



AVOID ISSUES: UNDERSTAND THE DIFFERENCES IN POLYPHOSPHATE FERTILIZER PRODUCTION

Phosphorus is a primary nutrient essential for crop production. It helps plants capture and convert the sun's energy, stimulate root development, increase stalk and stern strength, and improve flower formation and seed production.

A popular way to deliver phosphorus to crops is with polyphosphate fertilizers. In this technical bulletin, we provide an overview of polyphosphate fertilizers and the differences in production to help users avoid potential tank and equipment issues.

WHAT ARE POLYPHOSPHATE FERTILIZERS?

Polyphosphate fertilizers were specifically developed to provide phosphorus and other essential nutrients to growing crops. The most commonly applied polyphosphate is ammonium polyphosphate¹ (APP), which The Andersons produces at several of its plant locations in the Midwest. These blends, including 10-34-0 and 11-37-0, are designed to have higher polyphosphate content compared to orthophosphate content. Having higher polyphosphate content is essential for ammonium polyphosphate stability and durability. With that said, plants are only able to take up phosphorus in the orthophosphate form. As a result, users can usually expect 30 percent of their APP solution to be in orthophosphate form and immediately available to the plant. The remaining 70 percent will be in polyphosphate form at the time of application and will be converted in the soil to the orthophosphate form for the plant to use later in the season.

Storage and Stability

Polyphosphate fertilizers are usually produced to provide a high nutrient content in a clear, crystal-free fluid that remains stable when stored at temperatures below 70 degrees F. When producing and storing polyphosphate fertilizers, three factors impact overall stability: temperature, time, and impurities.

Temperature: When storage temperatures exceed 70 degrees, polyphosphate fertilizers start to breakdown and nutrients fall-out within a short time period. Figure 1 shows the polyphosphate loss of these fertilizers with regards to three different temperatures – 140 degrees, 95 degrees, and

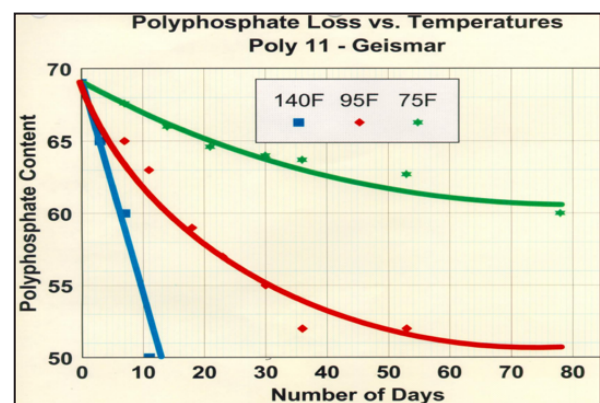


Figure 1: Polyphosphate Loss vs Temperatures. Source: John Walker, Senior Engineer, Nutrien.

75 degrees – over 80 days. As temperatures reach 95 degrees F and beyond, the polyphosphates are lost at a dramatic pace over a few months.

Time: Extended storage time results in reduced stability of polyphosphate fertilizers. To limit issues due to time, it is important to not have carry-over polyphosphate product remain in your tank from one season to the next.

Impurities: Phosphoric acid originates from phosphate rock. Different phosphate rock reserves contain varying degrees of impurities and trace minerals. Both the source of the phosphoric acid and the production method of reacting the polyphosphates will impact the degree to which those impurities end up in the polyphosphate fertilizer.

Explaining Polyphosphate Loss

Polyphosphates are produced by reacting phosphoric acid and ammonia at high temperatures. Polyphosphate loss occurs due to hydrolysis as a result of time and temperature. Impurities held in solution by polyphosphates will fall out when polyphosphate content lowers due to hydrolysis. Hydrolysis is any chemical reaction in which a molecule of water ruptures one or more chemical bonds².



The loss of polyphosphates usually results in several product quality issues including lower nutrient analysis of the product and settling in the bottom of the tank(s). The Andersons' process of producing polyphosphate fertilizers helps to reduce the risk of hydrolysis and avoid possible quality issues. Continue reading to learn the differences in The Andersons capabilities versus portable reactors.

