



White Paper

Increasing Urea Plant Capacity and Preventing Corrosion Related Downtime

HOW NEW TECHNOLOGY HELPS MANUFACTURERS INCREASE PROFITS

General managers at urea processing facilities face two big challenges: increasing fertilizer output while reducing downtime. However, limitations inherent in most urea strippers tie the hands of plant managers. The lower temperature thresholds of stainless steel strippers artificially cap output. Inevitable corrosion means costly downtime and possibly reduced fertilizer quality.

The need for passivation air also decreases output capacity and creates safety issues. Combined, these challenges greatly limit urea manufacturers' productivity.

Unable to meet demand spikes, many plants must continue to operate at maximum capacity with little room for downtime. Fixing corroded stripper tubes is exceptionally costly. Even a few days of downtime can cost businesses millions in lost revenue. Replacing strippers every 10 years is also a time-consuming and costly procedure.

How can urea manufacturers increase capacity without increasing downtime risks? Is there a way to significantly improve the life of urea strippers?

Fortunately, next-generation urea tubing has emerged, allowing plants to operate at optimal temperatures without corrosion, erosion or the need for passivation air. Now urea plants can increase output, greatly reduce stripper-related downtime and double the life of their strippers. This white paper will explore the challenges of traditional strippers and reveal the many advantages of next-generation urea tubing.

UREA PRODUCTION CHALLENGES

Seasonally, urea manufacturers experience demand spikes. To meet increases beyond the capabilities of a plant, very few options are available.

Replacing the stripper with a larger unit is one choice. However, strippers cost millions and take years to manufacture. Many plants do not have physical room to accommodate a larger stripper. Other challenges emerge with a stripper replacement. For example, the low-pressure system, compressors, pumps and valves may need replaced, adding cost and time.

The stainless steels or bimetallic strippers used by most urea manufacturers cannot operate above 205°C (401°F). The ideal temperature for urea stripping is between 210°C – 212°C (410°F – 413.6°F). However, due to the upper temperature limits of stainless steel, plants cannot operate at their optimum capabilities, sacrificing significant plant capacity.

If a urea manufacturer could increase output, the cost of fertilizer production could be reduced, providing the business a competitive advantage and the ability to meet demand spikes.

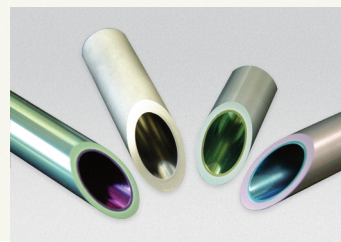
REDUCING OPERATING COSTS

Plant managers must assure reliable processes are in place and downtime is minimized. However, stripper challenges are generally accepted costs for urea manufacturers.

Passivation air presents a major issue for urea manufacturers. Designed to prevent the corrosion of stainless steel, passivation air constantly coats the inner surface of stripper tubes with an oxygenated process solution. The aerated solution maintains the passive oxide layer, preventing rapid corrosion failure. When the process solution seeps into a crevice, major problems may occur. The resulting crevice is no longer oxidizing enough to maintain a protective layer, creating potential for a rapid failure.



OmegaBond® Advanced Tubing allows urea processors to put the optimal corrosion-resistant material where it is needed most.



Using OmegaBond® Advanced Tubing increases the life of a stripper, plant capacity and energy efficiency.



White Paper

Operating and maintaining passivation air equipment adds more costs and points of failure. Compressors, pumps, and distribution systems must be installed to supply a steady stream of air at the correct rate. If any component should fail or underperform, interrupting the air supply, the plant equipment can experience severe and rapid corrosion.

Passivation air must also be removed after stripping. This adds process costs and hazards resulting from the combination of oxygen and hydrogen—an explosive gas mixture.

Even with excellent control measures in place, stainless steel still exhibits corrosion. It's not unusual for plants to accept corrosion as a normal operating challenge and set aside funds to replace equipment on a regular basis.

UNPLANNED DOWNTIME

Urea plants process materials in very large, linear processes. Any break in the chain shuts down the whole process. All components must work together reliably—all the time. While failures typically occur with pumps or valves, when the stripper is involved, the results can be significant. When stripper problems occur, they take at least 5 days to fix and weeks are more common. The large nature of strippers means spare parts are not available onsite and could take weeks to be installed. Even minor leaks mean shutting down the stripper, cooling it, washing out its interior and starting it back up. Just shut-down and start-up procedures could take days. The result is often millions of dollars of lost revenue.

If a stripper experiences accelerated corrosion that causes the wall thickness to fall below required safety margins, the result could be catastrophic for the business. For example, if a stripper needed replacement and one was not on order, a plant could be effectively shut down for years.

A brief examination of the history of strippers provides further insight.

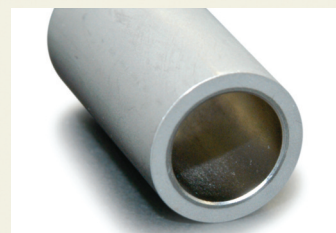
BRIEF HISTORY OF STRIPPER TUBING

Prior to the 1990s, strippers were mainly constructed using stainless steel. The underlying challenges of stainless steel included the need for passivation air, a high likelihood of corrosion and temperature limitations.

