Stable and reliable ANAMMOX process provided by Mutag BioChip 25™ biofilm technology

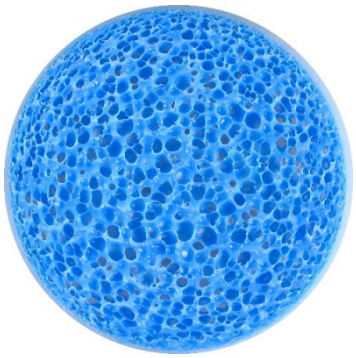
The abbreviation ANAMMOX stands for **AN**aerobic **AMM**onium **OX**idation. Within the scope of this process which takes place during the biological treatment of wastewater and sewage, ammonium nitrogen (NH_4^+) and nitrite (NO_2^-) are being symproportioned to molecular nitrogen under anoxic conditions.

The bacteria used for this purpose, the so-called planctomycetes, are characterized by a very slow growth (reduplication period: approx. 28 days at 30°C) and during the ANAMMOX process they consume the greenhouse gas carbon dioxide (CO_2). Moreover, they do not require any dissolved oxygen in the wastewater; hence the supply of process air does not need to be taken into consideration. Since the related energy consumption is hence obsolete, no greenhouse gas is being produced but it is even being used up within the scope of the reaction. As a result, the ANAMMOX process is effectively contributing to the protection of the climate and the environment.

Brilliant, as one might expect. However, there are a lot of existing ANAMMOX plants which are permanently or recurrently facing the problem of keeping the process on a stable level. The procedural regulating processes required for the stabilization are however technically optimized; nevertheless the plant operators are regularly facing the problem of the extremely slowly growing planctomycetes being flushed out of the reaction tank and/or of preventing the decay of generated pellets.

In order to counter this problem, the bacteria sludge has to be exchanged between the existing plants whereas this measure must be taken very frequently and is very costly. Additionally, a negative side-effect of this measure is that it favors the spreading of certain fungi, diseases and pathogens among the existing plants, which in turn leads to further negative impacts on the slowly growing and correspondingly sensitive biocoenosis and hence to a further instability of the ANAMMOX process.

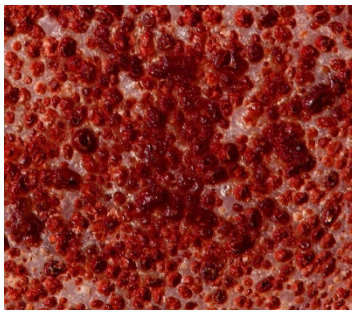
Consequently, a new and effective solution for maintaining the process stability is urgently required in order to avoid the negative and expensive consequences of the bacteria sludge exchange. A suchlike solution can be realized by means of a special biofilm carrier-based technology. In this context, it has to be taken into account in the first instance that planctomycetes are hardly able to grow on smooth surfaces and are hence being washed down by water turbulences from biofilm carriers possessing a smooth surface. Subsequently, the precious biomass is leaving the reaction tank along with the wastewater flow via the tank outlet and must be replaced – it would hence be required to bring in new biomass into the system from another ANAMMOX plant, causing all the negative effects of the sludge exchange mentioned further above.



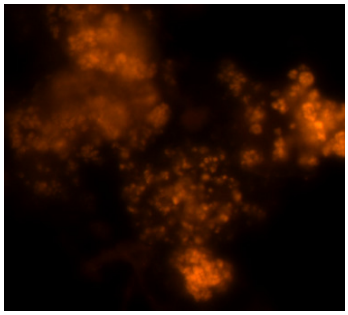
Mutag BioChip 25™ without biofilm, possessing optimal pore structure

For that reason, the surface characteristics of the biofilm carrier must ensure the permanent attached growth of the bacteria. In other words, the biofilm carrier has to provide a porous and micro-rough surface structure which enables the planctomycetes to permanently attach to the carrier surface. Long-term studies with the Mutag BioChip 25™ carrier media have reliably shown that planctomycetes can permanently settle in the protected pore structure of this carrier and are hence prevented from being flushed out of the reaction system.