UNDERSTANDING THE DIFFERENCE: PORTABLE REACTORS VS. THE ANDERSONS' STATIONARY REACTORS

Production capabilities, processes, and raw materials vary between portable reactors and stationary reactors. These factors directly impact the overall quality of polyphosphate fertilizers, including storability (shelf-life), polyphosphate content, amount of impurities, and more.

There are primarily two ways to produce polyphosphate fertilizers – through a portable reactor or a stationary reactor like many of The Andersons facilities.

Portable Reactors: Supply, Process, and Storage

As the name suggests, portable reactors are portable and usually hauled by a semi-truck. Several companies will contract with a portable reactor company to have them come to their facility, produce the product on-site, and then discharge the product into their tank(s). Most of these reactors use acid originating from western US phosphate reserves, resulting in acid known to be high in magnesium and fluorine. In polyphosphate fertilizer production, magnesium and fluorine are undesirable as these impurities accelerate polyphosphate loss.

Portable reactors commonly run 35 to 40 tons per hour at an elevated discharge temperature of 80 to 90 degrees Fahrenheit. This type of reaction produces a product containing an average of 65 to 68 percent polyphosphates.

Polyphosphate hydrolysis occurs quicker with portable reacted product due to the elevated product and storage temperatures. As a result, impurities fall out of solution as a combination of magnesium (Mg), aluminum (Al), iron (Fe), and ammonium phosphate. When cleaning tanks, most dealers purchasing and storing product from a portable reactor see an average of 10 to 12 inches of residue remain in the bottom of the tank after the tank is emptied. In a 300,000-gallon tank storing product from a portable reactor, a dealer will likely have about 75 tons remain in the bottom of their tank or storage vessel. Impurities have also been known to cause issues at the time of planting for growers, including plugging planting equipment.

With storage tank temperatures between 80F to 90F, shelf life is shortened to 3 to 4 months when product is produced by a portable reactor. When polyphosphates drop below 60 percent, the stability of blends containing potassium (K_2O), sulfur (S), and zinc (Zn) is greatly reduced. Precipitate is highly possible and should be expected.

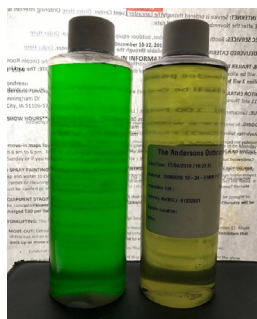
Stationary Reactors: Supply, Process, and Storage

With The Andersons' stationary reactors, much care is taken to produce polyphosphate fertilizers that not only store well according to standards but also perform well in the field.

The Andersons removes large portions of impurities such as excess magnesium during its process leading to increased product stability over time. The final product results in a cleaner, clearer, more durable product containing higher polyphosphates (70 to 75 percent). Further, the finished product is chilled after production and is discharged to insulated storage between 40 and 60 degrees F. The low temperature reduces the likelihood of polyphosphate loss. These factors increase shelf life and allow blends containing K, S, and Zn to hold together better and longer. When dealers inspect their tanks following the season, they typically have little residue remaining in the bottom.

Physical Product Comparisons

Figures 2 and 3 show samples of 10-34-0 products. In each image, the product on the left was produced using a portable reactor in Nebraska. The product on the right was produced at The Andersons' facility in Gibbon, NE. Both samples were produced in November 2019 and pulled from storage in December 2019. Figure 4 shows settling already occurring in the portable reactor sample bottle. In addition, even though this same sample is a brighter green, it is not as clear as the stationary reactor sample. The "cloudiness" is caused by polyphosphate hydrolysis due to high production and storage temperatures. Impurity/phosphate solids begin to form and eventually fall out of solution. If these solids get pumped out of the storage vessel, plugged filters, orifices and nozzles may occur. At a minimum, the solids will need to be removed from the tanks at the end of the season. For guidelines on tank storage and cleaning, visit The Andersons website.



Figures 2 and 3: 10-34-0 samples from a portable reactor (left) in Nebraska and The Andersons' Gibbon facility in Nebraska (right).

1. Dr. Raun Lohry. "Ortho vs. Poly". Fluid Fertilizer Foundation. <https://fluidfertilizer.org/wp-content/uploads/2016/05/35P17-19.pdf>
2. Merriam-Webster. "Hydrolysis definition," Accessed Jan. 17, 2020.

FOR MORE INFORMATION

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