Operation manual
for the

Plankton Reactor
and
Plankton Light Reactor

Cultivation apparatus for phyto- and zooplankton

The AQUA MEDIC ***plankton reactor*** has been designed especially for aquaristik use an is recommended by professional aquarists. The reactor is designed for long term cultivation and production of phyto- and zooplankton for feeding fish fry or filter feeding organisms.

1. Introduction

For the nutrition of many fish larvae, living plankton is a precondition. But also for feeding many invertebrates, esp. sponges and corals without Zooxanthellae living Plankton is the only choice.

The **plankton reactor** is a simple system for the production of plankton in a natural food chain. If the food chain shall be realized completely, you need 2 reactors:

The **plankton light reactor** for the production of microalgae and the **plankton reactor** for the production of zooplankton. Both reactor differ only in the lighting. As it is recommended to use them together, they are described together in the following.

In the first stage microalgae are produced with light and CO_2. They can be fed directly to many filter feeding animals. The growth rate of the algae in the **plankton light reactor** is enormous. With optimum supply of light, CO_2 and nutirents (plant fertilizers) the biomass of the algae may increase 4-fold during 24 hours.

The algae are used for feeding the 2nd stage of the food chain: the zooplankton.This is produced in the **plankton reactor .** Here rofifers (*Brachionus plicatilis*) are the best choice. Rotifers have an enourmous growth potential. If they are supplied with enough algal food, they can double their biomass in 4 days. A quarter of the culture can be harvested every day.

The microalgae can, however, also be used for raising brine shrimp. If fed in the right quantity, they are fully grown in 10 - 14 days and can be fed to bigger fish.

Secies spectrum:
In the **plankton reactor** many different species of marine and freshwater algae and many species of zooplankton from sea and freshwater may be cultivated.

The main emphasis is for sure seawater. Here the microalgae *Nannochloropsis spec* and *Dunaliella spec* have been proved to be suitable. The zooplankton with the highest growth rate are for sure the rotifers of the genus *Brachionus*. In seawater, *Brachionus plicatilis* is the best suited candidat.

For freshwater, we recommend algae of the genus *Scenedesmus* or *Chlorella* and rotifers of the genus *Brachionus*, especially *Brachionus rubens*.
Inoculums of these species, you get from your local dealer.

Algae produktion in the plankton light reactor

For mass production of microalgae in the **plankton light reactor** you have to create the same environment as for the growth of water plants in aquaria:

- suitable illumination.
- sufficient nutrient supply (esp. nitrogen, phosphorous, iron and trace elements) suppply with CO_2 .
- sufficient water movement. This is of special interest, because the microalgae are kept in suspension by the water movement. In completely quiet water, they would sink to the bottom in some days.
- suitable temperature. set up in a warm place, optimum is 20 - 28°C.

In the **plankton light reactor** these conditions can be fulfilled.
The reaction pipe is transparent, the diameter is calculated, that the illumination of
1 x 18 W is enough. The light is concentrated into the algal culture with a special reflector. Also, the culture is warmed up by this. For the nutrient supply of the algae, we recommend the fertilizer for water plants **floreal** combined with the iron fertilizer **ferreal**, from the AQUA MEDIC program.

The reactor is aerated from below, so that the algae stay in suspension. We recommend , to ensure high growth rates to add CO_2 into the aeration nozzle. You can use a standard CO_2 unit, we recommend **CO_2 complet** from AQUA MEDIC.

Zooplanktonproduction in the plankton reactor

For the production of zooplankton in the **plankton reactor** the same conditions are valid, as for the alga culture:

- sufficient water movement
- the right temperature (20 - 28°C)
- sufficient oxigen supply
- enough of the right food

The oxigen supply and the water movement are guaranteed by the aeration. A suitable food are the living microalgae, that are produced in the **plankton light reactor** .

2. Set up and maintenance of the plankton light reactors and the plankton reactor

2.1. Delivery

The **plankton reactor** consists of following components:

-Reaction vessel, volume app. 3 l, with air injection port and check valve
-Wall mounting plate with clamps
-Cleaning brush.

In adition the **plankton light reactor** is supplied with:

-illumination unit, incliding external ballast.

To run both **plankton reactors** you need a air pump with higher pressure capacity . We recommend the use of the AQUA MEDIC Mistral 200 or 300.

2.2. Mounting

First both holding plates (3) are mounted at a suitable place at the wall in a room with a right temperature. The 4 clamps (4) can be hooked into the holding plates. The reaction vessel (1) is pressed into the clamps. Take care, that the clamps of the upper plate fit under the black stringers of the reactor vessel. Thes prevents, that the reactor slides down. The funnel shaped top of the reactor allows the injected air to escape, and works as splash protection. In the case of automation of the system, it can take a pH probe.

