarium products.



We finance our expenses through income from our computer program **AquaCalculator**, which is specially designed for marine aquarists.

The license fee is less than 10€ per year. You can then use AquaCalculator on as many of your own devices as you like. Each license is linked to one of three different operating systems, for each of which we create and maintain separate versions.



Several thousand aquarists already use our program and have successfully improved the water values of their aquariums. Complicated calculations, e.g. for the dosage of salts or additional chemicals, are done for you by our software. Water values, aquarium occupants and maintenance work can also be perfectly documented.

In this compendium, we deliberately show you screenshots in some places that show how AquaCalculator can make your life as an aquarist easier.

With every license you support and appreciate our development work!

Introduction / Basics

Natural seawater has a certain composition. Many of our aquarium inhabitants need a composition that is as similar as possible to live well and stress-free.

With suitable sea salt mixtures, we can set optimal conditions. Various animals, especially small polyped stony corals (SPS), "consume" larger amounts of these bulk elements (carbonates) and at a lower level also magnesium. If these consumptions were NOT balanced, then certain animals would no longer grow or even degenerate.

In aquariums with demanding corals (especially stony corals), an additional calcium and alkalinity supply is practically unavoidable. Balancing these values only by frequent water changes is expensive and requires a lot of work.

In addition to the method presented here, this could also be compensated for by lime reactors or the lime water method, which was used even more frequently in the past. However, the dosing/balling method has decisive advantages over other methods:

- Ca, alkalinity and also Mg can be adjusted precisely and independently of each other
- Other trace elements can also be added as needed
- Various aquarists report that coral growth improved once they switched to dosing

Whether you choose high-purity premium products from well-known manufacturers with certain additional advantages or cheaper standard products (so-called balling salts) is relatively unimportant. AquaCalculator makes your life much easier, from preparing the stock solutions to super-precise dosage calculations.

The method owes its name to *Hans-Werner Balling*, because he made it accessible to the public. At that time, the addition of so-called NaCl-free salt was introduced to make the water more like natural seawater. Hans-Werner is a thoroughbred marine aquarist and has been working for Tropic-Marin for many years.



Balling ≠ Balling!

Various information can be found on the Internet, in books or at aquarium dealers. Few recipes stick to the original recipe presented by Hans Werner Balling. Proposed stock solutions and dosages etc. are sometimes quite different.

In the following, a particularly widespread variant (Fauna Marin Balling-Light[®]) is explained clearly and in detail.

Different versions of AquaCalculator

The user interface of the different AquaCalculator versions are optimized for the different display sizes and specifics of the different operating systems and displays.



The screenshots shown in this compendium are from the Microsoft Windows version.

The functions required to perform the dosing/balling method are available in all AquaCalculator versions. Display, operating elements may be slightly different.

Dosing / Balling method at a glance



Taking care of salinity increase



Due to the dosage, the salinity in the aquarium increases slowly but steadily. To compensate for this, we therefore remove saltwater at certain intervals and refill it with freshwater, or we correct this at the next water change.

1. Target values, recipe selection and stock solutions

1.1 Defining your desired Target Values



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Since the Ca, Alk and MG values are dependent on the salinity/salinity of the aquarium water, we should also take the salinity into account and adjust it if there is a deviation. (Higher salinity also means higher Ca, Alk and Mg concentrations in the water).

Proposed salinity

	Settings:	My setpoints	
Salinity		<u>^</u>	
Salinity	Target value 34,80 ♥ [psu]	Min Max 32,00 - 36,00 -	
or density: or specific gravit or conductance	1,0232 y 1,0262 52,80	[g/cm³] at 25°C(77F) [unitless] at 25°C(77F [ms/cm] at 25°C(77F	F)

For the Ca, Alk and Mg values, we adopt the values customary in marine aquaristics, or adapt them according to our own ideas.

Ca/Alk/Mg	Target value	Min	Max	j
Calcium	440 time	/1] 360	450	
Alkalinity	8,0 🗘 [°dH	6,0 🗘	10,0	Ľ
Magnesium	1300 🗘 [mg	/1] 1250 🗣	1350 🗘	

1.2 Recipe selection

With AquaCalculator you can calculate the dosing quantities of practically all products available on the market (we call these "recipes").

If this is not enough for you, you can define recipes according to your own ideas.



