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Rethink Tomorrow

Wastewater Solutions

# Novozymes BioRemove™ 5825

## Application Sheet

**BioRemove 5825 is a blend of nitrifying bacteria that removes ammonia from wastewater. It is used in a variety of industries that use aerobic treatment to establish, maintain, or restore nitrification.**

### Benefits

BioRemove 5825 is the quickest and most reliable solution for nitrification. It helps prevent ammonia-related permit violations and simplifies wastewater operations.

Bioaugmentation with BioRemove 5825 makes the nitrification process more robust, enabling industrial wastewater plants to withstand higher loading of toxic waste streams and waste streams containing high concentrations of ammonia or other nitrogenous compounds. BioRemove 5825 helps ensure compliance by shortening the recovery time after process upsets and reducing the impact of shock loads on effluent quality.

BioRemove 5825 promotes consistent and reliable treatment and reduces the need for nitrification-related operational changes. It has a wide range of activity and helps ease operations in cold temperatures.

### Performance

Nitrification is a two-step aerobic process. In the first step, beneficial microorganisms oxidize ammonium ($NH_4^+$) to nitrite ($NO_2^-$) and nitrite is oxidized to nitrate ($N0_3^-$) in the second reaction. Nitrification is a sensitive process and is more easily interrupted than other biological wastewater treatment processes. The most frequent sources of nitrification problems include environmental factors, toxicity, solids washout, and loading variation. In some cases, environmental factors must be corrected prior to using BioRemove 5825.

After BioRemove 5825 is added to a wastewater system, nitrifying bacteria colonize on floc particles and become part of the biomass (Fig. 1). Having a healthy floc-forming microbial community helps maintain nitrifiers in the system and is important for the success of any nitrification program.

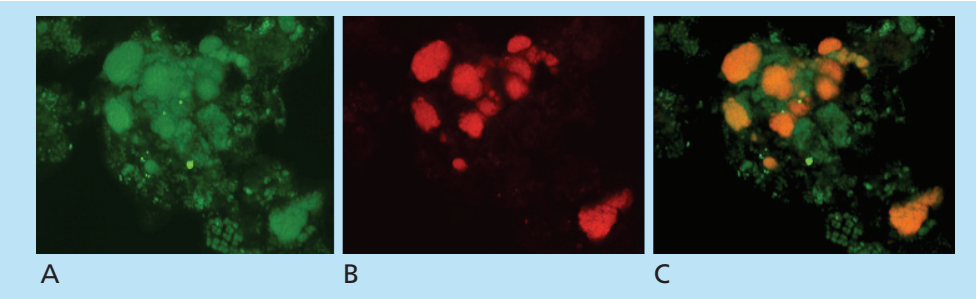


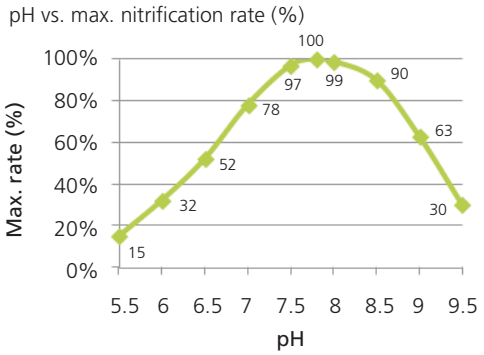

**Fig. 1.** This series of pictures of the same floc particle was taken using molecular probes and various microscopy techniques. A shows a floc particle from a nitrifying biomass stained green for all bacterial types. B shows the same floc particle stained red only for ammonia-oxidizing bacteria. C is an overlay of the two pictures showing the spatial distribution of nitrifiers within a well-formed floc particle.

## Application guidelines

Key environmental factors include pH, dissolved oxygen, alkalinity, and temperature. Toxicity and solids loss can also cause nitrification inhibition. To get the optimal performance from BioRemove 5825, the following guidelines should be observed:

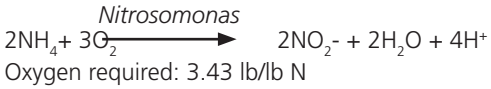
### pH

The optimal pH for nitrification is 7.0–8.5. Nitrification can occur outside this range, but plants should adjust the pH to the optimal range for recovery and start-ups until nitrification is well established.