Mutag BioChip 25™, colonized with ANAMMOX bacteria



Active biomass growing in the pore system

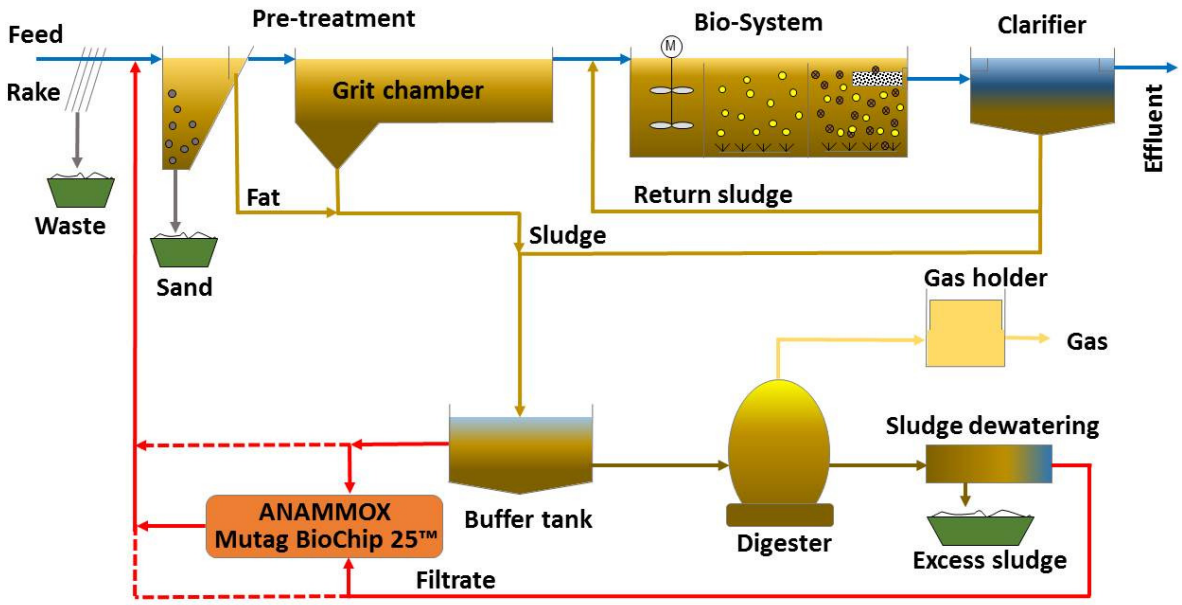


ANAMMOX bacteria, detected on the Mutag BioChip 25™ by microscope (magnification factor 1,000)

One of the pre-requisites for a high space-time-yield is that the bacteria can settle in protected areas where they can reproduce while the substrate transfer through diffusion into deeper biofilm layers is ensured. Due to the material thickness of approx. 1.1 mm of the carrier media, the diffusion depth of approx. 0.5 mm on both sides of the carrier is not being exceeded. This fully meets the requirements of an optimal habitat in the form of a special pore system having a depth of approx. 0.5 mm on or in the Mutag BioChip 25™, respectively.

ANAMMOX: example of application

Municipal/domestic sewage treatment plants are being loaded with a high ammonium nitrogen load (NH_4-N) coming from their sludge treatment process. This partial flow is usually re-supplied to the biological main flow process where it is causing energy consumption due to the process air flow on the one hand and BOD consumption on the other hand (carbon source required for the de-nitrification process). Under optimal conditions, it is however possible to treat this filtrate flow by means of ANAMMOX process and hence to relieve the treatment plant energetically and hydraulically.



ANAMMOX with Mutag BioChip 25™ in sewage treatment plants

Dr.-Ing. Markus Geiger
René Trübenbach

info@mutag.de | www.mutag.de |