Why skimming?

AquaCare GmbH & Co. KG
Am Wiesenbusch 11 - D-45966 Gladbeck - Germany
☏ +49 - 20 43 - 37 57 58-0 • 🖷: +49 - 20 43 – 37 57 58-90
www.aquacare.de • e-mail: info@aquacare.de

To keep fish they must be fed very good. But feeding causes organic waste that must be eliminated continuously. (photo: Othmar Pötsch)

Why skimming?

In all marine systems wastes are continuously produced. Fishes secrete most of the food in form of ammonia/ammonium (= NH_x), protein, amino acids and fibres. To prevent fish and other animals against toxic concentrations, these substances must be eliminated or changed into harmless material.

With biological filtration almost every substance may be converted into carbon dioxide, water, nitrate, phosphate and sulfate - liberalization. But these products accumulate. The most important biological filters are living rocks. Other filters like trickling filter, the system of JAUBERT, the mud filter of LENG SY, plant filters with macro-algae or mangroves, algae turf filter of ADEY & LOVELAND or refuges that are driven in a bypass to the aquarium, are working with the help of biology.

If small or large skimmer, this technique is the main component of modern marine filter systems. photo: AquaCare

With skimming or flotation proteins and some other substances are taken out of the system before the biological filtration works. The raising of nitrate and phosphate lowers with skimming. The water has lower concentrations of biological oxidizing substances. So the redox (ORP) is higher and the animals grow better.

If high concentrations of organic matter occur (death of an animal, too much feeding), a biological working trickling filter reacts very slowly. Bacteria must adapt to the new input. Especially nitrifying bacteria *Nitrosomonas* and *Nitrobacter* need a long time to react to the new concentration. The flotation process reacts automatically and prevent a rising of toxic products like NH_x and nitrite.

The higher the organic loading (the more fish is in the aquarium and the better you feed them) the more important is the skimmer. Very low loaded system might be kept without skimmers, too.

The principle of skimming

Proteins and some other substances have the characteristic to adsorp on surfaces. In the skimmer a very large surface is produced by injecting small bubbles into the water. The proteins are take up by the surface (static attraction, adsorption). In addition other substances are able to dock: dirt particles, dead cells (bacteria, algae, fungi) and partially metals (you must take care of an adequate supply with trace elements).

In modern reef aquaristic a cohabitation of soft and hard corals, anemones and fishes is without skimming nearly impossible. Photo: AquaCare.

The flotate of a skimmer should have dark colour. As a consequence waste products are highly concentrated. Photo: AquaCare

To create a flotation process you need small air bubbles (diameter <1 mm), a salinity of minimum 15‰ and not too much fat in the water.

Some factors affect the skimming:

- The higher the temperature the higher the speed of the adsorption process.
- The smaller the air bubbles the larger the surface and the power of the skimmer.
- The higher the contact time between air and water the better the flotation process.
- The lower the motion in the reaction (contact) tube the higher the adsorption force between air bubbles and proteins.
- The lower the protein concentration in the water the higher the percentage of the skimming rate.
- The supply of ozone into the inlet air is charging the uncharged proteins. So they are able to dock at the bubble surface. The skimming is about 30% better with ozone. With ozone a skimmer is working more regularly, so if a lot of organic load is reaching the skimmer it will not overflow so quickly.

Additional advantages of the flotation technique

During the flotation process a high amount of air is passing the water. If too less oxygen is in the water oxygen will migrate into the water (with the patented water and air flow in the AquaCareFlotor you can achieve 2 mg/l oxygen above the saturation concentration. Deficits caused by animals and bacteria (bio filter) are balanced.

In sea water tanks carbon dioxide is used by plants and algae and by animals with zooxanthellae. So the carbonate hardness (alkalinity) is sinking and pH value is rising at days. At night carbon dioxide is produced and drops the pH. Additional chalk reactors are enriching the water with carbon dioxide. A good skimmer is balancing these oscillations and ensures a stable pH value.

With a good skimming the undesirable free floating bacteria in the water are reduced about 20%. Very fine sediments and precipitates (e.g. produced by phosphate reducing agents or lime water) are taken out of the water and realises a better view to the animals.

Some variants of skimming technique

There are different methods for producing air bubbles:

- **Air stones** made of wood or other materials:
  This first method to create fine bubbles in sea water has some advantages and disadvantages.

With only less pressure (about 100…150 mbar; 7…10 psi) air is pressed through a fine porous material. The size of the bubbles is affected by the size of the pore and the equability of the material. The kind of wood is not so important than its structure. The efficiency of the air stone at small skimmers (up to about 1000…2000 l/h water flow) is unsurpassable as long as the air stone is changed regularly every 4…12 weeks. With the time the pores are clogging and the air stone is producing less but bigger bubbles. The life time of air stones gets less if you use ozone. Another disadvantage is the needs of an air pump that supplies the air stone.

- **Venturi or injector:**
  The injector is a nozzle that sucks air into the water flow without an additional air pump.

If a venturi is built in the right way it will clog with lime or salt. But unfortunately some producers are building the venturi in a wrong way and the air input will change very rapidly with the time. If a venturi has a too small size you must clean it very often because crusts of lime and salt will arise. The size of the bubbles and consequently the efficiency of a skimmer depends on the inlet pressure: the higher the pressure the smaller the bubbles, the better the skimming effect. With more than about 1 bar (15 psi) there is any significant difference between air stone bubbles and venturi bubbles. Because you must produce the water pressure for the venturi with a strong pump you need more energy that with a air stones or dispergators. But the maintenance of a good injector is very low.

