



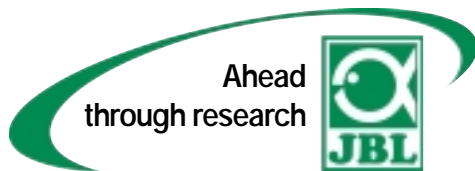
JBL

WHAT - WHY - HOW?

BIOTOPE

aquarium
water





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Text: Dr. Rainer Keppler,
JBL Company Biologist
Layout: akzenta PR, D-53797 Lohmar
Translation: Sue Unwin-Sp  th, D-79110 Freiburg

AHEAD THROUGH RESEARCH ...

JBL
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1. INTRODUCTION

An aquarium may be thought of as a small ecosystem, subject to practically the same laws of nature as ecosystems in the wild. However, due to the extremely small scale of an aquarium as a biotope and the relatively high fish stocking density, certain biochemical processes may grow out of hand to the advantage or disadvantage of others and may upset the biotopical balance of

the aquarium. The aquarium owner must therefore intervene to maintain a balance which suits both the fish and plants. **Before any measures can be taken to regulate the conditions, it is important to know the exact concentration of certain substances which are representative of certain biochemical processes in water.**

The extended and revised test programme by JBL is the ideal "tool" to specifically check the biochemical processes which are most important in the aquarium biotope. The programme provides reliable information, enabling you to take targeted remedial measures.

This brochure contains information on the most important biochemical and biological processes and their interaction in an aquarium. The possibility of testing using JBL Test Sets is pointed out wherever applicable. The special features of the JBL Test Sets are described in the last section of the brochure.

Water is a very special "juice". Rainwater collects in rivers or in ground water, for example, absorbing minerals and other organic substances which change the composition of the water. Water, in its natural form, has its own individual and particular properties depending on its origin. A clear optical example is the mixing of "white and black water" in the Amazon region, the natural biotope of many of our aquarium fish and plants.

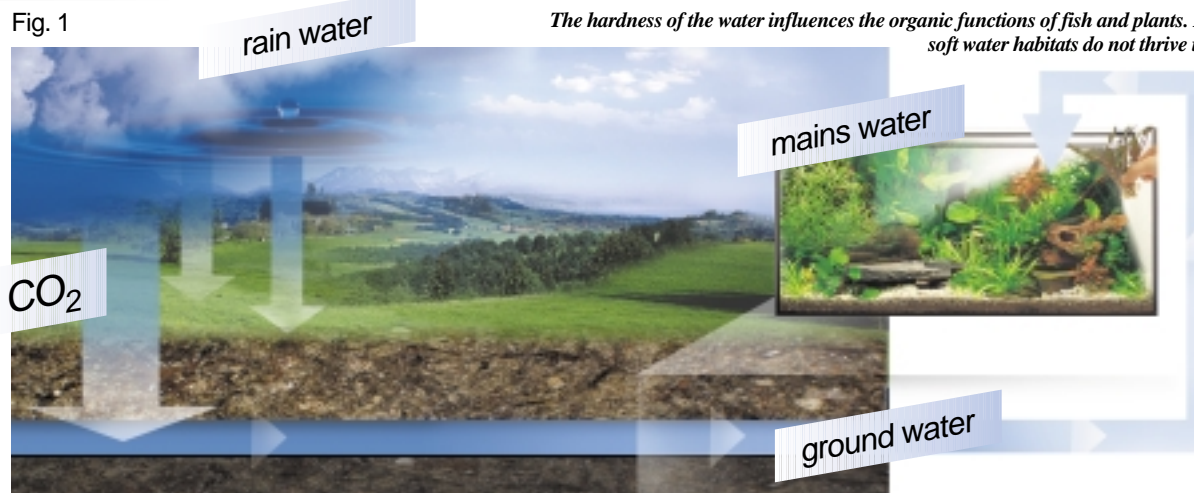


2. WATER HARDNESS

The majority of aquariums, with very few exceptions, are filled with mains water, which comes from ground water or streams which also have ground water as their source. Ground water is, after all, rainwater which has seeped through the soil to the deep subterranean layers. The hardness of the water is caused by the rainwater which contains CO_2 (through its contact with the atmosphere) dissolving minerals from the various earth and rock layers through which it passes.

The hardness of the water varies according to the type of rock layers the water passes through before gathering as ground water on a water-impermeable layer, and how long the water is in the ground. See figure 1.

Fig. 1



Rainwater containing CO_2 penetrates various rock layers, absorbing many minerals on the way.

The "hardness" of water, according to DIN 19640, refers to the alkaline earth ion content and is classified as follows:

Total Hardness (TH):

The total of all alkaline earth ions dissolved in the water, i.e. calcium and magnesium ions. Other, less frequently occurring ions are ignored.

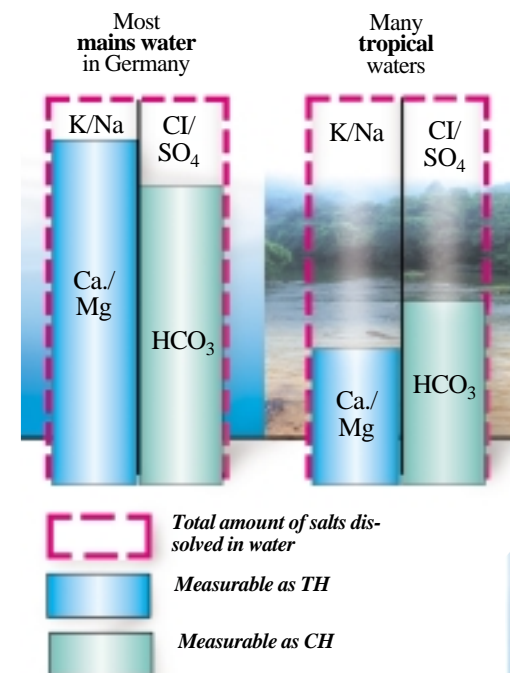
Carbonate hardness (CH):

The calcium and magnesium ions referred to above are not present in the water in the form of pure ions, but as dissolved salts e.g. calcium or magnesium carbonate, sulphate or chloride. The quantity of alkaline earth ions present in the form of carbonate is called the carbonate hardness.

The carbonate hardness (CH) is, as a rule, lower than the total hardness (TH). In some cases, e.g. in some S.E. Asian waters, all the calcium and magnesium ions as well as other ions e.g. sodium and potassium may be present in the form of carbonates, with the result that the CH exceeds the TH. This may be illustrated by a simple diagram. See figure 2.

Water hardness in Central Europe and in the Tropics:

Fig. 2



The hardness of the water influences the organic functions of fish and plants. Fish and plants originating from soft water habitats do not thrive in hard water.



Tetra prefer soft water.

In Germany, measurements are made in degrees of hardness, German scale °d. The following conversion table enables comparison to be made with other common measurements:

Conversion table for units of water hardness

Total hardness	alkaline earth ions mmol/l	alkaline earth ions mval/l	German degree °d	ppm CaCO ₃	English degree °e	French degree °f
1 mmol/l alkaline earth ions	1.00	2.00	5.50	100.00	7.02	10.00
1 mval/l alkaline earth ions	0.50	1.00	2.80	50.00	3.51	5.00
1 German degree	0.18	0.357	1.00	17.80	1.25	1.78
1 ppm CaCO ₃	0.01	0.020	0.056	1.00	0.0702	0.10
1 English degree	0.14	0.285	0.798	14.30	1.00	1.43
1 French degree	0.10	0.200	0.560	10.00	0.702	1.00

Carbonate Hardness	Acid binding (mmol/l)	German degrees (°d)	French-degrees (TAC)	hydrogen-carbonate (mg/l)
Acid binding capacity 1 mmol/l	-	2.78	4.94	61.0
German degrees 1°d	0.36	-	1.78	21.8
French-degrees 1° TAC	0.20	0.56	-	12.3
hydrogencarbonate 1 mg/l	0.016	0.046	0.08	-

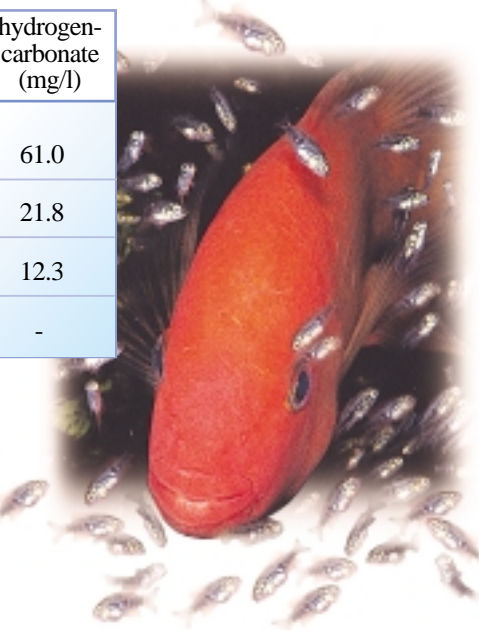
There are normally four classes of hardness:

below 7 °d	soft water
7 - 14 °d	medium hard water
14 - 21 °d	hard water
over 21 °d	very hard water

Most tropical plants and fish tolerate a wide range of water hardness.

