The Rise of Zirconium Clad Equipment in Acetic Acid Processing

Acetic acid is a chemical backbone of the modern world. This organic compound is used in a variety of industrial and consumer goods, like clothing, plastics, medicines, perfumes, paints and food additives.

Behind these goods stand the world's acetic acid producers who provide the colorless liquid to a range of manufacturers, including the vinyl acetate monomer industry. Of the world's producers, Asia is the largest, accounting for most of the total global production, followed by North America, Europe and Middle East. To keep these acetic acid operations running reliably and safely, today's fabricators and engineers rely on one metal—zirconium. However, that was not always the case.

In the late 1970s and early 1980s, acetic acid producers found they had a problem. The most important operating equipment they installed—nickel alloy reactors and piping systems—was corroding and suffering mechanical failure in hot, high-pressure processing environments, resulting in costly rebuilds and production downtime.**

Chemical processors looked to replace nickel alloys with another, more reliable metal. With its exceptional corrosion-resistant properties, zirconium was an attractive option, although it was expensive and had design limitations.

In 1985, one fabricator turned to zirconium explosion cladding and started, what would become, a global shift toward zirconium clad reactors, and related equipment, for acetic acid production—a trend that has continued until today.

Now, there are more than 50 zirconium clad reactors in operation worldwide. Most of these reactors use Zr700, a commercially pure and highly formable grade of zirconium, to carbon steel.

The Strength & Value of Zirconium Clad for Acetic Acid Production

For more than 30 years, engineers have resorted to explosion welding to economically add the corrosion-resistant strength of zirconium to their process equipment designs.

Explosion welding is a solid-state, cold-welding process that uses precise detonations to force, or bond, dissimilar metals together while preserving the physical, mechanical and corrosion-resistant properties of each metal. Explosion welding is also the only practical method to effectively produce a durable, high-strength bond between large sheets of reactive metals, like zirconium and steel.

About 90% of the world's acetic acid production uses the Methanol Carbonylation method. The method requires safe, reliable zirconium clad equipment**, including:

- Large reactors with walls up to 100 mm (4 in) thick*;
- Heat exchanger tube sheets up to 100 mm (4 in) thick*; and
- Large columns up to 5 m (15 ft) in diameter and 40 m (130 ft) high.

The functional benefits of using zirconium clad in these applications are many—from lifetime equipment savings to design flexibility, project continuity and safety. However, these benefits are only fully realized with the right clad partner, a partner with quality processes and expertise to protect your investment, from specification to delivery and support.

Choosing the Right Clad Manufacturer Matters

Design engineers face two significant challenges when selecting a clad manufacturer.

First, the titanium and zirconium clad supply chain has become highly globalized with a fast-growing number of providers in China—and to a lesser extent, in India and Japan. While these new vendors may attract buyers with deep discounts, few have experience producing the large clad plates modern companies need for fabricating reliable equipment.

Second, due to the highly competitive nature of the industry, chemical processors and equipment fabricators carefully protect details related to their proprietary equipment. This means there is very little information publicly available on the specifications required to safely and reliably implement titanium and zirconium clad designs.

As a result, there is a common misperception that all clad providers use the same standards. Unfortunately, some companies learn this the hard way. With mounting pressure to minimize project expenses, it can be tempting to choose less expensive providers on the front end. However, the lack of experience, standards and quality processes may cost significantly more time and money in the end.

By choosing a trusted clad metals partner-expert to guide you throughout the design process—ideally from specification onward—you can avoid these pitfalls and protect your investment.

Five Steps to Selecting the Right Titanium and Zirconium Clad Partner

When selecting your vendors along the value chain, consider these five steps to ensure you set yourself up for success:

1. Use detailed cladding specifications from the start to contain project costs and ensure project success. Share your quality requirements; request in-person audits; demand more than standard specifications for large vessels; and request proof that every clad plate is of good quality before it ships to the fabricator.

2. Require all vendors demonstrate a commitment to quality and compliance systems. Request proof of delivering defect-free, high-quality materials and products on time.

3. Choose a reputable clad manufacturer. Ensure they have the proven track record, technology, verifiable clad supply and know-how required to meet the chemical processing industry's demands.

4. Ensure the correct implementation. Choose a clad designer and fabricator who can prove they have the required and unique technology and equipment for large plates; verifiable project success; and who will commit to a thorough in-process inspection plan.

5. Understand long-lead clad impacts on your project timeline. By asking vendors if they stock alloys and plates upfront, you can build an accurate project timeline and set expectations.

Why NobelClad

For over 50 years, NobelClad has provided customers with innovative technologies to join dissimilar metals. Today, we remain the proven leader in explosive welding and offer the widest collection of customized clad metal products in the world—and more than products, we are solutions partners.

Few people in the world know how to do what we do, and even fewer go beyond ASTM B898, the global standard specification for reactive and refractory metal clad plates, including titanium and zirconium explosion cladding.

NobelClad's titanium and zirconium clad plates are the largest commercially available plates, and they are two to three times larger than solid titanium and zirconium plates. With fewer welds, our large plates offer better reliability when used to manufacture pressure vessels, formed heads, heat exchanger tube sheets, and thick-walled clad piping and elbows.

When you choose NobelClad, you invest in titanium and zirconium clad and a partnership that ensures the long-term viability, safety, and reliability of your chemical processing equipment, which translates to lower costs over the equipment's lifetime.

Knowledge is the First Step to Creating Value

We believe in sharing our metallurgical expertise and invite you to attend an interactive, free 45-minute webinar – An Introduction to Explosion Cladding Technology. We will cover:

- Design strategies for reducing CAPEX;
- Keys to titanium and zirconium clad project success; and
- Practical examples of titanium and zirconium clad equipment for chemical applications.

Fill out this form – and a NobelClad expert will contact you soon to schedule your 45-minute webinar on An Introduction to Explosion Cladding Technology.

Resources

** NobelClad manufactures much thicker plates for reactors and tube sheets, but these thicknesses are most common for acetic acid.*

*** J. Banker, "Explosion Cladding: An Enabling Technology for Zirconium in the Chemical Process Industry," Journal of ASTM International 7, No. 8 (2010): 1-10. https://doi.org/10.1520/JAI103050*

***B. J. Sanders, "Zirconium Corrosion Resistance: Key to Success of the Methanol Carbonylation Acetic Acid Process," in Zirconium Production and Technology: The Kroll Medal Papers 1975–2010, ed. R. Adamson (West Conshohocken, PA: ASTM International, 2010), 439-446. https://doi.org/10.1520/MNL12127R*