



**KRÜGER**



**ANITA™ Mox**  
**AnoxKaldnes™ MBBR**  
**Solution for High Strength Ammonia Streams**  
**Anammox Process**

## The Principle of the ANITA™ Mox Process

ANITA™ Mox is a single-stage nitrogen removal process based on the MBBR (Moving Bed Biofilm Reactor) technology. The ANITA Mox process is used for treatment of streams highly loaded in ammonia, such as effluents from anaerobic sludge digestion, drying condensates, industrial wastewaters, and landfill leachates.

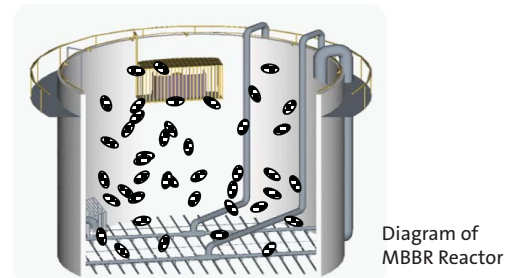
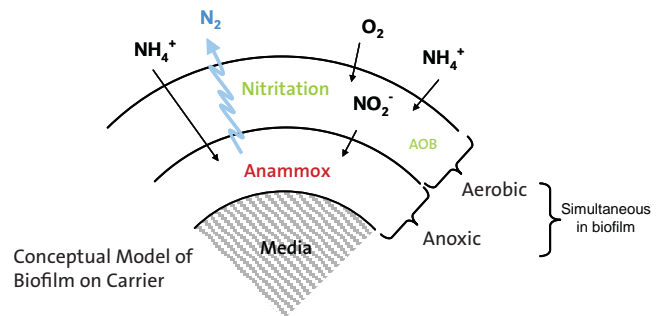
The ANITA Mox process combines aerobic nitrification and anoxic ammonia oxidation (anammox).

The two steps take place simultaneously in different layers of a biofilm. Nitrification (aerobic) occurs in the outer layer of the biofilm. A portion (55%) of the influent ammonia is oxidized to Nitrite ( $\text{NO}_2^-$ ). Anammox (anoxic) activity occurs in the inner layer. In this step, the nitrite produced and the remaining ammonia are utilized by the anammox bacteria and converted to nitrogen gas ( $\text{N}_2$ ) and a small amount of Nitrate ( $\text{NO}_3^-$ ).

The aerobic and anoxic reactions occur in a single MBBR reactor equipped with specially designed plastic carriers that support the biofilm, thereby preventing washout of the bacteria from the reactor.

The ANITA Mox process, using a single-stage MBBR with a proven aeration control strategy, achieves ammonia removal up to 90% and total nitrogen removal in the range of 75 to 85% without external carbon addition and with lower energy cost compared to conventional nitrification-denitrification.

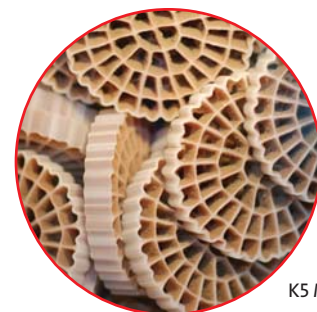
Process conditions in the reactor are monitored and maintained to provide the optimal environment for the combination of bacteria.



*The MBBR reactor's effluent screens provide a positive barrier to loss of anammox bacteria, since they keep the media and biofilm in the reactor.*

### Operating Parameters, Ammonia Removal in Digester Dewatering Stream

Parameter	Conventional Nitrogen Removal	ANITA™ Mox
Oxygen Requirement (lb O <sub>2</sub> /lb N)	4.6	1.9
Methanol Consumption (lb / lb N)	3.0	0
Sludge Production (lb VSS / lb N)	0.5-1.0	0.1



K5 Media

## A Key Element of the ANITA™ Mox Process: The Carriers

A key element of the MBBR technology is the AnoxKaldnes™ carriers, also called media. The very slow growth rate of the anammox bacteria makes their retention a critical objective of the process. The MBBR reactor's effluent screens provide a positive barrier to loss of anammox bacteria, since they keep the media and biofilm in the reactor. The media is also designed to provide a large protected surface area for the biofilm and optimal conditions for biological activity.

A variety of AnoxKaldnes carrier types provide flexibility in adapting the system to specific water characteristics and available volumes.

## The BioFarm in Malmö, Sweden Sjölunda WWTP

The ANITA Mox BioFarm, at the 50 MGD Sjölunda WWTP, began operation in 2010 and treats centrate from anaerobic digesters.

The BioFarm's 4 reactors are equipped with:

- Air diffusers and continuous aeration control
- Three different mixer technologies
- Three different media types

This ANITA Mox plant was designed to treat up to 440 lb NH<sub>4</sub>-N/d with up to 85% total nitrogen removal. Seeded carriers from the BioFarm are available for start up of new plants. Seeding new plants significantly accelerates their biological startup.

Chart 1 depicts volumetric nitrogen removal rates at the BioFarm, from startup to full load.

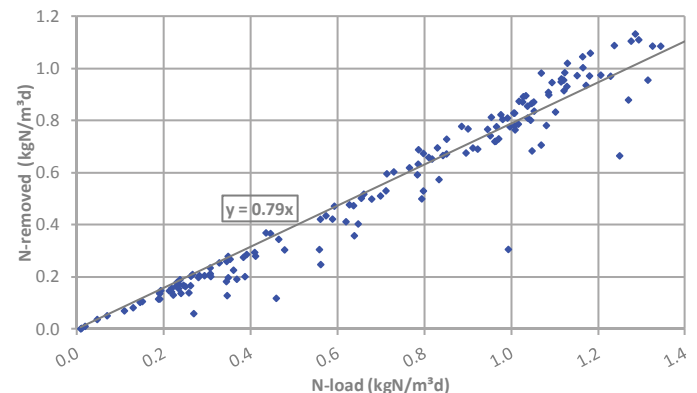
Chart 2 depicts the accelerated startup of one of the Biofarm reactors using a small portion (10%) of media containing the deammonification biofilm.

### Benefits relative to conventional ammonia removal

- ▶ Robust
- ▶ Compact
- ▶ 60% less oxygen requirement
- ▶ No external carbon needed
- ▶ Reduced sludge production

Chart 1

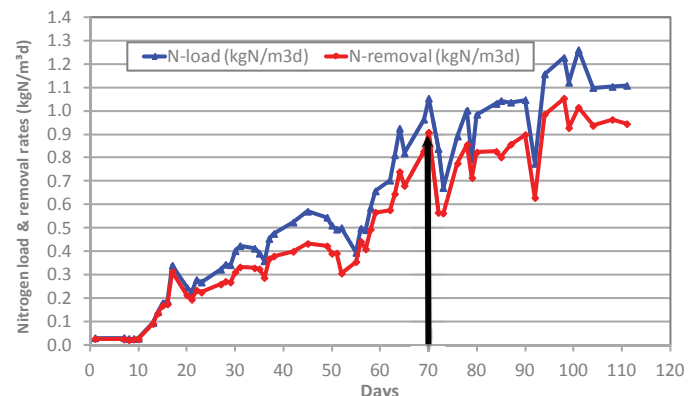
Full-scale Nitrogen Removal (Including Startup)



79% Nitrogen removal, Up to 1.1 kg/m<sup>3</sup>/d based on Reactor Volume

Chart 2

Full-scale Start-up with 10% of Media Seeded



Nitrogen removal = 0.9 kgN/m<sup>3</sup>/d after 70 days, based on reactor volume

Energy consumption = 1.4 – 1.7 kWh/kg N-NH<sub>4</sub> removed

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