By the early 1990s, titanium began replacing stainless steel strippers. Unlike stainless steel, titanium is highly resistant to corrosion, does not require passivation air and can operate at very high temperatures. However, titanium's weakness was erosion, often localized in the top 2 feet of stripper tubes. To compensate, strippers needed to be vertically flipped after 7-9 years. This was a large and costly maintenance procedure.

By the mid-1990s, bimetallic tubes emerged. These were stainless steel tubes with zirconium inner tubes tightly fit inside. The benefit of these bimetallic tubes was the reduction of corrosion due to the zirconium liner. However, temperature limitations still existed due to the stainless steel outer tubes. Passivation air was also required. Unfortunately, it was not unusual for seepage to occur between the zirconium and stainless steel layers, creating significant corrosion in the bottom of strippers. In addition, bimetallic tubes were sensitive to welding procedures, often resulting in unexpected costly failures.

By the early 2000s, wider use of zirconium in strippers began to emerge. Tubes were comprised of pure zirconium, providing exceptional resistance to erosion and corrosion, and eliminating the need for passivation air. In addition, zirconium could operate at exceptionally high temperatures, maximizing urea output. Zirconium was found to be the ideal material for urea processing. However, the main downside of pure zirconium tubing was its high cost.



OmegaBond® Technology eliminates any possibility of solution seepage between the liner and the tube because it isn't just a tight fit, it's a metallurgical bond.

Timeline of Selected Materials Used for Stripper Construction



TOLL FREE: 877-777-5140 | PHONE: 541-967-6977 | EMAIL: custserv@ATImetals.com

Data are typical, are provided for informational purposes, and should not be construed as maximum or minimum values for specifications or for final design, or for a particular use or application. The data may be revised anytime without notice. We make no representation or warranty as to its accuracy and assume no duty to update. Actual data on any particular product or material may vary from those shown herein. U.S. and foreign patents; other patents pending. © 2012 ATI. All rights reserved.

Allegheny Technologies Incorporated
1000 Six PPG Place
Pittsburgh, PA 15222-5479 U.S.A.
www.ATImetals.com



White Paper

THE NEW SOLUTION: NEXT-GENERATION UREA TUBING TECHNOLOGY

Designed to increase urea processing output, reduce downtime and cut operating costs, next-generation urea tubing technology provides manufacturers advantages previously unavailable. By combining the benefits of titanium and zirconium into a single stripper tube, urea manufacturers can operate strippers at higher temperatures while eliminating corrosion, erosion and passivation air. The result: greater plant capacity, lower maintenance, less downtime and significantly enhanced stripper life.

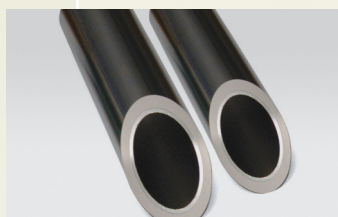
Next-generation urea tubing has a titanium outer tube with a metallurgically bonded inner zirconium tube. Because the titanium and zirconium tubes are bonded at the atomic level, no gaps exist between the tubes, eliminating seepage (see Figure 1). The result is a uniquely bonded inner and outer tube that behaves as a single tube. The two metals are joined using an extrusion bond—a multi-step process that results in a virtually unbreakable bond.

Passivation air is not necessary with titanium and zirconium. Eliminating the need to remove passivation air downstream improves yield, reduces environmental concerns and improves plant safety.

In addition, next-generation urea tubing eliminates temperature limitations inherent with steel alternatives, allowing the strippers to run at 212°C (414°F), thus improving capacity by up to 15 percent. In addition, corrosion is eliminated in the stripper, ensuring impurities such as iron, nickel and chrome—the core components of stainless steel—do not exist in the final product. Erosion inside the tubes is also eliminated, ensuring an extensive stripper life without the need to flip the stripper.

Next-generation urea tubing works with standard titanium stripper designs, replacing pure titanium tubes.

As urea solution passes through ferrules into next-generation urea tubing, the zirconium inner tube prevents corrosion and erosion, even right below the ferrule ends (see Figure 2). Now strippers can run at higher temperatures. The result is higher conversions at the high-pressure loop, recycling less material through low-pressure loops.



The core components of corrosion and erosion are eliminated when OmegaBond® Tubing Technology is used.

Figure 1: This photomicrograph shows the metallurgical bond between titanium and zirconium layers.

