

Sandvik, Safety, Safurex: three words that spell quality in urea and fertilizer production



Food is one of our fundamental needs – and Sandvik plays a vital role in helping to provide it. Agriculture relies increasingly on artificial fertilizers such as nitrates made from urea. Urea production is a highly corrosive process requiring the toughest of corrosion-resistant stainless steel grades. This is where Sandvik comes in. Since our last visit, the company has made great strides towards become a leading supplier to the urea industry. We asked Magnus Brodin, Global Product Manager for Chemical Segment, and Irais Quintanar, Product Specialist, Chemical Segment, within Sandvik, to explain Sandvik's contribution to urea production, its guiding principles in this area, and how they are put into practice.

By John Butterfield and James Chater

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Magnus Brodin



Irais Quintanar



advantage, as it allows them to eliminate the possibility of accidents and reduce down time, costs and increase output.” Good news for the end user, at a time of high urea prices.

Development of new materials is Sandvik’s most important contribution to safety and quality. But it does not stop there. As Irais Quintanar explains: “We have complete control of our processes, from melting right through to final production. What sets us apart from our competitors is the purity of our materials. We recycle our own material and during the argon oxygen decarburization (AOD) process we reduce levels of contaminants, such as carbon and sulphur that are detrimental or can cause corrosion.”

by 1970. Alloy 25.22.2, also known as BC05 or 2RE69 (25%Cr, 22%Ni, 2%Mo), proved to be a phenomenal success, being used in countless projects round the world. In particular, it set a world record of thirty-six years of continuous use in tubes in German urea manufacturer SKW’s carbon dioxide strippers.

Safurex™

So why develop a new material?

Mr. Brodin: “We have a strong belief that it is important to be focused on the end user, so when Stamicarbon approached us again and said they needed a grade which allowed them to eliminate oxygen in the production process, we were happy to



Agriculture relies increasingly on artificial fertilizers such as nitrates made from urea.

Safety first

The first and last thing that strikes one about Sandvik’s approach to urea production is the emphasis on safety. “Safety is at the top of our agenda,” begins Magnus Brodin. “Urea production is potentially dangerous. Ammonium, the principle feedstock for urea, is highly toxic: you don’t want to get any of that in your bloodstream. Also, nitrogen in combination with carbon dioxide at high pressure can cause explosions. This is one example why we work closely with our customers to explore ways of improving safety. It is also to their

Sandvik 2RE69 - 25.22.2

Sandvik can boast heaps of experience and a long history – over forty years in fact – of working with the fertilizer industry. In the 1950s Stamicarbon, a leading urea manufacturer based in The Netherlands, discovered that the addition of oxygen at the urea synthesis stage made it possible to use a modified form of 316L: 316L Urea Grade. But when in the 1960s it invented the carbon dioxide stripping process to reduce steam consumption and facilitate large-scale production, it was found that this accelerated deterioration of 316L Urea Grade. Clearly, a better material was required. Stamicarbon turned to Sandvik, and the two companies worked together to produce a new grade, which was ready

collaborate. In both our collaborations, Stamicarbon’s process expertise and our materials expertise made the perfect fit.”

The new duplex grade, Safurex™, was developed by Sandvik and Stamicarbon at the beginning of the 1990s. In 1997 Safurex™ was applied in a high-pressure scrubber at a DSM urea plant. Gradually its use spread to other areas – condenser, stripper – and in 2002 it became standard in the synthesis process.

Safurex™ is applied in contact with carbamate solutions and allows increased corrosion resistance in low oxygen conditions. It also eliminates local corrosion such as SCC (stress corrosion cracking), crevice-, and pitting corrosion etc. It also has superior mechanical



Sandvik has a long history of research and development in the field of developing corrosion resistant alloys with end-users for the urea industry.

properties that allow us to, for example, design with thinner wall thicknesses. SCC had been a constant problem with 300 series grades, especially those in contact with seawater, which are used in dry regions such as The Middle East. SCC can do its mischief in a matter of minutes, with grave safety implications. “The combination of dealing with corrosion from seawater, high pressure and high temperatures is perfect for us,” states Mr. Brodin, who evidently relishes the challenges posed by the toughest conditions.

