



A WaterZoo guide to...

Nitrate (NO₃)

Nitrate is the end product of the Nitrogen cycle in most aquatic environments. Highly toxic ammonia excreted by fish is mineralised in an established aquarium by naturally occurring bacteria into slightly less harmful nitrite. This nitrite is then mineralised into nitrate by another species of bacteria. Unfortunately, nitrate is not mineralised further by bacteria that occur in conventional aerobic filtration and will continue to accumulate unless measures are taken to reduce it.

There are differing views on how toxic nitrate is to aquatic organisms, some species seem tolerant, whilst others require very low levels. There are several certainties regarding the toxicity of nitrate.

- The amount of nitrate present in an unpolluted natural environment is close to zero.
- Neither fish nor invertebrates can go from water low in nitrate to water high in nitrate and not suffer to some degree.
- Many fish, but not invertebrates seem able to cope with high nitrate levels if they gradually rise over a period of months. Although this may result in less vibrant colouration & increased susceptibility to diseases.

There are several indicators that high levels of nitrate may be present. New inhabitants are not able to cope with the sudden increase in nitrate levels, so if you lose fish shortly after introduction, especially if your other fish are OK, you may have high nitrate. Increased algal growth, nitrate acts as a fertiliser for algae, so is another indicator. Without doubt the best way to check for nitrate is to use a test kit, we stock several that are accurate and easy to use.

There are three main reasons for high levels of nitrate, these are: -

- Insufficient water changes. As a rough guide water changes of 10-25% at least fortnightly in established aquariums should be sufficient to prevent high levels of nitrate. The frequency water changes are required is dependent upon, stocking level, size & type of fish, feeding regime, quality & type of food, efficiency of filtration, evaporation rate & nitrate level in new water introduced.
- Overstocking, the higher the ratio of livestock to water volume, the faster the nitrate will accumulate. Keeping stocking levels on the low side reduces the speed at which the nitrate level increases.
- Overfeeding, the more food added to the aquarium (especially high protein food), the more waste produced. A percentage of this food is converted into nitrate. Feed small amounts and often. Aim to leave the fish a little hungry, this way they will digest the food fully, thus producing less waste.

The simplest and most cost effective defence against high nitrate is frequent partial water changes. It is worth noting that tap water can be high in nitrate as well as phosphate. It is not unusual to have a level around 20ppm or even higher, the higher the level, the less effective water changes become. You may want to check these levels to make sure this is not contributing to any problem. We advise using only Reverse Osmosis (R.O.) water in aquariums with a nitrate problem. Although R.O. water is ideal for any aquarium as almost all impurities have been removed. In freshwater a remineralising product will need to be added to replace vital minerals and pH buffer removed by the purification process.

Whilst using low nitrate water is a good place to begin. There are other ways of controlling or even reducing nitrate accumulation. Below is a brief overview of some suitable products and methods.

NitrateMinus from Tetra consists of a liquid with tiny granules in suspension. This is added to the aquarium weekly and becomes mixed with the substrate where it removes nitrate by bacterial action. In our experience when used as directed for several months NitrateMinus can reduce the nitrate level to below 10 parts per million, in both freshwater and marine aquariums.

Red Sea NO₃-PO₄-X is developed specifically for marine aquariums that effectively controls not only nitrate, but also phosphate. This is an excellent product and levels well below 1 part per million can easily be achieved when used in conjunction with the Red Sea Algae Control test kit.

Interpet Nitrasafe is a nitrate-removing chemical in a cloth bag. This can be installed in an external canister filter or where there is a good water flow. This can remove up to 7000 mg of nitrate. This would reduce the nitrate level in a 100 litres of water from 100 parts per million to a more reasonable 30 parts per million. This product may appear initially expensive, but it can be recharged with dishwasher salt, so it can be used many times before exhausted. Nitrasafe is for freshwater use only.

There is a special kind of slow filtration unit called a nitrate reactor, these work very differently to conventional filtration and are able to remove large quantities of nitrate. The unit is made up of a chamber filled with a plastic or sulphur media for a special type of bacteria to colonise.

Aquarium water is added to the unit at just a few litres per hour, this creates conditions that are low, but not totally devoid of oxygen. In these very specific conditions bacteria remove the oxygen molecule from nitrate and turn it into nitrogen gas that bubbles harmlessly into the atmosphere. These units require frequent monitoring and adjustment to perform well, but offer excellent nitrate removing capability with minimal running costs.

Certain types of porous biological filtration media can remove small amounts of nitrate in a less controlled way than the nitrate reactor, Ehfisubstrat and Seachem DeNitrate are good examples. For this to work the media should never be cleaned thoroughly.

If you have a freshwater Juwel aquarium, they produce a green nitrate removal sponges called Nitrax for all models. This removes nitrate by bacterial action and requires replacement every two months.

There is a more natural approach to nitrate control by emulating nature. Plants and algae use up large quantities of nitrate during growth. For this method to work you need lots of plants growing so vigorously that they need frequent pruning. Fast growing species are best for this purpose, floating plants are also excellent due to their rapid growth. See The WaterZoo guide to growing aquarium plants for more information. For marine aquariums, *Caulerpa sp.* or *Chaetomorpha* (Chaeto or Spaghetti algae) can absorb large quantities of nitrate, although eaten by many fish, care needs to be taken as it can be invasive. For this reason it best grown in an illuminated sump tank, often known as a refugiums. There are several other methods to control nitrate only in marine aquariums. Protein skimmers cannot directly remove nitrate, however it can slow its increase by removing pollutants before they are mineralised into nitrate. Live rock is widely used by aquarists maintaining reef aquariums. Due to its porous internal structure areas with very little water movement & low oxygen conditions develop. This makes the live rock work at removing nitrate in a similar, but less controlled way to a nitrate reactor. For this method to work copious quantities are required, as rough guide use 1kg per 4.5 litres

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