



No Fools Gold Here

Unique operating conditions drove designers and manufacturers to use explosion welded titanium clad for the world's largest pressure oxidation gold autoclave.



EXECUTIVE SUMMARY

Polymetal International, one of Russia's largest gold producers, required an expansion of their existing gold processing facility in Amursk, Eastern Russia. In order to double their production capacity and to treat a high refractory ore type, a new pressure oxidation autoclave is being constructed to process the concentrate from the orebody. Explosion welded titanium clad vessels give the hydrometallurgical designers a more economical, reliable solution when high temperature and high pressure operating conditions exist.

CHALLENGES

Pressure oxidation autoclaves require very specific lining systems that protect the vessel from corrosion and abrasion. With lower operating temperatures, a carbon steel pressure vessel is initially lined with a corrosion resistant membrane. Then an acid resistant brick lining system is installed to insulate and protect the membrane from process temperature and abrasion. These refractory lined autoclaves face various challenges: higher maintenance costs, larger vessels to accommodate the thick refractory lining, and lower service temperatures due to lining stability limitations. Also, the down time associated with brick lining maintenance and relines result in significant loss of production availability.

Polymetal wanted to increase their total production capacity by 200,000 tons per annum of gold concentrate from multiple mines in Eastern Russia and Kazakhstan. A new autoclave circuit was required to process this material.



It's not just about capital cost – as process conditions get more severe and operating temperatures increase it becomes more practical to use explosion clad titanium construction, and more economical over the life of the operation.”

– Murray Pearson, P.Eng., MBA
Director, Technology Development Metallurgy
Hatch

SOLUTIONS

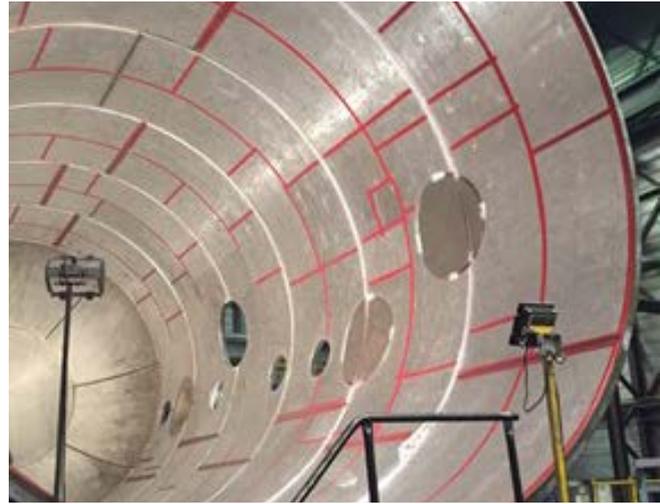
The unique operating conditions required to process these sulfide minerals and achieve high gold recovery require higher temperature and pressure.

Given the severe operating conditions for this autoclave, it was not practical to use a refractory lining system. It would have increased the size of the vessel beyond what was practical to construct and transport, and it would have limited the process volume of the vessel. The solution at hand was to construct a titanium clad vessel made from explosion welded clad plate.

Explosion clad autoclaves do not require a refractory lining. This is due to the corrosion resistant alloy, typically titanium, which acts as a corrosion barrier. While titanium, tantalum, specialty stainless steels, or nickel alloys can be bonded to carbon steel, titanium is the preferred alloy for pressure oxidation vessels due to high performance, ductility and lower total cost of ownership over the life of the asset.

Titanium clad lining systems offer excellent corrosion resistance to oxidizing environments and can be in direct contact with the process environment, resulting in lighter vessels.

This allows design temperatures up to the limitations of the pressure boundary materials – up to 315°C (600° F) for C-Mn-Si steels for example, as permitted by the ASME Boiler and Pressure Vessel Code Section II, part D and Section VIII Div 1. and Div. 2.



Top:
Pressure oxidation vessel
construction at Coek Engineering



“There was a mutual agreement on the criteria for building this vessel. The technical requirements drove us to use explosion welded titanium cladding. It is the best technique if you want to use titanium as a protective layer.”

– Murray Pearson, P.Eng., MBA
Director, Technology Development Metallurgy
Hatch

RESULTS

The autoclave vessel design was driven by the conditions needed in order to process this concentrate. The client’s decision to use explosion bonded titanium clad construction was also supported by Hatch engineers who were responsible for the design and build.

This vessel will be the largest pressure oxidation autoclave in the world. It is approximately 5.75 m (18.8 ft) in diameter and 50 m (164 ft) in length, with a fabricated weight of 990 tonnes (2.18 million lbs.).

Hatch was adamant in choosing partners with the most experience in the industry relating to this type of construction. NobelClad would provide the explosion welded titanium clad plate and Coek Engineering would undertake the construction of the autoclave. Quality control and long-standing relationships fuel this partnership. All three companies have been working together for over 25 years by delivering quality engineering, manufacturing, and fabrication of unique materials to end users.