Carbonate hardness values of between 5 and 15 °d and a total hardness of up to 20 °d are ideal.

However, this does not mean that plants and fish cannot be kept well in even harder water, if the other water values are kept at the best possible levels.



Careful maintenance of the natural water conditions is vital when breeding tropical fish.

The carbonate hardness is the most important guarantor of stable water conditions in the aquarium. In particular, any dangerous drop in the pH value can be prevented reliably by the ability of carbonate hardness to "buffer" acids. For this reason the pH value

remains a lot more constant in aquariums with medium hard or hard water, than in those with extremely soft water. If, for example, some acid is added to water with a high carbonate hardness, nothing happens at first glance. The carbonate hardness has absorbed the acid and thereby made it harmless. Only the total carbonate hardness has been reduced by the acid. If however the same amount of acid is added to water low in carbonate or free of carbonate, the pH value immediately declines dramatically and the fish will die. Therefore the carbonate hardness is also known as the "acid-absorbing capacity" nowadays.

Fish eggs and young fry are less adaptable than mature fish. When breeding fish, it is advisable to adhere to the values recommended in literature for the individual species.



In order to safeguard aquarium water against an unexpected acid "dive" (sudden drop in the pH value) we recommend a minimum carbonate hardness value of 4 - 5 °d. In regions with very soft tap water any desired hardness value can be easily adjusted by using JBL Aqua Dur plus. By adding JBL Aqua Dur plus you can also achieve an ion distribution in the water, which is highly suitable for most aquarium fish and to a large extent corresponds to water in their natural habitat.

Very often the available tap water turns out to be too hard for the care or the breeding of certain fish species. With the corresponding softening filters (ion exchangers) or reverse osmosis units you can achieve water almost free from hardness and, in the case of reverse osmosis, water practically free from harmful substances. Ask your specialised dealer for advice. The hardness level of the water obtained by this procedure must then be increased to the level required for the specific fish species. Again JBL Aqua Dur plus is ideal for this purpose. Especially in regions where water containing harmful substances

can be expected, treatment with reverse osmosis and the addition of JBL Aqua Dur plus is highly recommended.

Test sets are available from JBL for measuring TH and CH.

Conductivity

Salt dissolved in water gives water the ability to conduct electricity, and the more salt that is dissolved, the more electricity conducted. A conductivity measuring instrument or conductivity meter is needed to measure the salt content of water. The unit of measurement is MicroSiemens, abbreviated to µS. Usually a large proportion of the conductivity of water is due to the salts in the hardening constituents. One degree German hardness corresponds to a conductivity of about 33 µS. In water with 10 ° German hardness, for example, conductivity of at least 330 µS is to be expected. In general, however, conductivity is somewhat higher due to additional salts which are present. High nitrate levels or the addition of cooking salt are common causes of increased conductivity in an aquarium. When keeping fish from extremely soft, low-salt waters, measuring conductivity is important in order to prevent osmotic stress caused by excess salt levels.

SOME LIKE IT HARD!

The colourful fish world of the African Lakes Malawi and Tanganyika provides a typical example of popular aquarium fish, which prefer harder water. Characteristic of these lakes is the alkaline pH level and CH levels higher than TH.



JBL AquaDurMalawi/Tanganyika creates these conditions in the aquarium, too.



3. THE pH VALUE



The pH value indicates whether a liquid reacts in an acidic, neutral or basic (alkaline) manner. The pH scale ranges from 0 (very acid) to 14 (very basic), with neutral at about 7. The pH value shows the concentration of certain ions which are responsible for an alkaline or acid reaction.

For aquarium owners it is important to know that when there is a one point change in the pH value, the concentration of ions responsible for the change alters **tenfold**, in the case of two points there is a **hundredfold** change and for three points a **thousandfold** etc.

Most freshwater fish and plants can only survive in the pH range of 6-8. Some specialists require pH ranges of 5 or 9. Marine fish need ranges of between 8.2 and 8.4. Figure 3 illustrates the pH scale. Maintaining a pH level of around 7, in the neutral

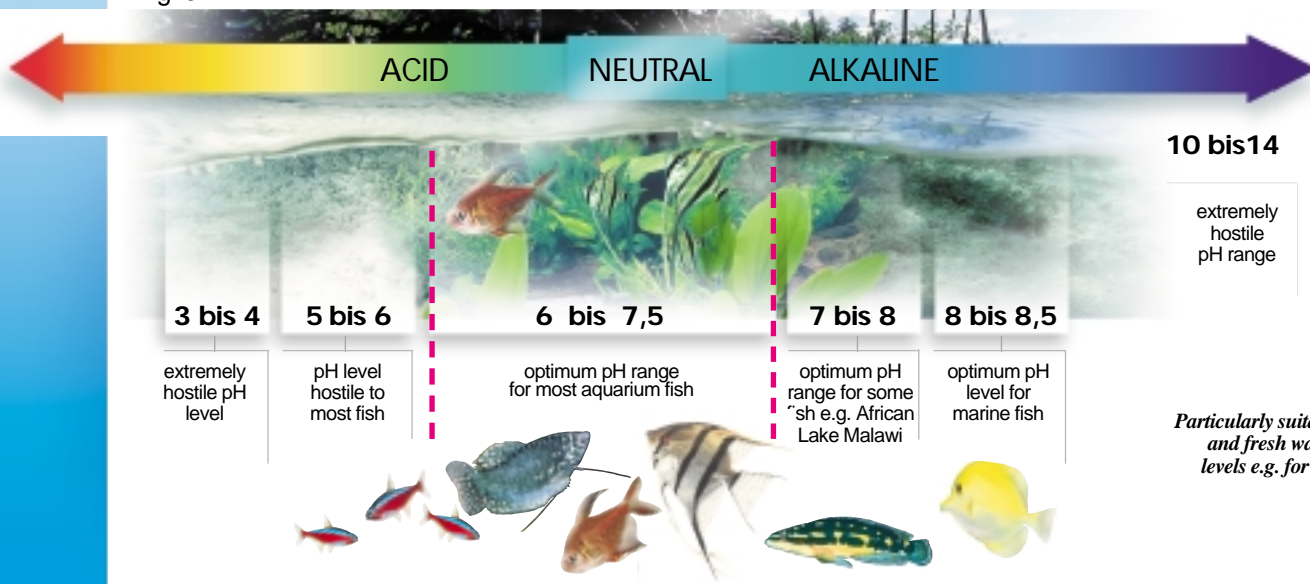
area, is recommended for the following reasons:

As a one point fluctuation in the pH value corresponds to a tenfold alteration in the ions responsible for the change, any change in the pH value is stressful for all the organisms in the water, whether fish, plants or micro-organisms. Sudden deviations in pH levels may lead to increased susceptibility to disease in fish, poor growth in plants and may even kill micro-organisms.

Some fish and plants prefer the more acidic range of pH 6-6.4, while others prefer the neutral to slightly basic range of pH 7.5 or more.

The most conducive conditions for most species is a carefully controlled pH value of about 7, in the neutral range.

Fig. 3



Most of the plants sold for aquariums come from tropical regions. The majority of such plants should be kept in water which is slightly acidic to neutral (pH 6.5-7).

When a pH value of one extreme or the other develops, only those species can be kept which prefer such conditions.

The decomposition and conversion of organic waste products via ammonium and nitrites to nitrates is closely linked to the pH value. More details may be found in section 5 of this brochure. In natural waters the pH level is determined by the interplay of two components, carbonate hardness and CO₂. For this reason the use of CO₂ is the most natural and desirable of all methods of regulating the pH level in an aquarium.

The new JBL CO₂ Sets in the ProFlora u and m range enables the optimum adjustment of the pH values in the neutral range and at the same time provides aquatic plants with vital CO₂.

More details can be found in the JBL brochure "Plant care".

JBL pH Test Set 7.4-9.0.
Particularly suitable for saltwater aquariums and fresh water aquariums with high pH levels e.g. for the care of Malawi cichlids.

