



Duplex stainless steels bring new opportunities

Duplex grades of stainless steel were once relatively rare in North America but the market is now maturing. This is creating new potential to cut the costs and enhance the sustainability of storage tanks. However, it's also an opportunity for fabricators to open up new markets.



Interest is growing from operators of refineries, chemical, petrochemical and processing industries across North America to the use of duplex stainless steel in place of carbon steel or austenitic stainless steel for bulk storage tanks.

While interest is growing, it is not new. An ethanol producer in Lima, Ohio first installed tanks based on Forta LDX 2101 for storage and fermentation in 2007. There are also countless other tanks around the world using the same material.

However, adoption has so far been limited in North America as the market for duplex stainless steel is relatively undeveloped. That has created an opportunity for tank operators, engineering consultants and fabricators to lead the way.



Corrosion resistance for process continuity

Like other stainless steels, duplex grades have inherent corrosion resistance that provides protection against the chemicals being stored inside the tank. This is a major advantage compared with carbon steels that require coatings.

Eliminating coatings provides significant value over the life of a tank. It enhances safety as even a small scratch on a coating will expose the underlying carbon steel to corrosive media. Left unchecked, the resultant corrosion can lead to the sudden catastrophic failure of the tank, with risk to the health and safety of workers as well as process continuity and reputation.

Scratches in coatings are notoriously difficult to spot during inspection and maintenance. This requires taking the tank out of service regularly before draining and cleaning it.

By building a tank from duplex stainless steel, an operator achieves operational savings and protects process continuity and efficiency. They also gain flexibility in use as the duplex stainless steel tank can be drained down to store many other fluids without having to switch to a new type of coating.

High strength for weight savings

The other main benefit of duplex stainless steel is its high strength compared with common austenitic grades of stainless steel such as 304 or 316. That makes it ideal for the shells of storage tanks that are designed according to the API 650 standard. This standard enables engineers to use high-strength material to reduce the thickness of walls for tanks of five meters diameter and larger.

High strength means that engineers need less material to provide the same structural support, so they can design tanks with more slender walls. This reduces the amount of material used in the tank, and also saves the lifting and handling requirements during construction, as well as the time and filler material required for welding.

Corrosion resistance also contributes to weight savings as tank designers can cut out the 1–2 mm corrosion allowance required for carbon steel tank walls – a significant saving for large tanks.

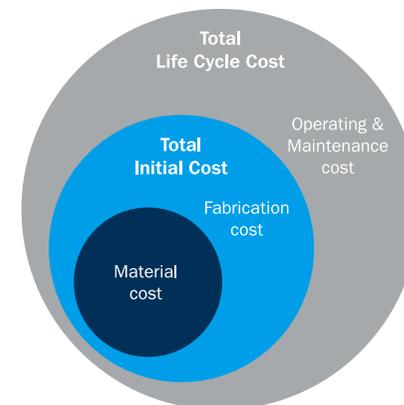


Fig. 1. Initial cost is just a fraction of the total life cycle cost of a structural material.

Sustainability

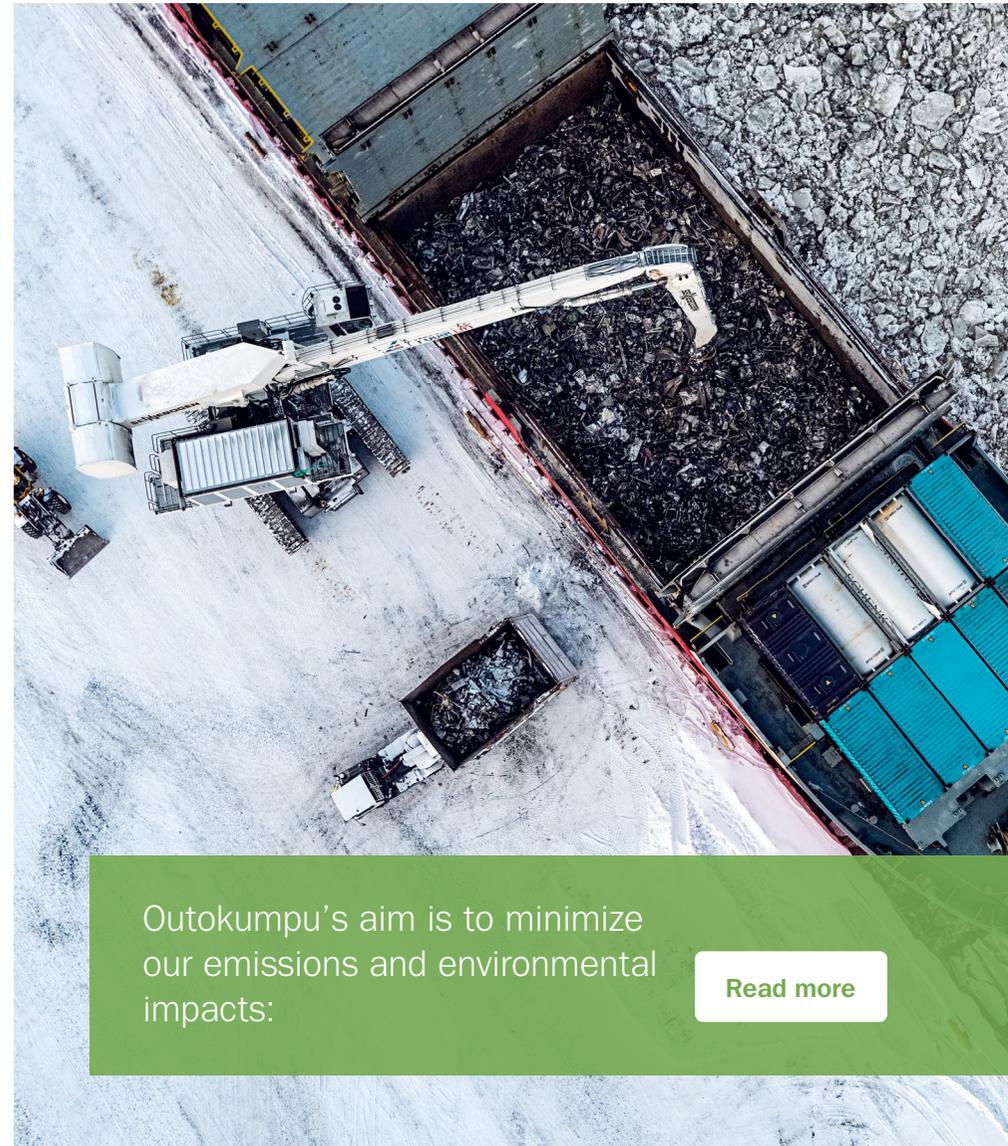
From an environmental point of view, reducing the amount of material required will save the carbon dioxide (CO₂) emissions associated with stainless steel production.