However, the development of Safurex™ has not meant the end of applications using 25.22.2. Mr. Brodin: “2RE69 or 25.22.2. is still the most commonly used material in urea plants, especially in China. Safurex™ is by and large used exclusively in Stamicarbon’s latest synthesis process, which basically means in plants that have been built since 2002. 25.22.2 is an austenitic grade and these are more susceptible to Stress Corrosion Cracking than Duplex grades (Safurex™)”. In addition to the collaboration with Stamicarbon, Sandvik works closely with all other major urea licensors. Mr. Brodin: “I guess you could say that Sandvik has always been a pioneer in the development of materials and was actually one of the first companies to supply bimetallic tubes. For example, with a major international contractor we have developed two products – the first is a bimetallic tubing that combines zirconium with 2RE69 (25.22.2); the second is

U-bend tubes for carbamate condensers. Bimetallic tubes are used in the manufacturing of strippers with zirconium being used in their inner layer where corrosion can be most severe.

Market leader

Clearly then, Sandvik has built up an unrivalled position in the urea market. “We are the only producer with a complete range of products,” Mr. Brodin tells us. “Not only do we supply our own tubes, pipes, bars and welding consumables, but we also carry stock on complementary products such as plate, fittings and flanges. This allows us to respond very quickly to end user need ensuring

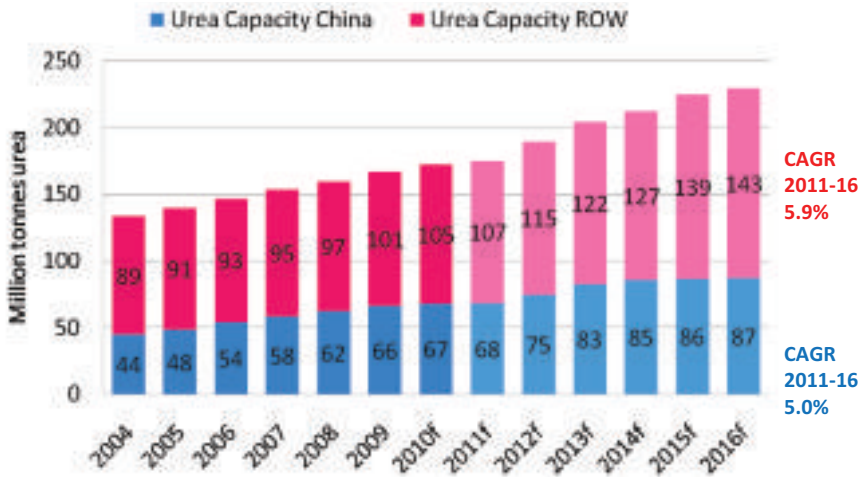
deadlines can be always met. When necessary we can even subcontract such operations as forgings as part of a product package. Not only this, but because of our vast knowledge and experience in urea industry we are able to provide our many customers and partners with continued technical support and help.