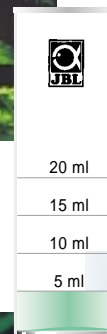


The pH levels can be tested and controlled using the JBL pH Test Sets 3.0-10; 6.0-7.6 and 7.4-9.0.




The turquoise golden perch from Lake Malawi in Africa illustrates how the requirements of fish differ (pH of 8-8.5).

Many "South Americans", like this discus, prefer slightly acidic water (pH around 6.5).



4. NITROGEN COMPOUNDS

The following three types of nitrogen compounds may result from the decomposition of organic matter in water and may also enrich under certain circumstances:

 Ammonium (NH_4^+) und ammonia (NH_3)
(not separable under analysis)

 Nitrite (NO_2)

 Nitrate (NO_3)

As one of the components of protein, nitrogen is a vital element. As the proteins decompose, nitrogen forms in the water in the form of ammonium (NH_4^+). The main source of ammonium from the decomposition of proteins is the digestive process of all living organisms in the water. These organisms are only able to break down proteins to ammonium and therefore deposit the nitrogen compounds which the organisms cannot utilise back into the water via the excretory organs. Decaying plant matter also produces ammonium,

which passes into the water.

In an efficient and healthy ecosystem, practically all the ammonium would be absorbed by algae and plants as nutrient and, as a source of nitrogen, be used to produce proteins. A small amount of ammonium is converted to nitrate by bacteria, using oxygen in the process. This nitrate also serves as nutrient for the plants. Finally the plants are consumed or die, again producing ammonium. The nitrogen cycle only operates efficiently in the manner described in a healthy ecosystem i.e. one without any significant accumulation of any of the by-products.

The individual steps in the nitrogen cycle follow the same course in an aquarium as they do in nature. However, in any aquarium, however sparsely stocked with fish, more nitrogenous waste products (excretion from the fish, left-over feed, dead plant matter) are produced than can be converted by the living plants, so that nitrogenous compounds inevitably accumulate in the aquarium eventually. In a "well-established"

aquarium with a biological filter this accumulation of nitrogenous compounds takes the form of a steadily increasing nitrate content. Only a small proportion of the ammonium which is produced in the aquarium can be utilised as a nutrient by the plants. A far larger proportion has to be "oxidised" into nitrate by nitrifying bacteria which mainly settle in the filter, **consuming oxygen**. This oxidation takes place in two stages, carried out by two different groups of bacteria, which always occur together as one supplies the substrate for the other. In the first stage, ammonium is oxidised to nitrite by bacteria of the nitrosomonas group, which is then immediately oxidised further to nitrate by bacteria of the nitrobacter group. The toxicity of ammonium is linked to the pH value, (see section 7 of this brochure). In a healthy aquarium, the conversion of ammonium to nitrate, or nitrification, proceeds without any signifi-

Nitrate up to a concentration of 200mg/liter does not harm fish, whereas low concentrations of nitrite (over approx. 0.5 mg/litre) is highly poisonous for fish.

cant accumulation of ammonium or nitrite. Values of 0.1 mg/l should not be permanently exceeded.

Increased ammonium or nitrite levels in an aquarium are always an indication of a disturbance in the bacterial decomposition process or poisoning of the nitrifying bacteria.

This may have different causes such as excessive feeding, overstocking with fish, insufficient oxygen content, medication, changes in the pH value etc.

A NATURAL BALANCE

Many aquarium keepers prove time and again that it is not difficult to establish and maintain a natural balance over a longer period of time even in small aquariums. Typical of such aquariums is a very low number of fish and dense planting with aquatic plants from the very beginning.

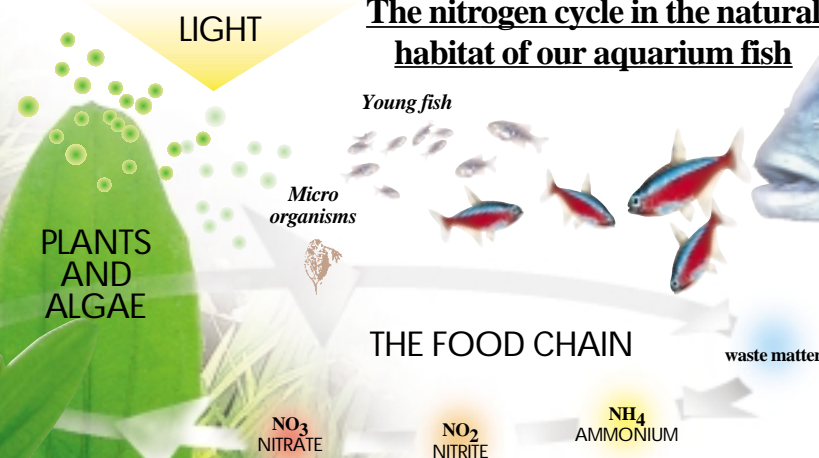


The nitrogen cycle in the aquarium

In an aquarium, far more waste products are produced than can be used by the plants.



The nitrogen cycle in the natural habitat of our aquarium fish



After restoring the optimum conditions (reduction in number of fish stocked, feeding better suited to requirements etc.) or after concluding medical treatment an efficient bacterial flora can be reintroduced to the aquarium through the addition of **JBL Denitrol** or **Filterstart**. The most effective method is to add the solution directly into the filter. Since **JBL Denitrol** only contains beneficial cleansing bacteria, the beneficial effect can be further increased by additional doses.



the enzyme activity of these bacteria due to excessively high nitrate quantities. This is, to use the specialist term, also referred to as product inhibition. Or more drastically expressed: the bacteria are "upset" because they have to swim in their own dirt.

The presence of nitrite accompanied by a high concentration of nitrate, as described above, is often called a "sudden converting back" of nitrate into nitrite due to an inadequate supply of oxygen. This is simply wrong because a re-conversion of nitrate into nitrite only takes place at oxygen levels so low that your fish would very rapidly pass over to the "great aquarium in the sky". This brings us to the possible methods of nitrate removal:

The classical and still absolutely valid method of removing the nitrate from the aquarium is to regularly change some of the water.

Dense, healthy vegetation can also contribute considerably to a reduction in nitrate levels or at least can slow down its increase considerably.

The typical accumulation of nitrates in aquariums with efficient bacteria households presents no threat to the fish. Nevertheless the nitrate content should be kept as low as possible, since a high nitrate content, above approx. 50 mg/l, promotes the growth of algae.

We would like to point out a phenomenon in connection with nitrate formation, which unfortunately happens quite often: if nitrate is allowed to accumulate freely (without suitable care measures, which we will consider in detail later on), then, as experience shows, at about 200-250 mg/l a level is reached at which bacteria of the nitrobacter group gradually stop working. This can be recognised by an increase in the nitrate levels. The reason for this is a reduction in

Another very effective possibility of nitrate removal is filtering with special filter material on the basis of ion exchangers, as for example **JBL NitrateEX**. Here the nitrate is selectively extracted from the water. After the material has been exhausted, it can simply be regenerated with sodium chloride. Removing the nitrate by using **JBL NitrateEX** enables a prolongation of the intervals in which some of the water has to be changed to 4 weeks instead of the usual 1-2 weeks. However no method of nitrate removal, no matter what it may be, can totally replace the regularly change of some of the water. Regular partial changes of



water dilute many of the undesirable substances which cannot yet be detected in tests.

The last method of nitrate removal to be mentioned, which has already been touched on, is the possibility of "converting back" nitrate into nitrite, a part of the so-called de-nitrification, a biological way of eliminating nitrate.

Certain types of bacteria, deprived of oxygen, are able to respire the oxygen bound in the nitrate molecules, thereby producing gaseous nitrogen which escapes into the atmosphere. This process has long been known in connection with poorly ventilated agricultural soil, where it is known as "nitrogen depletion". This reaction is now frequently exploited in sewage technology and the treatment of drinking water to reduce the nitrate levels.

JBL has succeeded in developing a product which allows denitrification processes to taken place in the aquarium without the disadvantages of a denitrification filter. This product, **JBL BioNitratEx**, contain insoluble nutrients which provide the denitrifying bacteria with the energy they require for this hard work. At same time there is no risk that nutrients will accidentally leak into the aquarium and cause damage.

The low-oxygen environment needed for denitrification is created by a net bag containing the nutrients. The net bag reduces the flow of water, causing a lack of oxygen which forces the bacteria, with the aid of the nutrients in the bag, to use the oxygen absorbed in the nitrate to breathe. As already mentioned, this process produces gaseous nitrogen which escapes into the atmosphere, and the nitrate is removed.... The instructions should be carefully followed when using this product.