Different formulations mean different dosing quantities!

In the program, simply select the product/formulation you are using in the module "**Ca/Alk/Mg adjustment**", that you use. This is easily and conveniently possible in several places in the apps.

For our example we choose Fauna Marin - Balling Light ®.



You don't know which recipe to use?

You are spoilt for choice with over 100 products and it is also a question of the available budget.

Price / Availability

More expensive products usually offer higher **chemical purity**, although some cheaper manufacturers now also offer high-purity goods. (little to 0 accompanying / pollutant substances).

Dosage form

- Dry (balling) salts to mix yourself
- ightarrow Cost-effective, no trace element dosing integrated





Dry mixtures of (balling) salts to mix yourself in combination with dry or liquid trace elements \rightarrow Attractively priced incl. trace elements



Concentrated liquid dosing solutions that can be diluted with water.
 → somewhat more expensive, can be used without scales, incl. trace elements



Ready-to-use dosing solutions with integrated trace elements
 → Most expensive (high weight when shipped), incl. trace elements



Number of components



Especially beginners often use products that consist of only 2 components. However, with these you can only adjust/keep the 2 most important values constant. Calcium and carbonate hardness. Other quantities/trace elements are balanced out depending on the recipe.



Formulations with at least 3 main components also allow specific adjustment/balancing of magnesium, which is often necessary especially when starting with the dosing/balling method.

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1.3 Stock Solutions

Dosing would also be possible by adding dry (balling) salts directly. However, in the long run it is impractical to weigh out the salts separately for each dosage and then dose them by hand.

Therefore, I recommend preparing so-called stock solutions from the respective (Balling) salts and osmosis water or using ready-made stock solutions. We dose these with a dosing pump, which has the following advantages:

- Weighing in the salts/mixing can be done for several weeks/months.
- Liquid stock solutions can be dosed automatically
- There are not "THE Balling stock solutions", but various formulations. (In the end, only a precisely suitable amount of salts should be dosed. How much water is "also dosed" is irrelevant).
- You must know what concentrations "your own stock solutions" have!
 Only then it's clear "how many millilitres" of the stock solution must be dosed in order to introduce the correct amount of (balling) salts.
- ✓ The water volume of your aquarium is decisive for the dosing quantity. The larger your aquarium, the greater the consumption.
- ✓ Stock solutions should not exceed the so-called saturation limit. If this is the case, precipitation will occur in the solution and one would dose too little (balling) salt.
- For preparing the stock solutions, osmosis water, distilled water or water from an ion exchanger is recommended.
 The use of tap water bears the risk of introducing impurities, toxins, etc. In addition, the concentration limits may be exceeded, and the required dosage cannot be clearly determined.
- Do not mix different Balling salts together to form a stock solution. -Ingredients could crystallize - saturation limits could be exceeded.
 - Individual parameters can no longer be raised separately and in a targeted manner.

1.4 Mixing of stock solutions

AquaCalculator supports you in mixing the stock solutions.

Starting point is the desired filling quantities of your stock solution containers. Depending on this, AquaCalculator gives you the exact quantities and mixing instructions.





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<u>Tips & Tricks</u>

- Use the most accurate scale possible to measure dry salts, or a calibrated measuring vessel or syringe to measure liquid ingredients in your formulations.
- Use containers with the largest possible filling opening. After all, you must pour the salt through the opening when filling! The containers also need a lid so that the stock solution does not evaporate too quickly. So-called "wide-necked containers" are ideal. It is essential to "calibrate" the actual filling quantity of the containers and not to rely on the manufacturer's specifications. The factory markings are often incorrect.
- Salts are added to water, never the other way round.
 By following these 3 steps, you will obtain the correct concentration of the stock solutions.





Wrong: Adding the calculated amount of ingredients to the 'Total volume filled up already with osmosis water'.

- Some salts develop heat of reaction when added (especially CaCl₂).
- The calculated amount of salt cannot be dissolved?
 a) Check: Did you use "too little osmosis water" or "too much Balling salt"?
 b) Did you not use the specified products?
 (e.g. anhydrous calcium chloride instead of CaCl2 * 2H2O).
 By the way, salts dissolve better in warm water than in cold water.

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Deposits can form in the containers during longer storage periods.

 -> Empty/clean before refilling.

