ENHANCING WASTEWATER TREATMENT WITH CHIP-TUNING

Discover how the application of chip-tuning techniques transforms wastewater treatment processes, unlocking new levels of efficiency and effectiveness in managing water quality and process stability.

CHIP-TUNING: ENHANCING EFFICIENCY

Chip-tuning represents the pinnacle of efficiency enhancement. This drive for increased efficiency in both municipal and industrial wastewater treatment plants (WWTPs) arises from challenges related to water quality, process stability, and insufficient performance in COD removal and nitrification processes. The introduction of stricter regulations and the need for higher removal efficiency further emphasize the importance of optimizing existing technologies through "tuning".

ADDRESSING CHALLENGES IN WASTEWATER TREATMENT

In many cases, improving existing WWTPs and processes is challenging because achieving the required increase in removal efficiency is hindered by limited on-site reaction tank capacities. Consequently, expanding the WWTP becomes a necessity, which may not always be straightforward due to site-specific construction challenges. This situation is analogous to car-tuning: enhancing an engine's performance by increasing its cubic capacity is often impractical, making chip-tuning a more viable alternative.

INCREASE WWTP EFFICIENCY WITH MUTAG BIOCHIP™

Existing WWTPs often experience shortcomings in their biological stages, which can be effectively addressed through tuning with Mutag BioChip™ high-performance biofilm carriers. This tuning process can also elevate WWTPs to achieve the highest possible treatment performance. By using chip-tuning with Mutag BioChip™ biofilm carriers, WWTP operators gain substantial benefits, including enhanced treatment efficiency, consistent process reliability, and optimal discharge quality.

For new WWTP construction projects, the Mutag BioChip™ enables implementation on a compact footprint. Consequently, it offers significant advantages that surpass those of conventional biofilm carriers.

In the following sections, we will explore how the Mutag BioChip™ carriers have consistently delivered these advantages in both municipal and industrial large-scale applications over the years.

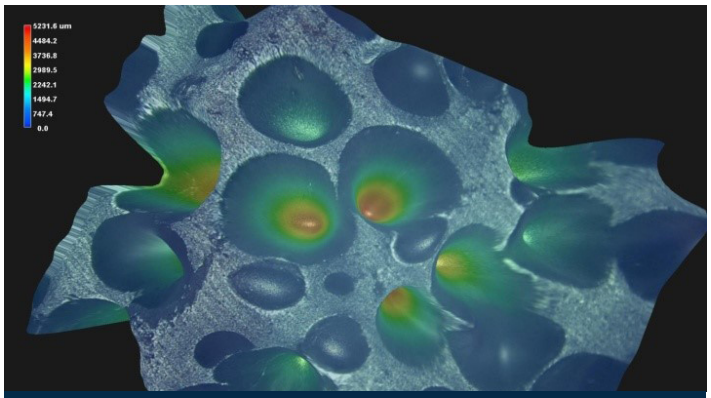
ENHANCING BOD/COD REMOVAL AND NITRIFICATION

Biological wastewater treatment plants play a crucial role in removing BOD/COD and, depending on discharge requirements, oxidizing ammonium through the nitrification process. This process involves the bacterial conversion of ammonium nitrogen (NH4-N) into nitrite (NO2) and subsequently nitrate (NO3) in two steps.

To create the ideal habitat for nitrifying microorganisms, the Mutag BioChip™ ensures that they have access to oxygen and essential substrates. This is vital because the size of the bacterial population largely depends on the available surface area for microorganism growth.

With its fine pore structure and protected active surface area, reaching up to 5500 m^2/m^3 which is roughly equivalent to an area the size of 21.1 tennis courts per m^3, it creates highly favorable conditions for bacterial growth.

Mutag BioChip™.



Scanning electron microscopic picture of the porous carrier surface, zoom factor 100.

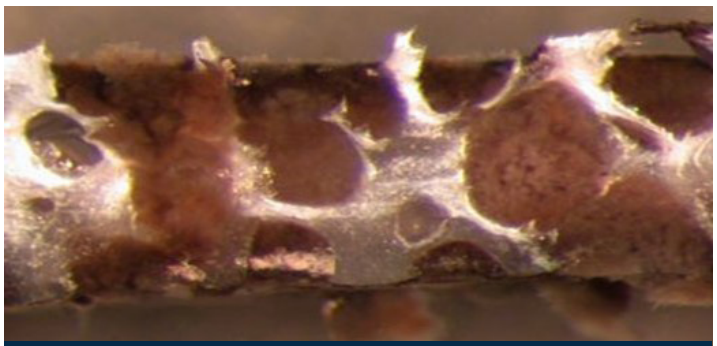
Pore system at magnification.

