Operation Manual
for the
AQUA MEDIC
Nitratereductor 400

Denitrifying filter for fresh and sea water aquaria up to 400 l .

With the purchase of this Nitratereductor you have selected a top quality product. It has been specifically designed for aquaristic purposes and has been tested by professionals.

With this unit, you are able to reduce the nitrate concentration of your aquarium water efficiently to a harmless level.

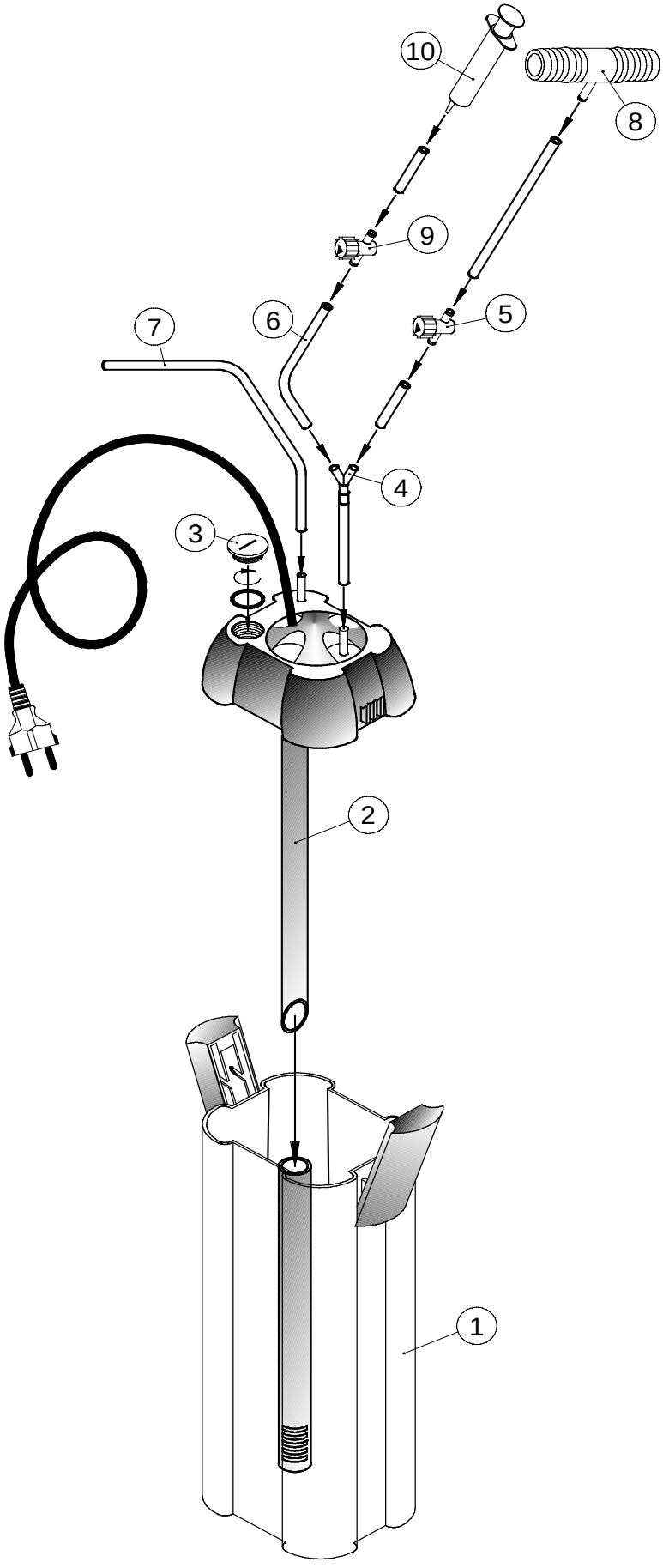


Fig. 1: Nitratereductor 400

1. Filter housing
2. Tube
3. Cap with O-ring
4. Y-piece (Feeding/ Water inlet)
5. Adjustion valve
6. 6/4 mm tube
7. 8/6 mm tube
8. T-piece (Bypass)
9. Valve for feeding syringe
10. Feeding syringe
11.dripp Counter