To conclude it should be said that this way of reducing nitrate takes place, to a greater or lesser degree more, in every aquarium. In the ground-covering material or in rotting waste material limited areas may develop which have no oxygen (without harming the fish!). In these areas



A big help for aquarium-keepers with high nitrate levels: JBL BioNitratEx to reduce nitrate levels and JBL Nitrate Test to monitor levels.

the denitrifying bacteria (which exist in every aquarium) can then break down nitrates. This works even better if all the tiny bits of rotten deposits are not removed and the ground is not always ploughed up in regular "cleaning fits".

For this reason aquariums with a "healthy amount of dirt" function better than ones which are excessively clean.

5. PHOSPHOR & SILICIUM COMPOUNDS

5.1 Phosphor compounds

Compounds of phosphorus, especially phosphate, perform important functions in the metabolism of all life-forms. Energy-rich phosphates play an essential part in muscle work, for instance. Animal organisms need calcium and phosphorus for the skeletal development, as do aquarium fish. Young, vigorously growing fish need a lot more than adult, slowly growing fish. Phosphates are also vital for the metabolism of plants e.g. to build sugar.

How do phosphoric compounds get into the aquarium?

As the fish in the aquarium have to take in the essential phosphoric compounds through their food, the digestive processes of the fish must be the first source of phosphates to be considered. Young, growing fish secrete less phosphate than adult fish fed with the same amount of food. If the fish are correctly fed according to the needs of the species, the phosphates resulting from the digestive processes of the fish will be kept within reasonable bounds.

Phosphate levels in the water can rapidly reach high levels due to overfeeding or even leftover feed!

Using care products containing phosphates, as for example fertiliser for indoor plants or improperly defrosted frozen food can cause a real flood of phosphates. Tap water can also contain considerable amounts of phosphate. Unfortunately especially in regions with hard tap water it is still common practice for polyphosphates to be added to the water, either by the waterworks or by dosing equipment installed in the home, in order to keep the hardening constituents dissolved. This prevents the build-up of scale in pipes.

Which effect do high levels of phosphate have on the aquarium?

Although phosphorus (phosphate) is an important plant nutrient, it is relatively scarce in nature. In unpolluted waters values are between 0.001 and 0.01 mg/l.

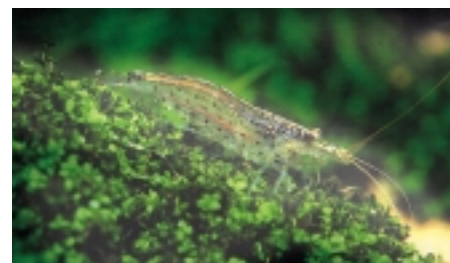


Feed your aquarium fish with care and observe their feeding habits. Undetected food will pollute the aquarium water.

Through appropriate mechanisms, the plants are adapted to this low supply of phosphate and therefore only need small amounts for growth. If the phosphate content in the aquarium increases a hundred times or a thousand times the natural level (or even more), which unfortunately happens quite often, then the perfect conditions are provided for the undesired growth of algae. If the corresponding amounts of nitrate are also present, a dramatic algae plague is almost a foregone conclusion.



If the air roots of indoor plants (e.g. Philodendron) are trained into the aquarium, they extract a lot of unwanted harmful substances such as phosphates. At the same time the indoor plants grow a lot faster and form denser and lush foliage.



Shrimps from the Caridina or Neocaridina family are insatiable algae eaters.

However it depends on the proportion of the two substances, nitrate and phosphorus. In natural plants the nutrients phosphorus and nitrate occur in the ratio of 1:16, that is 1 part phosphorus to 16 parts nitrate. This ratio is known as the Redfield ratio, named after its finder (why not "Google" the term on the Internet).

Converting these figures for phosphate and nitrate, you reach a ratio of 1:23. If the nutrients, phosphate and nitrate, occur in this ratio, which corresponds to the ratio which occurs naturally in plants, there is normally no unwanted growth of algae.

A degree of variation does not immediately lead to a plague of algae. The "good range" is between 15 and 30, i.e. there has to be 15-30 times as much nitrate as phosphate.

As phosphate levels usually increase faster than nitrate levels in most aquariums, artificially increasing the nitrate level by adding potassium nitrate is usually recommended to bring the level back into the "good range" once again. This can be successful, but not in all cases. We therefore recommend that you do not mix a nutrient soup with much higher concentrations than required, but rather reduce the factor that is too high. In most cases this will be the phosphate.

In addition, algae can store phosphate in considerable amounts and therefore can live for a very long time with a lack of phosphate. For this reason phosphate is often not recognised as the cause of unwanted algae growth.



In the fight against the troublesome growth of algae, Siamese barbels can be very useful helpers.

How can excessively high or low phosphate levels be prevented?

Providing the aquarium fish with a diet of high quality feed which meets the specific needs of the species and which contains the physiological required amount of phosphoric compounds, minimises the phosphate pollution of the aquarium caused by the excretion of the fish. The JBL brochure "What?-Why?-How?", **Correct feeding** describes how the wide range of JBL feeds help you to provide your fish with all the nutrients they require.

If you feed frozen food, you should defrost it as follows in order to avoid excess phosphates: let the required amount of feed defrost in a bowl with some water in it. After it has defrosted, drain it in an Artemia sieve (JBL **Artemio 3**) in order to separate the feed organisms from the water which now has a high phosphate content. Now the feed organisms can be vitaminized with JBL **Atvitol** and fed to the fish.

Care products or fertiliser for room plants containing phosphates should therefore not be used in an aquarium. If you are not sure whether a product you use contains phosphates, check it with the JBL **Phosphate Test Set PO₄ sensitive**. JBL care products are all phosphate-free for this reason. Unfortunately it is often the case that mains water contains phosphate, added by the water supply company to prevent a build-up of limescale.

Reliably reducing phosphate levels

Two high-performance JBL products are available to reliably reduce phosphate levels in aquarium and mains water: JBL **PhosEx ultra** and JBL **PhosEx rapid**. JBL **PhosEx ultra** is a highly efficient filter material based on iron, which reliably absorbs phosphate and does not release it into the water again. We recommend **PhosEx ultra** as a long-term measure to prevent any unwanted accumulation of phosphate in the first place. It can also be used to reduce existing excessively high phosphate levels.



Dense, healthy planting combined with regular partial changes of water (with phosphate-free water) also helps to keep phosphate levels in aquarium water low.

JBL **PhosEx rapid** is a liquid iron preparation which is ideally suited as an immediate remedy to effectively reduce phosphate levels. Before applying **PhosEx ultra**, we recommend using **PhosEx rapid** to reduce any existing high phosphate levels and thereby retain the capacity of **PhosEx ultra** in the filter and prolong its service life. In small aquariums, where **PhosEx ultra** cannot be used in the filter, **PhosEx rapid** is the best choice. In this way phosphate levels in the aquarium can be reliably reduced to levels below 0.5 mg/l (preferably below 0.1 mg/l) which have proved to be sufficiently low in freshwater aquariums. If an aquarium has been kept for a long time without any measures being taken to restrict the phosphate level, a considerable store of phosphate may have built up in the substrate over time.

With JBL's Phosphate Test Set PO₄ sensitive you can monitor the phosphate levels in your aquarium, whilst at the same time simply and quickly checking the effectiveness of PhosEx ultra and PhosEx rapid.



This can be seen by the fact that, when the phosphate level has been decreased using **PhosEx rapid**, it quickly increases back to the old level, often on the very next day. In such cases, repeated applications of **PhosEx rapid** are often the most effective method. If the mains water contains phosphate, using **PhosEx rapid** in a separate container is usually sufficient. Let the water stand for one day and then transfer to the aquarium without the sediment.

Finally it should be noted that algae can store phosphate if there is more available than they require. They can survive long on this store, even when there is then insufficient phosphate in the water. Therefore any successful reduction in algae may not occur until long after the phosphate level has been reduced.

5.2 Silicium compounds

Where does silicium (silicate) in aquariums and mains water come from?

Silicium is one of the most common elements on earth. As silicate rocks weather, silicium in the form of silicate is washed into the surface and ground water. Depending on the nature of rocks in the area in question, mains water has varying levels of soluble silicate. Levels of up to 40 mg/l, in rare cases even higher, can be found in mains water. Silicate is non-toxic and there are no threshold levels given in the regulations governing drinking water.

Silicate in the water also apparently prevents limescale in supply pipes. Therefore water companies are tending increasingly to add silicate to mains water instead of phosphate. This is progress from the aquarium-keepers' point of view as silicate does not have the same disastrous effect on algae growth as phosphate. Therefore increased silicate levels in mains water are to be anticipated.

What significance does silicate have for the aquarium?

