DOES STAINLESS STEEL CORRODE?

Supreme Precision Castings Limited has been producing precision castings since 1984. Through Supreme Precision Castings' quality focus and customer responsiveness, they have established a worldwide customer base providing components to Europe, North America, Australia, Asia and of course New Zealand.

As New Zealand's leading producer of precision Stainless Steel castings, they are often approached to provide Stainless casting solutions, to replace fabrications or machined components and are often approached in the first instance by someone perplexed that their existing Stainless-Steel component is showing signs of corrosion.

Is "Stainless Steel" less staining steel?

Yes, these steels certainly are stainless. When we talk about staining, what occurs to our mind is the reddish-brown oxide typical of that found on commercial structural steel exposed to the atmosphere. Stainless steels are fairly free from such a phenomenon.

These steels are rendered stainless or less staining due to an impervious thin layer that is formed on the surface as the steels are exposed to an oxygen-containing environment. This oxide layer protects the inner metal from deterioration or degradation. This means, these steels do get oxidized, but the oxide layer so formed is stable and protective rather than destructive.

How is this steel different from other steels that stain or corrode?

Stainless steels essentially contain chromium (10.5% as a minimum) as one of the alloys in the metal. It is this element that imparts the corrosion resistance as a stable chromium oxide is formed on the surface. This invisible oxide layer is impervious and self-healing when scratched, so long as the exposure of the steel is to an oxidizing environment. Any chromium greater than 10.5% together with some other alloying element, enhance the formation of the protective layer. Over the years several grades of stainless steels have been developed to suit different environments and design requirements. They can be broadly classified as the austenitic (300 series sheets of steels the most common of which are 304 and 316), martensitic (400 series the most common of which is 410 and 416), duplex (commonly 2205) and precipitation hardening (17-4 or 15-5 PH).

Broadly, the above series of steels withstand corrosion as below:

- 300 Series: General atmospheric corrosion and scaling
- 400 Series: High strength and general corrosion
- Duplex: Pitting and Cavitation corrosion (marine)
- PH: Very high strength and general corrosion under varying temperature conditions

The 300 Series Stainless Steels contain both nickel and chromium, the total of which is a minimum of 23%. They are prone to intercrystalline corrosion at temperatures between 450 to 750 deg C. The

intercrystalline corrosion is overcome either by maintaining a carbon content of 0.03% max or by the addition of some stabilizing elements such as Titanium or Niobium.

The 400 Series Stainless Steels are primarily straight chromium steels (12% on average) and they show satisfactory resistance to weather and water.

Duplex grades of steels have higher chromium (25% on average) and medium Nickel (say 5%) and they have outstanding pitting and cavitation corrosion resistance, which make them more suitable for marine applications.

Precipitation hardenable grades have chromium contents similar to 300 series but contain less nickel (say 4 to 5 %). These steels derive their precipitation hardening characteristics from copper (3.5% approx.). They have outstanding corrosion resistance in high strength condition.

Stainless steels can spring corrosion surprises!

There have been instances of corrosion occurring on 304/316 grades of steel on account of contamination. Examples of contamination found in service are Plain carbon steel wire brushes when used on Stainless steel, result in surface contamination from bristles and consequent corrosion and Deposition of metal particles on the casting surface from the coolant while machining, sets off corrosion on the metal surface. Such contamination should be avoided in all counts on these steels.

Other tricky situations also exist in the design and application of components made from stainless steels.

A gap or a crevice formed or left by an inadvertent design change on a product or assembly could prove very expensive and accelerate corrosion many times on an otherwise sound material. This is due to the accumulation of electrolyte (an aqueous medium) in the crevice, which sets off catastrophic crevice corrosion.

It is again cautioned that an innocent design change (for example a reduction of fluid flow velocity) in a process system could significantly alter the corrosion resistance characteristics of stainless steel components in service. The flow changes could facilitate undesirable concentration gradients of the electrolyte in the system.

The surface finish of a component has a significant role to play in terms of corrosion resistance. A smooth finish is undoubtedly more desirable and a compromise has affected the service performance deleteriously in some cases.

In-situ weld repair of stainless steel components can give rise to serious corrosion problems due to sensitization or weld decay effects. In these cases, the selection of the stainless steel grade had not been satisfactory. A stabilized grade or a low carbon grade might have been better suited for the application.

In short, there are several factors govern the corrosion of stainless steels in service, beginning from the steel grade selection to the design of components to the shaping and fabrication, treatment, application and servicing. To derive the full benefit it is imperative to consult the manufactures of stainless steel components at the early design stage.

The team at Supreme Precision Castings has over 20 years of experience in investment casting, metallurgy, foundry operations, casting techniques and tool making and are dedicated and committed to achieving the best results for their customers.