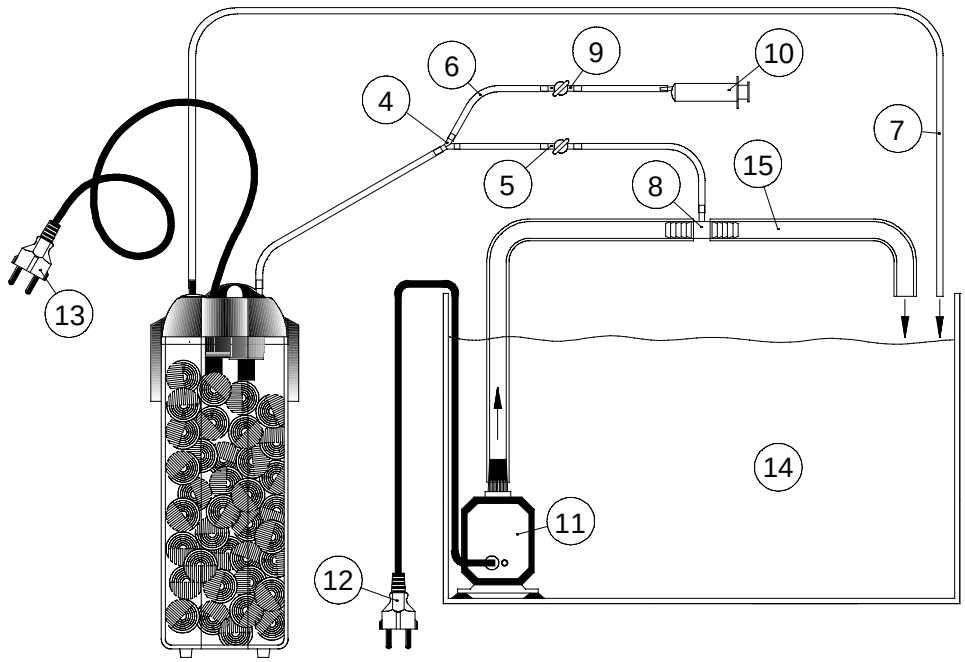


Fig. 2: Nitratereductor 400 beside a filter tank or an aquarium: 4.) Y-piece (connection for feeding syringe and water), 5.) adjustion valve for waterflow 6.) 6/4 mm tube (feeding and water inlet), 7.) 8/6 mm tube (water outlet to drip counter), 8.) T-piece for bypass, 9.) Pressure side of the circulation pump, 10.) filter tank or aquarium, 11.) circulation pump, 12./13.) power plug

1. Product description

The AQUA MEDIC ***Nitratereductor*** consists of the reaction vessel (height = 37 cm, volume approx. 2.3 l).

The reaction vessel is filled with AQUA MEDIC ***Deniballs.*** In the top of the filter, the water outlet is placed. Besides the top, you find the water inlet and the port for the pressure resistent mV electrode (thread PG13,5). For the Nitratereductor 400 a special probe whith is shorter in length is available (220.14).
One tube with ***Denimar*** tablets to feed the bacteria is included.

2. Theory

Nitrate is coming into the aquarium via 2 different paths:

- with the tap water, with every water change or with the replacement of the evaporated water
- by biological reactions in the aquarium.

These biological reactions are responsible for the farmost biggest part of the increase of the nitrate level.

How is nitrate produced in the aquarium?

When the animals are fed with dried, living or frozen food, proteinaceous substances get into the aquarium. These are the basics of the diet for the animals. A big part of the nitrogen, from the food is however excreted into the water. This nitrogen is metabolised by bacteria, living in the aerobic filter via the toxic intermediate substances ammonium and nitrite to the less toxic nitrate. These biolochemical reactions take place in the presence of oxygen:

The bacterium Nitrosomonas oxidises Ammonia to Nitrite, the bakterium Nitrobacter the Nitrite to Nitrate.

Ammonium + Oxigen ----- > Nitrite + Oxigen -----> Nitrate
(Nitrosomonas) ***(Nitrobacter)***

In most aquaria, nitrate is the endproduct of bacterial metabolism and accumulates in the water. Only higher water plants and algaes are able to remove this nitrate from the aquarium water.