For the aquarium, silicate is significant as a nutrient for diatom, some aquatic plants (e.g. hornwort), calcareous sponges and many other invertebrates. Brown coating caused by diatom may appear in newly set-up aquariums or after partial changes of water. Due to the skeleton of silicium, this algae feels slightly rough, in clear contrast to the feel of slimy algae.

Diatom coating disappears once the aquarium has run in and sufficient competition from other algae and microorganisms has become established. This also significantly reduces the level of silicate in the water. The occurrence of algae can be prevented by filtering through JBL **SilicatEx**.

Any existing coating of diatom quickly disappears by filtering through JBL **SilicatEx**.

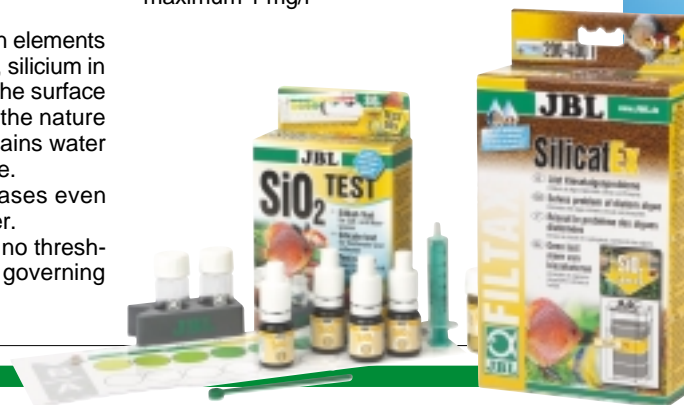
We recommend the following levels:

Freshwater:

1 mg/l to 2 mg/l can be tolerated.

Saltwater:

maximum 1 mg/l



Important:

If there is no reduction in the coating after filtering through **JBL SilicatEx** for more than two weeks, the problem is almost certainly not diatom but bacteria which do not process silicate as a building material. This bacteria (reddish and brownish coating, usually referred to as slimy algae) cannot be eliminated from the scientific point of view by restricting the level of silicate. This can be combated by increasing the redox potential and removing organic nutrients (siphon off sediment, give less food etc.).

It should also be mentioned that diatom, like all other algae, need phosphate as a nutrient. It is therefore feasible that no diatom occur in an aquarium with considerable levels of silicate because the level of phosphate is too low. In addition to absorbing silicate, **JBL SilicatEx** also absorbs phosphate, thereby reducing both of the vital nutrients for diatom at the same time.

Simultaneously the basic nutrient for other forms of algae is also eliminated.

6. HEAVY METALS

Heavy metals dissolved in water can have a catastrophic effect on all living creatures. Thanks to the strict European regulations concerning the maximum concentrations of heavy metals in drinking water, the "danger from the tap" is extremely low.

Modern water conditioners, such as **JBL Biotopol** are easily able to render harmless any amounts of heavy metals in the drinking water and therefore banish any danger posed to the creatures in an aquarium. However, we would like to look more closely at two heavy metals as they play quite a significant role in the aquarium. One is lead and the other copper.

Lead is still often the cause of the mysterious death of fish. Some readers will be sure to remember the practical, flexible metal tape, sometimes with foam on one side, used on long-stemmed plants to stop them floating upside down in the aquarium in shops. Some aquarium-keepers find this very practical and plant the entire bunch of plants and tapes in their aquarium at home. These tapes are made of lead and are a time-bomb ticking away for the living creatures in the aquarium. If the pH level remains above 7 there is hardly any danger, as the lead does not dissolve easily in the water. However, if the pH level drops below 7, lead ions may be released into the water and gradually kill the fish!

This is particularly dangerous if a CO₂ unit is purchased after an aquarium has been running for several months or even years. The addition of CO₂ can cause deposits of lead which have previously posed no danger to suddenly be dissolved with all the fatal consequences mentioned above.

Unlike copper, which is described below, lead cannot be measured with simple tests. Therefore please remove everything from the roots of plants which looks in any way like metal before setting the plants in the aquarium.

Copper can sometimes get into mains water through the use of copper piping in household plumbing or water boilers. This applies to new piping and appliances in particular.

Instead use **JBL Plantis**, the specially developed plant pins made of water-neutral plastic, to anchor aquatic plants.



A protective layer of lime scale builds up inside pipes over the course of time, effectively preventing copper dissolving in the water.

Using the **JBL Copper Test Set Cu**, dangerous concentrations of copper in mains water can be easily measured.

If this is the case, allow the water to run for some time before taking some for use in the aquarium. Showering beforehand elegantly solves the problem without wasting water.

Many medications, particularly those against oodinium, contain copper as an active ingredient. As copper ions have the unpleasant tendency to form insoluble compounds with the carbonate of the water hardness, becoming therapeutically ineffective, the amount of free copper required in the water should be regularly monitored. The **JBL Copper Test Set Cu** is very useful here.

The frequent use of substances containing copper in the aquarium can cause a considerable amount of copper carbonate to build up. If the pH level drops e.g. through the use of CO₂, the same happens as with lead. For these reasons treatment with medications containing copper should be carried out in a quarantine tank whenever possible. It should also be mentioned that invertebrates are very sensitive to copper, whether in saltwater or freshwater.



Sensitive fish such as the red neon react strongly to copper. Many diseases and disturbances in the biological balance of an aquarium can be explained by dissolved heavy metal compounds.



Invertebrates are particularly sensitive to copper. Dangerous copper concentrations can be easily identified using the JBL Copper Test Set Cu.



7. THE INTERPLAY OF VARIOUS FACTORS

A. pH level, CO₂ content and carbonate hardness

As already mentioned in the chapter on water hardness, CO₂ and carbonate hardness are the prime factors governing the pH level of the water.

More details on this subject and on simple and useful methods to adjust the best pH level in the aquarium are to be found in the JBL Brochure:

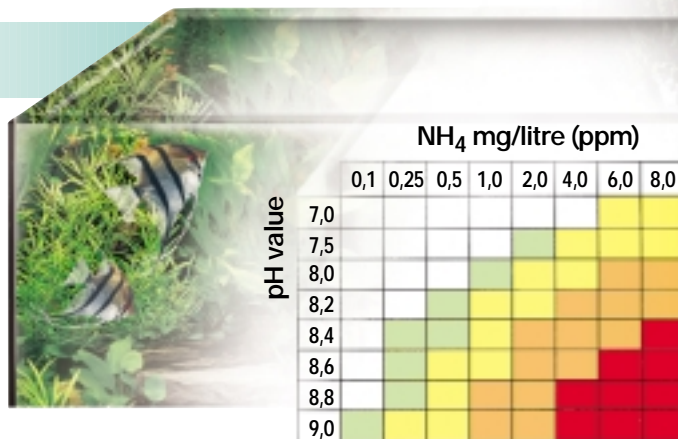
"What?-Why?-How?", Plants.

B. pH-value and nitrogen cycles

As mentioned above in section 3, certain bacteria (nitrifiers) cause organic waste products in the aquarium to decompose, thus preventing fish poisoning through ammonium or nitrite. These bacteria thrive best in freshwater with pH-values around neutral. Values below 7 or above 8 are detrimental to bacterial growth and inhibit the cleansing capacity of these bacteria.

In view of the fact that nitrifying bacteria grow very slowly anyway, one should avoid inhibiting their growth even further by creating unfavourable pH-values or even by allowing the pH-value to fluctuate. This applies to newly installed aquariums in particular, where bacterial cultures still have to develop gradually.

Also, the pH-value has a direct impact on the toxicity of the ammonium compounds in the water. With pH-values around 7 or below, any ammonium compound is present in the form of ammonium (NH₄⁺), which is largely non-toxic to fish. The higher the pH-value, the more highly toxic ammonia (NH₃) will be generated from ammonium. Under certain conditions (undersized filter, no or little CO₂ supply, etc.), ammonia concentrations in densely stocked aquariums may reach dangerous levels. The emergency measure in cases like this is to drastically



- May be harmful to sensitive fish and small fry.
- May be harmful to adult fish, very harmful to young fry.
- Very harmful to adult fish, lethal for small fry.
- Absolutely lethal for all species of fish.

lower the pH to a value around 7, using JBL pH-Minus. At least 50% of the aquarium water ought to be changed at the next opportunity.

In any case, the actual cause of the ammonia or ammonium enrichment must be eliminated in the long term.

Ideal fish stock (maximum 1 cm of fish per litre water) and good vegetation prevent the increase in toxic nitrogenous compounds in the aquarium.