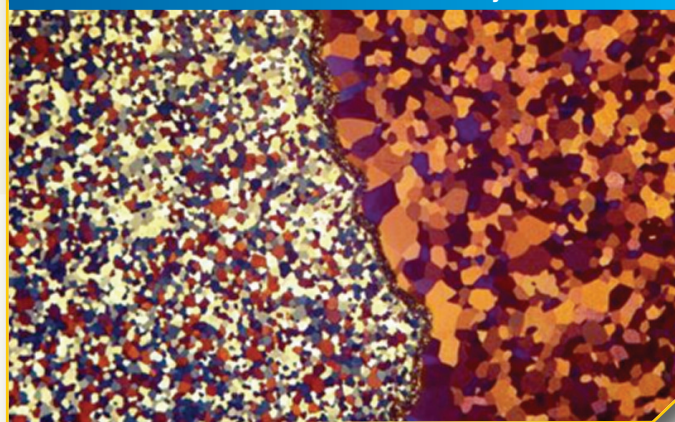
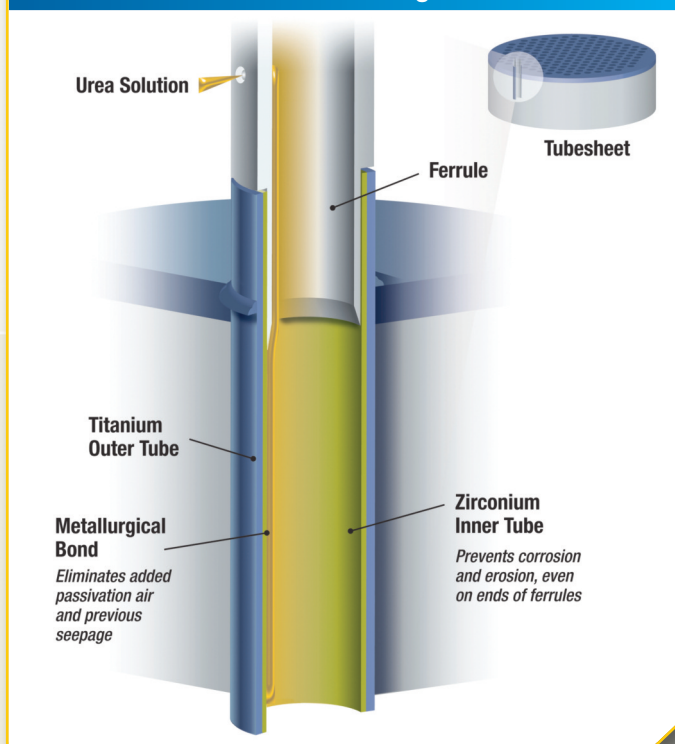


Figure 2: This illustration provides a visual cut-away of the inside of a next-generation urea tube while molten urea solution flows through it.





White Paper

BENEFITS OF NEXT-GENERATION UREA TUBING

Next-generation urea tubing provides many significant advantages to urea manufacturers including:

- Increases plant capacity by up to 15 percent by eliminating upper temperature limitations, allowing strippers to operate at up to 212°C (413.6°F)
- Eliminates passivation air and related installation and maintenance of pumps, compressors, condensers and related downstream equipment
- Lengthens the life of the stripper to at least 25 years, 5-10 years more than the average lifecycle
- Eliminates corrosion and erosion, greatly reducing downtime and maintenance costs
- Ensures iron, nickel, chromium and titanium do not contaminate product output
- Eliminates the possibility of seepage between liner and tube
- Reduces plant operating costs and improves return on capital investments
- Enables urea plants to run at higher efficiencies with less downtime
- Reduces the potential for corrosion due to improper welding, simplifying weld procedures enabling welding directly to tubesheets
- Reduces energy consumption by decreasing steam consumption
- Works with older titanium strippers
- Eliminates the need to flip, rotate or turn strippers

WHAT TO LOOK FOR IN NEXT-GENERATION UREA TUBING

When looking for a company to provide next-generation urea tubing, consider the following important requirements.

Fully integrated production: Work with a company that owns the entire process from raw materials to the final production of tubing. This ensures complete control over the quality of source materials and the ability to always secure raw materials.

Experts in tubing: Seek a provider with at least 50 years experience working with zirconium and reactive metals, ensuring the most comprehensive testing, construction and quality assurance processes.

Uses materials inherently impervious to corrosion and erosion: Only acquire tubing comprised of materials that prevent corrosion and erosion, greatly increasing the life of a stripper.

Corrosion-resistant heads, tubesheets and joints: Seek corrosion-resistant components to ensure a long stripper life, maintenance-free operations and the elimination of passivation air.

Metallurgical bond between outer tube and liner: Ask if the liner has a metallurgical bond to the outer tube. This eliminates the chance of seepage between the layers that can cause corrosion.

Approved by Saipem: Only work with a company that is approved by Saipem, ensuring the highest standards of quality.

Technical services support: Ask if the company provides metallurgical support and corrosion expertise.

THE OMEGABOND® TUBING

OmegaBond® Tubing is the next generation solution; it is the only technology that combines the benefits of zirconium and titanium, ideally optimizing urea processing. ATI is a world leader in specialty metal manufacturing, with over 50 years of experience from raw material to final product ensuring a reliable and high-quality solution.

OmegaBond® Tubing combines titanium grade 3 and zirconium 702 using a unique metallurgical process that creates high-quality corrosion- and erosion-resistant tubing designed to leverage the strengths of each metal. The result: maintenance-free operations, less downtime and higher quality output.

To learn about our free onsite materials engineering assessment, email assessment@ATImetals.com or visit www.ATItubingsolutions.com to learn more about OmegaBond® Tubing.