Added Peace Of Mind

PRODUCERS, DISTRIBUTORS, STORERS AND USERS OF ADBLUE® TURN TO PUMPING EQUIPMENT FROM BLACKMER® TO HELP ELIMINATE HARMFUL PRODUCT CONTAMINATION

By F. Scott Jackson

Since 1999, diesel-powered truck manufacturers in Europe have found the use of AdBlue® in a Selective Catalytic Reduction (SCR) process to be the most effective way to meet the NO_x-emission standards spelled out in European Union Directive 1999/96/EC.

Introduction

In 1999, the European Union adopted Directive 1999/96/EC, which established lower nitrogen oxide (NO_X) emission levels for diesel-powered vehicles operating on the continent. These new emission levels were scheduled to be phased in over a number of years with Euro IV thresholds coming online in 2005, followed by Euro V in 2009. The final, targeted NO_X-reduction levels will be reached in 2014 when Euro VI comes into full effect, which will require that diesel engines emit no more than 0.5 grams (0.018 ounces) per kilowatt hour (g/kWh).

These new standards set off a search amongst the continent's diesel-engine manufacturers to identify and develop a technology that could meet the stricter emission requirements. The technology that has gained the widest acceptance among engine manufacturers, especially those who build heavy-duty trucks, is a process that is known as Selective Catalytic Reduction (SCR). SCR was originally developed as a stationary technology that could be used to reduce emissions in power plants and utilities. In the 1990s, Daimler AG, the German automotive giant, began to experiment with mobile applications for SCR.

The catalyst in the SCR process is a liquid known as Aqueous Urea Solution 32 (AUS 32), which is a solution of 32.5% automotive-grade urea and 67.5% deionzied water. In Europe, AUS 32 is more commonly known as AdBlue®, a name that has been trademarked by the German Association of the Automobile Industry. When injected into a diesel vehicle's exhaust stream, AdBlue turns the harmful NO_X into harmless nitrogen and water vapor, which can be emitted safely into the atmosphere. When the Euro VI NO_X emission standards become law in 2014, it is expected that virtually every new diesel-powered vehicle on the road will be outfitted with an SCR system.

In conjunction with the introduction of AdBlue to the motor-fuels pool, the International Organization for Standardization (ISO) created specification 22241, which delineates the quality characteristics of AUS 32 that must be met in order to operate an SCR system in motor vehicles with diesel engines. This white paper will take a look at the ways that producers, shippers, handlers, transporters, storers and end-users of AdBlue can ensure that the product that ends up in a diesel vehicle meets the ISO 22241 standard, while realizing that even the smallest impurities in the AdBlue can severely damage the SCR system, as well as the vehicle's engine.

The Challenge

It's this simple: for SCR equipment to operate as intended, any contamination of AdBlue must be avoided. This can

AdBlue® must be kept contaminant-free throughout its life-cycle, such as when stored in IBC totes.

be easier said than done, and, first and foremost, means that the equipment used to produce, transfer, transport, store and dispense AdBlue must be compatible with its unique characteristics.

The most effective way to produce AdBlue is through a process called Synthesis Production. In this process, 100% automotive-grade urea is injected into a production line where it is diluted with deionized water until it achieves the 32.5% urea-67.5% water ratio that enables it to be called AUS 32, or AdBlue. The advantages of Synthesis Production, when compared to the less-popular or effective Decomposition process, are that the producer has online control of all AdBlue components during production; large production capacities can be achieved; product quality is consistent; production costs are lower; and, perhaps most important, product contamination cannot occur during production.

Realizing how critical it is for AdBlue to remain uncontaminated at all points in the production and supply chain, the European Chemical Industry Council (CEFIC), through the Automotive Grade Urea Sector Group, which is part of the Association of Petrochemical Producers in Europe (APPE), has listed the materials that can be used in direct contact with AdBlue:

- Highly alloyed Cr-Ni and Cr-Ni-Mo steels, or stainless steel 304, 316 and 316L
- Titanium
- Hastelloy® C alloys
- Additive-free polyethylene
- Additive-free polypropylene
- Additive-free polyisobutylene
- Additive-free perfluoroalkoxyl (PFA)
- Additive-free polyfluoroethylene (PFE)
- Additive-free polyvinylidenefluoride (PVDF)
- Additive-free polytetrafluoroethylene (PTFE)
- Additive-free co-polymers of vinylidenefluoride and hexafluoropropylene