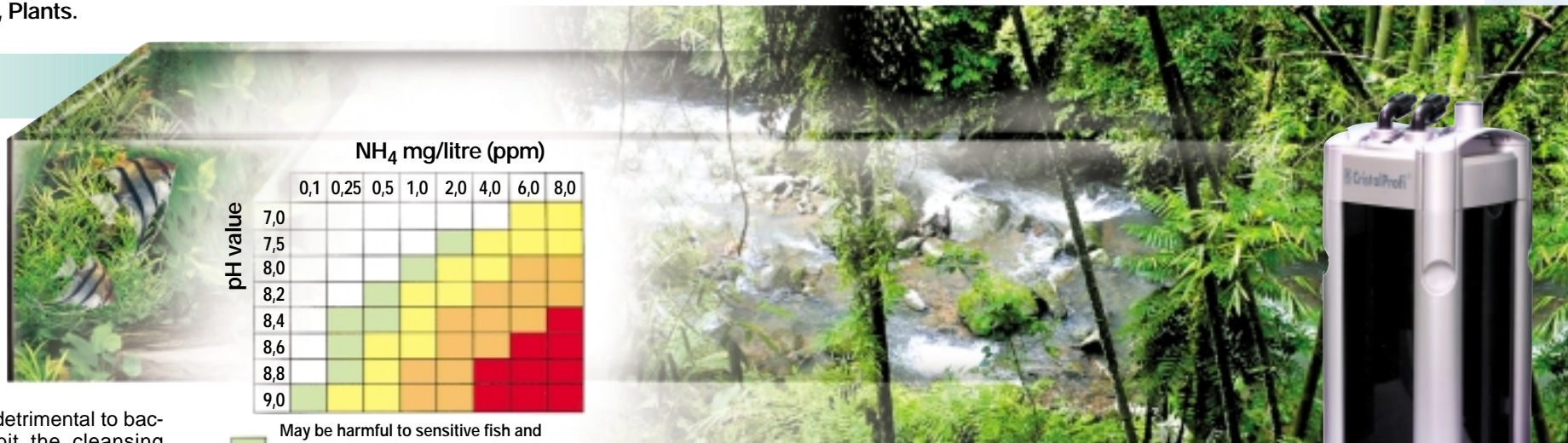


Care ought to be taken to create an environment which is conducive to bacterial growth. That means: moderate fish stocking commensurate with the aquarium size (maxi-

tion transforming of ammonium into nitrate, can have a significant influence on the pH value, which is quite often underestimated.

The end-product, nitrate, in combination with water is nothing other than an acid (saltpetre acid) and therefore "consumes" carbonate hardness. In waters with weak buffers with a low carbonate hardness, nitrate levels of 20-50 mg/l are enough to let the pH value drop to a dangerous level. A major catastrophe can result if a partial change of water is not carried out for several months or even years.

The constantly increasing nitrate level "nibbles" more and more from the carbonate hardness until nothing is left and the pH



Your aquarium is subject to the same laws of nature as an ecosystem in a natural habitat. Due to the extremely small dimensions of an aquarium, water quality has to be maintained using biological filtering e.g. with the JBL CristalProfi range.

mum 1 cm of fish per litre), adequate feeding (no overfeeding), sufficient oxygen supplied by a good stock of vegetation (no diffusers!), largely constant water values (pH, CO₂, etc.) and efficient biological filtering, e.g. by means of an external or internal filter from the JBLCristalProfi range.

Nitrification itself, that is the bacterial oxida-

level drops down to the "cellar", which would put an end to your fishes existence.

However with responsible care, with carbonate hardness levels not below 4-5°d and by regularly changing some of the water (every 2 weeks), such events will need never occur.

8. THE CALCIUM AND MAGNESIUM CONTENT

Calcium and magnesium are one of the so-called alkaline earth ions and, together with bicarbonate and sulphate, provide the main part of the water hardness. Calcium is needed by many life-forms as an important nutrient.

Fish need it for their skeletal development, plants as a nutrient. Invertebrates (snails, crustaceans, lower animals in saltwater) need it for the development of calcareous substances in shells etc. Magnesium is closely linked to calcium and plays an important role in metabolism e.g. in muscle contraction too.

In a marine aquarium the supply of calcium and magnesium to all life-forms is practically always ensured by a balanced diet and the occurrence of calcium and magnesium in water.

In salt water aquariums however, especially if corals and other calcium forming organisms (for example calcareous algae) are kept, the growth of these organisms can rapidly lead to a shortage in the supply of calcium and magnesium.

In order to provide the amount of hydrogen carbonate necessary for the utilisation of the Ca the carbonate hardness should not be lower than 7°d, which at the same time stabilises the pH value at the required level of 8.2 - 8.3. By using the JBL Test Sets Calcium Ca, Magnesium/Calcium Mg/Ca, CH and pH 7.4 - 9.0 these water values, vital for invertebrates to survive in a reef aquarium, can be easily and safely monitored.



The natural levels in saltwater are about 400-440 mg/l Ca and 1200 - 1600 mg/l Mg.

This value should also be ensured in the aquarium in order to provide the optimum growing conditions for calcium-forming organisms.

JBL MagnesiumMarin simply and easily corrects the magnesium content in saltwater

JBL offers you the product CalciuMarin to correct the measured values and for an optimum supply of calcium.

In addition to calcium this product also contains a balanced combination of hydrogen carbonate and the trace element strontium, which is important for the formation of calcium. Both the calcium content as well as the CH and pH values are thus set at the required level. The magnesium level can be easily and simply corrected using JBL MagnesiumMarin. It contains a balanced combination of magnesium compounds, which do not cause any changes in the ions in the aquarium water.

JBL CalciuMarin is a biologically accessible calcium for invertebrates in marine aquariums.



9. THE JBL TESTS

The test sets may be grouped in two classes depending on the test principle applied:

A. Titration Tests

This type of test involves measuring certain water ingredients by adding a test solution in drops to a sample of water until the added indicator changes colour. The number of drops of test solution used in the process provides information on the quantity of water ingredients tested.

The following JBL Test Sets are based on the titration method:

JBL Test Set TH
JBL Test Set CH
JBL Test Set Calcium Ca
JBL Test Set Magnesium/Calcium Mg/Ca

B. Tests based on colour reactions

Some water ingredients respond with typical colour reactions when adding certain chemicals. The intensity of the colour reaction correlates directly with the concentration of the substance under investigation. The concentration of the substance in question can be determined by comparing the colour of the sample with a predefined colour chart.

The following JBL Test Sets are based on colour reaction:

JBL pH Test Set 3.0 - 10
JBL pH Test Set 6.0 - 7.6
JBL pH Test Set 7.4 - 9.0
JBL Test Set Permanent
CO₂ plus pH
JBL Ammonium Test Set NH₄
JBL Nitrite Test Set NO₂



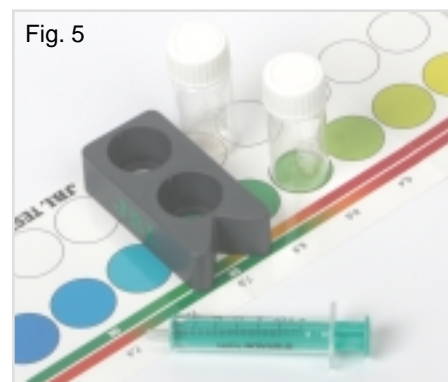
JBL Nitrate Test Set NO₃
JBL Iron Test Set Fe
JBL Phosphate Test Set PO₄ Sensitive
JBL Silicate Test Set SiO₂
JBL Test Set Oxygen O₂

THE TEST KIT

To make sure that all inveterate "aquarians" have access to precise and reliable test results, **JBL** present their Test Sets **pH 6.0 - 7.6** and **7.4 - 9.0**, **Ammonium**, **Nitrite**, **Nitrate**, **Iron**, **Phosphate**, **Sensitive** and **Silicate** in one kit, which satisfies even the most exacting demands:

The principal piece of equipment of the test kit is the comparator block, a grey plastic component with two recessed holes for holding the test tubes, and a notch to read the appropriate test value (Fig. 5).

Fig. 5



It includes two test jars, a graduated plastic syringe and a detailed colour chart.

Fill both test jars with a defined quantity of sample water for testing. Reagents will eventually be added to only one of these test jars, which will then show a colour reaction. A colour strip in the traffic light colours – red, amber, green – shows an approximate result for the values measured. A series of diagrams on the reverse gives a clear illustration of how the test is carried out.

Now place both test jars in the comparator block such that the jar



Fig. 6

with pure sample water (without reagents, the blank sample) is seated in the recess at the notched end, and the jar with reagent is seated in the recess at the smooth end of the comparator block (Fig. 6). Now move the comparator block over



Fig. 7

the colour chart until the colour fields of the chart are underneath the blank sample, and the white fields are underneath the samples with added reagent (Fig. 7). As soon as both colours match as closely as possible in both test jars, the concentration of the investigated substance can be read from the notch in the comparator block.

