

Strength and corrosion resistance attract customers to duplex

Lean duplex is an interesting material for use in storage tanks, especially in the food and drink industry. These tanks were fabricated by Nirota, using 3D design.

Duplex stainless steel still has only a tiny share of the market for stainless steel. However, customers are increasingly drawn to it because of its favourable strength-to-weight ratio, which allow materials savings of up to 50% compared with austenitics. In this article we take a look at a number applications and industries where duplex use is likely to increase, because of the material's strength and corrosion resistance.

By James Chater

Upside opportunities

With a world market share of around 1%, duplex stainless steels are still underrated. Their market share is higher in Europe (3.9%) than in the America or Asia, but the European economy is especially stagnant at the moment. This means that the main upside opportunities are in the Americas and especially Asia, where the share is only 0.3%.

Duplex
Euro/Africa, 233,000 t, 3.4%
Americas, 20,000 t, 0.9%
Asia, 62,000, 0.3%
Total, 316,000, 1%
(Source: ISSF Crude Steel Survey 2012)

In the Middle East, too, the opportunities presented by both desalination and the oil & gas industry suggest that opportunities for duplex abound. This is why Special Piping Materials opened a new warehouse in the Middle East which specialized exclusively in duplex and super duplex grades - the first company in the region to carry these grades in stock (1).

Many end users are beginning to appreciate that for the same strength, duplex can save material use up to 50% compared with other types of stainless steel. This is an essential advantage at every stage, from welding and fabrication to transport and installation. The benefits include space saving, reduced fuel consumption during transportation and ease of manoeuvring during installation. This is especially true of lean grades, which is why companies like Outokumpu have been especially active in pioneering their development.



Neptune™, part of PSG®, a Dover company The Neptune 500 series of hydraulically actuated “dia-pumps” manufactured in duplex stainless steel.

More duplex in tanks

Duplex use appears to be on the increase in the construction of certain types of tanks (food, dairy, alcohol). Gert Gijssens, of the Belgian firm of Kametal, recently told KCI that more customers are getting to know about duplex and are changing to duplex from other stainless grades. The main attraction is weight saving, but corrosion resistance is important as well. His company recently delivered some duplex tanks to Belarus (2).

Tanks

Duplex is especially interesting for tank construction in the food & drink and dairy business, because of the twin demands of weight reduction and corrosion resistance (see box). Even in a mildly corrosive application such as drinking water tanks, duplex grades such as the lean grades 2304 and LDX 2101 have been specified. One company that has made a specialty out of water storage tanks is PVI Industries. PVI recently installed four tanks 3,000-gallon tanks in an apartment/office building complex in British Columbia, Canada. Each of the tanks will be connected to a plate-and-frame heat exchanger to generate domestic hot water. The tanks are made of a Outokumpu's LDX 2101 lean duplex grade (which PVI has trademarked as AcquaPLEX®). It can withstand temperatures up to 200F, though the recommended maximum temperature is 140F. The water heaters are welded using advanced techniques such as synergic pulse welding machines and six-axis robotic welding. An in-house pickling and passivation process is employed to ensure that the material is restored to its fully passive condition after welding has created a heat-affected zone. This makes the material far more resistant to materials that are susceptible to chloride stress cracking, such as 316L. Another water heating tank made from duplex stainless steel is offered by Lacaze Energies. The water of the solar DHW Coil Cylinder is heated from solar energy or some other source. It has one or two coils made from 316L and has electrical pins made of Incoloy. Duplex is used in several new products that heat water from domestically produced solar energy, including Kingspan's Tribune HE, Heatraesadia's Megaflo and Grant's DuoWave Solat.

Pumps and valves

Pumps and valves need to be able to handle corrosion, erosion, high temperatures and high pressures. At



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the same time, the space where they are installed is limited, meaning that lighter, thinner-gauge construction is an advantage. Duplex and super duplex grades offer this possibility. Outokumpu reports that more easily formable duplex grade FDX™ is proving to be well suited for pump casings. Grundfos is one customer which is hoping that this grade will result in higher performance and shorter maintenance times. Pump maker Ebara is using duplex stainless steel (S32750 and S31803) in its pumps for oil & gas, power generation and desalination to achieve weight saving, longer service life, cost savings and short processing times.

Power generation and desalination are two expanding industries where duplex pumps are widely used. When the Turkish power company Eren constructed its Zonguldak Eren Termik Santrali III thermal power plant, it ordered cooling water pumps in duplex stainless steel from Toroshima. Pioneer Pump has just completed a large order for self-priming pumps for the British Nuclear Group in the UK. The order consisted of a number of 12” and 6” duplex stainless steel vacuum-assisted pump sets.