At the lower end of the reactor a valve is placed (6), for harvesting the Plankton, and a check valve in the air tube, that prevents a flow back of the water in the case of power failures. A 6 mm air tube is directed from the air adjuston valve, to the air pump (not included).

Illumination of the **plankton light reactor:**
To start the illumination, the flourescent tube is mounted into the water protected sockets of the lamp. With the aid of the holding clamps (8), the whole illumination unit can be clicked to the reactor and secured with a rubber band (9). The power plug of the illumination unit is put into the socket of a timer (not included).

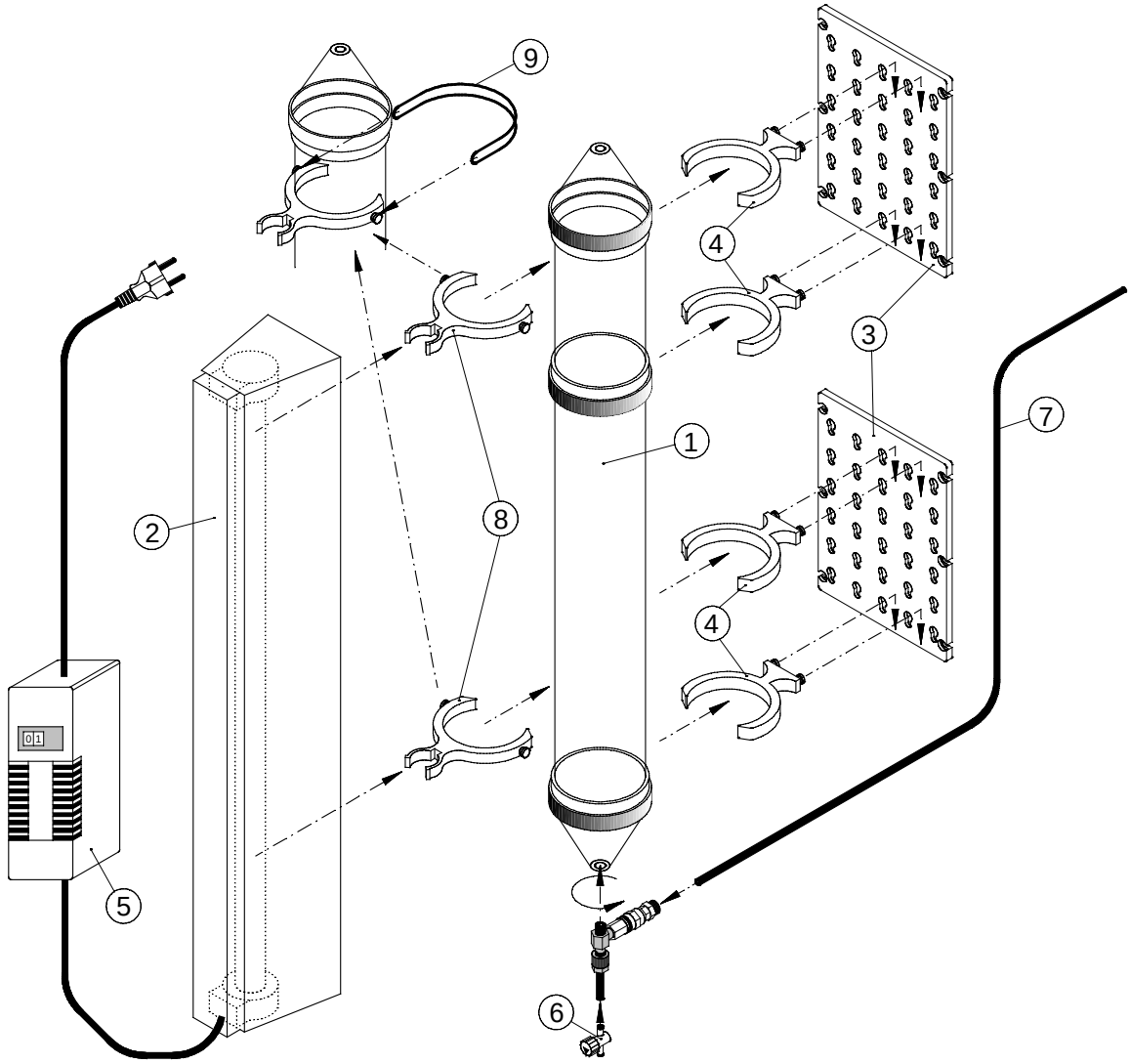

Fig 1: Plankton Light Reactor

1. culture vessel
2. illumination unit*
3. mounting plate (2 pcs)
4. mounting clips (2 pcs)
5. ballast*
6. valve for drain and harvest
7. air inlet hose
8. clip for mounting the illumination unit *
9. rubber band to fix the clip(8)*

* only for plankton light reactor

3.Operation of the plankton and the plankton light reactor

3.1. Microalgae production in the **plankton light reactor**

Before starting, the reactor should be flushed with warm tap water. Then it can be filled with cold (25°C) but previously cooked seawater. It is important for the first start to cook the seawater, so that no foreign Plankton organisms may enter the reactor. Especially zooplankton (rotifers) or filamentous algae can destroy the whole system. A ringle rotifer is enough!

