Mutag BioChip 25™
- high-performance biofilm carrier media for MBBR, IFAS and Anammox process -

Major benefits at a glance

First of all, it has to be pointed out that Multi Umwelttechnologie AG’s process-engineering staff possess nearly 20 years of profound experience with nearly each type of MBBR carrier media available on the global market. The different shortcomings of these carriers had been taken into consideration when the Mutag BioChip 25™ and its previous model Mutag BioChip™ (having a protected active surface area of 3,000 m² / m³) were developed by company Multi Umwelttechnologie AG. In the following, the major benefits of the Mutag BioChip 25™ are explained more in detail.

High removal performance due to specific carrier characteristics:

The Mutag BioChip 25™ has a protected active surface area of 4,000 m²/m³, which has been scientifically certified, whereas the most competing products provide only between 500 and 800 m²/m³ as per the statements of the respective suppliers. Taking into consideration only this particular point, the removal performance of the Mutag BioChip 25™ is correspondingly higher per m³ of carrier media. Moreover, the Mutag BioChip 25™ has further specific characteristics which increase the removal performance: the biofilms which establish inside the pores are kept very thin due to self-cleaning by shear forces which work on the outer side of the carrier (resulting from the carrier’s movement in the wastewater) whereas, with regard to the diffusion depth of biofilms, thin biofilms are essential for an optimal substrate and oxygen transfer from the water to the microorganisms. In conjunction with the particular motion characteristics, measured biodegradation rates of the Mutag BioChip 25™ and its previous model in comparative trials with “conventional” media were up to 10 times higher than those of conventional carrier, considering the similar bulk volume of the different carrier types.
No clogging:

The Mutag BioChip 25™ has a very fine and detailed pore system which provides the large surface area of 4,000 m²/m³. In fact, the biofilms on the Mutag BioChip 25™ establish inside the pores. Inside the pore system, the biofilms are protected from any mechanical influence, for example resulting from shear forces. Clogging shall mean the unintended and uncontrolled growth of microorganisms as it can be observed with many conventional tube-shaped carriers, particularly in wastewater with high loads of readily biodegradable COD. The Mutag BioChip 25™ is prevented from clogging due to its specific shape and motion characteristics: The movement of the carrier elements in the wastewater creates shear forces at the outside of the Mutag BioChip 25™ carriers, which permanently abrade the biomass growing out of the pores. Consequently, the biofilms are permanently thin and the optimal transfer of substrate, nutrients and oxygen from the wastewater to all biofilm layers is ensured. Clogged carrier elements (please refer to the picture below) are characterized by thick biofilms which do not allow for the deeper biofilm layers being supplied with substrate, nutrients and oxygen. Consequently, these deeper layers are not at all or only hardly biologically active, whereas the thick biofilms reduce the surface area purposed for the attachment of active microorganisms, resulting in a decrease in biodegradation capacity.

Since 2008 (market launch after several years of R&D), the Mutag BioChip 25™ and its previous model Mutag BioChip™ (3,000 m² / m³), have been successfully operated in a vast number of WWTP's in countries all over the world without any reports related to clogging effects. On request, it is possible to visit large-scale reference WWTP's in operation.
Constant removal rates = high process stability:

Due to the fact that the optimally thin biofilms on the Mutag BioChip 25™ are controlled in their thickness by the aforementioned self-cleaning effect due to shear forces, the removal performance is maintained at a highly constant level (no decrease in performance caused by thick biofilms as with “conventional” tubular carriers). Especially for the end-customer and authorities, the stability of the biological treatment process is a highly important criterion in order to not exceed the required effluent parameters at any time.

Smaller footprint of the reaction tanks = savings in construction expenses:

The high biodegradation performance of the Mutag BioChip 25™ carrier allows for using less carrier volume than with “conventional” carriers since there is less Mutag BioChip 25™ volume required for providing the similar protected active surface area. This fact is highly beneficial to customers as they can save money due to smaller tank volumes, and it is a crucial feature when there is only limited space available when building a new WWTP.
Reserve capacity = easy and quick upgrade at any time:

If similarly large tank volumes are applied as with “conventional” carriers or if conventional carriers are replaced with Mutag BioChip 25™, the media filling degree will be very low (due to the higher surface area per m³ of carriers). The lower media filling with Mutag BioChip 25™ allows for maintaining a media filling degree reserve which can be activated by simply adding more carriers until the same filling ratio is reached as with competing carriers. This fact is interesting in a situation where a WWTP has to deal with higher loads and/or volume flows, for example resulting from a production increase in the connected industrial plant. With conventional carriers (which provide no reserve capacity; 60% media filling is considered to be the maximum), a suchlike simple upgrade of the treatment capacity is not possible and there have to be built additional reaction tanks = very costly for the customer.

