



Outokumpu: Focus on lifecycle costs, sustainability & standards



Bernd Beckers: "The initial cost of the material in the context of an entire project is just a tiny percentage."

As the world's largest single producer of duplex stainless steels, Outokumpu is an integral player in the global market. It was the first company to produce a commercial grade duplex back in 1931. Today it continues to drive ahead innovative new uses for its range of duplex grades such as tanks and pressure vessels, rebar and bridges. Stainless Steel World recently spoke to Mr. Bernd Beckers, Head of Global Segment & Product Marketing, and Mr. Peder Claesson, Product Manager Forta (including duplex), about the company's duplex activities. Their focus on lifecycle costs, sustainability and updating standards to include duplex are important factors in driving ahead the adoption of these materials in an increasingly wide range of applications.

By Joanne McIntyre



Peder Claesson: "In selected applications duplex could be workable down to -60 or even lower..."

In Ghent, Belgium, two new bridges for cyclists are under construction utilizing 1600 tons of stainless rebar 2304. The bridges are expected to open in March 2018.

There is no doubt that duplex stainless steels are truly 'all round' materials that play a critical role in a wide range of applications. Originally developed for the chemical and pulp & paper industries, these versatile materials have also long been adopted in the oil & gas and sub-sea sectors. Today they are also enjoying increasing popularity in infrastructure and construction, as well as for tanks and pressure vessels. The superior lifecycle cost of duplex combined with its high strength and corrosion resistance and sustainability are factors that are opening doors to many applications.

ABC sector

"The architectural, building and construction (ABC) sector is the biggest growth market for duplexes", explains Mr. Beckers. "Lean duplex can replace carbon steel solutions with the benefits of high strength and corrosion resistance plus a lifecycle cost advantage. In coastal areas in Asia there is a trend to use a combination of duplex and carbon steel rebar. The duplex rebar is used in the outermost areas of a structure and carbon steel is used as normal in the middle. It's been proven that adding just 2% duplex rebar can increase the lifespan of a structure by up to 300 years!"

A great example is the use of stainless steel rebar in bridges. Mr. Beckers: "People are frustrated with traffic disruptions caused by infrastructure problems which impact commuters' daily lives. Here in Germany a high number of bridges are rated as insufficient to carry heavy loads so restrictions are imposed including fewer lanes, speed limits, weight restrictions or even bridge closures. There is an increasing understanding that we need to find better solutions to cope with today's requirements. Duplexes not only greatly extend the life of bridges but also reduce the maintenance required over the years. The bridges and infrastructure market shows interesting potential across the globe and we have many ongoing projects for stainless rebar in bridges, coastal protection and other infrastructure."

An example is the intermodal connector project in Norfolk, Virginia (US) which is utilizing over 500 metric tons of Forta DX 2304 duplex stainless steel concrete reinforcement for highway bridges in the coastal area near the Port Of Virginia.

"Adding just 2% duplex rebar can increase the lifespan of a structure by up to 300 years!"

Mr. Claesson adds: "Another example is the Söderström bridge in Stockholm, Sweden. This is a repair project on an existing bridge in the center of the city. We are supplying Forta LDX 2404 as both flat stainless steel products and prefabricated components as hollow sections from our plate service center, PSC Nordic in Degerfors.

The sections are welded together to produce long beam arcs. The girders are then replaced one by one while the traffic is still crossing the bridge; only some lanes of traffic need to be closed as work is carried out. Supplying prefabricated modular sections significantly speeds up the installation process and minimizes disruption to this inner city bridge."

Duplexes are making rapid inroads into the construction market without affecting the market for stainless steels, explains Mr. Claesson. "Traditionally bridges were built using a carbon steel and concrete sandwich construction

and today these are made with concrete and with duplex rebar. So duplex is directly replacing carbon steel; it's not cannibalizing stainless steel applications."

"In the architecture sector there is greater awareness of lifecycle cost thinking. There are also environmental factors such as avoiding coatings and maintenance work which is driving demand. Not only is it extremely unpleasant to work in a closed environment such as recoating inside a tank, it's also dangerous. Company health and safety executives have a strong interest in avoiding such work where possible and the safest maintenance work is that which doesn't need to be done. Duplex definitely has a role to play here."

Focus on lifecycle costs

The suitability of duplex in replacing carbon steel means it extends the lifetime of critical parts, for instance in constructions in splash zones close to the coast, or for parts of road bridges that are exposed to de-icing salt. That is achieved by substituting critical parts which can represent 2 – 5% of total steel consumption. For these components it could extend their lifetime from 30 to 40 years to 120 years or even more, representing a huge advantage on the overall lifecycle costs.

"The initial cost of the material in the context of an entire project is just a tiny percentage," explains Mr. Beckers.

"The lifecycle cost of duplex is the driving force and it supports steel as a sustainable solution because, while we substitute the mild steel parts susceptible to corrosion with duplex, the efficiency of the carbon steel for the non-critical parts will still be met. You could almost say you improve

Sustainability

Sustainability is an issue Outokumpu takes very seriously and it forms part of the company's annual report. The company has yearly targets to reduce its carbon footprint in production year after year. It also has targets for the amount of recycled content used and is proud to be at the forefront in the industry with an average scrap proportion in its stainless steel of 85%+. Outokumpu has reduced direct per ton CO₂ emissions by 25% over the last decade with a target to achieve a further 20% reduction by 2020.

