Mitigating The Reverse Midas Touch of Fertilizer Corrosion

Julie Holmquist and Lisa Marston, Cortec® Corp., USA, outline how an annual preventative maintenance solution promises to slow down the corrosion clock in the production, distribution, and application phases of the fertilizer industry.

In the mythical story of King Midas, everything the greedy ruler touches turns to gold. The opposite is true in the world of fertilizer, where metals quickly rust in the presence of rich nutrients that feed the soil.

Cortec® Corp. has been an eyewitness to the corrosive effects of these minerals at a fertilizer application company in the Midwestern US, where workers have struggled to keep

Figure 1. The impact of corrosion on a fertilizer spreader truck. Image courtesy of Cortec®/Anthony Price.

expensive fertilizer spreaders in good condition. Pretty much all parts of the equipment that the fertilizer touches suffer from this problem. From the pans to the bed to the braces and hose fittings, these spreader trucks are in such bad condition that they either need to be replaced or rebuilt every few years.[1] This problem is by no means isolated, as small and large firms at different stages of the fertilizer industry struggle to preserve asset integrity. Fortunately, one simple annual preventative maintenance solution promises to slow down the corrosion clock in the production, distribution, and application phases of the fertilizer industry.

Why are fertilizers corrosive?

Before looking at solutions, it is important to understand the causes and effects of the corrosion problem. The most common minerals found in fertilizers are nitrogen, phosphorus, and potassium, represented by the familiar N, P, K ratios listed on fertilizer bags. Many fertilizers contain at least one if not all three of these components. Individually, nitrogen and phosphorus are not necessarily corrosive elements and are sometimes components of corrosion inhibitors. However, when mixed in certain proportions with each other and combined with other elements to form salts such as sulfates and chlorides, corrosiveness increases. Acidic conditions and the presence of moisture also intensify the corrosion risk from these chemicals.[2] Potassium components are already in the form of corrosive salts, such as potassium chloride, potassium hydroxide, and potassium sulfate, by the time they are added to fertilizers.[3] Some of the most corrosive fertilizer blends are ammonium nitrate and ammonium sulfate, which attack even brass and galvanised materials.[4] Urea, containing an even higher nitrogen content, is also very aggressive.[5] Although still corrosive when dry, granular fertilizers do more damage when moisture is present; they are among the most aggressive agricultural materials that trucks haul. [6]

Pros and cons of tougher alloys

Since mild steels are more vulnerable to corrosion, one obvious answer to the fertilizer corrosion problem would be to manufacture and buy infrastructure and equipment with tougher, more durable alloys. For example, nickel alloys and stainless steel have been recommended for potash handling equipment and 316 stainless steel for fertilizer plants that handle sulfur-containing fertilizers such as potassium sulfate. [7 – 8] However, even stronger alloys are not fail-proof. Using galvanised steel for storage containers can be a great option when dealing with dry fertilizer, but the introduction of even 3% moisture by weight can damage galvanised surfaces.[9] Also at issue is the higher cost of more corrosion-resistant metals. In some cases, such as the construction of plant fixtures, this cost may be justified, but even here, the passage of time will eventually demand some type of corrosion mitigation to extend the service life of ageing structures.

Another impediment to relying on tougher alloys is that not all equipment used is specifically built with fertilizer handling in mind. For instance, standard front-end loaders are often used to move materials around the plant, loading dock, or storage site. These may have a very good original coating that will hold up under most circumstances but is not designed to withstand the severe attack of fertilizers. Uncoated metals stand even less chance of survival. Unless equipment manufacturers enhance their designs with alloys and coatings made to put up greater resistance to corrosion (and perhaps even then), fertilizer plants, transporters, and applicators will need to find their own preventative maintenance workarounds to counter the constant attack.

Cost of corrosion

If left unchecked, corrosion threatens serious losses to the fertilizer industry. Front end loaders and fertilizer spreaders can cost tens of thousands to hundreds of thousands of dollars to replace – a cost that simply is not sustainable when looking at replacement every two to three years. While restoration is an option, that, too, is costly. In the case of Cortec's client, damage to spreader trucks was so serious that truck beds needed to be torn off and trucks rebuilt from the frame up every two years or so. This had to be done during the off-season, because there is no time to spare during fertilizer season, when, according to the agriculture publication *CropLife*, one day of downtime can cost the fertilizer applicator thousands of dollars.[10]

An extra layer of protection

Fortunately, the simple addition of secondary coatings during off-season routine maintenance has been emerging as a practical solution to slow down the corrosion clock. VpCI®-391 is one water-based removable corrosion inhibiting paint that can be applied for

temporary protection and removed when it is no longer needed (although it is often so inconspicuous that it does not even have to be removed). It can be applied as a clear or tinted coat directly over bare metal or painted surfaces. Since friction and abrasion will naturally wear a coating away over time, it is recommended that the equipment be washed down and a new coat applied every year during annual maintenance.

Protecting fertilizer distribution equipment

More than 10 years ago in North America, a river barge company was struggling with corrosion on front-end loaders used to handle deicing salts and/or fertilizers at river ports. The materials being handled were so aggressive that the equipment typically looked a decade older in just one year, requiring frequent replacement. A preventative maintenance solution therefore seemed like a more logical choice. Around 2011, the company implemented a new annual preventative maintenance plan in the slow season with three steps:

- Power wash the equipment with an alkaline cleaner.
- Dry the equipment.
- Spray the whole vehicle with VpCI®-391 from top to bottom except for the windows.

This annual preventative maintenance programme has continued for at least a decade, and the user has been very happy with the results.[11] The same method can be applied to excavators used around a fertilizer plant.

Protecting fertilizer application equipment

In 2022, Cortec began its talks with the aforementioned Midwest fertilizer application company that was plagued by corrosion on spreader trucks. This company provides a full range of services: testing soil, creating custom fertilizer blends, and finally applying them to the fields. The company owns dozens of one- or two-ton trucks and needed to replace/rebuild them every year as truck beds, spreader pans, lines, pumps, hose connections, and brace bars were corroding. Cortec compared the situation to that of salt spreaders used to deice winter roads and recommended replacing the 'old school' way of dealing with the problem (e.g., getting new equipment or rebuilding the old) with an annual washdown using a flash corrosion inhibiting alkaline cleaner followed by the application of VpCI®-391 on new and rebuilt trucks.

For trucks that had already started to corrode but were not yet scheduled for an overhaul, Cortec suggested a few coatings that might buy them some time (even though it is not ideal to apply a coating directly over rust). Once all the trucks have gone through the refurb cycle, they can be placed on the annual VpCI®-391 preventative maintenance routine. Since the company started applying coatings in the last two years, there have been no complaints, leading to the conclusion that the solution is meeting their needs.

Conclusion

There is no perfect cure to fertilizer corrosion, but there are practical ways to diminish its severity. Supplementary coatings present a viable option for annual preventative maintenance on equipment in the production, distribution, and application phases of the fertilizer industry. The chief advantage is extending the functionality of high-dollar assets while saving rebuild time. Although not an earth-shattering discovery, this is one simple way to block the reverse Midas touch of fertilizer corrosion. WF

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