Each 2 ml **floreal** and **ferreal** are added for fertilization. Now the inoculating culture can be added.

Cultivation of the microalgae:
After inoculation, the culture is slightly green. The light should be switched on now. The optimum duration of the illumination for microalgae is 16 hours. Illumination for 24 hours gives only a slight increase of the growth rate.
Under these conditions the green colour of the culture increases and after some days you can start to harvest. Under ideal conditions, you can harvest 1 - 1,5 l of algae culture per day. They can be removed via the valve at the bottom. The missing water is then replaced by fresh prepared and filtered sea water. Take care: Use only perfect clean cans or buckets to prepare the seawater. Zooplankton may destroy an algal culture competely in a very short time. The most important factor for successful long term running the algal culture is to keep it perfectly clean.

Fertilization. The daily added seawater is enriched with 1 ml **floreal** and **ferreal**. The harvested microalgae can be used to feed the zooplankton culture (rotifers or artemia) or may be fed directly to the aquarium as food for invertebrates (mussels, spiral worms, and others.)

Cleaning:
After some weeks of permanent culture, wall growth may occur at the reactor. As soon, as the culture is shaded by this and the algal production decreases, the reactor has to be cleaned. Therefore, the culture is filled into a clean vessel that can be closed. The **plankton reactor** is now cleaned with warm water with the cleaning brush. The clean reactor is refilled with the old algal culture and fresh sea water (1:1) .

Filamentous algae:
If nuisance organisms have entered the reactor - e.g. filamentous algae or algae feeding zooplankton, the reactor has to be sterilized. We recommend to use - after mechanical cleaning with the brush - 2% H_2O_2 (Hydrogenperoxide) for minimum 24 hours. Afterwards the reactor is filled with cooked and cooled down sea water. In this case, the you have to use a new pure culture for If you reuse the old culture, the filamentous algae would spread out again.

We recomend to use a microscope with a magnification of app. 400 fold for the control of the culture. This allows easy recognition of filamentous algae or other nuisance organisms.

Enhancement of the algae production by fertilisation with CO_2:
The algal production can be increased for several times, if the culture is supplied with CO_2 in sufficient quantity. To do this, a T- piece is put in the air pipe, between the check valve (7) and the reactor. CO_2 is added via this T- piece to the air. For the CO_2 supply, you need a standard CO_2 unit (AQUA MEDIC **CO_2 complet**) . The CO_2 is directed from the bottle via pressure regulator, needle valve, bubble counter with check valve to the T-piece and into the algal culture.

For optimum dosage of CO_2, we recommend to use a night shut off - to avoid a pH drop during the night. Therefor a solenoid valve is switched between the pressure regulator and the bubble counter. The best solution - in every case - is the use of an automatic CO_2 control unit with a pH controller. This ensures, that only that much CO_2 is added to the culture, what is used by the algae. In adition, the pH is always kept in the right range. The pH probe can be placed in the top (4) of the **plankton light reactor**. For marine microalgae, the pH should be set to pH 7,5.

3.2. Zooplankton production in the **plankton reactor**

For the **plankton reactor** the same conditions can be applied as for the **plankton light reactor.**
Cleanness is the most important supposition also for the production of zooplankton. However, it is not necessary to cook the media before use. For starting, the **plankton reactor** is filled with clean fresh prepared sea water. As food microalgae from the **plankton light reactor** are added, so the colour is slightly green.

If the **plankton reactor** is run with rotifers, the inoculating culture can now be. If Artemia shall be raised, the reactor can be inoculated with Artemia eggs. We recomend to use decapsulated eggs. This avoids trouble with the hard residues of the shells. Decapsulated Artemia eggs are available at your local dealer - **life A** from AQUA MEDIC.

rotifers.(*Brachionus*)

For the production of rotifers, we strongly recommend to use the complete 2 stage food chain. *Brachionus* cultures, that are fed with living microalgae are much more healthy and viable, than cultures fed with yeast of liquid foods. As it is not good for a rotifer culture to stay without food for some days, the microalgal culture in the **plankton light reactor** should be set up first, before the zooplankton culture is started. To check the *Brachionus* culture, we recommend to use a magnifiing glass (best is a stereo microscope) with a magnification of app 20 fold and some petri dishes for observation.

