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Mechanism of Corrosion Resistance

The mechanism of corrosion protection of stainless steel differs from that of carbon steels, alloys steels, and most other metals. In these other cases, the formation of true oxide barrier separates the metal from the surrounding atmosphere.

The degree of protection afforded by such an oxide film is a function of the thickness of the oxide layer, its continuity, its coherance and adhesion to the metal, and the diffusivities of oxygen and adhersion to the metal in the oxide.

In high temperature oxidation, stainless steels use a generally similar model for corrosion protection. However, at low temperatures, stainless steels do not form a layer of true oxide. Instead a passive film is formed. The oxide film should be a continuous, non-porous, insoluble, and self-healing if broken in the presence of oxygen.

Passivity exists under certain conditions for particular environments. The desired range of conditions over which passivity can be maintained depends upon the precise environment and on the family and composition of high-alloy steel. For example, when conditions are favourable for maintaining passivity, stainless steels exhibit low corrosion rates. If passivity is destroyed under conditions that do not permit restoration of the passive film, then stainless steel will corrode much like a carbon, or low alloy steel.

The presence of oxygen is essential to the corrosion resistance of stainless steel. The corrosion resistance of stainless steel is at its maximum when the steel is boldly exposed and the surface is maintained free of deposits by a flowing bulk environment.

Covering a portion of the surface-for example by biofouling, painting, or installing a gasket-produces oxygen depleted region, which is anodic relative to the well aerated boldly exposed surface. In such situations, higher content of alloy is required to prevent corrosion.

With appropriate grade selection, stainless steel will perform for very long times with minimal corrosion, but an inadequate grade can corrode and perforate more rapidly than a plain carbon steel will fail by uniform corrosion.

Selection of appropriate grade of stainless steel is then a balancing of the desire to minimise cost and the risk of corrosion damage by excursions of environmental conditions during operation or downtime.

Confusion exists regarding the meaning of *passivation*. It is not necessary to chemically treat a stainless steel to obtain the passive film; the film forms spontaneously in the presence of oxygen. Most frequently, function of passivation is to remove free ion, oxides, and other surface contamination.

To combat your problems on corrosion concerning your area of application, feel free to contact Vishal Kumar at **vishal@acmealloys.com**