Energy savings potential:

The special shape and specific gravity of the colonized Mutag BioChip 25™ provide particular motion characteristics which require less agitation energy in the form of process air supply in order to keep the carrier suspended in the wastewater. By using the Mutag BioChip 25™ WWTP operators have the possibility to benefit from significant savings in OPEX (operational expenditure).

Low transport costs due to less required carrier volume:

As mentioned above, the Mutag BioChip 25™ is exported by Multi Umwelttechnologie AG to countries all over the world. It is obvious that the transport costs are significantly lower than with “conventional” carriers which need to be delivered in higher volumes in order to provide a similarly large surface area.
Favorable price - surface area ratio:

The Mutag BioChip 25™ offers a price-to-surface area ratio which is more favorable than many other carrier types. In order to properly evaluate offers for carrier media, it is required to compare prices of different media not per m³ but per m² provided by any type of carrier media, since each media has a different m²/m³ ratio. For this reason, it needs to be taken into account the protected active surface area (in m²/m³) and not solely the volume (in m³) of carrier media which is crucial for the removal performance.

Comparison of the protected active surface areas of different types of MBBR carrier media

Abrasion and wear:

One single element of the Mutag BioChip 25™ media has a very low mass compared to its size. Consequently, the impulse transferred in the case of contact with another carrier element is that insignificant that each kind of abrasion and wear is maximally reduced. Contrary to that, it is not a rarely occurring phenomenon that several tubular carrier types (often injection-molded and heavy related to their size) break after a certain time in operation and subsequently, the broken carrier parts can be found on the water surface in the clarifiers of the WWTP.
Abrasions of carrier media in operation

No plasticizers = no risks to health and environment:

Among others, biofilm carrier media are used in the aquaculture sector for the oxidation and elimination of nitrogen. However; abraded material pieces (please refer to the pictures above), decomposition products and other substances released by the plastic carrier elements enter into the water cycle; they are directly ingested by fish and enter into rivers, lakes and oceans, and consequently into the human food chain.
Undefined plastics mostly of unknown origin, such as plastic re-granulate (recycled plastic material) for example, can release bisphenol A (BPA) and phthalates, which may cause cancer and have hormonal effects.

Biologists already found these substances in human blood and as deposits in human organs. Low-molecular phthalates (phthalate esters) turned out to be problematic since their toxicity is potentiating in conjunction with other substances, as scientifically proven. Furthermore, phthalates are suspected of causing diabetes.

Without plasticizers, hollow bodies for the water treatment (i.e. biofilm carrier media; small plastic wheels) made of brittle plastics would break due to a lack of elasticity. The plasticizer shifts the thermoplastic range to lower temperatures, resulting in the fact that the plastic material shows the desired “more elastic” characteristics within the range of the operation temperature.

Contrary to that, the Mutag BioChip 25™ is completely free from phthalates or other plasticizers and does not contain Bisphenol A or any other aromatic compounds. It is made of virgin polyethylene (no recycled PE), inorganic fillers, small amounts of monoester of glyceric acid (produced from coconut fat; absolutely harmless), citric acid and soda Na₂CO₃.

No recycled plastics = clearly defined material density:

For reasons related to savings in raw material costs, numerous types of injection-molded “conventional” biofilm carriers are made of recycled plastics (re-granulates). The origin and the composition of such re-granulates are not always possible to be exactly specified and the re-granulates may hence consist at significant percentage of different plastics which may have a negative impact on the material durability (solidity, break resistance). The material density under operating conditions is of major importance. Due to the various types of the recycled plastic materials and their previous applications, re-granulates can show up a significant deviation and fluctuation in the material density. These deviations can only be rarely and consistently adjusted to new density states during the production process. A consequence of this can be a deficiency in the desired carrier movement characteristics.
Due to the fact that the Mutag BioChip 25™ is made of virgin PE (no recycled material), the material density of the high-performance media is fully controllable during the production process, allowing for optimal motion characteristics during the operation.

**Not just plastics, but competent process-technological know-how:**

The Mutag BioChip 25™ and its previous model Mutag BioChip™ was developed based on considerable experience gained in the operation of numerous different types of “conventional” biofilm carrier media. Moreover, the developer and manufacturer of the Mutag BioChip 25™ (Multi Umwelttechnologie AG) possesses a considerable process data pool resulting from a vast number of pilot trials and from the operation of numerous implemented large-scale plants operated with the high-performance carrier. Based on this data, Multi Umwelttechnologie AG is able to provide the purchasers of the carrier media with basic design calculations, information on additionally required equipment (e.g. aeration and carrier media retention system), competent technical support and after-sales service; no matter if it is about MBBR, IFAS or Anammox process. Moreover, Multi Umwelttechnologie AG is specialized in the engineering (basic as well as detail engineering) of complete wastewater treatment plants operated with Mutag BioChip 25™ carriers.

*3D-engineering by Multi Umwelttechnologie AG*