Engineering Solutions to **Erosion and Corrosion**

Headquartered in Perth, with a growing network of workshops in both Australia and overseas, Callidus Welding Solutions' main 2,400m2 workshop is dedicated solely to non-ferrous metals and alloys. With significant experience in joining, rebuilding and overlaying corrosion and wear-resistant alloys for the mineral processing, power generation, marine and mining industries, their services extend from robotic and automated welding and fabrication of process equipment, through to repairs and maintenance of in-service equipment and surface engineering.

"We're not your average welding and fabrication business," said Gary Lantzke, CEO of Callidus Welding Solutions (CWS).

"Our company vision is to deliver engineered solutions tailored to our clients' specific erosion and corrosion challenges. In saying that, our focus in recent years has been non-ferrous materials and high-end, newer breed materials such as austenitic and martensitic stainless steels, high-temperature alloys like Inconel and Hastelloy®, and duplex, super duplex and titanium."

"All of these materials have great corrosion resistance and operate well at high temperatures and in aggressive service environments.The problem is that some are quite soft and when they're used in processes that feature really fast movement, they suffer erosion. So, for the last ten years or so, CWS has focused on how to improve the longevity of these materials," said Lantzke.

Whether it's a worn titanium feed pipe, a corroded super duplex valve body or a cracked Inconel injection stem, CWS has seen (and repaired) it all before. CWS has identified the root cause, proposed and undertaken repairs and developed welding procedures for countless fabrication and repair challenges.

It is CWS' heritage of repair and maintenance of high-cost plant and equipment, and their ability to understand exotic metals and the changes they undergo after operating in severe service conditions that gives CWS the unique ability to embark on innovative research.

"In our experience, designers and plant engineers often opt for materials that will suit a process, without actually knowing how that process will play out in reality. If the material selected by a plant engineer doesn't work, it can be exceptionally difficult to repair or maintain."

"For instance, duplex and super duplex are extremely difficult to weld over. Most hard-facing applications contain chromium alloys, and when you start adding chromium to chromium, cracking is much more likely to occur," said Lantzke.

"This forms the basis of our research - how do you take parts of an alloy and add certain parts of other alloys, to create a hybrid alloy that offers optimum in-service performance?"

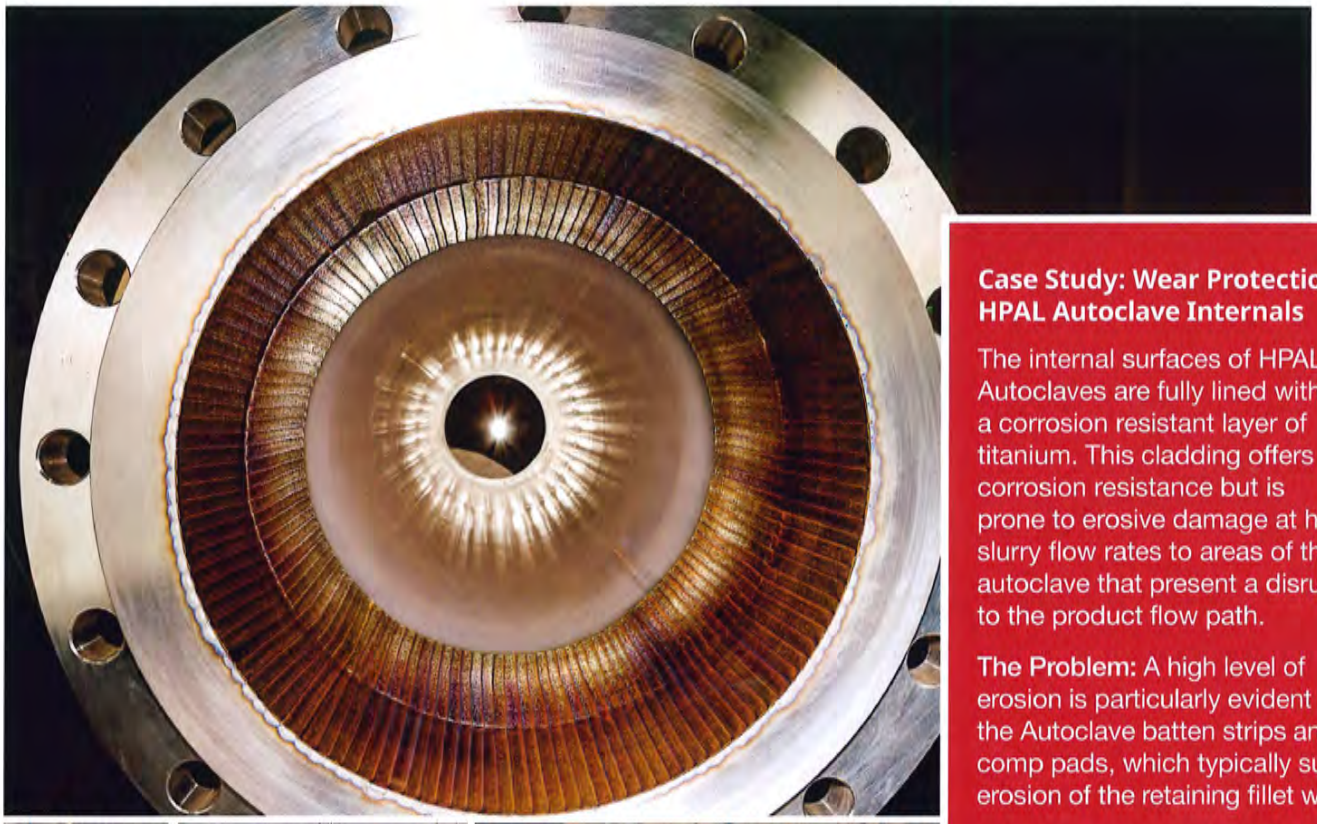
"In duplex and super duplex, we started with a high corrosion resistant matrix and added elements to improve its wear performance. We actually found that when some alloys precipitate, they turn into carbides that offer improved corrosion and wear resistance."