The urea market

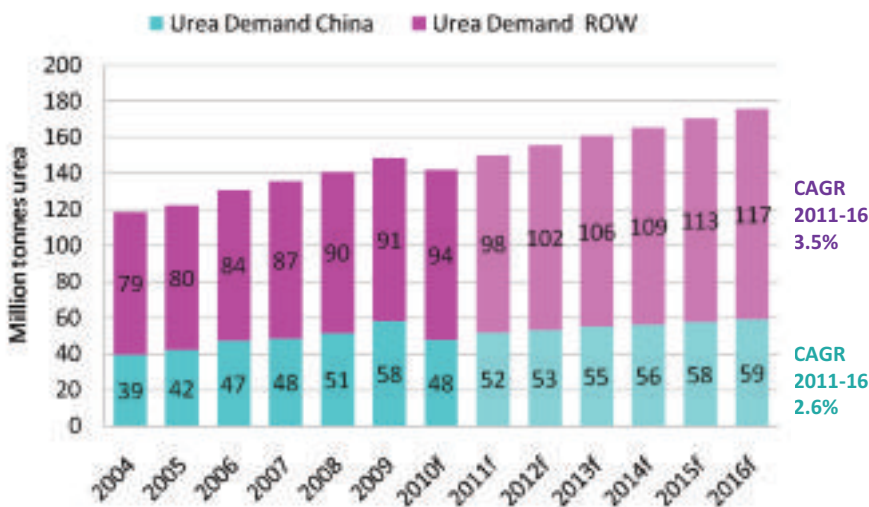
After the two successful collaborations with Stamicarbon to develop new grades, what does the future hold? “The projections for the urea market are buoyant,” enthuses Mr. Brodin. “We expect consumption will continue to increase through the coming years. As the world’s population rises so the demand for food increases and hence for the use of fertilizers. Also, the urea price has been rising and is now fairly stable. With manufacturers able to fetch a good price, we can expect more projects and investments. I expect there to be a steady stream of upgrades. Even if manufacturers don’t rebuild entirely, they will need to renew their strippers and other high-pressure areas, as these are where the really severe processes occur.”

“Urea is a very well defined market,” continues Mr. Brodin, “where the main players all know each other. We have a shortlist of professional fabricators; we know who is doing what. To help us keep tabs on the industry, we maintain a database with business intelligence, and licensors keep us up to date on the latest projects.”





Global area demand outlook for urea to 2016. Source: CRU Fertilizers.



Global area capacity outlook till 2016. Source: CRU Fertilizers.

Which are the fastest-growing regions?

Ms. Quintanar: "The most important markets correlate to high populations or rich hydrocarbon resources. This means China, India, the Middle East, and Russia. A lot of the investment comes from China."

"China is our strongest market,"

Mr. Brodin continues. "This is the country with the highest number of urea plants. Demand is growing and living standards are improving, so demand for good food is increasing."

Ms. Quintanar: "In China our customers use Stamicarbon's or Saipem design, which allows construction of larger plants, or local Chinese designs that have capacity limitations and so are only suitable for midsize plants. For these Chinese-designed plants we have acquired a dominating position in the market. In India, the focus is more on the

Saipem design, but we still have a high market share. In Russia, things are more difficult, as they use more standard types of material; but here too we are able to do business."

How large can a plant become, and what are the consequences for Sandvik? "The largest production plants can now produce above 3,500 metric tonnes per



day," says Mr. Brodin. This equates to over one million tonnes per year. "As a result," says Ms. Quintanar: "Sandvik supplies pipes to plants in Safurex in large diameters, up to 18 inch OD and heat exchanger tubes of up to 40 metres length, and bending is now required."

Conclusion

As an experienced producer of specialized, high-purity stainless steel products, Sandvik has made urea one of its strongest areas. With the focus clearly on safety, quality and cost control, it has established a leading position in this market. For decades it collaborated with key licence holders to develop advanced products capable of withstanding the most severe conditions. More than merely a producer, Sandvik has positioned itself to become a reliable and indispensable partner in urea production, a sector with exciting growth possibilities.

Urea production in a nutshell

Without nitrogen, plants cannot grow. The problem is that N is usually found in a gaseous form, whereas it has to be "fixed", in other words made available in solid or liquid form, for it be of nutritional value to plants. This can be achieved by making artificial urea. Urea, which can also be found in nature and has several applications in the chemicals industry, can be manufactured using ammonia as a feedstock. Ammonia is produced by causing methane to react with steam over a catalyst and then applying the Haber-Bosch process (synthesis over an iron catalyst). To make urea, ammonia is reacted with CO2 in a pressurized reactor, a highly corrosive process. The resultant urea finds uses in several artificial fertilizers.