This method of colour comparison is known as compensation method, because intrinsic colorations of the water will be compensated by moving a blank sample along over the colour fields of the colour chart.

Another substantial benefit of the compensator block is the fact that scattered light incident from the side will be screened off, with the effect that the colours can be assessed with a very small margin of error. Combined with the comparator block, the finely graduated colour shades of the colour chart allow highly accurate measurements with superb resolution.



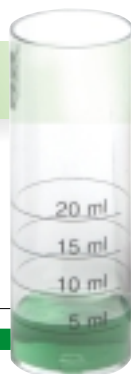
THE JBL TEST

THOROUGH TESTING:



JBL regularly organises expeditions and workshops to the natural habitats of aquarium fish. The biotopes of our aquarium fish are examined in detail.

JBL Test Sets provide invaluable help and are subjected to rigorous tests.



JBL quality tests for one of the most beautiful experiences in a wonderful underwater world



JBL Test Set TH

Titration test for determining total water hardness. One drop of test solution used corresponds to 1°d total hardness. Colour change from red to green. 1 test reagent.



JBL Test Set CH

Titration analysis for determining the carbonate hardness or the acid binding capacity of water. One drop of test solution used corresponds to 1°d CH. Colour change from light blue to yellow-orange. 1 test reagent.



JBL Test Set Permanent CO₂ plus pH

Device with permanent display of the CO₂ content or of the pH value in the aquarium caused by CO₂. 1 reagent. 1 display device. 2 colour scales (CO₂ and pH).



JBL pH Test Set 3.0 - 10

Simple colour test for approximate determination of the pH-value of water in the range from 3.0 to 10 in increments of 0.5.
1 test reagent.

**JBL pH Test Set 6.0 - 7.6**

Highly sensitive colour test with comparator for the accurate determination of the pH-value of water in the range from 6.0 to 7.6 in increments of 0.2.
Also highly suitable for controlling CO₂ fertilization.
1 test reagent.

**JBL pH Test Set 7.4 - 9.0**

Highly sensitive colour test with comparator for the accurate determination of the pH-value of water in the range from 7.4 - 9.0 in increments of 0.2. Especially suitable for marine and fresh water aquariums with high pH-values, as for example for the care of Malawi cichlids. 1 test reagent.

**JBL Ammonium Test Set NH₄**

Highly sensitive colour test with comparator for the accurate determination of the ammonium content in water.
Testing range increments:
0.05; 0.1; 0.2; 0.4; 0.6; 1.0; 1.5; 3; 5 mg/l.
3 test reagents.

**JBL Nitrite Test Set NO₂**

Highly sensitive colour test with comparator for the accurate determination of the nitrite content in water.
Testing range increments: 0; 0.025; 0.05; 0.1; 0.2; 0.4; 0.6; 0.8; 1.0 mg/l.
2 test reagents.

**JBL Nitrate Test Set NO₃**

Highly sensitive colour test with comparator for the accurate determination of the nitrate content in water.
Measurement increments:
0.5; 1; 5; 10; 20; 40; 60; 80; 120; 160; 240 mg/l

**JBL Test Set Copper Cu**

Highly sensitive colour test with comparator for the accurate determination of the amount of dissolved copper in freshwater and saltwater. Test range: 0.15; 0.3; 0.45; 0.6; 0.8; 1.2; 1.6; 2.0 mg/l (Measuring chelatised copper requires a wait of 12 hours). 2 test reagents.

**JBL Oxygen O₂**

Colour test without comparator to measure dissolved oxygen in freshwater and saltwater.
Test range: 1 – 10 mg/l.
2 test reagents.

**JBL Test Set Magnesium/Calcium Mg/Ca**

Titration test for the combined measurement of magnesium and calcium saltwater. 1 drop used reagent Mg 2 corresponds to 100 mg/l Mg colour change from red to green.
2 test reagents (reagent 2 double).
Characteristics as given for Ca Test.

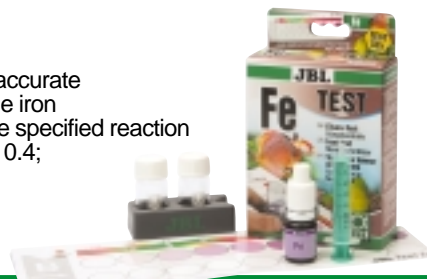
**JBL Calcium Test Ca**

Titration test for determining the calcium content of salt water.
One drop of test solution (reagent 3) corresponds to 20 mg/l Ca.
Colour change from wine red to blue.
3 test reagents.



JBL Iron Test Set Fe

Highly sensitive colour test with comparator for the accurate determination of the iron content in water. 90% of the iron bound to complex formers will be detected within the specified reaction time. Testing range increments: 0; 0.05; 0.1; 0.2; 0.4; 0.6; 0.8; 1.0; 1.5 mg/l. 1 test reagent.



JBL Phosphate Test Set PO₄sensitive

Highly sensitive colour test with comparator for the accurate determination of the phosphate content in water. Especially recommended as a check of excessive algae growth. Testing range increments: 0; 0.25; 0.5; 0.75; 1.0; 2.0; 3.0; 5.0; 10.0 mg/l. 2 test reagents.



JBL Silicate Test Set SiO₂

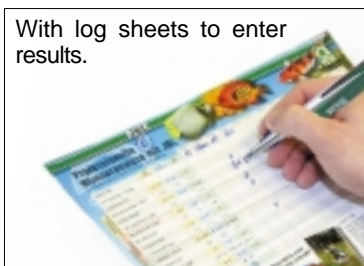
Highly sensitive colour test with comparator for the exact measurement of the silicate level in water. Specially recommended to control the growth of diatom. Measurement increments: <0.1; 0.2; 0.4; 0.8; 1.2; 2.0; 3.0; >6.0 mg/l



JBL Test Combi Set

Tests for the 5 most important water values in a practical plastic case: pH 3.0 – 10; CH; nitrite NO₂; nitrate NO₃; iron Fe

With log sheets to enter results.



JBL TESTLAB

Professional testing case for freshwater analysis.

Contains 9 different tests for comprehensive water analysis:

pH 3.0 – 10 (2x); pH 6.0 – 7.6; CO₂ tables; GH (2x); CH (2x); Phosphate PO₄ sensitive; Ammonium NH₄; Nitrite NO₂ (2x); Nitrate NO₃; Iron Fe.



With thermometer, ballpoint pen and log sheets to record results.



JBL TESTLAB MARINE

Professional testing case for saltwater analysis.

Contains 10 different tests for comprehensive water analysis:

pH 7.4 – 9 (2x); CH (2x); Calcium Ca; Magnesium Mg;

Copper Cu; Phosphate PO₄ sensitive; Silicate SiO₂; Ammonium NH₄; Nitrite NO₂ (2x); Nitrate NO₃.

With thermometer, ballpoint pen and log sheets to record results.



