

# NitriFire™ Nitrifying Bacteria

## Ignite your nitrification!

### Product Evolution

Environmental Business Specialists, LLC (EBS) has supplied private labeled nitrifiers to industrial and municipal clients for almost 25 years. We sourced these microorganisms from several suppliers with good results for our clients. In early 2019, EBS began exploring the option of producing nitrifiers in-house to ensure a more reliable product supply and direct control over product quality.

EBS founder Mike Foster has almost three decades of experience identifying and solving nitrification issues in refineries, poultry and meat processing facilities, municipal plants, and petrochemical facilities, as well as extensive applications expertise with commercial nitrifiers to address system deficiencies. This knowledge, combined with technical support from Dr. Andrew Englande, served as the foundation for our intensive process to produce commercial quantities of differentiated nitrifier formulations, not just me-too products.

The EBS NitriFire™ Series of nitrifying bacterial formulations represent a year of product and process development. Our applied R&D team consists of professionals with microbiology and environmental engineering backgrounds and almost forty years of combined wastewater or industrial microbiology related experience.

The EBS NitriFire Series replaces our existing NitriStar™ product line. Rather than drop ship product from a third-party supplier, every shipment will be checked for activity and packaged by experienced EBS personnel.

### Key Product Features

- Balanced ratio of Ammonia Oxidizing Bacteria (AOBs) and Nitrite Oxidizing Bacteria (NOBs).
- Multiple package sizes for cost effective application in systems of all sizes.
- State-of-the-art QA/QC using the dual techniques of both respirometric ammonia and nitrite oxidation measurement as well as chemical conversion measurement.
- Regular DNA sequencing to ensure the presence of desired microorganisms and identification of any undesirable ones.
- High purity products with less heterotrophic contamination to improve stability and shelf life even once the package is opened.

### Product Details

NitriFire 5X is a blend of *Nitrosomonas* and *Nitrobacter* spp. bacteria designed to supplement nitrification in municipal and industrial wastewater treatment systems. It can be applied to activated sludge systems, aerated lagoons, fixed film bioreactors, and sequencing batch reactors. NitriFire 5X can be used to supplement nitrifying systems not meeting their desired level of nitrification, or as an aid to establish nitrification during system startups or re-establish nitrification following system upsets or shutdowns.

Many commercial nitrifier formulations only contain *Nitrosomonas* strains and only impact the first step (ammonia oxidation) of the process. By including a significant level of *Nitrobacter*, EBS NitriFire also is effective at addressing the situation of elevated nitrite (aka nitrite block) and facilitate completing the reaction to nitrate.

Nitrifiers are slow growing organisms, challenging and costly to manufacture, and cannot be stabilized in spores or a dry form. Stability testing shows that the EBS NitriFire 5X formulation offers improved product shelf life and better stability if accidentally left unrefrigerated for up to 48 hours. EBS will continue to ship product on icepacks via overnight courier to ensure prompt delivery of the highest quality product. While the shelf life for NitriFire 5X is six months when refrigerated, it is generally recommended to add the entire container to one's system in three days or less. Extensive shelf life testing showed that NitriFire 5X maintains its activity for three months after the container is opened and refrigerated.



## Product Details continued

**Ammonia Conversion Rate:** Equal to or greater than 500 mg  $\text{NH}_3\text{-N}$  per hour per kg of product.

**Nitrite Conversion Rate:** Equal to or greater than 250 mg  $\text{NO}_2\text{-N}$  per hour per kg of product.

**Genus/Species:** *Nitrosomonas/Nitrobacter* spp. – Class One Organisms

**Product Form:** Liquid Slurry

**Appearance:** Rose to Brownish Red in color

**Odor:** Musty

**Product Density:** 8.41 lbs./gallon

**pH:** 6.7 – 7.4

**Boiling Point:** 212°F (100°C)

**Freezing Point:** 32°F (0°C) - Do not allow product to freeze

**Shelf Life:** Six months if kept unopened and refrigerated at 40-45°F (4.4-7.2°C). Do not freeze. Once opened, shelf life is approximately 3 months.

**Packaging Specifications:** Standard packaging for NitriFire products is 1.25-gallon jugs containing 10 pounds of product. For smaller systems, NitriFire is offered in cases of four one-quart bottles (2 pounds each). For larger orders, five-gallon containers (40 pounds) are available.

## Application Rate and Feeding

The NitriFire 5X application rate is directly based on the amount of nitrification improvement needed in pounds per day nitrogen (ammonia + nitrite). The unique balance of AOBs and NOBs in NitriFire 5X allows you to address limitations in both ammonia oxidation and nitrite oxidation with a single product. The recommended application rate is one pound of product per 5-10 pounds of desired improvement in nitrogen conversion. Typically, EBS recommends a three-day application based on the initial amount of ammonia and/or nitrite needing to be converted. To determine the required amount to order and apply, follow these steps:

1. Determine the pounds of ammonia/nitrite to be treated:  
 $(\text{Effluent Flow in MGD}) \times (\text{mg } \text{NH}_3\text{-N} + \text{NO}_2\text{-N in effluent}) \times 8.34 = \text{lbs./day to be treated.}$
2. Divide the number of pounds of untreated nitrogen by 5 to determine the daily application rate.
3. Multiply the daily application rate by 3 to determine the three-day requirement.

