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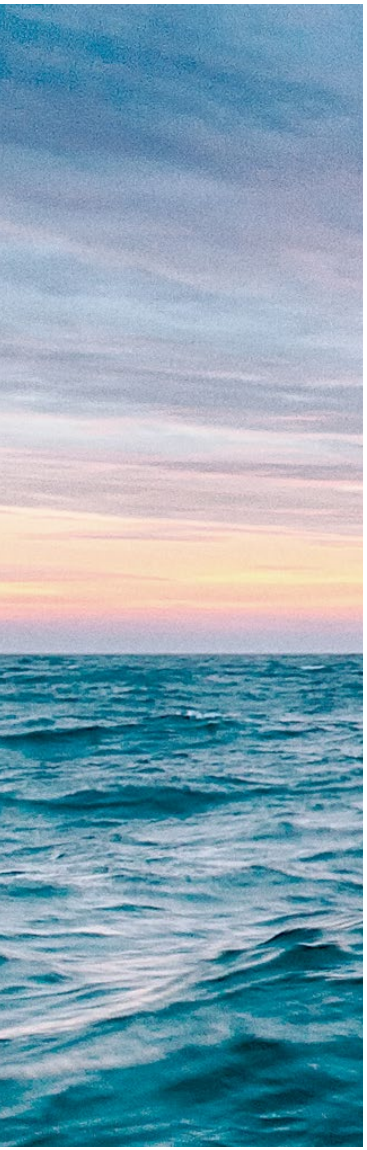
Corrosion resistant alloys for oil and gas infrastructure

North America's oil and gas supply chain has a global outlook, with energy companies and engineering specialists designing and specifying systems for projects around the world.

Rodrigo Signorelli, lead technical manager for marine and energy, and Rick Duncan, product manager for pro coil and quarto plate answer some questions on how Outokumpu's corrosion resistant alloys are helping the sector deliver world-class solutions and adapt to the growing need for environmental sustainability.



What do oil and gas customers need from corrosion resistant alloys (CRA)?

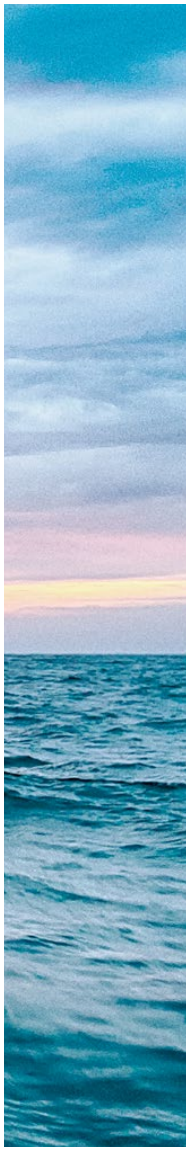
Engineers face the challenge of choosing the most appropriate CRA and product form, achieving the right certifications and meeting project timelines for risers and flowlines, umbilicals, control lines and other applications.

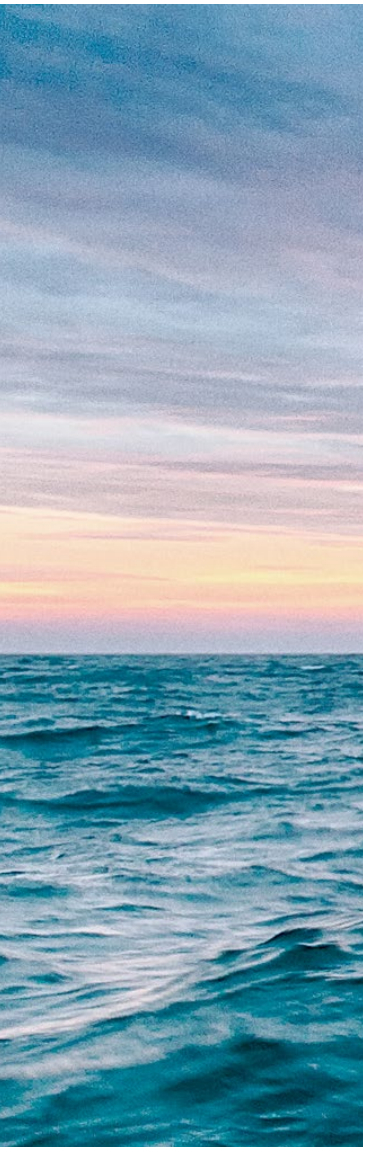
Our alloys provide the vital combination of corrosion resistance and strength. In the field this delivers safety, long life, process continuity and control of risk for assets such as pipelines, control tubing, umbilicals, downhole fittings like band straps and band clamps as well as topside structural and other applications. It's also important to deliver product to meet tight physical, mechanical and dimensional tolerances.