We recommend labelling the containers of your stock solutions.

- You rule out any confusion.
- In case of deviating values, you can quickly and easily "correct" them with the information on the labels
- It facilitates the next filling process of the containers



2. Initial setting of the water values

2.1 Adjustment of salinity

If the salinity of your aquarium deviates from the desired value, you use the **calculation module Salinity of** AquaCalculator and correct it.

The function **Change salinity in aquarium** tells you what to do, regardless of whether the value is too high or too low.



2.2 One-time correction / Adjustment (Ca, Alk, Mg)

- Measure/determine the concentrations of Ca, Alk and Mg in your aquarium water, e.g. with droplet tests.
- Open AquaCalculator and select Quantity/Trace elements (Ca/Alk/Mg ...) and there Correct values/One-time adjustment.
 - Enter the values just determined for Ca,Alk, Mg
 - Click on Calculate dosage amounts



Note: Depending on how serious the deviation from the target value is, the dosage may not be displayed in the table at once. If not all target values have been reached after 1 week, calculate the further dosage again based on another measurement of Ca, Mg and alkalinity.

Using dry (balling) salts? → Click on "Show dosing for dry (balling) salts".

Dosage of	Adjustment	day-# 1	day-#2	day-# 3	day-#4	day-#5	day-#6	day-#7	То	tal
FM Calcium-Mix	Calcium	6,1 g	6,1 g	6,1 g	-	-	-	-	18	3,3 g
FM Carbonate-Mix	Alkalinity	3,6 g	-	-	-	-	-	-	З,	6 g
		-	-	-	-	-	-	-	-	
FM Magnesium-Mix	Magnesium	29,3 g	29,3 g	29,3 g	-	-	-	-	87	7,8 g
		-	-	-	-	-	-	-	-	
NaCl free salt	1	-	-	-	-	-	-	-	-	

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Carry out the calculated dosage



Add stock solutions/products in a place with good flow (e.g. in the technical aquarium), not directly to corals or other animals.



Stock solutions (or balling salts) for increasing calcium and alkalinity must be added at a time interval of at least 5 minutes. Otherwise precipitation will occur and the desired increase in concentration will not be achieved.

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> Measure the concentration of Ca, Mg and alkalinity again.

Note: If these are slightly lower than the calculated values when dosed over several days, this is completely normal.

Your aquarium has probably already partly used up these elements.

Special case:All or individual values are already higher than the target value at the beginning. \rightarrow Reduction of too high values by dosing is not possible!

If the salinity is not too high (as already described, it has a 1:1 effect on the Ca, Alk and Mg concentrations), you have 2 options:

- a) Wait until the values decrease by themselves (consumption in the aquarium). This may also only be necessary for individual values.
- b) Change the water with a salt mixture having low concentration of the corresponding element(s).

Special case: Target values are not achieved or are not plausible?

Possible reasons:

- Your water test kits measure incorrectly, have expired or you are not measuring correctly with them
 - (see operating instructions, further information: Compendium of Water Parameters).
- The magnesium content is still too low (< 1200mg/l) before you have started dosing the other stock solutions/products.
- One of the values is too high and waiting does not reduce the concentration. Have you possibly installed reef ceramics or other non-standard reef rocks that could lead to a release of Ca/alkalinity/Mg?

3. Determining the consumption of the aquarium

3.1 Knowing "your aquariums consumption"

Dosing means, that you provide exactly as much of the respective quantity elements as your aquarium requires (=consumes). So let's find the consumption of your aquarium!

- As soon as the Ca, Alkalinity and Mg values are set correctly, stop the dosing. and the addition of other agents/devices that can influence Ca, Mg and alkalinity.
- > Do not carry out any water changes during this period.
- > Measure the Ca, Mg and alkalinity values daily and at the same time.

We will now determine how long the aquarium needs to break down a certain amount of Ca/Alk/Mg through consumption!

A good compromise is to carry out the measurements until the values have fallen:

- by at least 15 mg/l
- for Ca
- by at least 1°dH, max 2°dH
- by at least 10mg/l
- for alkalinity for Mg



3.2 Set Ca, Alk and Mg values one more time



By determining your aquarium consumption, the water values have again developed into a suboptimal range.

 \rightarrow _Bring them back into the <u>optimal range</u>!

