



The role of stainless steel in offshore applications

Stainless steels, including duplexes and super duplexes are of enormous benefit to the offshore oil and gas industry. They offer reduced weight, increased strength and corrosion resistance, and favourable lifecycle costs, compared to other materials.

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Offshore projects are crucial for the production and processing of hydrocarbons around the world. Set up in some of the most extreme environments, offshore activities constitute almost 30% of the world's crude oil production. However, the saline marine environment mandates high safety and longevity standards for offshore platforms. Infrastructure for marine and offshore applications is often susceptible to considerable amounts of air- and water-borne salts. Conventional carbon steel

structures suffer frequent corrosion, requiring regular maintenance and upkeep.

Stainless steel, on the other hand, guarantees to be a robust material choice for heavy-duty offshore applications. The metal is inherently resistant to corrosion, even in marine and coastal environments, and offers a high strength-to-weight ratio for infrastructural applications. Stainless steel also ensures a long design life along with impressive resistance to extreme pressure and

high temperatures. It is noteworthy that by using stainless steel, the life expectancy of offshore structures can be increased by nearly five times as compared to its competitors.

Lifecycle cost

In addition to an enhanced life, stainless steel is further qualified for use in offshore applications by the burgeoning emphasis on minimal lifecycle cost (LCC) in architecture and construction. This concept underlines the strong demand for the development

of new infrastructure that is highly durable and does not require extensive maintenance or repair.

Weight reduction is also a major driver while installing offshore structures.

Reduced weight implies that the structure costs less to build while allowing for more drill pipes and production equipment to be carried for oil and gas production and exploration.

Grades for offshore applications

SS 316L has been a major austenitic stainless steel grade used for offshore applications. It augments strength at high temperatures and also defends the structures against severe acidic environments.

Austenitic grades, containing 6% molybdenum, have conventionally been in use for permanent immersion in seawater. However, with the globally volatile nickel prices over the past years, duplex stainless steel grades have extensively taken over the austenitic grades. Given their excellent combination of mechanical properties and resistance to stress corrosion cracking, duplex grades make a good choice for offshore applications. UNS S32205 is the most common duplex stainless steel grade used in offshore installations.

While duplex stainless steel grades have proven their mettle for heavy-duty offshore applications, the new generation of super duplex stainless steels has properties similar to those of seawater corrosion-resistant

austenitic stainless steels. Further, these grades have improved mechanical properties than duplex grades. These super duplex grades are distinguished by the presence of higher levels of nitrogen, chromium, molybdenum, and nickel that contribute to the improved resistance to pitting and crevice corrosion in them. Some examples are UNS S32750 and UNS S32760 which are used for more aggressive offshore applications, for example, submerged components. While we observe that stainless steel is a better alternative to carbon steel, it is crucial to understand that choosing the best stainless steel grades for specific requirements is necessary for a cost-efficient and long-life offshore setup. As India's largest stainless steel producer, and with a dedicated R&D, Jindal Stainless specializes in manufacturing these high-end grades. The company holds a majority share in the domestic consumption of all such grades.

Stainless usage in offshore applications

- *Submerged components:* pipelines and grills for oil, sewage and water, risers for oil platforms, heat exchangers for ships and coastal power plants, equipment attached to hulls of boats and ships.
- *Platform structure components:* pumps, winches, storage vessels, process vessels, blast gates, umbilical tubes, rebars, cable trays, stairs, tread plates,

walkways, oil and gas coolers, gravity separators, etc.

- *Deck components* for boats and ships like deck eyes, brackets for anchor ropes, shackles, etc.
- *Coastal (land-based)* handrails, ladders, lamp posts, etc.

A study by the Department of Metallurgy and Materials Science, University of Manchester/UMSIT, titled 'Developments in the Use of Stainless Steel for Offshore Pipework Systems', shows how using a super duplex stainless steel deluge system in offshore projects helps reduce the weight and size of the setup as compared to 90/10 cupro-nickel (Cu-Ni) alloy. The deluge system requires minimum nozzle pressure and water flow. The super duplex stainless steel system uses fewer pipes to control water flow velocity, as compared to 90/10 Cu-Ni systems. Thus, the dry weight of a super duplex stainless steel deluge system is reduced by ~15%.

Moreover, it was found that due to the higher strength of super duplex stainless steel, the pipe requirements for the setup were reduced by ~38%. This also implies that applications such as sprinklers and firewater deluge systems, if developed using super duplex stainless steel, will further reduce weight by ~20%. The reduced weight and pipe requirements in a standard super duplex stainless steel deluge system thus essentially translate into a cost-efficient alternative when compared with 90/10 Cu-Ni alloy. As per the study, the effective cost of super duplex stainless steel piping material used for developing a standard deluge system will be nearly half of that for using 90/10 Cu-Ni alloy.

Way forward

Corrosion has posed a significant roadblock for the offshore oil and gas industry. Today a large number of corrosion-resistant stainless steel alloys have been developed, with duplex stainless steels having proven their worth for offshore applications. With lower nickel content, these high-end duplex grades are perfect for the developing Indian offshore landscape. Considering the rising fuel requirement in India, the country needs to establish dynamic coastal and marine infrastructure for offshore



Stainless steel valves and pipes in an offshore project.



It is essential to choose the best stainless steel grades for specific requirements for a cost-efficient and long-life offshore setup.

projects. This will include setting up offshore platforms with related logistics including supporting coastal infrastructure. Moreover, as a metal, stainless steel is quintessential for achieving sustainable and clean energy production. It is motivating to see the Indian industry is self-sufficient for developing such grades for a plethora of applications.

The Indian market

India is the third-largest consumer of oil and energy in the world. Oil and gas continue to be major import commodities for India. Fuelling growth across sectors, oil and gas play an important role in building robust infrastructural applications in the nation. With a committed effort from the government and the domestic stainless steel industry, harnessing stainless steel production to address energy access, energy efficiency, energy sustainability, and energy security in the nation is now possible.

India stands tall as the world's second-largest producer and consumer of stainless steel. With an accelerated growth rate, stainless steel is at par with the global economies as the fastest growing metal in the country. Jindal Stainless continues to empower the domestic industry by producing the best quality stainless steel grades, imparting professional training to local producers, and mediating with policymakers to ensure a level-paying field for the domestic industry. With strong economic growth, the energy demand in India is also expected to grow exponentially. This will require the up-scaling of existing offshore infrastructure in the country. As Indian stainless steel manufacturers become increasingly specialised in developing higher grades, it is possible to accomplish an efficient infrastructure and a self-sustaining ecosystem for offshore drilling and processing through indigenous resources.