THE MUTAG BIOCHIP™: A BACTERIAL HAVEN

The carrier showcases a diameter of up to 30mm and a thickness of approximately 1.1 mm. Its surface features numerous closely spaced, open pores and channels, offering bacteria an ideal habitat. This habitat provides a significantly larger surface area compared to conventional biofilm carriers. Bacteria can flourish in exceptionally thin biofilms, not just within the pore system but also on the gaps between the pores, effectively covering the entire surface area.

BIOFILM FORMATION IN MBBR SYSTEMS

In a moving bed bioreactor (MBBR), shear forces between chip-shaped carrier media clean their surfaces during contact. Fostering the growth of thin biologically active biofilms. These biofilms remain accessible to oxygen and substrates across all layers.



Cross section through the pore system colonized by biologically active biomass, material thickness approx. 1.1 mm.

LOW TARE WEIGHT AND OPTIMAL SUSPENSION

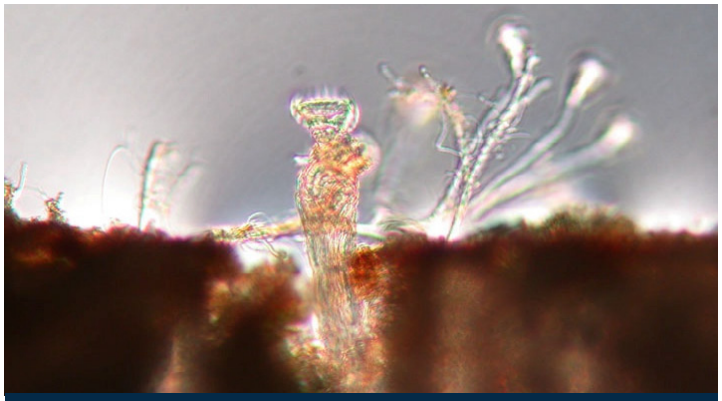
The Mutag BioChip™ boasts low tare weight relative to its surface area and require minimal energy for suspension in the MBBR tank. Its paraboloid shape like potato crips, encourages movement driven by process air and tank water turbulence. This low weight, combined with smooth movement and flexibility, minimizes kinetic energy upon impact, ensuring an extended lifetime. In contrast, larger, heavier carrier media experience increased abrasion and wear due to their higher kinetic energy.

OPTIMAL BIOFILM GROWTH AND ENHANCED BIODEGRADATION

The Mutag BioChip™ is ultra-thin. This feature ensures efficient oxygen and substrate diffusion to biofilm layers from both sides, with a shallow diffusion depth of around 0.5 mm. In contrast, carriers with thicker biofilms or dead biomass face challenges in achieving such efficient supply.
Additionally, the substantial surface area fosters the growth of pollutant-removing microorganisms, allowing for significant chip-tuning and remarkable enhancements in biodegradation efficiency. In retrofitted WWTPs, these advantages contribute to stable and consistent removal rates, thanks to the optimal habitats and generous surface area.

Our aim is to maximize the presence of active bacteria within small reactors. To achieve this, we analyzed the Mutag BioChip™ carriers previously used in a high loaded nitrification stage. We assessed their aerobic ammonium-oxidizing bacteria (AOB) and nitrite-oxidizing bacteria (NOB) content using advanced VIT ® gene probe technology.

Mutag BioChip™ nitrification stage in the RAS of a sturgeon farm.

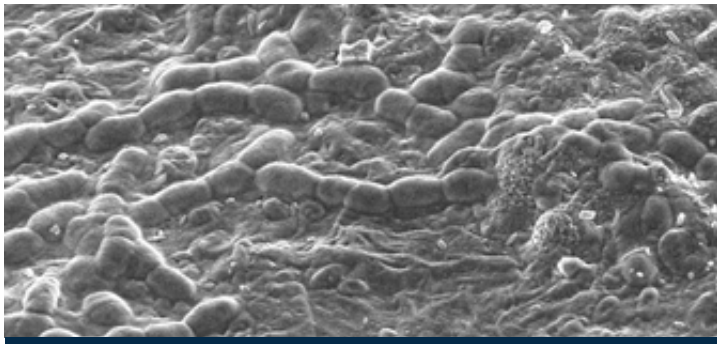


Habitat "pore" of the Mutag BioChip™.