This corresponds to a repetition of the steps in chapter 2.2. The Ca, Alk and Mg values should then be **back in** the target range.

4. Balance consumption permanently

4.1 Setting up your dosing pumps

Place the dosing pump and the containers with the stock solutions in a suitable place. To avoid any surprises in the event of defects or leaks in the dosing pump hoses, they should be mounted as follows:

- It is best to mount the container with the stock solutions below the water level of the aquarium. (prevents the stock solution from running into the aquarium unintentionally).
- Allow hoses leading from the dosing pump to drip into the aquarium or technical aquarium above the water level.

(prevents unintentional leakage of the aquarium water)



- Mark the dosing pump channels / stock solutions containers
 E.g. with C(alcium), A(alkalinity), M(agnesium)
- Mount the hoses. Attach the lid to the container with stock solutions (to prevent evaporation!). Insert the hoses (possibly through a hole you made yourself) in the lid. Note: Do not seal the container so tightly that a vacuum is created when the stock solutions are sucked out!
- > Set and start the dosing pump according to the manufacturer's instructions.
- > Empty/clean the container once empty / before refilling it with new stock solution

<u>Tip:</u> The best time to dose is in the morning before switching on the aquarium lighting. There the pH value is lowest and thus the risk of precipitation is lowest. Set a value between 15 and 30 minutes as the time difference for dosing between the individual stock solutions.

<u>Tip:</u> Several dosing times per day are more pleasant for your animals than a single dosing, especially in aquariums with high consumption.

<u>Tip:</u> Do not rely exclusively on the dosing pump's programmed filling doses. These are often inaccurate and can also change due to wear.

Measure the actual dosing quantities a) for new units b) approx. every 6 months.

Adjust the programming of the dosing pump in case of deviations.

4.2 Permanently balancing Ca, Alk and Mg

Perhaps you have already noticed.... the required dosing quantities of stock "per day" have already been calculated.



4.3 Compensation for Salinity Increase

Increasing the Ca, Alk and MG concentrations, the dosage also results in the addition of NaCl (common salt), which inevitably leads to an increase in salinity. If we do not compensate for this over a longer period of time, the salt content will eventually increase too much!

Select Adapt salt concentration

Informatio	on					×
Dosage	e calculated	d automatically le	eads to a slig	ht increase of salt co	ncentration of your aquarium!	
Compe In case	nsation is r of rare wat	normally done to terchanges also	gether with t more often.	he next waterchange.		
How do y Replace Use le	you want to ce part of m ess sea salt Current sa Based on N	compensate the ny tanks salt wat mixture for wate alinity aquarium 34, this value, the amou	increase in s er by freshwa er change 31 🚔 [psu] unt of saltwater	salinity? ater	is determined.	
After	NaCl	NaCl-free salt	Total	ncreasing of salinity	Salt water to be replaced	
28 days	29,3 [g]	0,0 [g]	29,3 [g]	0,29 [psu]	0,85 [l]	
29 days	30,3 [g]	0,0 [g]	30,3 [g]	0,30 [psu]	0,88 [I]	-
30 days	31,4 [g]	0,0 [g]	31,4 [g]	0,31 [psu]	0,91 [l]	
31 days	32,4 [g]	0,0 [g]	32,4 [g]	0,32 [psu]	0,94 [l]	
32 days	33,4 [g]	0,0 [g]	33,4 [g]	0,33 [psu]	0,98 [l]	

AquaCalculator shows you, depending on the number of dosing days, "how much salt water you would have to replace with fresh water". to compensate for the increase in salinity caused by the dosing!

You want to save yourself some work and a water change is due anyway?