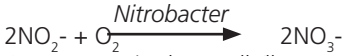



### Dissolved oxygen

The theoretical oxygen demand for complete nitrification is 4.57 lb per lb of nitrogen. Typically, nitrifying plants will have a dissolved oxygen concentration above 2.0 mg/L but may fully nitrify with less than that. For a recovery or start-ups, a DO > 2.0 mg/L is recommended until nitrification is well established.




Oxygen required: 3.43 lb/lb N




Oxygen required: 1.14 lb/lb N

**Total oxygen required: 4.57 lb/lb N**

## Alkalinity

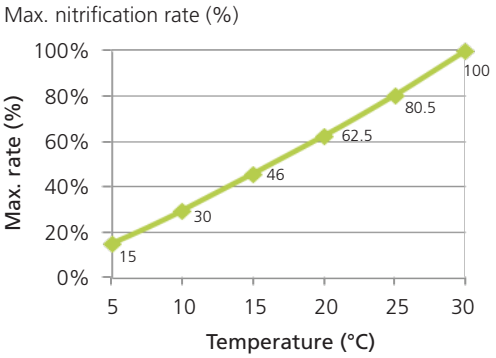
The reaction that converts nitrate to nitrite creates nitrous acid ($NHO_2$), which consumes alkalinity and can lower pH. Sufficient alkalinity must be present to avoid a pH crash.

The theoretical demand is 7.14 lb as $CaCO_3$ per lb of N.

## Temperature

Nitrification readily occurs at 15–30 °C. As temperatures decrease below 15 °C, nitrification becomes inhibited and often fails.

BioRemove 5825 is active at temperatures below 4.0 °C and can protect systems from losing nitrification.




## Toxicity

Rapid inhibition can be caused by exposure to certain organic and inorganic compounds. Even intermittent exposure can cause nitrification disruptions.

BioRemove 5825 can increase a plant's tolerance to toxic compounds and actually allow it to accept higher loadings. This provides potential cost savings by minimizing off-site disposal costs for toxic waste streams.

Sometimes inhibition is caused by the accumulation of compounds on floc particles where nitrifiers are colonized. The long-term exposure to these compounds can cause a steady decline in nitrification performance.

To regain nitrification, the toxic sludge often needs to be wasted from the system before using BioRemove 5825. Simple benchtop testing can be performed with BioRemove 5825 to determine whether a sludge or waste stream is too toxic to support nitrification.

### Compounds which cause acute toxicity include:

- Cyanide
- Phenol
- Chlorinated hydrocarbons
- Metals
- Amines
- Spent caustic waste

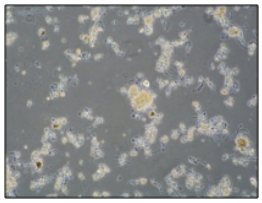
### Compounds which cause chronic toxicity include:

- Fluorides
- Surfactants
- Metals
- Oils
- Long-chain fatty acids

## Solids loss

Nitrification can be impacted when a large amount of solids is lost from the system. This can result from a hydraulic surge or from settling problems due to poor floc structure.

Heavy dosing of BioRemove 5825 can bridge the gap during the recovery period. This gap can be further shortened by using Novozymes' biomass reinforcement products for improving settling and building solids.



Pin floc (left) can lead to excess solids loss from the clarifier and contribute to nitrification problems.

Healthy floc (right) is important for consistent and reliable nitrification.

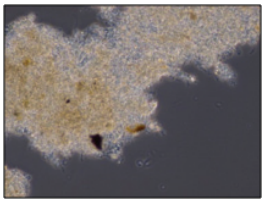


Figure 2 shows the recovery of nitrification at a chemical plant. BioRemove 5825 was added directly to the aeration basin in decreasing quantities over 10 days to ensure a complete start-up of the nitrification process. Nitrification was achieved after just 5 days.