### Example Calculation

Effluent Flow = 1.5 MGD

Effluent Ammonia = 15 mg/L

Effluent Nitrite = 6 mg/L

Target effluent ammonia = 1 mg/L

Amount of total nitrogen to be removed =  $15 + 6 - 1 = 20 \text{ mg/L}$

a.  $(1.5 \text{ MGD}) \times (20 \text{ mg/L}) \times 8.34 = 250 \text{ lbs./day N}$

b.  $(250 \text{ lbs./day N}) \div (5 \text{ lbs. N per lb product}) = 50 \text{ lbs./day product addition}$

c.  $(50 \text{ lbs./day}) \times 3 \text{ days} = 150 \text{ lbs. needed for application}$

## Necessary Environmental Conditions:

A healthy and stable population of nitrifiers (*Nitrosomonas* and *Nitrobacter*) will not exist without the following conditions:

- **Oxygen:** The minimum acceptable level of dissolved oxygen (DO) to support nitrification is approximately 1.0 mg/L with >2.0 mg/L DO considered optimum. These levels are dependent on the F:M ratio, as higher heterotrophic activity generates more competition for available oxygen. Nitrification generally halts at <0.5 mg/L DO with anaerobic conditions killing off nitrifying bacteria.
- **Temperature:** Nitrification is temperature sensitive. The optimum temperature for nitrification is generally considered to be 82-96°F (28-36°C). At 59-61°F (15-16°C), the nitrification rate is approximately 50% of the rate at 86°F (30°C). Temperatures above 113°F (45°C) will essentially kill the nitrifiers. Below 50°F (10°C), nitrification ceases but will recover when the temperature increases.
- **Alkalinity and pH:** The optimal pH range for nitrification is 7.2-8.0 with values above 8 more desirable than values below 7.2. Alkalinity is consumed during nitrification, with 7.14 mg of alkalinity as  $\text{CaCO}_3$  being destroyed for every mg of ammonium ion oxidized. It is important to maintain adequate alkalinity in the aeration tank to provide pH stability and inorganic carbon for the nitrifying bacteria. A good target is to maintain a minimum residual alkalinity of 50 mg/L in the aeration tank after complete nitrification.
- **High Mean Cell Residence Time (Sludge Age) or low F:M:** Compared to carbonaceous BOD conversion, nitrification generally requires a higher Mean Cell Residence Time (MCRT), which is the average number of days that microorganisms are kept in the activated sludge process. This is due to the lower growth rate of nitrifying organisms which is further exacerbated by cold temperatures. During winter months, an increase in MCRT by reducing the wasting rate (WAS rate) or adding supplemental nitrifiers is often required to maintain effective nitrification.



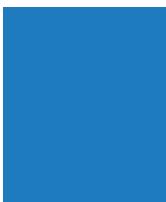
## Necessary Environmental Conditions continued

- **Inhibition/Toxicity:** Both *Nitrosomonas* and *Nitrobacteria* are more susceptible to inhibition and toxicity than heterotrophs, with small increases in inhibitory wastes causing a dramatic reduction in nitrification. Many heavy metals (Cu, Cr, Ni, and Zn), quaternary amines, and phenolic compounds can be inhibitory at amounts sometimes lower than 0.25 mg/L. Some soluble forms of cBOD can inhibit the activity of nitrifying bacteria at concentrations well below the inhibitory threshold of heterotrophs. If any inhibitory compounds or forms of cBOD are present, they must be degraded significantly for nitrifying bacteria to oxidize ammonium and nitrite.
- **BOD:** Nitrifiers depend on heterotrophs to reduce cBOD to relatively low concentrations (<40-50 mg/L). Excess BOD can cause a significant oxygen demand, which may cause a drop in DO that adversely affects nitrifying bacteria. Fluctuations in BOD loading may lead to intermittent nitrification.

## More than just Bugs

EBS is more than just a supplier of bugs in a jug. We are recognized as experts in identifying and troubleshooting nitrification problems in activated sludge systems, particularly in petrochemical plants, oil refineries, and meat/poultry processing facilities. Through the use of batch respirometry and advanced instrumental analysis for suspected chemical inhibitors, EBS can ensure that our products are only added to systems capable of supporting healthy bacterial growth and performance. EBS capabilities also include data review and on-site troubleshooting to provide a comprehensive approach to wastewater treatment optimization.

The EBS microbiology lab can monitor the biological health of your system over time through the use of microscopic exams and flow cytometry to assess total and live bacterial cell counts. The Lange Advanced Analytical Lab analyzes for toxic or inhibitory compounds from industrial processes through the use of GC and HPLC, identifying problematic compounds that can disrupt nitrification. These value-added services, in conjunction with our product offerings, create a unique value proposition for EBS clients while ensuring that product application results in maximum effectiveness.



**To learn more about NitriFire, please contact us at  
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