The desalination industry is growing by about 9% per year. Plant construction is especially intense in the Middle East, Africa and East Asia. China increased its capacity by 16% in 2014, and India is expanding at 19% per year between 2014 and 2019. The saline conditions that predominate in the saltwater intake area necessitate highly

corrosion-resistant grades. There has therefore been a trend away from 300-grade austenitics. Until recently, 6% molybdenum grades were the norm, but recently several projects have turned to duplex, attracted by the weight saving and the opportunity to reduce expensive alloying materials. At first, grade 2205 was the most specified material, but recently Outokumpu has offered lean grades such as LDX 2101® and 2304 for milder corrosion service. Recently a super duplex grade, SAF 2507, was specified at Singspring plant in Singapore (commissioned in 2005), instead of the more traditional 254 SMO. Duplex is used in the pumps most subject to corrosion, erosion and high pressure. The membrane feed pump requires a tough material such as 254 SMO or SAF 2507.

Duplex valves for desalination

A valve company that has been riding the trend of replacing austenitics and superaustenitics by duplex and super duplex is Castflow, a Spanish company that produces valves for the desalination industry. According to Kurt Hillegems, the valves function to protect the very expensive pumps used in the desalination process. He estimates that his company consumes about ten to 15 tonnes of super duplex per year in valve manufacture (3).

A function related to desalination is seawater cooling. Marafiq recently ordered two seawater cooling pumps from Torishima for the Jubail-2 main seawater cooling pumping station in



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Saudi Arabia. The complex also includes seawater desalination, electric power generation, water transmission and water distribution. The pumps' function will be to pressurize seawater for industries in Jubail. They will receive Variable Frequency Drives (VFD) to enable the systems to adjust to fluctuating demand. The major wetted parts will be made of super duplex stainless steel to protect against the highly corrosive seawater.

Scrubbers

Flue gas cleaning of "scrubbing" is another application that is likely to increase as environmental regulations become more stringent. Air pollution is especially a problem in rapidly expanding cities of high-growth

economies such as China and India, and in countries where coal is still the chief source of energy. The Asia-Pacific air quality control systems market is expected to exceed USD 40 billion by 2019, with a projected growth rate of 6.7% per year. Flue gas desulphurization systems are prime users of superaustenitics and (super) duplex stainless steels. Since the beginning of 2015 the US shipping industry has been facing new regulations that require that exhaust gases should contain no more than 0.1% sulphur. This requires a change of fuel, a switch to LNG or the installation of a scrubber, for which the preferred material would be a 6%Mo grade such as 254 SMO or the super duplex 2507.

Building

In the safety-critical parts of buildings and installations, strength is indispensable, as is resistance to severe weather conditions. Fasteners for solar panels have traditionally been made from grades like 304 and 316, but recently lean duplex grade 2304 has been specified because of its higher mechanical resistance, even in welded fabrications. Wall thicknesses can be reduced, leading to lighter, less obtrusive designs.

Duplex is an attractive material for load-bearing functions. The Haynes Inlet Bridge, Oregon, USA, is a concrete structure that was reinforced with duplex 2205 stainless steel bar supplied by Carpenter. It is expected to last 120 years with "literally no maintenance", in spite of the saline and seismic conditions.



A duplex butterfly valve undergoing liquid penetrant inspection to check integrity of casting quality at Wärtsilä Shipman Valves.



In the Star City Casino in Sydney, Australia, duplex 2205 was used to create drum and cone structures that look light and transparent.

Conclusion

This selective survey (we could have included oil & gas, biofuels, fertilization and geothermal) suggests that more and more customers are becoming aware of what duplex can offer. With more grades and products coming on the market, it is only a matter of time before its market share increases significantly.

References

- (1) Interview with Les Buckley of SPM, video, www.stainless-steel-world.net.
- (2) Interview with Gert Gijssens, video, stainless-steel-world.net.
- (3) Interview with Kurt Hilegems, video, www.stainless-steel-world.net.
- (4) Interview with Trevor Fairghurt, video, stainless-steel-world.net.

Expanded valve range



Illustration of a new Wärtsilä Shipharm Valves 8-inch size, 150 lbs duplex butterfly valve.

The importance of duplex stainless was underlined when Wärtsilä Shipharm Valves announced that its entire range of high-pressure valves is now available in duplex and super duplex. This includes including gate, globe, check, ball, and butterfly valves in size ranging from half an inch to 48in. Previously, only its low-pressure valves had been available in duplex. Wärtsilä Shipharm specializes in valves for seawater and other corrosive applications. According to Trevor Fairhurst of Wärtsilä, the company's strongest market had been in valves made of nickel aluminium bronze, but this is now being eroded by duplex and super duplex. The extension of its duplex valve range cost the company 2 million euros, plus three quarters of a million euros spent on refurbishment of its factories (4).