We provide local technical support from our global technical team, including our mill at Calvert, Alabama. This includes assistance with alloy selection so that oil and gas companies will choose cost-effective materials that give them the right level of performance for their applications.

We can also help customers set technical specifications, select the appropriate level of cleanness, or deliver a particular edge finish.

From a commercial point of view, availability, lead time and quality certification can be as important as sourcing material at the right price. That's where it's helpful to be a global supplier with over 20 years' experience in oil and gas. We have multiple supply routes and can therefore deliver product to meet our customers' ambitious lead times. In addition, we hold quality certifications from industry bodies such as NORSOK and NACE.





What factors influence alloy selection?

Typically, we find that the specifications for CRA vary widely. That's partly because the corrosivity of oil differs by region, as some fields have a higher hydrogen sulfide content, making them sour. Plus, as wells go deeper, they get hotter and more corrosive. Oil and gas fields also become progressively more acidic over time as carbon dioxide (CO_2) content rises and forms carbonic acid.

Pipelines are an important area for us. In clad or mechanically lined pipe (MLP), the CRA is used as a thin layer to provide chemical protection inside a carbon steel host pipe. The choice of alloy depends on the corrosiveness of the oil product.

For clad pipe, we deliver quarto plate up to 70 mm thick to specialist rolling mills. They combine it with a thicker carbon steel backing plate to produce metallurgically bonded plates. These are then processed into pipe and fittings at tube and pipe mills.

Alternatively, for weld overlay production, we provide coils or sheet for welding into carbon steel shells. And similarly, our flat products are formed into liner pipes for MLP. These are mechanically pressed into carbon steel backing pipes.

Conversely, for flexible pipe for offshore projects, customers are more likely to specify duplex grades in the form of strip 25 mm to 200 mm wide and up to 4 mm thick.

Duplex grades provide both strength and chemical resistance. And because we produce the strip to extremely tight dimensional tolerances, our customers can form it into special profiles that are twisted into interlocking spirals to form the inner layer of flexible pipe.

What grades are suited to oil and gas environments?

We provide a range of alloys, starting with austenitic grade 316L, or even its higher corrosion resistance version with 2.5% molybdenum.

For offshore applications, alloys such as Ultra 6XN and Ultra 254 SMO may be suitable. The latter has a price advantage compared with other 6Mo grades as it has relatively low nickel content. And for sour environments, alloys such as Ultra 904L and Ultra Alloy 825 work well.

When high strength is required, a duplex or super duplex grade might be suitable. Forta LDX 2101 is suitable for less corrosive environments. When requirements step up, Forta DX 2205 and Forta DX 2304 may be more appropriate, whereas super duplex grades of Forta SDX 2507 and Forta SDX 100 provide the combination of excellent corrosion resistance as well as high strength.

Figure 1. Laying an offshore gas pipeline on the seabed.

How do you support the market for umbilicals and tube?

A broad range of grades is used in umbilicals and for hydraulic or pneumatic control lines, as well as for chemical injection lines.

This is a growing market for us as many operators are switching from seamless tubing to long seam welded (LSW) tubing. The logic is that tube mills can produce LSW tube in much longer continuous lengths, helping to control risk of leakage from the regular butt-welded joints needed with seamless tube.

To support the market, we provide alloys in strip form up to a maximum of 5 mm thick and at least 25 mm wide.

What's Outokumpu's experience with certifications and specifications?

Because our alloys are used in safety-critical applications, we can demonstrate their quality with certifications from bodies such as NORSOK and NACE. This provides our customers with traceability and assurance in the consistent high quality of our production.

The other aspect of quality is meeting complex technical specifications. Every energy company, fabricator and EPC (engineering, procurement and construction) contractor has its own set of specifications and company standards. These cover alloy composition, industry standards and certifications, as well as mechanical properties and tolerances. When combined, the resultant specification can be quite complex.

Over the decades we've been supplying the industry, we've developed strong project management and communication tools to ensure that we meet each customer's unique requirements.

Learn more about stainless steel for the oil & gas industry:

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How can Outokumpu help the oil and gas industry meet climate objectives?

Sustainability is a major driving force in industry, with some energy companies setting an objective to achieve net zero operation by 2050 and others facing tightening regulation from governments.

