



FEATURED STORY

In a world of rising prices, duplex appears more attractive than ever

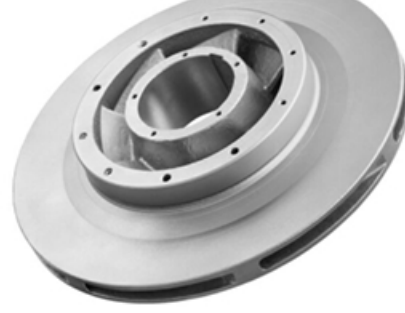
The Tramlink is a bi-directional tram made of duplex stainless steel. This tram runs in Erfurt, Germany. Photo: EVAG_Jacob Schröter.

As inflation once again takes hold, duplex stainless steel can be seen as an attractive alternative to higher-alloyed materials in many applications. This, together with advances in welding and fabrication, may explain why duplex is gaining the interest of a wider range of specifiers.

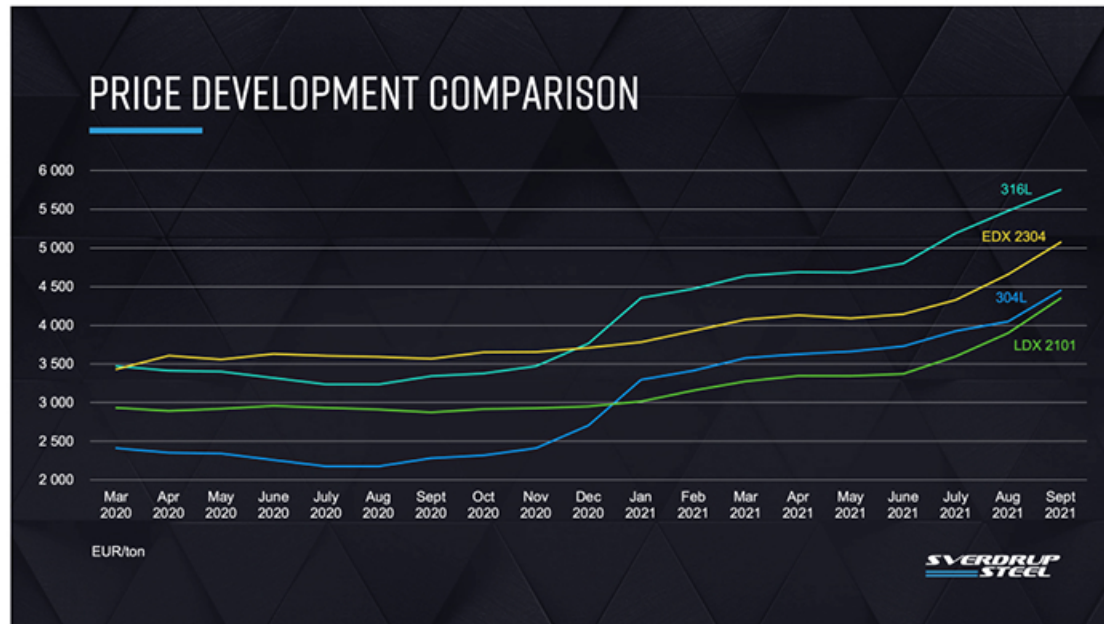
By James Chater

Unwelcome spectre

Those of us who are old enough to remember the 1970s are experiencing an uncomfortable sense of déjà vu. The oil shock of 1970 triggered high rates of inflation, which gradually tapered off in the 1990s. Now various factors, including low interest rates, post-Covid catching up, scarcity of certain raw materials and stretched supply chains, have caused the old spectre to return to the feast as an unwelcome visitor. The post-Covid recovery has led to a dramatic increase in pent up demand for such commodities as fuels (especially natural gas), land, wheat, steel rebar and copper, the prices of which have soared. This applies also to most of the key ingredients of stainless steel and CRAs: in 12 months, nickel rose from around 14,300 USD/T to 20,000 but has since fallen to around 18,000; molybdenum now stands at 41,846 USD/T, up from around 18,836 a year ago; titanium had also rebounded as the aerospace sector emerged from its Covid slump (1). Prices of all steels and alloys have been rising, but it is notable that in the last two years lean duplex has become less expensive than certain austenitics (diagram).



Sandvik broke new ground when it made a WAAM-printed impeller in superduplex.



Price movement of lead duplex and austenitic grades.

Merits of duplex



The WAAM-printed structural connector designed by MX3D and Tokenoa, made in duplex stainless steel.

No one knows if this is temporary or longer-lasting. In either case, it is likely to motivate specifiers to reassess the merits of duplex. With its carefully balanced austenitic and ferritic structures that ensure greater strength and toughness without sacrificing corrosion resistance, duplex is more sparing in its use of expensive alloying elements than nickel alloys or superaustenitics. Moreover, advances in ease of welding or fabrication have further increased its attractiveness. Experiments by Friedlander Contracting International Ortec Group show that it is possible to weld small-diameter and thin-walled superduplex pipes with orbital GTAW, without filler metal, using an orbital closed head welding machine. Posco can now produce welded duplex tubes for tube heat exchangers using the LBW welding process, with no loss of quality compared with the traditional seamless tubes, and with considerable savings of time and money.

