SNCR Reagent Supply Alternatives and Cost Minimization

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Summary

Reagent cost is the most significant component in the economics of an SNCR system and there are many options to consider. SCR systems also need to consider their options to providing ammonia to their equipment, often involving on-site storage and handling of urea.

There are three choices for the basic reagent: anhydrous ammonia, aqueous ammonia, and urea. They are all basic chemical commodities which are readily available in the market.

Anhydrous ammonia is almost always the least expensive reagent to use for new installations from a capital and operating cost basis. Increasingly, however, the use of anhydrous is not considered due to federal and state regulatory burdens, local considerations, or Corporate Environmental Policy. Aqueous ammonia can be stored in atmospheric tanks, but at a highly diluted concentration, resulting in high transportation costs. There is very little advantage in using aqueous ammonia since it still is subject to regulatory storage limitations and there is no advantage in delivered cost.

Urea, on the other hand, is increasingly the chemical of choice. Very recently, the trend in the industry has been to move away from proprietary urea solutions to generic urea solutions. Substantial cost savings accrue from this change, has been demonstrated in dozens of boilers, and opens the door to several suppliers and several handling methods. For low quantity users, pre-blended solution in quantities of 40-50% is the best choice if such a supplier is available within economic hauling distances. For medium and high volume, or for facilities in remote areas, the most economical choice is to receive solid urea on-site via supersack, pneumatic truck, dump truck, or rail.

As commodity chemicals, ammonia and urea are subject to supply and demand pressures. The cost to produce both are also highly influenced by the cost of natural gas, its basic feedstock and seasonal trends due to agricultural uses. On the east coast, the current price of ammonia is in the range of $130 – 150 per ton fob. Similarily, commercial grade urea prill is currently selling for $120 – 140 per ton fob. Converting urea into its ammonia equivalent, that price is equivalent to $250 – 300 per ton of ammonia. Therefore, there is a very substantial cost disadvantage to using urea for NOx control.

Hauling distance and hauling method is a very significant factor in the delivered cost of chemicals. This needs to be carefully analyzed on a case-by-case basis, especially for new applications. This decision will dictate the starting point for on-site receiving, storage, and handling equipment design. For illustration the transport costs for urea into New England is summarized below:

1. Dry urea in bulk pneumatic truck. Very convenient for unloading operations into silos and requires the lowest on-site capital. It is however, usually the most expensive dry urea option due to the availability of these units and the low likelihood of backhaul. Into New England, for example, the hauling cost alone is approximately $60 per ton – a significant percentage of the total delivered cost.
2. Dry urea by rail, if rail siding is available on-site, is usually the cheapest and is the preferred method for large quantity users. A hauling cost in the neighborhood of $20 per ton is typical into New England.
3. Dry urea in standard dump trailers is a very economical choice for transporting dry urea – in the neighborhood of $25-30 per ton in New England and is an excellent choice for those facilities without rail siding.

4. Dry urea in supersack delivery is a good choice for small quantity users not within economic hauling distances from a liquid supplier. The cost to fill supersacks is not as large as one might think ($5-7 per ton), but can be economically transported long distances on flat bad trucks or trailers. The bags can be lined with a vapor barrier which keeps the material from absorbing water and clinkering – which is a problem in silo systems. Manual handling and space requirements on-site are factors.
5. Liquid delivery. Usually economical if consumption of urea liquid is less than approximately 250,000 GPY.

Anhydrous ammonia is stored in horizontal pressure vessels at a pressure of 150 psig. External heaters are installed in thermo siphon loops which provide heat based upon pressure control feedback. The tanks must have secondary containment and are registered with State and Federal agencies. If siting allows, and the facility is willing to accept the public relations and regulatory burden, this is clearly the way to go for all facilities.

Storage of dry urea in silos should be avoided if possible. This is due to the hygroscopic nature of the material. There have been numerous reports of bridging and clinkering in silos. If necessary due to tight site constraints, silos may be unavoidable, in which case the dry urea should be kept under a blanket of dry, instrument quality air. The silo openings should be water tight and protected and provisions made for extra provisions for poke holes, entryway, vibrators, and high slope/low friction cone bottoms. Reclaiming from the bottom is adequately accommodated with screws.

The best method to avoid the dry urea storage problem is to receive dry urea and immediately convert the material to a liquid and store in tanks in that form. The site space needed for liquid tanks compares favorably with covered storage buildings. If a dry stockpile method is used, the urea can be handled with front end loader or overpile reclaim.

The process to convert dry urea to a liquid is straightforward. Demineralized or soft water is used and blended with the urea gravimetrically on a batch basis with the addition of approximately 900 BTU/lb of heat. In this way, the system has an affirmative control on solution strength, which is essential for process control and monitoring. A less automated system would involve a manual technique of volumetrically introducing the urea to a mix tank, say from a dump truck or bulk truck, and measuring the solution strength manually with a hydrometer before batch transfer to liquid storage.

DNT has completed a fully automated urea dissolving system for a new cogen facility on the island of Kauai. Because of the remote nature of the site, liquid urea is not available. Because of transportation issues, the project decided to receive dry urea in supersack. The system successfully passed its performance Test, creating 5000 lbs of 39-41 wt% solution automatically. The technique is equally applicable to silo systems and DNT has been issued a contract to install one of these systems at an existing SNCR facility.