Conversely, CEFIC recommends that the following materials not be used in direct contact with AdBlue:

- Materials forming compounds as a result of reaction with ammonia, which may negatively interfere with the SCR converter system, such as carbon steels, zinc-coated carbon steels and mild iron
- Non-ferrous metals and alloys, such as copper, copper alloy, zinc and lead
- Solders containing lead, silver, zinc or copper
- Aluminum and aluminum alloys
- Magnesium and magnesium alloys
- Plastics or metals that are coated with nickel, either electronically or chemically

Even though AdBlue is not deemed to be a hazardous substance per European product-classification guidelines, it should not come into contact with other chemicals, especially nitrates and nitrites.

Also, any surfaces that come in direct contact with AdBlue must be free of foreign matter, such as oil, fuel, greases, detergents, dirt, dust and any other chemicals or natural products. Prior to a first use with AdBlue, all surfaces must be cleaned and rinsed with deionized water and AdBlue. The use of tap water should be avoided due to the high amounts of alkali and earth-metal ions that may be contained in it. If tap water has to be used, the surface must be rinsed with adequate quantities of AdBlue before being put into service.

In addition to avoiding any type of contamination of AdBlue at any point during its handling, and choosing compatible materials of construction for the equipment that will come into contact with it, producers and handlers of AdBlue all along the supply chain should be familiar with its unique product characteristics, including:

- Because of its water content, AdBlue freezes below -11°C (12°F), meaning it must be protected from extreme cold during storage
- When AdBlue freezes, it goes from a liquid state directly to a solid with no intermediate “slushiness” stage
- AdBlue can freeze and thaw with no resulting degradation of the urea solution
- It is stable at storage temperatures up to 29°C (84°F); exposing AdBlue to heat above 32°C (90°F) will decrease its useable shelf life

- When exposed to air, the water in AdBlue will evaporate and produce crystallized urea, which can harm the vehicle's SCR unit, and transfer or pump components.

The Solution

To help producers, handlers and users of AdBlue eliminate contamination risks, CEFIC has produced a "Quality Assurance Guidance Document" for AdBlue that is a summary of best practices that should be observed in order to safeguard its integrity during production, storage and distribution.

According to CEFIC, the following areas should be considered when handling AdBlue:

Tank Storage

- During the filling of storage systems, as well as the loading or unloading of tank trucks or any other means of transportation, avoid contamination with dust or soil
- To avoid contamination, intermediate storage tanks should be equipped with air-particle filters for the venting system
- The entire storage system – including tanks, pipes, pumps, filters and filling stations – should be dedicated solely to AdBlue use to prevent any cross-contamination
- Prior to first use, clean and rinse all storage-system components with deionized water or AdBlue
- All subsequent cleaning and maintenance should be performed in accordance with ISO 22241 standards and documented in writing

Loading

- All loading equipment should be dedicated for the handling of AdBlue
- The loading area must be kept clean and the potential for any form of contamination must be minimized before loading
- All components of the loading system should be emptied, cleaned and closed off after use
- All equipment must be stored in a controlled manner in order to avoid misuse and contamination

Bulk Transport

- Transfer of AdBlue from one means of transport to another should only be allowed if adequate cleaning procedures and checks have been performed
- All construction materials, including gaskets, must be compatible with AdBlue
- Openings and hoses must be stored and secured in such a way that impurities cannot enter them
- Dedicated means of transportation should be standard in order to minimize contamination risks

Blackmer's line of sliding vane pumps for the transfer of AdBlue (AUS 32).

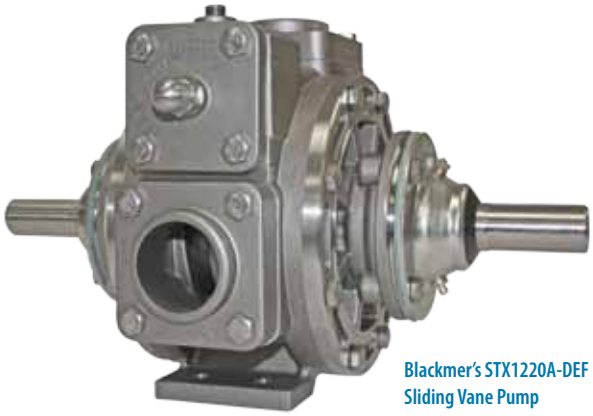
Unloading

- Every unloading instance of AdBlue from one compartment/tank into another must be planned in such a way that product quality is assured
- Unloading equipment should be dedicated for use with AdBlue
- All unloading-system components should be emptied, cleaned and closed off after use
- Hoses should be cleaned and closed after each use and stored in a controlled manner
- All dispensing units should be cleaned on a regular basis