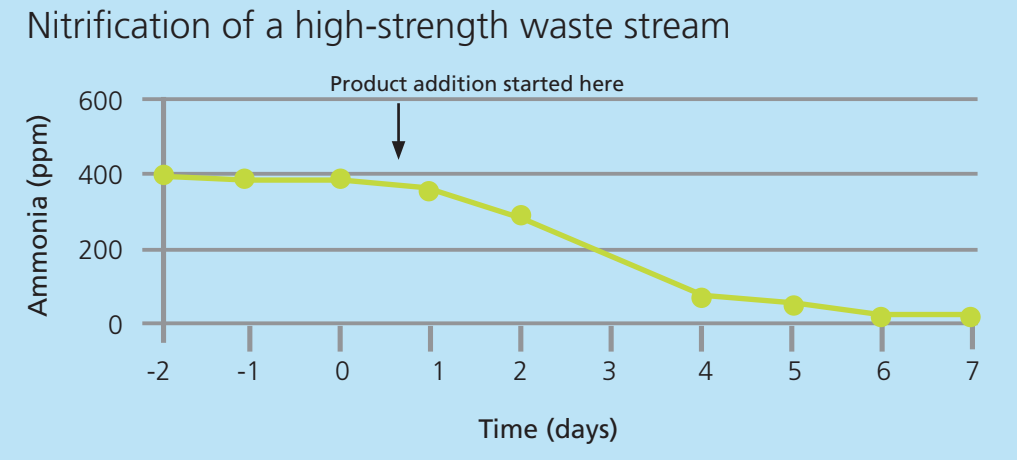



**Fig. 2.** Recovery of nitrification at a chemical plant.

BioRemove 5825 is the fastest and most reliable biological nitrification product on the market. Figure 3 shows BioRemove 5825 compared to a leading competitor nitrifying product. After a 24-hour bench test, BioRemove 5825 removed 136% more ammonia than the competitor product.

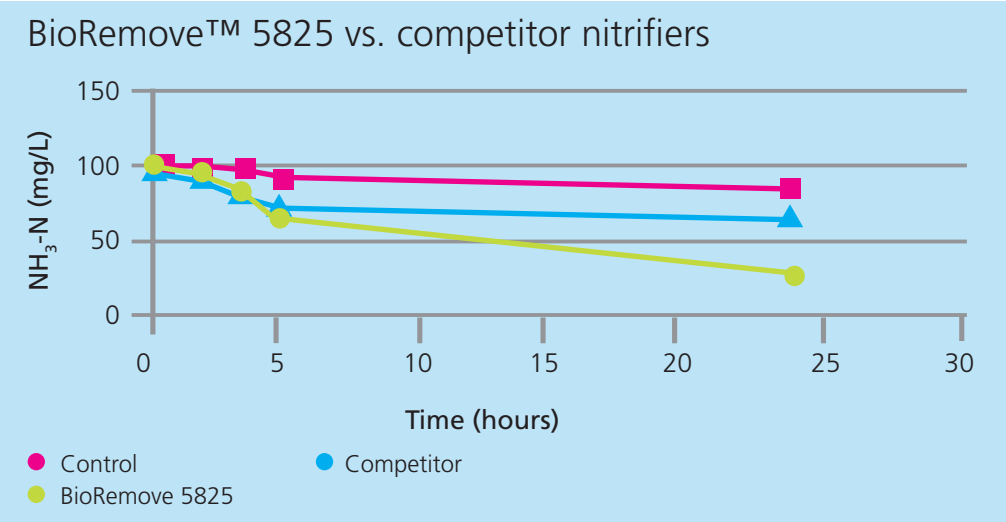



**Fig. 3.** Novozymes BioRemove™ 5825 removed 136% more ammonia compared to the competitive product.

## Recommended use

BioRemove 5825 is added directly to the influent of the aeration basin in active sludge systems or lagoons. This product has been successfully used in activated sludge plants and lagoons in refineries, food processors, renderers, municipalities, paper mills, landfills, steel plants, and chemical plants.

The dosage rate is dependent on the influent flow rate, hydraulic retention time, sludge age, and influent ammonia concentration. During an initial seeding period, an increased amount is used to quickly establish the microorganisms in the system, with lower daily dosages continuing for a week or more. The effluent should be monitored for ammonia, nitrate, nitrite, dissolved oxygen, and pH as a minimum. Additional recommended monitoring includes TKN, alkalinity, and effluent BOD.

## Product characteristics

BioRemove 5825 contains *Nitrosomonas* and *Nitrobacter* species in a highly concentrated liquid. It has an ammonia removal rate specification of > 500 mg $NH_4^+$/kg/hr and is the industry standard for nitrifiers.

## Safety, handling and storage

Refrigerate BioRemove 5825 upon receipt and throughout the period of use. Do not allow the product to freeze. Avoid excessive skin contact with liquids. Wash hands thoroughly with warm, soapy water after contact. Avoid contact with eyes.

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