Lightweight tankers

Technoimpianti Apm (TiApm), an Italian road tanker manufacturer, produces tankers for special applications. They have been working on 19 LPG road tankers for use in the Nordic countries. The selection of Forta LDX 2404 allows the tank to be 2 mm thinner which accounts for a 1.2 ton (20%) lighter semi-trailer compared to the original carbon steel design. Forta LDX 2404 is a molybdenum-containing duplex with high contents of chromium and nitrogen. The grade combines a higher mechanical strength than other common duplex grades with a generally high corrosion resistance. A lighter tanker means an increase in the weight of transported goods, resulting in lower shipping costs per kg and mileage and an overall reduced carbon footprint.



The Sheikh Jaber al-Ahmad Al-Sabah Bridge in Kuwait: 1,600 metric tons of stainless steel rebar Forta DX 2304 was used for the 36 km long causeway project. The bridge is expected to be in service by the end of 2018.

the competitiveness of carbon steel by selectively using stainless steel on critical parts."

A good example is Outokumpu's recently delivery of duplex for the two locks, or spillway gates, in the upgraded Lossendammen dam structure in Central Sweden as part of a 3-year project. Originally built 50 years ago, Lossendammen is part of the critical infrastructure in Sweden. Harsh climate conditions and constant contact with flowing water called for robust solutions. The dam can hold an impressive 500 million cubic meters of water, and it serves 17 hydropower plants along the River Ljusnan. Outokumpu's high performance Forta LDX 2101 duplex stainless steel was chosen for the two arched locks. The grade has high

strength and high resistance to stress corrosion cracking and corrosion fatigue, yet good weldability enabling the desired arched shape. Forta LDX 2101 also enables thinner structures and therefore weight reductions without compromising safety.

"In the UK the Steel Construction Institute is developing Steel Construction Guidelines, translating the standards into formulae that engineers can apply and outlining how we can make use of the strengths and benefits of stainless steel in structural components. This is important work and we are privileged to support this venture with both manpower and funding to enable the Institute to achieve this excellent task. A new design manual has been published to which both duplex and lean duplex have been added."

Developing industry standards

Outokumpu has worked closely with standards authorities for many years to support the development of new standards. "Getting our lean duplex grades included in the German national building standard has proven to be a door opener," explains Mr. Beckers. "Increasingly, engineering companies see high strength duplex steels as an alternative for structural engineering applications, for example storage tanks. In the early days there were some pioneers, for instance Dutch tank builders, who realised the potential of duplex and lean duplex in the construction of large storage tanks and we were supportive in this. To begin with they were just seeking approval for a specific tank on their own, with support from us. We were creating the first reference cases with those tank building entrepreneurs.

Only after the work on setting standards - particularly getting them considered in API 650 - did this business really take off and there is huge potential for storage tank applications.

We have a similar situation in Germany with duplex in construction applications. The groundwork has been done and more engineering companies and fabricators are considering the benefits of duplex stainless steels and are changing their drawings to reflect this. Duplex grades 2205 and 2304 have been included in the German standards for some years, and now so are the



The use of prefabricated modular duplex components allowed the Söderströmbron bridge in central Stockholm to remain open to traffic during repairs, minimizing traffic disruption.



The intermodal connector project in Norfolk, Virginia is utilizing over 500 metric tons of Forta DX 2304 duplex stainless steel concrete reinforcement for highway bridges in the coastal area near the Port Of Virginia.

lean duplexes. Now that fabricators can purchase the duplex from a distributor and make their components this sector is rapidly growing."

Mr. Beckers explained an interesting urban restructuring project currently underway in Munich, Germany where a former industrial area is being transformed into a residential district. "The old production halls have been converted into living accommodation, event venues and shops. The architects and developers are keeping the charming character of the industrial buildings but making them comfortable for living. This requires putting ceilings in, adding structures inside and out such as beams, stair cases and balconies. Having consulted with us, the architects and engineering companies see that lean duplexes prove to be the ideal material as it is light and maintenance free. Looking to the future there is further, ongoing standardization work to be done for fastening elements such as screws and bolts. We are also contributing to this and it will be finalised soon. This will complete the picture as we will have not only the component itself but the fastening elements too, covered by the standard."

Outokumpu is also participating in a number of field testing programs to help demonstrate how duplexes can be used once standards are in place. "Specifiers and end users are keen to understand how duplexes perform in a specific environment, for example de-icing. We need to make people understand

that it's not only the initial cost that has to be taken into account when choosing a material for a project, they must also look at the life-cycle cost as well."

Breaking through the temperature ceiling

Duplex is the fastest growing alloy group in Outokumpu's product portfolio and it still has enormous potential. The company is now looking at whether the temperature range in which these versatile materials can be deployed can be extended.

Mr. Claesson: "The process, petrochemical and chemical industries could offer many opportunities for duplexes. Current field testing of duplex at temperatures exceeding the upper barrier of 250 / 300°C are ongoing. We're also working on the low temperature range; in some cases the -40°C limit may be too conservative and there's room for accepting even lower temperatures."

"In selected applications duplex could be workable down to -60 or even lower. It's very much about knowing what you are doing. The material is impact tested at -40°C and the testing could give a value clearly higher than the required minimum which indicates a margin to be able to use it at a lower temperature without any risk."

"These tests are being done in cooperation with end users and standardized tests to see if the limits are too conservative. The demand is coming from industry, the end users, who see a need for this."