SERPENTINE®

PENETRANT TECHNOLOGY

ABOVE + BELOW GROUND PROTECTION

NITROGEN STABILIZER + PROPRIETARY ACTIVATOR + ADDITIVE PACKAGE

Frequently Asked Questions about Nitrogen Stabilizers

By John D. Bailey, PhD

Q: How long have you been working with nitrogen stabilizer products?

A: I've been working on technical product development for almost 17 years. My expertise has been focused on technical development of products to improve fertilizer efficiency and crop physiology, primarily through the use of biostimulants.

Q: How do nitrogen stabilizers work?

A: In a very general sense, nitrogen stabilizers involve chemistry (active ingredients) that help reduce the loss of nitrogen to the environment. In almost all cases, you will hear of "urease inhibitors" and/or "nitrification inhibitors" when it comes to these products. Below, I provide a general overview of these chemistries.

Urease inhibitors

Urease inhibitors block the soil enzyme, urease, which breaks down urea into nitrogen forms the plant can use. If there is a bit of soil moisture and temperatures are warm, when one spreads urea on the ground, urease breaks the urea down into water and ammonia – on the surface of the soil, ammonia is a nitrogen gas. This means that when urease is active on the soil surface, a proportion of the urea fertilizer is lost back into the atmosphere. Since our atmosphere is about 80% nitrogen, it makes sense that the nitrogen naturally wants to "go back home" by converting back into a gas. The most common urease inhibitor on the market today is called NBPT and it is used to help prevent ammonia volatilization of ammonia from urea.

Urease inhibitors really only bring value when used with urea or UAN that is surface applied and the risk of volatility is present. They don't bring much value to other types of nitrogen fertilizers that are NOT urea (such as ammonium nitrate) because these other forms aren't prone to ammonia volatilization. Urease inhibitors also don't bring much value if the urea is incorporated below the soil surface quickly after application, where the risk of volatilization loss is low. NBPT is the most common urease inhibitor on the market and its use is supported by a very large amount of independent, peer-reviewed data.

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Nitrification Inhibitors

Nitrificaiton inhibitors block a key soil process that converts nitrogen from a non-leachable form (ammonium) to a leachable form (nitrate). Naturally, once nitrogen fertilizer is below the soil surface, it is broken down into its basic forms by moisture and certain microbes, called nitrifiers. Nitrifying bacteria convert the more stable form of nitrogen (ammonium) into the leachable form of nitrogen (nitrate). Since ammonium has a positive charge (NH4), it can bind to soil particles like a magnet and is not as mobile in the soil. Nitrate has a negative charge (NO3-) and cannot bind to soil particles and is, therefore, mobile in the soil - this means it's leachable and the fertilizer can be lost to the environment.

Nitrification inhibitors block the activity of nitrifying microbes for varying amounts of time. They bring value because they give the nitrogen fertilizer a greater chance of being taken up by the plant before being converted to nitrate and leached away. DCD is one of the most widely used nitrification inhibitors on the market and its use is supported by a very large amount of independent, peer-reviewed data.

Q: Are there differences in how beneficial these products are?

A: By and large, yes, there are differences in how much benefit nitrogen stabilizers bring to farmers. A few factors that affect how much benefit a nitrogen stabilizer product brings are listed below:

Concentrations of active ingredients – this matters because the concentration of active ingredients determines how long and to what extent the nitrogen is protected from loss.

Application rates – the amount of material used to treat each ton of fertilizer matters because of point number 1. If a particular product is used at too small a rate, the benefit to the farmer can be much smaller. If a particular product is applied at too high of a rate, it can be overly costly to farmer without much additional benefit and can greatly impact how well the treated fertilizer handles in the field.

Soil moisture and humidity – In conditions where urea is spread onto moist soils, or where the relative humidity is high, the risk of volatilization loss is higher. Therefore, the use of an NBPT nitrogen stabilizer tends to bring value under such conditions. If soils are dry and(or) humidity is low, nitrogen volatilization risk is low, and a NBPT nitrogen stabilizer might not bring much value. On the other hand, a nitrification inhibitor stabilizer could still bring value under such conditions.

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Incorporation practices – On soils where fertilizer will not be incorporated into the soil using tillage or irrigation, the risk of volatilization loss is higher. Therefore, the use of nitrogen stabilizers tends to bring more value under such conditions. If fertilizers are incorporated within a few hours to a day after spreading (either mechanically, by irrigation, or by rain) the risk of volatilization is lower and an NBPT stabilizer might not bring much value. On the other hand, one could still get some value from a nitrification inhibitor stabilizer under such conditions.