What is the effect of nitrate in the aquarium?

1. Overfertilisation/Eutrophication. The aquarium is overfertilised, the algae growth increases and cannot be controlled anymore.

2. Toxic effects to the animals. Many invertebrate animals in sea water tanks are very sensitive to higher nitrate levels.

3. Working principle of the *Nitratereductor*

In the AQUA MEDIC ***Nitratereductor*** the water is treated anaerobically. In the absence of oxigen, many bacteria are able to use nitrate as a substitute for oxigen for their metabolism.

2 Nitrate ----> nitrogen gas + 3 oxigen

$2\,NO_3$ ----> N_2 + $3\,O_2$

The oxigen is used for the metabolism, the nitrogen is excreted into the water. Nitrogen gas is a natural compound of the water and totally harmless.

It is, however, necessary to increase the metabolism of the bacteria, so that they can reduce enough nitrate. For this reason, the nitrate removing bacteria have to be fed with organic substances. The tablet feed ***Denimar*** contains organic substances, that can be used completely by the bacteria. The only waste product is CO_2 .

The flow rate through the ***Nitratereductor*** is very slow. This is a main difference to other aquarium filters, where the water is often treated once per hour or even more often. The water in the ***Nitratereductor*** should have a retention time of 2-4 hours. It is however sufficient to treat it once per week. If the filter is adjusted correctly, the water leaves the filter nearly free of nitrite and nitrate.

4. Description of the *Nitratereductor*

The AQUA MEDIC ***Nitratereductor*** consists of a reaction vessel (1) of 2.3 l volume. To provide surface material for the bacteria, the filter is filled with AQUA MEDIC ***Deniballs*** They create an ideal microclimate for denitrification.
To avoid dead zones, the water is recirculated internally in the ***Nitratereductor***. A recirculation pump is placed in the top.

In denitrifying filters, especially in units, where the water has to pass through a long way, it can occur, that there is no even flow in the filter. Zones with a very low redoxpotential are created, where hydrogensulfide is produced (the filter starts to smell bad). On the other side, zones with a rather high flow may arise, where nitrate is reduced only to nitrite. In each case, the conditions vary in the different zones of the filter and it is nearly impossible to find its right working point.
These unpleasant effects are avoided by the construction of the AQUA MEDIC ***Nitratereductor***. The recirculation ensures a complete mixing and the same redox potential level in the whole filter. Zones with a very low redox potential and the production of hydrogen sulfide are avoided.
The redox potential can be used for the control of the filter. The effectivity and the reliability of the filter can be increased .

Connections
The following connections are located at the ***Nitratereductor***:

1. Inlet. Here, you can connect a 6 mm air tube. At the inflow, you find an adjustion valve, to adjust the flow rate. The best value is app. 0.5 - 1 l/hr (app. 1 drop per second). The adjustion at the inflow causes a delay, until you can read the adjusted drop number at the drop counter at the water outlet. The drop counter is mounted inside of the aquarium, close to the water level. If the flow rate is regulated in the outlet, the valve may not be

closed completely, in order to allow produced nitrogen to escape. During the start phase in the first weeks, the outlet valve should stay completely open.

2. Feeding. Through this opening, you can inject Denimar tablets with a syringe to enhance denitrification. Dissolve the tablets before in some ml of water. The valve has to be cleaned after every feeding and closed.

3. Redox electrode. Through this opening, you can put the special pressure resistant ORP electrode with a special length and standard thread (PG 13,5) Aqua Medic No: 220.19.