"We've also been looking at how to get titanium to last longer. Many years ago, after a plant shut down, one of my customers said to me, 'I just replaced every piece of titanium in the plant, at a cost of over $400,000—it just isn't viable long-term. Surely there has to be a better way.' So we looked at whether we could purposely contaminate titanium to give it better wear performance. After all, when you weld titanium, it goes hard. We figured there had to be a way to create a hard layer that was still serviceable," said Lantzke.

CWS now has two titanium hard-facing robots working day in, day out. The titanium nitriding process can be manipulated to provide a specific hard-facing layer with 375 Vickers (HV) through to 900 HV and anywhere from 1mm to 10mm thick. CWS is able to design titanium nitride coatings that are customised for specific items and processes.

Last year, CWS commenced a joint collaboration with AusIndustry and Deakin University, entitled 'Towards the Optimisation of a Novel Titanium Surface Modification Process.' "We are looking at how to take a process that we have already developed, make it tougher, and then apply it to other industries—not just industrial and mining—but military, marine and aeronautical applications as well," said Lantzke.

"We completed stage one of the collaboration project with Deakin University last year - refining a process that CWS has been developing for years. We know the process works—we've trialled it in-situ. Our clients were telling us that



they wanted to use it so we knew the process worked, but we didn't really know why."

"The results of stage one were so interesting that we couldn't deny moving forward. The results gave us enough information to immediately strengthen and improve our product, and opened up discussions around how to introduce alloying to the titanium nitriding process to create a brand new process and alloy."

"We're hopeful that the project will spawn two or three patents related to new overlays and surface engineering processes and products," said Lantzke.

According to Lantzke, more Australian companies must look towards innovation—as CWS has done—in order to survive, "To us, the standards and specifications are just a minimum level of acceptability. If Australian industry focuses on just bare compliance, we'll be no better than our overseas competitors. Australia needs to focus on technological, high-end advancements, and on being better than just average."

"If we do that, novel, inventive businesses will spring up that are able to offer their customers a real competitive advantage. That's where Australian industry has to go."

Case Study: Wear Protection of HPAL Autoclave Internals

The internal surfaces of HPAL Autoclaves are fully lined with a corrosion resistant layer of titanium. This cladding offers corrosion resistance but is prone to erosive damage at high slurry flow rates to areas of the autoclave that present a disruption to the product flow path.

The Problem: A high level of erosion is particularly evident on the Autoclave batten strips and comp pads, which typically suffer erosion of the retaining fillet welds.

The Solution: To reduce the rate of erosion, areas that are prone to erosive wear are coated (using an advanced thermal spray process) with a 300-500 micron layer of Titanium Dioxide with a typical coverage width of 70mm, allowing a minimum of 25mm each side of the fillet weld face.

The Result:

- Erosion reduction of titanium clad is 72%.
- The time frame for weld repairs inside the autoclave was reduced from 168 man hours to just 48 man hours.
- There has been no unplanned erosion breaches in 6 Years.
- The customer was extremely impressed with the performance of the applied TiO2 and have implemented trials in other areas of the clave to combat pit corrosion.
- TiO2 has also exhibited excellent results when applied to the wear areas of autoclave agitator blades.

For further information, contact CWS on (08) 6241 0799 or visit http://callidusgroup.com.au.