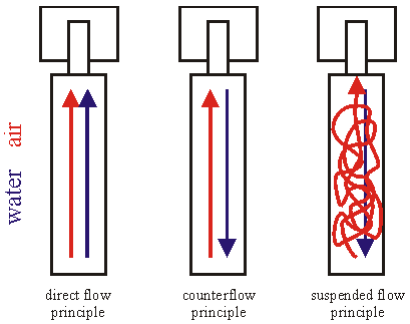
- **Dispergator:**
  The dispergator is a modified pump impeller (e.g. needle wheel). With a small injector at the inlet of the pump air is sucked into the inlet water flow of a pump.

The dispergator is chopping up the big air bubbles into small bubbles. The size of the bubbles is not so small than bubbles produced by an good air stone or venturi. The big advantage of an dispergator is the small energy demand and you do not use an additional air pump. The big disadvantage are the high forces that are created by the dispergator. These forces (cavitation) are destroying very fast simply build

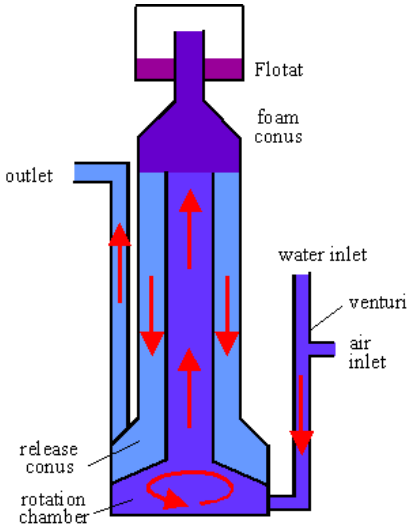
pumps and you need very fast new impellers – normally these spare impellers are very expensive. If a dispergator has some damages the pump gets very loud. - Only if the pumps has extremely good bearings the dispergator principle is serviceable.

- **Downdraft skimmer:**
  another variation to produce air bubbles is realized with the downdraft skimmer. A hard jet of water is flowing into a special construction (e.g. a tube with bio balls). The barriers are creating the bubbles. The height of the tube and the pressure of the water affects the size of the bubbles. If the system is build well it is an alternative for creating bubbles for a skimmer.

Different ways for air and water realizes some variants of skimmers:



- **Same way principle:**
  Inside the reaction chamber water and air are moving from the bottom up to the top – both elements have the same direction. The contact time of the gas bubbles is very low.
- **Counter-flow principle:**
  Inside of the reaction chamber the water is flowing downwards and the air is upwards. The contact time of the bubbles is longer – the skimming effect is better.
- **Suspended flow principle (Juelich principle):**
  The water that is mixed with air bubbles flows into the lowest point of the unit. At this point the pressure of the system is maximal: the gas interchange is consequently at this point the best. The water-air mixture is ascending in the centre tube. At the top the protein containing foam is creating. A part of the gas bubbles are flowing downwards inside the main tube. At the release cone the water flow declines because of the larger diameter of the tube - the water is flowing out of the system. The gas bubbles are kept in the main tube and they are not able to flow deeper. They will adsorb more organic substances because they stay a very long inside of the skimmer. At random the bubbles reaches the top and create the protein foam. The foam ascend the foam cone, will be drained and flows into the foam cup. With this system even very badly adsorbing proteins will get out of the water.



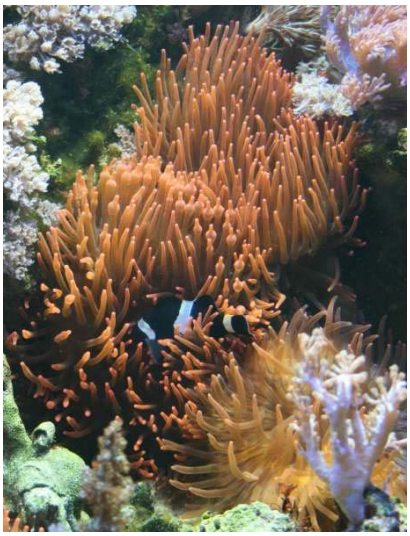
Too much skimming?

The opinion of AquaCare says: it is not possible to skim too much. The bigger the skimmer the cleaner the water. But the only danger is that the concentration of trace elements gets lower. Rule: the better the skimming the higher the trace elements dosing.

If you have an oversized skimmer you can feed much more than with other systems: fishes and invertebrates will thank from the bottom of their heart. Animals that are fed better are stable against diseases, are living more natural and show a natural behaviour. Basically the size of a skimmer – or if a skimmer is needed anymore – depends on the organic input (food, plankton, organic supplements) and not on the size of the tank.

Rule of the thumb: if neither phosphate nor nitrate occurs in too much concentrations the skimmer has the right size. If these substances are too low you must feed more or you have to take a smaller skimmer.

But feeding more is the best way: unfortunately there are still too much fishes in the aquaria that starve.



For a harmonic together the water quality plays a rule, too. Photo: AquaCare