Active ingredients must be matched to the fertilizer form – urea and UAN are fertilizers that are at the highest risk for urease-mediated volatilization. Therefore, NBPT stabilizers that tend to bring more value when applied to these fertilizers. Applying an NBPT product to other nitrogen fertilizers, such as ammonium nitrate, for example, bring no value to the farmer because this fertilizer isn't subject to volatilization. However, since ammonium nitrate is subject to leachability loss, a nitrification inhibitor stabilizer could bring value when used on such fertilizers.

Q: There are big differences in pricing for nitrogen stabilizers and they seem to keep getting more expensive. How do I and the farmer know we are using the right product?

A: Differences in pricing should be relatable to differences in active ingredient percentages and(or) efficacy. My advice to farmers and fertilizer managers is to be sure to check the labels and make sure that active ingredient percentages are sufficient and their use rate is acceptable. A low concentration product that is claimed to be effective at a low rate and high price probably is not going to bring farmers the greatest value. We have studied these actives for so long that we know the minimum levels needed to obtain good value to the farmer, so, it's relatively simple to determine which products have acceptable active ingredient levels and appropriate use rates.

Each farmer's situation requires a conversation with the fertilizer manager so that the fertilizer manager understands and can make sure that the right product and rate are selected for the farmer's given farming situation. In certain situations, where the risk of loss is high, products that have high levels of active ingredients and higher rates of application are probably the best choice...it really depends on the farming scenario. For example, if a farmer is surface-applying urea onto no-till fields in wet conditions at a time where temperatures and humidity are higher, the risk of volatilization is high – best to use a product with high active ingredients at the highest recommended volume. If a farmer is surface-applying urea in cool conditions where humidity is low, soils are dry and the farmer will follow-up with some light tillage to incorporate the fertilizer, it could make sense for the farmer to choose an alternative product with lower active ingredient concentrations at a lower labeled rate.

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Q: Are there ways in which we can improve nitrogen stabilizers?

A: Yes, there are some ways that we can improve how well nitrogen stabilizers work – for example, using a good penetrant system can carry the active ingredients further into the prill of urea, for example. This can help ensure a longer period of nitrogen loss reduction. We can also use better solvents to get a more thoroughly mixed solution which dries faster on dry fertilizer or mixes better with liquid fertilizer. This can improve the consistency of protection by improving the efficiency of coating and(or) mixing. From an aesthetics perspective, some of the products on the market smell horrible...a lot of people I've talked to over the years comment on it. A good scent is, believe it or not, quite critical components of a good stabilizer. I find that it's also quite useful to have a good dye in these products so that, at a glance, one can tell the fertilizer has been treated and if the coating was thorough.

I also think that there is something to be said about products that combine active ingredients to cover more pathways of nitrogen loss, for example, using both NBPT plus DCD together. There are a few of these on the market. While this is intriguing, it's also super important to make sure the concentrations of the actives and the recommended rates aren't so low that the farmer will get very little protection. This would be disastrous for farmers.

Finally, it's all fine and dandy to protect the nitrogen – it's a great idea – farmers should do it – but let's make sure the farmers is also able to use some technology to build a more extensive root system to pull that nitrogen up into the crop. With nitrogen stabilizers becoming more and more expensive, I worry that the farmers will have less money to invest in technology that can bring additional benefits and further improve fertilizer efficiency. Products and companies that strategically look at fertilizer efficiency in this manner will lead the way in the future by empowering farmers to make their operations more sustainable.

Q: What do you think about SERPENTINE®?

A: **SERPENTINE®** is a product that Crop Excellence® has brought to market that seems to provide several of the improvements I mentioned above. I've handled the product myself and think it's great. It actually smells nice, like fresh cut grass. Some of the other products on the market are not great for workers to handle in the fertilizer sheds. Worker safety is a huge, huge issue in our industry, so, having a product like **SERPENTINE®** with a nice smell is a welcome change.

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In evaluating **SERPENTINE®**'s ability to penetrate urea granules/prills, I verified that it gets into the center of the fertilizer quite effectively – as good or better than other popular products I tested. After treating some urea at the recommended commercial rates of 1-2 quarts/ton, it dried well and handled fine.

Scans of UREA prills treated with SERPENTINE®

As I look at the label, I see it has high levels of active ingredients, including both NBPT and DCD and is recommended at 1-2 quarts/ton is very acceptable. Protecting against more than one pathway of nitrogen loss by using high concentrations of actives at technically relevant rates is very beneficial to farmers. I am also told that the product is priced in a manner that will still allow farmers to invest in root supportive biology – that's a super beneficial aspect of this product, as well.

Taken together, seeing this formulation come online that provides very acceptable concentrations of a combination of active ingredients, has an acceptable use rate range, has good penetration and mixing with fertilizers, with a good smell and dye system all at a fair price, **I fully endorse the use SERPENTINE®.**