

CHIP-tuning in aquaculture (RAS)

CHIP-tuning is known from increasing the efficiency of car engines by means of belated alterations.

In the aquaculture sector, existing recirculating aquaculture systems (RAS) can be optimally tuned with Mutag BioChip™, or plants subject to new construction can be equipped for providing best biodegradation performance. The **CHIP**-tuning with Mutag BioChip™ provides benefits to the operator in the form of larger fish populations, maximum possible fish feed quantities, constant efficiency and process reliability, optimal water quality, closer recirculation flow, design of high-performance systems at very small footprint, etc. These are hence remarkable advantages compared to “conventional” biofilm carriers.

In the following, it is explained in brief why the Mutag BioChip™ carrier media is capable to provide these benefits which have been proven in aquaculture for several years. Complementary to this, further information material can be made available on request.

The main task of RAS plants is the oxydation of ammonium by means of nitrification process, i.e. the bacterial oxydation of ammonium nitrogen (NH₄-N) in two steps via the oxydation of the latter to nitrite (NO₂) and subsequently to nitrate (NO₃). For this purpose, the microorganisms require sufficient amounts of oxygen and other substrates. The maximum possible size of a bacteria population which can attach to the biofilm carrier media is defined by the size of the protected active surface area of the latter. Due to its detailed pore structure and its protected active surface area of >3,000 m²/m³ - comparable to the area of 11.5 tennis courts per m³ of carrier bulk volume - the Mutag BioChip™ provides optimal conditions.



Fig. 1: Mutag BioChip™ biofilm carriers (3,000 m²/m³), made of virgin PE without any plasticizers



Fig 2: Mutag BioChip™ nitrification in the RAS of a sturgeon farm

The Mutag BioChip™ has a diameter of approx. 20 to 22 mm and a material thickness of approx. 1.1 mm. Its surface shows a vast number of closely spaced, open pores. These open pores and channels provide to the bacteria an optimal habitat at the surface area size mentioned above which accounts for a manyfold of the surface area size provided by “conventional” biofilm carriers. On the entire surface area, i.e. not only inside the pore system but also on the spaces between the pores, the bacteria can establish in the form of thin biofilms.

The Mutag BioChip™ has a very low tare weight related to the surface area provided and can hence optimally be kept in suspension in the MBBR tank by means of low energy. The slightly parabolic shape – comparable to the known potato crisps – promotes the carrier movement caused by process air supplied for oxygenation, and by the water turbulences in the tank. Due to the low tare weight in conjunction with the optimal and easy movement in the water, the kinetic energy occurring on the carrier media elements impacting the tank wall and/or other surfaces is remarkably low (negligible) and allows for an absolutely long lifetime. Larger and heavier carrier media types tend to increased abrasion and wear due to their higher kinetic energy.

Due to the low material thickness of approx. 1.1 mm, the biofilms on the Mutag BioChip™ surface are being optimally supplied from both sides with substrate and oxygen. Here, it has to be taken into account that the diffusion depth of substrate and oxygen is approx. 0.5 mm and both oxygen and substrate can diffuse into all layers of the biofilm from both sides of the chip-shaped carrier media. Compared to this, the optimal supply of oxygen and substrate to biofilms on other carrier types is not granted due to thicker biofilms and/or due to dead biofilms/biomass (clogging/siltation).

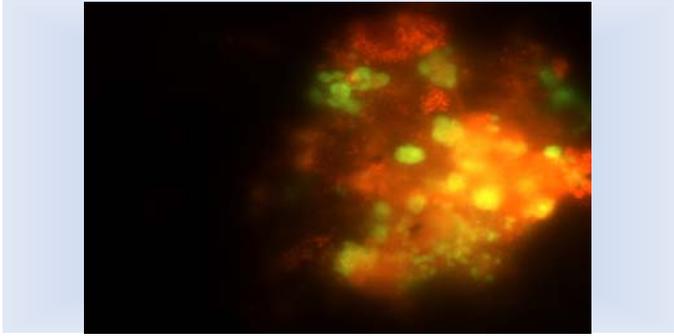


Fig. 3: nitrifying bacteria: ammonium-oxidizers (AOB, in red) and nitrite-oxidizers (NOB in green)

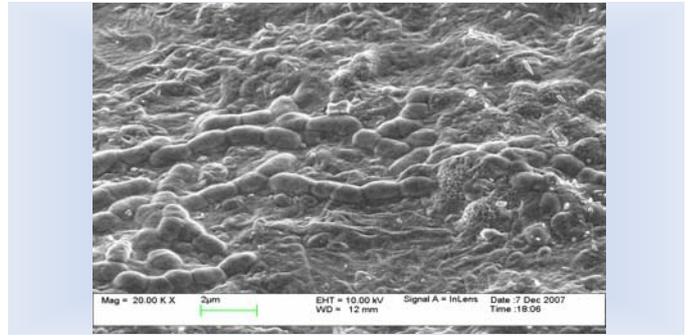


Fig. 4: biofilm in a pore of the Mutag BioChip™

The actual **CHIP**-tuning for optimizing the biodegradation efficiency by a multiple of it is allowed for by the large surface area of $>3,000 \text{ m}^2/\text{m}^3$ which is completely available for the growth of nitrifying bacteria. Moreover, the biodegradation efficiency was observed to be significantly more stable and constant in cases of fluctuations in the process parameters; this effect is to be ascribed to the optimal habitats and also to the large protected active surface area.

Considering the high biodegradation efficiency, the reaction tanks of recirculating aquaculture systems (RAS) which are subject to new construction can be correspondingly reduced in size or reserve capacities can be considered for upgrades in the future.

For a period of approx. 5 years, the Mutag BioChip™ has proven in the breeding of sturgeon, catfish, bass, trout and koi, and it has been used to great success by numerous fish breeders and process suppliers for years. The company Multi Umwelttechnologie AG is developer and producer of the Mutag BioChip™ carrier which is supplied for utilization in biological treatment plants in the field of aquaculture, but also for industrial and municipal wastewater treatment.

It has to be pointed out that the Mutag BioChip™ is exclusively made of virgin PE (no re-granulate made of recycled material) and does not contain any plasticizers which might be ingested by the fish and finally end up on the plate for human consumption via the food chain. The carrier material itself is very flexible, abrasion-resistant and does not break when it is exposed to pressure loads.

Multi Umwelttechnologie AG does not offer the supply of complete RAS plants but is able to provide assistance and constructional support in the design of MBBR tanks as well as of the related aeration and carrier media retention systems based on the decades-long experience gained in the field of MBBR technology. On request, Multi Umwelttechnologie AG can also provide process-related assistance during commissioning and normal operation.

Summary of major benefits

- efficiency upgrade in existing systems
- best water quality
- closer or completely closed recirculation flows due to optimal biodegradation efficiency
- energy savings in the treatment of feed water (tempering)
- higher, constant process stability in case of fluctuations in the process conditions
- smaller new construction plants or larger reserve capacities (reduction of reactor volume)
- less transport volumes in shipment at similarly large surface area
- long lifetime due to flexible, abrasion-resistant material and low mixing energy required in the MBBR tank
- virgin PE (no recycled material) without any carcinogenic plasticizers
- optimal supply of the microorganisms with substrate and oxygen due to thin biofilms
- support in the designing or engineering of the aeration and carrier media retention systems
- economical benefits in the price comparison per m^2 of protected active surface area

For more information, please visit www.mutag-biochip.com or kindly watch our multiple video clips which we uploaded on Youtube (key words: Mutag; Mutag BioChip).