And by choosing Outokumpu as a supplier, operators can further increase their CO₂ savings. We are the lowest-carbon stainless steel producer, thanks in part to the advanced energy efficiency measures we have in place at our mills.

However, it's also thanks to basing at least 89 percent of our production on recycled austenitic scrap. This avoids using energy to process virgin ores during our production. According to the Fraunhofer Institut in Germany, every ton of austenitic scrap cuts CO₂ emissions by 4.3 tons.

As we stand in 2021, the chemical, petrochemical and processing industries have not yet developed a technique for placing a dollar value on a ton of CO₂ emissions. However, political pressure is growing fast to control emissions and hit ambitious climate targets. Therefore, it may not be long before operators can assign a specific financial value to having a smaller carbon footprint.

And whatever method operators develop to value CO₂ savings, it will rely on accurate data like that in our Environmental Product Declarations (EPDs).



Outokumpu's aim is to minimize our emissions and environmental impacts:

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Fig. 2. Unloading of recycled content from a ferry at the port of Tornio.



The opportunity for fabricators

In theory it's possible to deliver a tank in duplex material at a lower cost than a conventional stainless tank or even a carbon steel tank. This depends on the size of the tank and the product to be stored inside it. However, in practice, it is not always possible to achieve this.

One aspect that held the market back in the past was availability. However, the market is maturing fast. Multiple North American mills have started producing duplex grades in recent years and are now providing distributors with a steady supply of quarto plate and flat products.

The next step is for fabricators to develop the same expertise and familiarity in working with duplex grades as they have with more common austenitic and ferritic grades.

A lack of familiarity has led fabricators to add a price premium when quoting for working with duplex materials. This allows their operators to spend more time on the project – but the higher costs can discourage engineers from specifying duplex grades. As a result, operators are missing out on the long-term operational and financial benefits from material savings and process continuity.

There is now an opportunity for fabricators to become the go-to experts in duplex grades by learning more about the family of alloys, adjusting working practices to suit and setting competitive prices to win projects. Not only against other duplex fabrication, but across carbon and classic stainless as well.

Peder Claesson, Head of Project Sales at Outokumpu, explains how biofuels and chemical industries can benefit from long-lasting storage tanks with a low lifetime cost:

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Why duplex stainless steel is different

Duplex stainless steel requires slightly different handling during fabrication compared to its more commonly-used cousins, austenitic and ferritic stainless steels. It is the appropriate mix of these two that makes duplex, duplex.

Ferrite provides the high strength and resistance to chloride stress cracking in duplex. Austenite not only improves general corrosion resistance and toughness, it increases pitting and crevice corrosion resistance.

Duplex stainless steels are made of a mix of both of these microstructures. The combination of the two phases provides the best of both worlds: high strength and corrosion resistance

Fabrication with duplex grades

It's important that fabricators recognize the two-phase microstructure when working with duplex grades. They need to take care in two areas – both are easy when you know how – it's a matter of applying slightly different guidelines.

With careful control of weld parameters and forming technique, the final product retains all the properties the customer is seeking with duplex. Working with duplex should be little more than working with conventional stainless. Different, not difficult.

Outokumpu stainless can provide the assistance you need to make the transition.





Supporting engineering consultants and designers

At the same time, it's worth engineering designers and consultants becoming more familiar with duplex grades.

To help operators in North America explore the potential for the duplex family, we recently updated our online tank calculator tool to provide tank sizing data based on the API 650 standard and with an option of metric or imperial units.

This tool is part of our Stainless Steel Finder and is designed to help tank designers compare material requirements with various duplex, austenitic and carbon steel grades. It integrates data on material properties with an algorithm that calculates the minimum thickness required for plates to withstand hydrostatic pressures at every point in the tank.

As an output, it provides a profile showing the number and thickness of plates required to build a tank, as well as a figure showing the potential for material saving.

While this is a useful first step in design, we can also provide a more detailed evaluation with a more sophisticated offline version that takes account of more parameters.

Duplex stainless steel offers exciting prospects to reduce the Total Cost of Ownership (TCO) of bulk storage tanks. With growing availability in the North American market, duplex is set to become the material of choice.

Explore our storage tank online calculator. Calculate and compare material options for storage tanks:

[Open the calculator](#)



Working towards a world that lasts forever

We work with our customers and partners to create long lasting solutions for the tools of modern life and the world's most critical problems: clean energy, clean water, and efficient infrastructure. Because we believe in a world that lasts forever.



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