Additive manufacturing

The main game-changer is likely to be additive manufacturing (3D printing). Sandvik and its part subsidiary BEAMIT can now 3D-print in superduplex Osprey® 2507 metal powder. In collaboration with Norwegian Eureka Pumps they have produced an impeller that is used in one of Equinor's offshore projects. Norwegian scientists have investigated the possibility of using wire arc additive manufacturing (WAAM) and gained promising results, suggesting that AM and WAAM manufacture of large components in the process industries is not far off. Meanwhile, in the construction industry, Takenaka Corp. and MX3D collaborated on a project

to WAAMprint a structural connector used in large structures. The hollow duplex stainless steel structure filled with concrete was found to be highly effective and economical for safety performance.



UK's first stainless steel road bridge was officially opened on Friday 23 October 2020 over the River Eamont at Pooley Bridge. It was designed by Knight Architects and uses duplex supplied by Outokumpu. Photo Courtesy of Outokumpu.

Applications

Oil & gas

Oil & gas is still the most important market for duplex and superduplex grades. The last few months have seen a resurgence in demand and price, especially for natural gas, which should encourage the launch of new projects. On the other hand, environmental concerns may inhibit further projects or may lead to a preference for natural gas over oil. Duplex is used in several applications: pumps, valves, heat exchanger tubes, pressure vessels and other process applications; also for structural components such as blast walls, where high strength is needed. Sandvik recently introduced SAF 2205™+ for use as bar in the oil & gas industry. It is designed to withstand extreme corrosion and is certified for subsea requirements. Impure elements such as phosphorous and sulphur were eliminated to increase resistance to pitting and crevice corrosion. Recent orders show duplex's versatility. Sverdrup Steel is supplying lean duplex, duplex and superduplex, along with 316L, for the HOD field in the North Sea. When delivering its API 610 V54 vertical pumps and two API 610 OH2 horizontal pumps to the ADNOC Bu Haseer development, Amarith faced two challenges: the very sour environment and restricted space. The pumps were made in superduplex and were split into two sections for reassembly on site. Sour environments are also driving the use of duplex in pipelines. One gas field in China had about 10% chloridion concentration in the water separated from gas, so grade 2205 welded pipe was applied.

Duplex in India

India's ambitious infrastructure projects are likely to be a growing market for duplex stainless steel. The country's railway system has been undergoing an extensive upgrade. Part of this is the new Pamban Bridge, which will connect the town of Rameswaram on Pamban Island to the Mandapam railway station on the mainland and will supersede a structure built over a century ago. It will be of the vertical-lift kind. The location is known as the second most corrosive place on earth. Therefore RVNL, the engineers, specified duplex grade 2205 for the four spans and girders of the new bridge. The engineers have launched a tender for the first 120 tonnes of duplex, and Jindal has stated its intention to bid. The demand for stainless steel in process industries is also increasing. Therefore in 2020 SAIL announced it now has the capability to produce superduplex SS 32205 or use in oil & gas, chemical processing, pulp & paper, food processing and biofuel plants.

Other applications



Weigel+ medical and DOI ortho-innovativ made this prosthetic foot and knee system using superduplex fasteners from Bumax.

be suitable for a prosthetic knee and foot system. The All Terrain Knee and Niagara 109 were designed by Weigel+ medical and DOI ortho-innovativ for those with an active lifestyle. The superduplex screws are resistant to corrosion in a marine environment and have high strength.

Duplex is finding use in petrochemical, chemical, desalination and fertilizer plants, offshore wind turbines, geothermal power and water management. In the case of superduplex grades, high corrosion resistance is the chief criterion, for example in the use of Sandvik's SAF 2507® superduplex grade in a geothermal plant in Brazil. Other grades offer some corrosion resistance and afford a lighter structure, important in building and infrastructure projects. This is the case in a new cyclists bridge in Sydney's Macquarie Park, which uses a double helix form similar to a pedestrian bridge, also made of duplex stainless steel, in Singapore. Another recent bridge made of duplex is the Pooley Road Bridge in England's Lake District. Midway Metals, Stirlings Performance Steels and Vulcan Stainless together supplied 170 tonnes of 2205 duplex, with most of the plate coming from Outokumpu. Because deicing salt is used in winter, corrosion was a concern, so a duplex grade, Outokumpu's Forta LDX 2101, was selected.

Two relatively new applications of duplex are for transport and prosthetics. Bi-directional trams are a new kind of tram developed in order to avoid the complicated structures needed to allow uni-directional trams to reverse direction. They are in use in Amsterdam, Brussels, Erfurt, Gmunden and other European cities. Manufactured by Stadler, they consist of three car bodies made of duplex stainless steel, applied for corrosion resistance and weight reduction. In 2018 nine of these trams were ordered by the city of Lugano in northern Italy. In 2020 Milan followed suit, ordering 80 vehicles for its urban and interurban services. Finally, duplex has entered the field of prosthetics. Bumax SDX 109 highstrength superduplex fasteners were found to

Conclusion

Duplex stainless is being applied over a broader range thanks to advances in fabrication, AM and welding. The current raw materials crunch may also focus end users' attention on the merits of this versatile class of stainless steel.

References

1. <https://tradingeconomics.com/commodity/steel>

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Featured Story by Joanne McIntyre

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Duplex appears in a wider range of applications

2020 has seen a resurgence in demand for duplex stainless steel in the process industry

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