Informatio	on					
Dosag	e calculated	automatically le	eads to a slig	ght increase of salt con	centration of your aquarium!	
Compe In case	nsation is n of rare wat	iormally done top terchanges also i	gether with t more often.	the next waterchange.		
How do	ou want to ce part of m	compensate the ny tanks salt wat	increase in er by freshw	salinity? ater	-/+-	
	are can calt	mixture for wate	r change			
- ose n	SS SEd Salt	mixture for wate	- change			
USC N	255 568 5811	Course Marcia	Selected sal			
0	How much I	Fauna Marin -	Selected sal Professional ded,	t mixture I sea salt		
0	How much le	Fauna Marin - ess salt to be ad nt on the salt min	Selected sal Professional ded, xture used.	t mixture I sea salt	₩	
After	How much lo is depender NaCl	Fauna Marin - ess salt to be ad nt on the salt min	Selected sali Professional ded, xture used. Total	t mixture I sea salt	Salt-mixture to be omitted at next water change	
After 28 days	How much li is depender NaCl 29,3 [g]	Fauna Marin - ess salt to be ad nt on the salt min NaCl-free salt 0,0 [g]	Selected salf Professional ded, xture used. Total 29,3 [g]	t mixture I sea salt ncreasing of salinity 0,29 [psu]	Salt-mixture to be omitted at next water change 33,9 [g]	
After 28 days 29 days	How much li is depender NaCl 29,3 [g] 30,3 [g]	Fauna Marin - ess salt to be ad nt on the salt min NaCl-free salt 0,0 [g] 0,0 [g]	Selected sali Professional ded, xture used. Total 29,3 [g] 30,3 [g]	ncreasing of salinity 0,29 [psu] 0,30 [psu]	Salt-mixture to be omitted at next water change 33,9 [g] 35,1 [g]	
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After 28 days 29 days 30 days 31 days	How much Iv is dependent 29,3 [g] 30,3 [g] 31,4 [g] 32,4 [g]	Fauna Marin - ess salt to be ad nt on the salt min NaCl-free salt 0,0 [g] 0,0 [g] 0,0 [g] 0,0 [g] 0,0 [g]	Selected sali Professional ded, kture used. 70tal 29,3 [g] 30,3 [g] 31,4 [g] 32,4 [g]	t mixture is ea salt 0,29 [psu] 0,30 [psu] 0,32 [psu] 0,32 [psu]	Salt-mixture to be omitted at next water change 33,9 [g] 35,1 [g] 36,3 [g] 37,5 [g]	

Select "Use less sea salt mixture for next water change".

The next time you change your aquariums water, do it with less sea salt mixture then normally required.

(You should to choose the sea salt mixture that you will use, because of different yields of the sea salt mixtures).

5. Readjusting in case of changes in consumption

In the best case, your aquarium runs optimally with the previously set dosing quantities and additions maintained by the constant addition.

However, the consumption in the aquarium can change again under the following circumstances:

- New consumers (corals, etc.) are added
- Aquariums & corals change their consumption.
 <u>Note:</u> The_use of the balling method often improves coral growth, especially in aquariums heavily stocked with stony corals. This also increases the consumption of stock solutions.

Continue to measure the parameters Ca, alkalinity and Mg regularly. If the values are constant and there are few or no new animals, you can extend the intervals between the measurements.

If you notice a stronger deviation of one or more water values, you should react and "readjust the dosage"!

Let's briefly review the most important points:

- > The parameters Ca, alkalinity and Mg can/should be set separately.
- Reducing a value can be done by waiting or changing the water with a salt that has a correspondingly low concentration of the corresponding quantity/trace element. Increase the value by dosing accordingly.
- After the values have been optimally adjusted (<u>one-time adjustment/correction</u>): Readjust setting/dosage amounts.



6. Recurring questions

Can I also use the dosing/balling method without knowing/measuring my water values? No, that is not recommended at all.

With which dosing quantities should I start?

We recommend following the procedure described (determining the consumption of the aquarium per day), as consumption is different in each aquarium due to several effecting parameters.

You still want to dose based on an estimate? AquaCalculator offers you the function "Estimate based on coral stocking".

	Measurement	Conceited dosage	Estimation based on corals in tank		
The cons	umption of Ca, Alk an Consumption depend	d Mg varies greatly in each ta is mostly on the number and her invertebrates consume on	nk. These data are only approxim growth of SPS and also LPS. Iv small amounts of these elemen	nate.	
	Measure Ca, Alk and	Mg values before the first do	se and the following days!		
In case of De-/	increasing individual	values, in-/decrease also the o	losage of your stock solutions ac	cordingly.	
Describe your tank					
Coff and and	few/no LPS		SPS tank with medium growth		
	DC	O LPS/S	SPS tank with very good growth		
LPS and few S	гэ				

Rough guide values for consumption per day

 Aquarium with soft corals and few/no LPS corals Mg: 0.20 [mg/L] Ca: 2.15 [mg/L] KH: 0.3 [°dKH] • Aquarium with LPS and few/no SPS KH: 0.8 [°dKH] Ca: 5.7 [mg/L] Mg: 0.40 [mg/L]. LPS/SPS aquarium with medium growth Ca: 8.6 [mg/L] KH: 1.2 [°dKH] Mg: 0.80 [mg/L]. LPS/SPS aquarium with very good growth Ca: 12.8 [mg/L] KH: 1.8 [°dKH] Mg: 1.0 [mg/L]

In my recipe, "when the Ca value/consumption is adjusted, the alkalinity value/consumption changes automatically". What is this?