Packaging and Filling

- Adequate precautions to prevent contamination must be taken at all areas where packaging and filling of AdBlue may occur
- All equipment that comes in direct contact with AdBlue must be compatible
- All containers – IBCs, drums, and small one-use plastic containers – must have their interiors cleaned
- Proper labeling and fool-proof connections must be employed on dispensing equipment in order to eliminate filling mistakes
- All packaging and cleaning must take place in a clean environment
- Proper cleaning of all surfaces that may come in contact with AdBlue must be performed before every filing operation

Realizing the importance of avoiding contamination when producing and handling AdBlue, Blackmer®, Grand Rapids, MI, USA, has created a family of AdBlue-compatible sliding vane pumps, which also meet ISO standard 22241-3:2008, titled "Diesel Engines: NO_X reduction agent AUS 32." These pumps can help optimize AdBlue-handling operations from the production plant to the storage terminal, and when the AdBlue is transferred into the various types of packaging. Additionally, these pumps



Blackmer's STX1220A-DEF Sliding Vane Pump

offer energy-efficient operation that will help keep energy costs under control.

Taking all of those operational demands into consideration, Blackmer's STX3-DEF Series Sliding Vane Pump is ideal for transfer operations that see AdBlue moved from the production plant to the storage terminal. These 3-inch pumps can deliver flow rates up to 946 L/min (250 gpm) at speeds of 800 rpm and differential pressures up to 8.6 bar (125 psi). This means that a 22,700-liter (6,000-gallon) transport truck can be unloaded in as little as 24 minutes. The pump's sliding-vane principle of operation also allows it to easily prime and pull a vacuum, especially when dealing with piping configurations that have a restricted inlet or long runs. The STX3-DEF pump is also constructed of stainless steel, which makes it highly compatible with AdBlue.

Blackmer has recently introduced another DEF product for the AdBlue-handling market – the STX2-DEF Series Sliding Vane Pump. The STX2 is a 2-inch pump that is similar to the STX1220A, with one notable exception: it is designed with pushrods so that it can run at slower speeds, making it ideal for package-filling operations that require flow rates between 60 and 189 L/min (16-50 gpm).

For AdBlue transfer from storage tanks into IBC totes, drums and smaller single-use containers, Blackmer has developed the STX1220A-DEF Series Sliding Vane Pump. The STX1220A-DEF pumps, which have no pushrods, run at speeds 700 to 1,200 rpm and can deliver flow rates from 186 to 348 L/min (49-92 gpm), which is the "sweet spot" during package-filling operations. Like their STX3-DEF counterparts, the STX1220A-DEF models are constructed solely of stainless steel, can handle differential pressures up to 8.6 bar (125 psi) and can be used in temperatures up to 115°C (240°F).

All of Blackmer's STX-DEF pump models can be powered by a base-mounted electric drive, diesel motor, truck-mounted power take-off (PTO) or hydraulic drive, and they are equipped with a double-ended straight-keyed drive shaft that allows either clockwise or counterclockwise rotation.

Conclusion

For more than a decade, SCR has been a trusted way to ensure that NO_X emission levels from diesel engines meet the parameters spelled out in European Union Directive 1999/96/EC. While SCR is a highly reliable way to reduce harmful NO_X emissions, the system can only function properly if its catalyst – in this case, AUS 32, or AdBlue – meets the specifications laid out in ISO standard 22241.

The ISO 22241 specs spell out very succinctly that AdBlue cannot be contaminated in any way and that failure to keep it contaminant-free can result in severe damage to a vehicle's SCR system and engine. Organizations like CEFIC have listed the best practices that should be followed in order to eliminate AdBlue contamination, while companies like Blackmer have heeded the call to produce pumping equipment that is compatible with AdBlue.

About the author

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