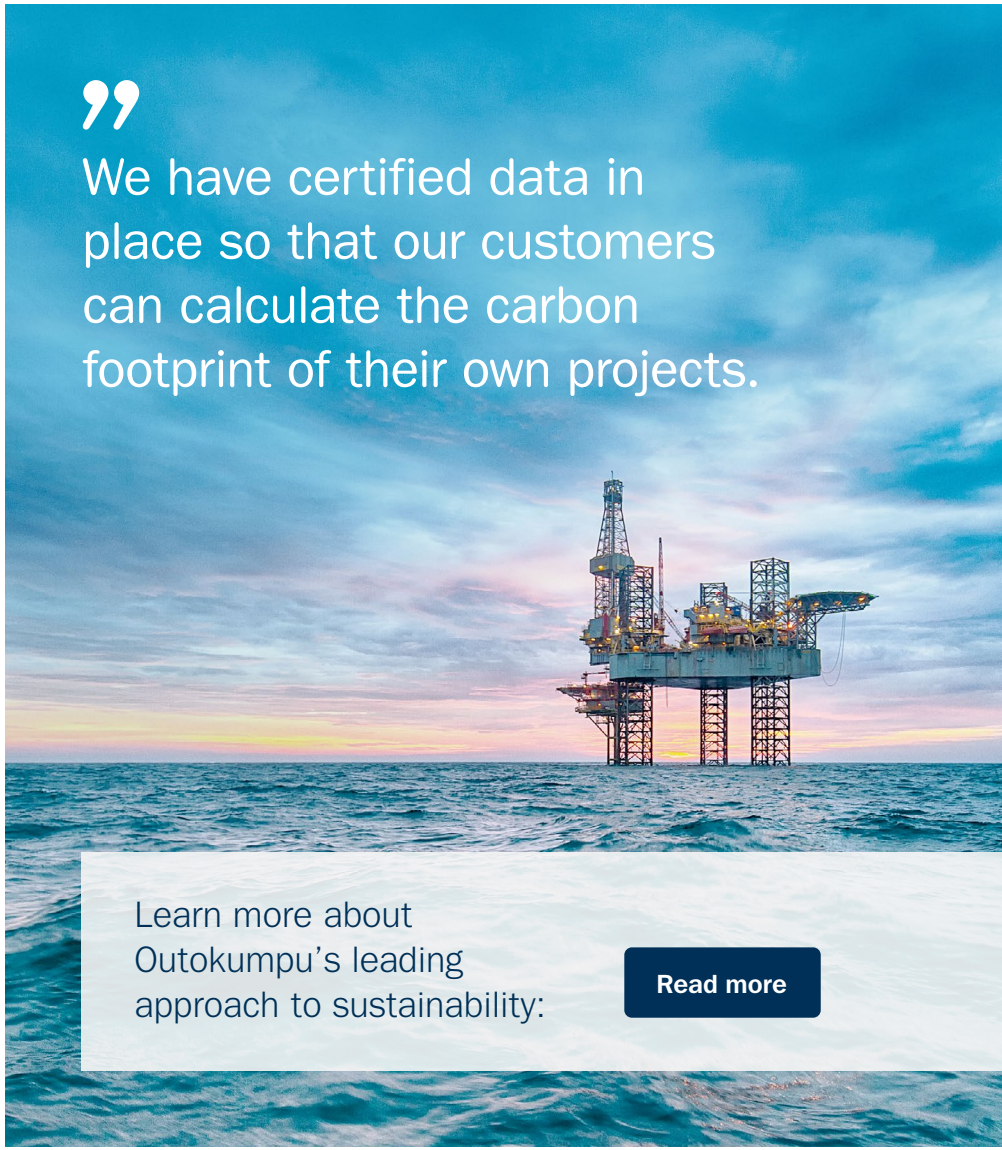
We're already seeing oil and gas companies make major investment decisions based on the carbon footprint per barrel.

As the industry focuses more closely on sustainability, it's likely that carbon dioxide (CO_2) emissions embedded in materials will become as important as price and lead time.

As a supplier of stainless steels and other alloys, we're already ahead of the curve when it comes to carbon footprint. We have certified data in place so that our customers can calculate the carbon footprint of their own projects.

Our carbon footprint is 30 percent lower than the average. That's partly due to our use of low-carbon electricity to power our mills and electric arc furnaces. However, it's also thanks to our use of recycled scrap. According to the Fraunhofer Institut in Germany, every tonne of austenitic scrap saves 4.3 tonnes of CO_2 emissions as it eliminates the energy-intensive processing of raw ore.

The oil and gas industry is yet to develop a mechanism that places a financial value on carbon footprint. However, we have already developed certifications, processes and data to help customers navigate the sustainability challenge.



About the authors

Rodrigo Signorelli is is based in São Paulo, Brazil, and is a materials engineer with a wealth of experience in applying stainless steel in industrial markets, he provides technical advice and support to customers across the world. He has played a key role in launching new stainless steel grades in his career, as well as promoting both long and flat products.

Rick Duncan has been in the high-performance alloy business for over 45 years. He joined Outokumpu Stainless USA in 2020, having previously provided management and technical sales support at Rolled Alloys. Prior to this, he developed his career in specialty alloys through commercial and technical sales roles at ATI Allegheny Ludlum and PCC Special Metals. He holds a double major in Metallurgy and Public Policy from Carnegie Mellon University, as well as a Masters in Business.

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