The manufacturer of the product recommends a so-called "balanced dosage" of the components for Ca / alkalinity.

Reason: The formulation is deliberately designed so that calcium to alkalinity are always adjusted in the same ratio. Uniform dosing quantities of the two different components are also possible depending on the formulation (simplification for the user).

Ex: If the target value of the alkalinity is changed, the Ca target value changes. (blue background, indicated by chain symbol) and vice versa



The disadvantage: If your aquarium does NOT consume Ca/Alk in the balanced ratio, then one of the two values in your aquarium will drop or rise significantly.

This is quite often the case and you should prevent this in any case!

<u>Tip:</u> Check the box "Adjust Ca/Alk separately" so that you can calculate exactly consumptiondependent dosing with this recipe as well.



Explanation:

1. Your aquariums consumption



3. Ca/Alk consumption either **balanced** or **dis-balanced**



2. Dosing to replenish consumption



4: Avoid dis-balanced consumption + balanced dosing!



I cannot "adjust the magnesium value" in my recipe?

! "Mg" can not be adjusted with this recipe

Unfortunately, this is the case with some formulations/products.

In this case, the manufacturers have deliberately omitted it.

Magnesium is typically contained in a certain concentration also in one of the other components.

But, adjusting Mg with this product doesn't makes sense, as otherwise Ca / alkalinity would be increased by far too much. It is better to switch to another formulation only to adjust Mg.

One of my values is stable for weeks or even rises above the target value. Should I still dose the corresponding product?

No. But dose the corresponding stock solution (or the dry Balling salt) again, once the value falls below your target value. This is often the case, especially with magnesium, if regular water changes are carried out with a well-adjusted sea salt mixture.

What is "ion balance" and what do I have to consider?

A shift in the ion balance occurs when the concentrations achieved in the "aquarium" (through consumption or additional dosing) deviate greatly from the concentrations in natural seawater.

In my opinion, some manufacturers deliberately place this term with the aquarist to be able to market their own products better. Too much importance is attributed to this.



For dosing, you use industrially available compounds, the Balling salts or stock solutions prepared from them. In addition to the desired elements (Ca, Mg, carbonate), these also consist of undesirable components (Na, Cl, SO₄, ...). In our aquariums, these compounds react further. Apart from the desired raising effect (Ca, carbonates for alkalinity and Mg), the undesired components also remain at first.

These balling salts are particularly interesting:

- Ca<mark>Cl</mark>₂ * 2H₂O - NaHCO₃
- Mg<mark>Cl</mark>2* 6H2O

Na and Cl (marked red above) remain as "common salt" and "water" (H2O). Natural seawater, however, consists only partly of NaCl/salt! In addition to this, we also dose "unbalanced amounts" of the balling salts for different consumptions (Ca, alkalinity and Mg). So, the sum formulae of the chemical reaction are not completely balanced.

A particularly often described way of (ion) balancing is the dosage of so-called NaClfree salt. If this is dosed too much, the amount of sodium chloride (NaCl) produced is, so to speak, adjusted to the usual salt mixture in seawater (consisting of 70% NaCl and 30% NaCl-free other salts). NaCl-free sea salt consists of the remaining components of a sea salt mixture (mainly magnesium, but also potassium, strontium, ...) and is only available in specialized aquarium shops.

Balancing the ionic balance with trace elements: Pros and Cons

Many marine aquarists simply don't add trace elements. Instead, regular water changes are carried out, which also replenish used trace elements.