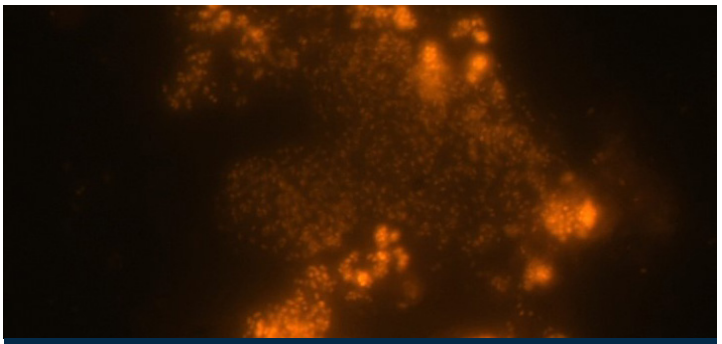
RESULTS

Results showed a stable population of both AOB and NOB on the Mutag BioChip™ carriers, highlighting their effectiveness in supporting these crucial microorganisms.

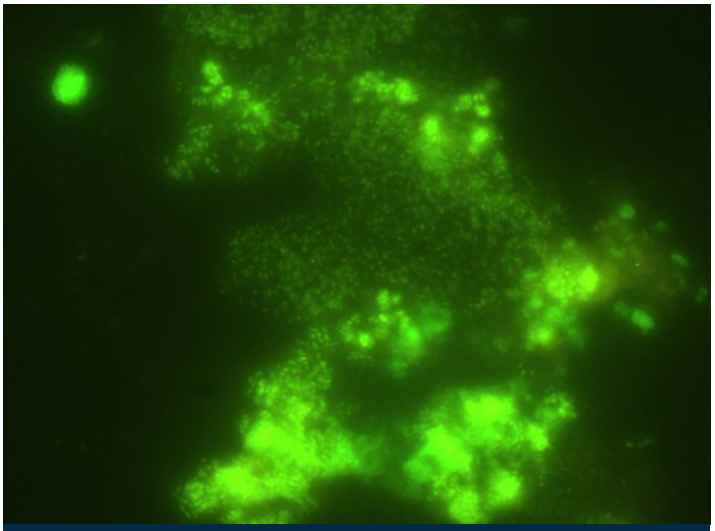
This demonstrates the success of Mutag BioChip™ carriers in providing an ideal environment for the proliferation of these crucial bacteria, all within a compact reactor space. We can efficiently reduce reactor volumes in the construction of new wastewater treatment plants. Additionally, we have the flexibility to allocate reserve capacities for potential future upgrades.



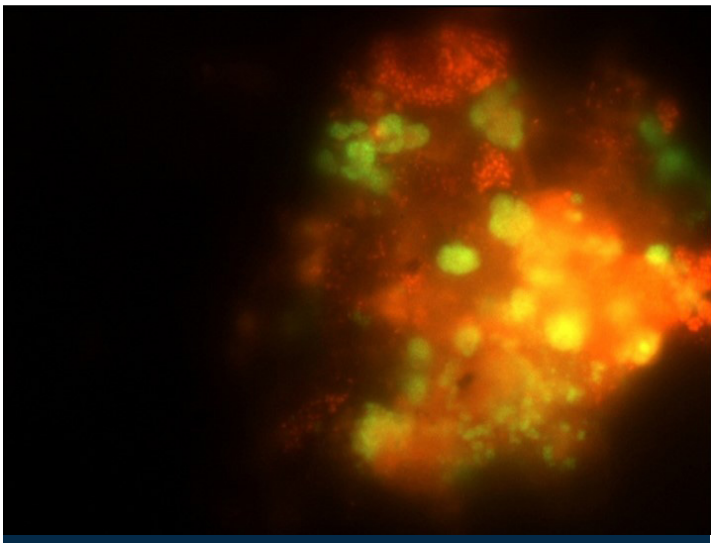
Biofilm in a pore of the Mutag BioChip™.



Ammonium-oxidizing bacteria (AOB) in a pore.



Nitrite-oxidizing bacteria (NOB) inside of a pore.



Both populations in one photo (AOB: red and NOB: Green).

OPTIMIZING WASTEWATER TREATMENT EFFICIENCY

Mutag BioChip™ has a proven track record of successful operation in various applications, including municipal WWTPs, coke oven plants for treating high-loaded and toxic effluents from gas cleaning processes, and numerous industrial WWTPs spanning industries such as pulp & paper, food & beverage, and chemicals.

Our products draw from decades of experience in applying conventional biofilm carriers in the MBBR. MUTAG serves as both the developer and producer of this exceptional high-performance biofilm carrier, ensuring reliable and efficient wastewater treatment solutions.

MUTAG

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