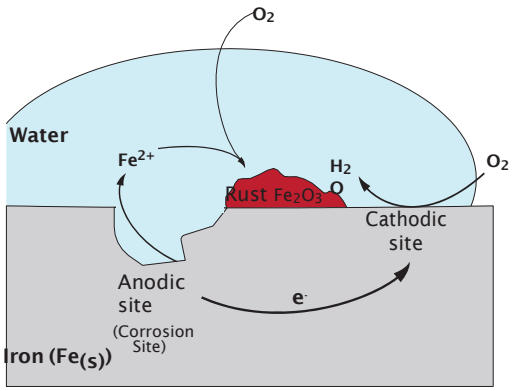
Fact Sheet: Stainless Steel & Corrosion

Medical & Dental Instruments & Equipment

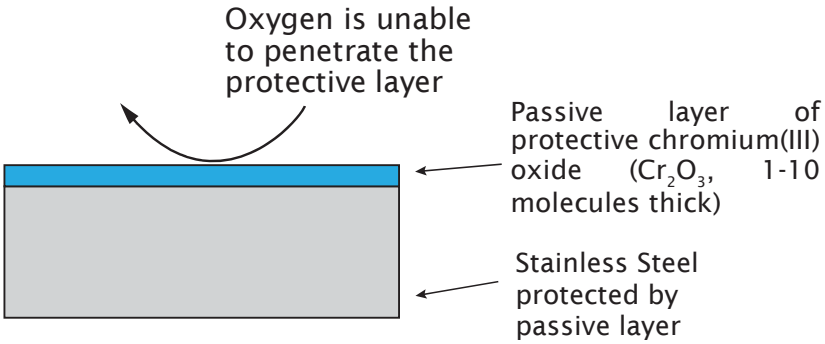
On earth (a rich oxygen environment) all metals, with the exception of gold and platinum, occur in nature as their oxides. Iron for example, occurs as an iron oxide or iron ore, which is mined, and then processed in smelters to drive off the oxygen to give steel.

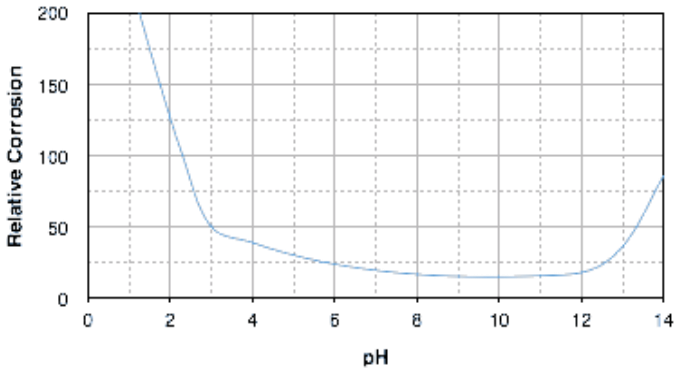
Under normal circumstances this steel will react with oxygen to revert back to its natural state (iron ore). This process is termed as corrosion and it is a galvanic process, i.e. an electrochemical process.



Stainless steel is an alloy of iron with other metals particularly chromium, and where the chromium is present at a concentration >10.5% then the steel is corrosion resistant. This resistance to corrosion is a result of the chromium reacting with oxygen to form a layer of chromium oxide on the surface of the metal. This very thin & strong "passive layer" protects the iron from the oxygen and therefor prevents the formation of iron oxide or rust.

This diagram represents a cross section of Stainless Steel. In solutions that are not acidic a passive chromium oxide layer forms and protects the steel under it from corroding. In acid environments, this protective layer can be dissolved causing the stainless steel to corrode.





This chart shows the relative corrosion of iron at various pH values in oxygen free solutions. It shows that the corrosion of iron is lowest in the pH range 7 to12. This is why in many industrial situations water is maintained in an alkaline pH in order to minimize the corrosion of iron and steel.[1]

NaOH (%)	Temperature (°C)	Corrosion Rate (mm per year)
50	65	0.1
50	57	< 0.1
30	65	< 0.1
30	20	< 0.1
22	55	< 0.1
14	88	< 0.1

Stainless steels have exceptional resistance to corrosion by alkaline solutions. By way of example, corrosion rates of type 302 & 304 stainless steel by sodium hydroxide (very strong caustic alkali) at various temperatures are shown in the Table opposite. Note the very high concentrations of sodium hydroxide and the high temperatures used in some of the tests. Even in these extreme conditions there is still very little corrosive effect (note the rate of corrosion is measured per year!).[2]

Environmental Factors that Increase Corrosion:

- Low pH (acidic)
- High chloride content (This can come from biological sources or some cleaning solutions)
- High Temperatures
- Microbial action & organic contamination. Bacteria in particular can produce a highly acidic localised environment on the contaminated surface.

Why is Prodet Perfect for Cleaning Instruments?

Prodet does not contain sodium hydroxide and the mild alkaline buffering agents are at a concentration below 1% in the wash solution. In addition to this, the alkaline builders used in Prodet are in fact corrosion inhibitors due to their layering effect and the formation of a "Passive Protective Layer".

This protective effect that alkaline solutions have on stainless steel is not the only advantage alkaline solutions have over neutral instrument cleaners. Mild alkalinity also increases the solubilization of soils, prevent re-deposition of soils onto the surface and prevent the pH of the solution becoming acid due to biological soils. Neutral detergents unless they are strongly buffered can become acidic when contaminated with biological soils.

1. *DOE Fundamentals Handbook Chemistry Volume 1 of 2. U.S. Department of Energy, Washington, D.C. 20585. DOE-HDBK-1015/1-93 January 1993.*

2. *"Corrosion resistance of the austenite chromium-nickel stainless steels in chemical environments. The International Nickel Company. New York. 1963. Note. This is an excellent paper giving extensive tables of corrosion data for stainless steel in a large varieties of chemical solutions.*