In a healthy *Brachionus* culture, that doubles every 4 days, always minimum 25% of the animals should carry eggs. The stomach of the animals should be filled with algae (green) and move around quickly. If no egg carrying animals are there and the body is transparent and the animals swim only slowly, this is a clear indication for food shortage.

3.3. Set up of the food chain

If the complete food chain is set up, healthy cultures can be maintained for long term, if the cleanness is always guaranteed.

It is recommended to keep a strict rhythm of feeding and harvesting the cultures. The following pattern has proven to be succcessful:

Daily 0,8 - 1 l are harvested from the algal culture, The reactor is then filled up with the same amount of fresh seawater and each 1 ml **ferreal** and **floreal** are added. The sea water, you may take water from an reef aqarium, has to filtered through a filter with small pore size(e.g a 5 µm filter from the reverse osmose unit), so, that no zooplankton can enter the culture.

From the rotifer culture also 0,8 - 1 l are harvested - for feeding. The rotifer culture is then filled up with the harvest from the algal culture. If you need more algal culture, - for direct feeding to invertebrates or as reserve, you can increase the daily harvest from the microalgal culture up to 1,5l.

For a shorte period of higher demand, you can also increase the harvest from the rotifer culture to a maximum of 2 l/day. However, in this case the algal culture has to be in a top condition - for a longer period, this is not recommended, as the culture may break down suddenly.

3.4. Automation of the system with dosing pumps

The plankton cultures need daily maintenance. Both, the algal and the rotifer culture have to harvested, diluted and fed daily, to keep the high growth rate.

This effort can be minimized by the use of dosing pumps. We recommend the peristaltic pump **SP 3000** from AQUA MEDIC.

In the following, a system is described,where an aquarium with invertebrates is supplied with live plankton every day.

One dosing pumps sucks water out of a tank or the aquarium. It is adjusted, so that the amount pumped per day is app. 1 Liter. This is controlled by a time switch. As the water from the aquarium might contain zooplankton, it has to be filtered. Here a 10“ Filter housing witha 5 µm filter cartige from the reverse osmose can be used.

This filter retains all zooplankton from entering the algal culture. From the filter, the water enters the algal culture. The water is added into the air pipe with a T-piece and pumped into the culture together with the air. The **plankton light reactor** is supplied with an overflow. The inflowing water forces now the same amount of algal culture to flow out into the zooplankton culture. It is important to switch a drip counter between the algal and the zooplankton culture to avoid, that rofifers enter the algal culture.

A second dosing pump adds parallel to the first one fertilizer into the algal culture from a storage vessel (app. 1 ml **floreal** and **ferreal**/day). This pump is controlled by a second timer. In adition, the

algal culture is supplied with CO_2 as described above, controlled with a pH computer and a solenoid valve.

The algal culture, that flows out of the **plankton light reactor** is directed, together with the air into the **plankton reactor.** This reactor is also supplied with an overflow.
Here, the same amount of rotifer culture flows out of the reactor like the inflowing algal culture. This can be directed into the aquarium, where the zooplankton and not yet eaten algae can be taken up by the invertebrates.

By this system, a higher amount of nutrients is entering the aquarium. For this reason a good filter system, esp. a Nitratereductor and a phosphatefilter are recommended to avoid the formation of filamentous algae in the aquarium.

If the external conditions are kept stable (temperature, CO_2 supply and nutrient supply) this system works without problems. Both culture vessels have, however, to be cleaned from wall growth, as described above.

4. Warranty

Should any defect in material or workmanship be found within twenty four months of the date of purchase AQUA MEDIC undertakes to repair or, at our option, replace the defective part free of charge – always provided the product has been installed correctly, is used for the purpose that was intended by us, is used in accordance with the operating instructions and is returned to us carriage paid. The warranty term is not applicable on the all consumable products.
Proof of Purchase is required by presentation of an original invoice or receipt indicating the dealer's name, the model number and date of purchase, or a Guarantee Card if appropriate. This warranty may not apply if any model or production number has been altered, deleted or removed, unauthorised persons or organisations have executed repairs, modifications or alterations, or damage is caused by accident, misuse or neglect.
We regret we are unable to accept any liability for any consequential loss.
Please note that the product is not defective under the terms of this Warranty where the product, or any of its component parts, was not originally designed and / or manufactured for the market in which it is used.
These statements do not affect your statutory rights as a customer.
If your AQUA MEDIC product does not appear to be working correctly or appears to be defective please contact your dealer in the first instance.
Before calling your dealer please ensure you have read and understood the operating instructions. If you have any questions your dealer cannot answer please contact us

Our policy is one of continual technical improvement and we reserve the right to modify and adjust the specification of our products without prior notification

AQUA MEDIC, Bissendorf 04/2003, Germany