Especially for high dosing quantities of the stock solutions and for best possible conditions for corals, a separate trace element dosing is a good choice. You can choose different ways to balance the ions:

- ... through trace elements integrated into the stock solutions
- ... through separate addition of trace elements

Trace elements consist of various ingredients (excluding Ca, Mg and carbonates), whereby there are usually 2 or 3 different so-called trace element complexes, depending on the manufacturer. Be sure to follow the manufacturer's information, as the exact ingredients and concentrations are usually not specified.

Trace elements that are added to the stock solutions in a fixed concentration are particularly practical. On the one hand, this eliminates the step of "separate dosing", on the other hand, the dosing of the appropriate quantity is then carried out automatically by the consumption of the stock solutions for Ca, Alk and Mg.



If trace elements are not dosed according to consumption, there is a risk of overdosing. This can lead to symptoms of poisoning. Since these concentrations can only be measured by ICP analysis,

some aquarists simply overlook this and possibly face problems later.

The product I want for dosing is not included in AquaCalculator!

Possible reasons:

- We do not know the product yet and have therefore not integrated it in our software. If you would like to draw our attention to it, please send us an e-mail. We will try to integrate it when it is available on the free market and appeals to a reasonably broad customer group.
- Product cannot be integrated into AquaCalculator's calculation functions.
 Reason: The manufacturer does not provide the necessary information with the product, nor does he provide it upon request.
 - a) Missing details on concentrations or mode of action of the stock solutions.
 - b) Missing details on ingredients

Examples of this: The high quality products from Triton, or special mixtures where the manufacturer personally informs the customer of specific dosing information.

If you like to create your own mixture/recipe (e.g. from freely available raw materials), select "**Self-defined recipe**" in AquaCalculator's recipe selection.

Then select the ingredients, concentrations, etc.! AquaCalculator will calculate the correct dosage for you. Molar accurate!

This option is for advanced aquarists! You can then freely define the following:

- Calcium chloride (dihydrate or anhydrous)
- Sodium hydrogen carbonate or sodium bi-carbonate and their mixtures
- Magnesium chloride or magnesium sulphate and their mixtures (corresponding hydrates or anhydrous)
- Different concentrations of the stock solutions incl. display of the saturation limits (the latter not with mixtures of several salts)
- Trace element mixtures to be integrated into the stock solutions (dry or liquid)



7. Shopping list



Description	Designation, remark	approx. price
Measuring device for	- Large hydrometer *1) or	20
determining the salinity/salinity	- Conductivity meter *2) or	200€
content	- Terracionneter	
	*1) and simultaneous temperature measurement *2) with integrated temperature measurement	
Water test kits for:	Use tests that are suitable for seawater and as	approx.
- Calcium	accurate as possible.	60€
- Alkalinity		
- Magnesium		
Formulations / products for	Selection from more than 100	Depending
dosing Ca, Alk, Mg	products/formulations	on
		product /
		size /
		form
Scales	- For weighing dry (balling) salts. The device	Approx 30
Scales	- as accurately as possible especially for smaller	€
	aquariums	c
3 or 4 containers	- Size depending on consumption/aquarium size	1 each
	- filling opening as large as possible / food-safe	10 €
Funnel	- To fill balling salts into containers.	5€
	- Filling pipe Ø as large as possible,	
	to match the opening Ø of your containers.	
3 or 4 syringes ~50ml	for manual dosing of stock solutions. Attach	5€
	hose to syringe to be able to suck liquid out of	
	containers.	
Dosing pump	Suitable models	approx
with at least 3 channels	Fauna Marin, Grotech TEC III NG, GHL dosing unit,	250€
	Aqua Medic Reetdoser triple or Quadro, IKS Vario	360€

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Sources & personal data

Michel Mohrmann Alexander Karkossa	Programming AquaCalculator for iOS and macOS Programming AquaCalculator for Android Phones/Tablets
Hans-Werner Balling	The Balling Method - A no longer new method of calcium carbonate supply for reef aquariums (journal "Koralle")
Armin Glaser	Guide to Seawater Chemistry - Theory and Practice for Aquarists (ISBN 978-3-9810570-2)
Dr Randy Holmes-Farley:	Reef Aquarium Water Parameters Solving Calcium /Alkalinity Problems / What is Alkalinity? Relationship between Alkalinity and pH Low/High pH: Causes and Cures/ Solutions to pH Problem
Robert Baur-Kruppas	



THANK YOU FOR YOUR ATTENTION!