4. Outflow to aquarium. Here, you can connect a tube 8/6 mm.

5. Set-Up

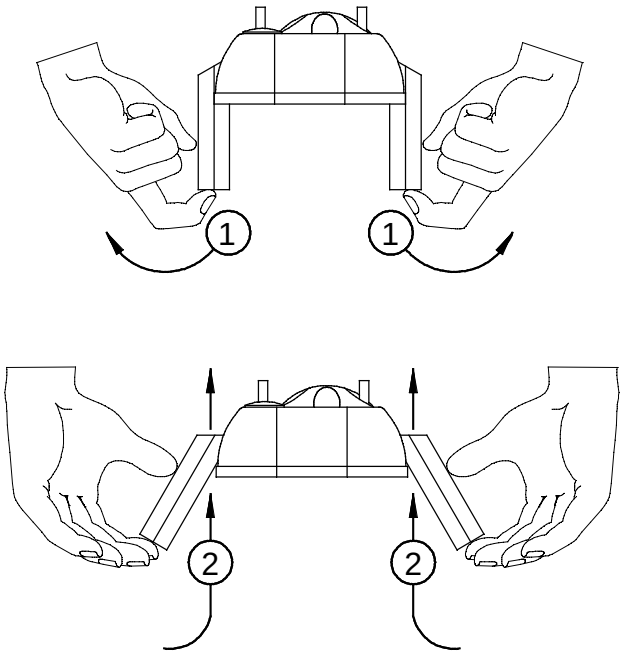
The ***Nitratereductor*** is a hermetically closed system. The produced gas (nitrogen and CO_2) can escape through the water outlet. For this reason, the outlet should never be completely closed, because an eventual overpressure may escape through the water inlet and interupt the inflow.

The ***Nitratereductor*** has to be placed in a way, that the water can flow off either direcly back into the aquarium or into the filtration chamber. In a seawater aquarium, it is advantageous, if the outflowing water is flowing into the inlet of the protein skimmer or the trickling filter. In the protein skimmer, the water is saturated with oxigen, before it comes back into the aquarium.

Inflow. The inflow into the reductor, can be realised as a bypass from the main circulation pump with the included T pieces. In case of a Percula aqurium the reactor has to be placed in the chamber behind the trickle filter. There is a special adapter available (503.00-17 - not enclosed) for the connection with one of the pumps for the water current. Put the adapter on the pressure side of the pump and stick it through the hole of the filterchamber.The flow rate is adjusted with the valve and the drop counter.

6. Starting

Before starting, the ***Nitratereductor*** is filled with aquarium water and controlled for leaking and the right position of the sealing. Close both clamps tightly. The internal circulation pump can be switched on.



Connection to an existing aquarium
If a ***Nitratereductor*** is connected to an existing aquarium with a rather high nitrate level, the inflow of aquarium water should not immediately be started. The bacterial growth is enhanced by the addition of 1 tablet of ***Denimar*** per day. If after 8 - 14 days, the nitrite has dissapeared from the reductor - a residual concentration of nitrate is harmless - the water flow can be switched on.

Connection to a new aquarium
If connected to a new aquarium, the bacteria do not have to be fed within the first 4 weeks, as the nitrate forming bacteria Nitrosomonas and Nitrobacter need this time to develope and to oxidise the whole amount of ammonia and nitrite into nitrate.

Feeding
The feeding has to be adjusted according to the nitrate loading of the aquarium. It can be controlled with a redox probe (see options). In a normal loaded tank, one tablet per day is sufficient. It is possible to feed several tablets (up to 3 pcs.) at a time.. The filter needs then no feeding for several days.
After some time, a slimy bacterial biomass is formed in the ***Nitratereductor.*** This a normal process. A high bacteria population ensures a high removal rate of nitrate.

7. Feeding with *Deniballs*

The white AQUA MEDIC ***Deniballs*** are made of a biodegradable plastic material. This plastic material is also produced biologically - the raw material is produced by bacteria. This new plastic material is completely biodegradable. It can be used by denitrifying bacteria in the ***Nitratereductor*** to remove nitrate. The ***Deniballs*** supply the surface area and the food for the bacteria at the same time. This means, that a ***Nitratereductor*** filled with ***Deniballs*** has not to be fed for a longer period - up to one year. The ***Deniballs*** need - especially in a seawater tank - a longer period to reach their full capacity. During this time 1 tablet of Denimar per day has to be added.

8. Maintenance
1. Control of the flow rate. The flow rate through the filter has to be checked regularly. The optimum is at app 0.5 to 1 l/hr. This has to be readjusted from time to time.

2. Recirculation pump. The recirculation pump has to be controlled regularly on clogging. The pump housing has to be opened and the magnet with the needle wheel removed. Both is cleaned under fresh water and mounted again.

3. Cleaning. If the bacterial biomass has increased after some years, the ***Bactoballs*** can be removed, cleaned with aquarium water and filled in again.