30/31

JBL

PROFESSIONAL WATER ANALYSES

	Increasing levels - your measurement levels were below the recommended levels			Reducing levels - your measurement levels were above the recommended levels		
Parameter	Freshwater	Saltwater	Garden pond	Freshwater	Saltwater	Garden pond
Temperature	JBL ProTemp heater-stat.	JBL ProTemp heater-stat.	Pond heater.	Cooling unit, ventilator, movement of water surface.	Cooling unit, ventilator, movement of water surface.	Floating plants, increase surface water movement.
KH Carbonate hardness	JBL AquaDur plus Lake Malawi / Tanganyika JBL AquaDur Malawi/Tanganyika.	JBL CalciuMarin, calcium reactor.	JBL AlkalonCombi.	Addition of JBL pH-Minus in stages. Mixing with reverse osmosis or de-ionised water.	Change of water, seldom needed however	Mixing with clean rainwater.
pH Acidity	JBL pH-Plus, strong water surface movement, little CO ₂ supply.	JBL pH-Plus, however carbonate hardness (KH) increase with JBL CalciuMarin usually sufficient!	Seldom necessary, pH stabilising with JBL Alkalon Combi usually sufficient.	Addition of JBL pH-Minus, CO ₂ , filtering with peat granulate (JBL Torrec).	Addition of CO ₂ and maintenance of KH of 7-10° GH.	JBL HumoPond Activ.
GH Total hardness	JBL AquaDur plus, JBL MagnesiuMarin.	Unnecessary.	JBL Alkalon Combi.	Mixing with reverse osmosis or de-ionised water.	Unnecessary.	Mixing with clean rainwater.
NH ₄ Ammonium	Unnecessary. In aquariums with plants only, with commercially available house plant fertilizer.	Not appropriate.	Unnecessary.	JBL AmmoEX. Immediate measure for ammonia poisoning: reduce pH level to 6.5. Increase biological filter activity, filter bacteria (JBL FilterStart/ Denitrol).	Drastic change of water and pH reduction to 7, protein skimmer, filter bacteria (JBL FilterStart/Denitrol).	Add JBL BactoPond.
NO ₂ Nitrite	Not appropriate as nitrite is toxic!	Not appropriate as nitrite is toxic!	Not appropriate as nitrite is toxic!	Change of water, JBL ClearMec plus, increase biological filter activity. Filter bacteria (JBL FilterStart / Denitrol).	Change of water, increase filter activity, addition of filter bacteria (JBL FilterStart/ Denitrol), protein skimmer.	Add JBL BactoPond.
Cu Copper	JBL Codinol, but only for treatment of diseases.	JBL Codinol, but only for treatment of diseases.	Not appropriate as harmful to micro-organisms and invertebrates.	Change of water, water conditioner JBL Biotopol / plus	Change of water. Complete elimination of copper from a marine aquarium is practically impossible.	JBL CondiPond, change of water.
O ₂ Oxygen	Aeration, plants, oxidisers, filter spray pipes, water surface movement, JBL OxyTabs.	Aeration, protein skimmers, O ₂ reactor, filter spray pipes, movement of water surface, macro-algae.	Aeration, JBL Oxyon, oxidisers, increase surface water movement	Unnecessary as there can never be too much oxygen!	Unnecessary as there can never be too much oxygen!	Unnecessary as there can never be too much oxygen!
Conductivity/ Density*	JBL AquaDur plus, JBL AquaDur Malawi/ Tanganyika.	Addition of sea salt.*	JBL Alkalon Combi.	Mixing with reverse osmosis or de-ionised water.	Addition of osmosis or de-ionised water.*	Addition of clean rainwater.
NO ₃ Nitrate	Unnecessary. In aquariums with plants only, with commercially available house plant fertilizer.	Normally not appropriate. Regulate by reducing skimmer efficiency if required.	Not required.	Water change, JBL NitratEX, JBL BioNitrat EX, JBL ClearMec plus.	JBL BioNitrat EX with active charcoal downstream, macro-algae cultures, protein skimmer.	JBL PondClear.
PO ₄ Phosphate	Unnecessary. In aquariums with plants only, with commercially available house plant fertilizer.	Not appropriate.	Not appropriate.	JBL PhosEX ultra, JBL PhosEX rapid, JBL ClearMec plus, fast-growing plants, change of water.	JBL PhosEX, change of water, macro-algae cultures, JBL BioNitrat EX with active charcoal downstream.	JBL PondClear, fast-growing plants, change of water.
SiO ₂ Silicic acid	Not appropriate.	Not appropriate.	Not appropriate.	JBL SilicatEX, heavy alkaline ion-exchanging resin (MP 600)	JBL SilicatEX, heavy alkaline ion-exchanging resin (MP 600)	JBL SilicatEX.
Fe Iron	JBL Ferropol or JBL FerroTabs.	JBL TraceMarin 3.		Change of water, JBL Biotopol / plus.	Change of water.	Change of water, JBL CondiPond.
CO ₂ Carbon dioxide	JBL ProFlora CO ₂ fertilizer system, slight movement of water surface.	JBL ProFlora CO ₂ system with pH-control unit.	Slight movement of water surface.	Aeration, increase surface water movement.	Aeration, increase surface water movement.	Aeration, increase surface water movement.
Ca Calcium	Sufficient calcium usually available in form of total hardness (GH). Otherwise proceed as for increasing GH.	JBL CalciuMarin, calcium reactor, limewater.	Sufficient Ca usually available in form of carbonate hardness (KH). Otherwise proceed as for increasing total hardness (GH).	Not required.	Change of water.	Not required.
Mg Magnesium	Sufficient Mg usually available in form of total hardness (GH). Otherwise proceed as for increasing GH.	JBL MagnesiuMarin, JBL Calciu-Marin.	Sufficient Mg usually available in form of total hardness (GH). Otherwise proceed as for increasing GH.	Not required.	Change of water.	Not required.

Professional analysis with JBL
Information on the Internet at www.JBL.de

Water analysis

	1 st Test	2 nd Test	3 rd Test	4 th Test	5 th Test	6 th Test	7 th Test	8 th Test	9 th Test	10 th Test	11 th Test	12 th Test	13 th Test	14 th Test
Date, hour														
Site/ aquarium / tap														
Temperature (°C)														
KH Carbonate hardness (°dKH)														
pH Acidity														
GH Total hardness (°dGH)														
NH ₃ Ammonium (mg/l)														
NO ₂ Nitrite (mg/l)														
Cu Copper (mg/l)														
O ₂ Oxygen (mg/l)														
Conductivity (µS/cm)														
NO ₃ Nitrate (mg/l)														
PO ₄ Phosphate (mg/l)														
SiO ₂ Silicic acid (mg/l)														
Fe Iron (mg/l)														
CO ₂ Carbon dioxide (mg/l)														
Ca Calcium (mg/l)														
Mg Magnesium (mg/l)														
Density at 25°C														

* only for the treatment of codium

JBL Test Sets are expedition-tested.

Note on CO₂

First measure the carbonate hardness (CH) and pH level. In the table adjacent, find the line or column with the carbonate hardness or pH value measured. The resulting CO₂ content is shown at the intersection of the corresponding line or column.

The range with sufficient CO₂ content for optimum plant growth and pH levels without negative effects for fish is highlighted.

Carbonate hardness and carbon dioxide									
mg CO ₂ at carbonate hardness (°dH)									
	KH2	KH4	KH6	KH8	KH10	KH12	KH14	KH16	
pH6.0	1	2	2	3	4	5	6	6	
pH7.8	1	3	4	5	6	8	9	10	
pH7.6	2	4	6	8	10	12	14	16	
pH7.4	3	6	10	13	16	19	22	25	
pH7.2	5	10	15	20	25	30	35	40	
pH7.0	8	16	24	32	40	48	56	64	
pH6.8	13	25	38	51	63	76	89	101	
pH6.6	20	40	60	80	100				
pH6.4	32	64	96						

■ recommended range

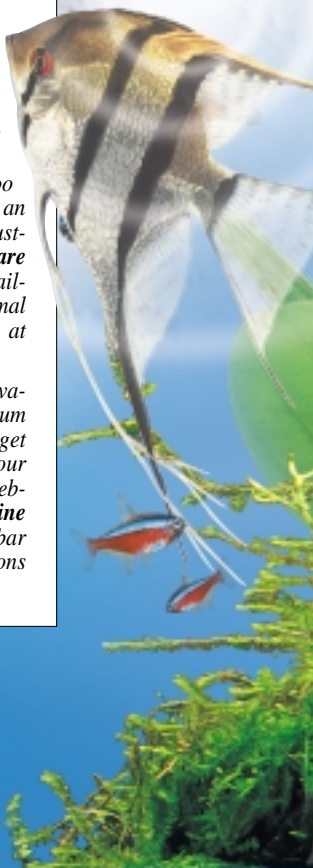
BIOTOPE AQUARIUM WATER

*you too can meet this high requirement by monitoring the quality of the water with the extensive **Test programme by JBL** and by processing your aquarium water with the **JBL care products**.*

*A log sheet is printed on the preceding pages in which you can record the values of your aquarium measured with **JBL Tests**. Next to each parameter you'll find the areas recommended for successful care.*

*If the measured values differ (too high or too low), you will also find an overview of the most suitable adjustments you can make with **JBL Care Products**. The log sheet is also available free from your specialist animal pet shop or for downloading at www.jbl.de.*

***A service by JBL:** If you enter the values you measured in your aquarium in **JBL online Laboratory**, you'll get a detailed interpretation of your values. Simply go to the website www.jbl.de, click "**online Laboratory**" on the menu bar on the left and follow the instructions in the menu.*



12. LITERATURE

We would like to
specially recommend
this book!

DREYER, STEPHAN;
KEPPLER, RAINER:

How to have a
successful aquarium,
1996 t.f.h. publications

Franckh-Kosmos,
Stuttgart 2008.
2nd edition



JBL

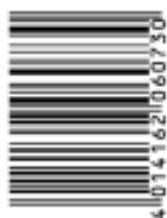


*Your specialist aquarists' retailer
will be pleased to advise you and
recommend further reading
including the other*

JBL WWH BROCHURES
on further topics from aquaristics.

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YOUR SPECIALIST SUPPLIER

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