4. Renewal of ***Deniballs***. The ***Deniballs*** have to be refilled/replaced once per year.

5. Feeding with ***Denimar***. 1 tablet/day during the first 4-6 weeks.

6. From time to time measurement of nitrite and nitrate concentrations in the outlet of the ***Nitratereductor.***

9. Options

With a redox potential control, the function of the ***Nitratereductor*** can be optimised and the reliability can be increased.

The optimal working point of the ***Nitratereductor*** can be determined by a measurement of the redox potential.

Denitrification and redox potential
The redox potential is a parameter which can be measured electronically. The value is a measurement for the equilibrium between reducing and oxidising reactions in the water.

The redox potential in the aquarium itself is kept at plus 200 - 400 mV (Millivolt). This high redox potential indicates, that oxidation reactions dominate over reduction reactions. Oxidation reactions are biochemical reactions, where a substance is oxidised, e.g. by oxigen.
A negative redox potential indicates the absence of oxigen and is lethal for most aquarium inhabitants.
The biochemical conditions in the ***Nitratereductor*** differ completely from those in the aquarium: Nitrate has to be reduced to nitrogen gas. This is only possible if there is no oxigen dissolved in the water.
The redox potential is low or even negative. The ideal range is between -50 and -250 mV.
If it exceeds -50 mV, the denitrification reaction may stop at the nitrite stage!

If it falls below -300 mV, all the nitrate is reduced. The bacteria then start to use sulphate. This is a very undesired process because the end product of this reaction is Hydrogensulfide. Hydrogensulfide (H_2S) is toxic and smells very strange like fouling eggs.

If a little bit of Hydrogensulfide is entering the aquarium, this is not critical. It is immidiately oxidized to sulphate. The closed version of the Nitratereductor causes no problems with bad smell.

Control of the Nitratereductor
The ***Nitratereductor*** can be controlled by the rate of feeding or the flow rate of water:
If the redox potential exceeds -50 mV or even gets positive, the dosage of food (Denimar tablets) can be increased or the flow rate decreased.
If the redox potential sinks below -300 mV, the feeding can be reduced or the flow rate increased.

If you work with the ***Denimar*** tabs, you should keep the flow rate constant and vary the food supply. If you work with ***Deniballs***, you should vary the flow rate.

10. Failures

Problems with the denitrification are mostly caused by wrong adjustion of the flow and the feeding rate. They can only be determined by measurements of the nitrite and nitrate concentrations in the filter or by measurements of the redox potential.

- The **pump produces noise.** If the pump housing contains air or gas, this causes a strons noise. In this case, the pump is pumping little or no water, and its cooling is insufficient. The pump may overheat and be destroyed. The housing of the pump has a small hole, where air and gas can escape. If this hole is blocked, it has to be cleaned with a needle.

- **Nitrite in the outlet of the filter.** If the outlet of the filter contains high amounts of nitrite, the feeding rate is too low. Increase the feeding (add 1 Denimar tablet per day) or lower the flow rate. In most of those cases, the redox potential is too high (above -50 mV).

- **Nitrate in the outlet of the filter.** High residual concentrations of nitrate often occur together with high nitrite values. **Caution!** Most nitrate tests are disturbed by high nitrite concentrations! In this case, the redox potential is also too high. Increase feeding rates, decrease the flow rate.

- **Hydrogen sulphide in the outlet of the filter.** The filter smells like fouling eggs. In most cases, the redoxpotential is too low. Reduce the feeding, check the flow rate and increase it if necessary.

- **The redoxpotential reaches values higher than zero. The flow rate is very low.** Mesure the pH in the reductor. If the pH is lower than 7,0 in seawater or lower than 6,0 in freshwater add some milliliters of a saturated solution of calciumhydroyide in freshwater with a syringe. Increase the pH to values higher than 7,0.

11. Warranty

AQUA MEDIC GmbH guarantee 12 months from the date of purchase on production and material defects. Further claims and claims resulting from improper use are excluded.

Warranty only by proof of purchase with the original invoice.

- Technical changes reserved –
AQUA MEDIC GmbH, Bissendorf/Germany

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