

Technical Bulletin

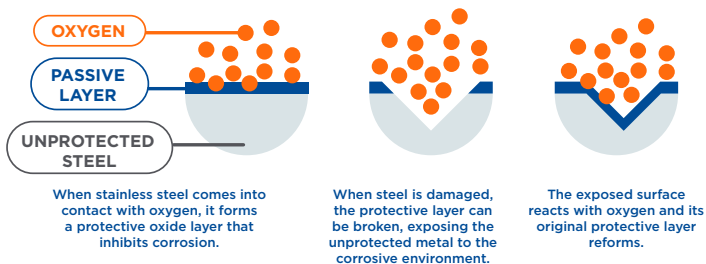
FOOD AND BEVERAGE

Passivation of equipment, a natural protection for stainless steel

Stainless steel has long been the material of choice for manufacturing various types of food processing equipment. It's popular for several reasons:

- Highly resistant to impacts, strain, wear, abrasion, and erosion
- Malleable, easy to weld, and easy to machine
- Highly resistant to corrosion and chemicals
- Resistant to extreme temperatures and thermal shocks
- Smooth, nonporous surface prevents food adhesion and reduces the adherence of biofilms
- Does not contaminate food or alter its organoleptic properties
- Attractive appearance

Stainless steel's high resistance is due to its ability to form a self-repairing protective layer. When stainless steel becomes damaged, the exposed surface reacts with oxygen in the air or with water to reform a protective layer.



Conditions that promote surface corrosion

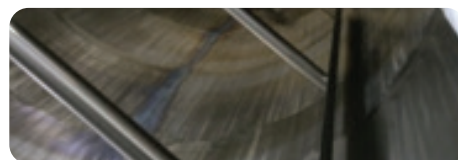
Despite this ability to form a protective barrier, certain conditions can gradually or systematically erode this layer and cause surfaces to corrode. Under such conditions, damage can occur very rapidly. The most common causes are:

- **Equipment modification:** When steel is welded, scrubbed with a wire brush, sanded, etc. Following modification, the stainless steel surface must be chemically passivated or exposed to the air after being cleaned so that a new passivation layer can properly form.



Contaminated iron filings on equipment – the ideal scenario for serious corrosion problems to occur.

- **Exposure to incompatible compounds or adverse conditions:** Poor cleaning, incompatible products, excessive operating temperatures, products allowed to dry on the surface, insufficient pre-rinsing or washing, inadequate phase separation, insufficient sequestrant concentration, wrong choice of additive in alkaline solutions.



Corrosion caused by cleaning solution runoff that has repeatedly dried on the surface. Note that the corrosion is found right where the solution has run off.

- **Incompatible production equipment** (brine, for example).

- **Overused equipment** (steel does not have enough time for self-passivation).



Corrosion of a tank; possibly caused by continuous use (no air self-passivation) or poor choice of products.

- **Corrosive water supply.**



Water supply reservoir with noticeable corrosion; possibly due to the evaporation of hypochlorite.

Preventive measures to combat surface corrosion

For these reasons, it's important to inspect equipment regularly in order to detect the first signs of corrosion, and protect your investment.

A good visual inspection will help you identify early warning signs. At the same time, it is essential to ensure that cleaning products and methods have minimal impact on surfaces. Equipment that can assess the condition of the passivation layer on stainless steel is also available.

If your environment does not allow steel to form an adequate protective layer, surfaces should be treated to quickly create this protective oxide layer. This surface treatment, called passivation, is a process applied to metals, particularly stainless steel and other metal alloys, to protect them against corrosion. Note that the goal of passivation is not to eliminate corrosion; it must be removed prior to this treatment.



Device for measuring the passivation layer of stainless steel.

Using passivation to treat surfaces

There are different passivation techniques that can be used depending on the equipment requiring treatment (tanks, pipes, outer vertical surfaces). A specialist can help you determine which methods are best for your particular needs.

When should you passivate?

- Before putting equipment into service
- When making modifications to equipment (welding, for example)
- When equipment is contaminated (with iron dust, for example)
- Upon the first signs of corrosion
- When the protective layer is gone
- As a preventive measure

Generally, if metal dust is suspected on the surface, it must be removed with manual cleaning if possible. Using cationic products tends to offer the best results.

Prior to starting passivation, the surfaces being treated must be completely free of organic deposits (oil & grease, protein, starch) as well as inorganic deposits (scale, silicate, rust). The metal being treated must therefore first undergo alkaline and acid cleaning to ensure it is free of deposits.

Various products can be used for passivation. Phosphoric acid was originally used for this type of treatment, but has since been replaced by nitric acid, which offers better results. Recent studies have shown that citric acid provides even better protection by increasing the chrome to iron ratio on the surface. The higher this ratio, the better the anti-corrosion protection. Citric acid is also much safer to handle and has a better environmental profile¹. At Sani Marc, our Clean Steel™ passivation technology is formulated using powerful oxidizers.

Table 1. Chrome to iron ratio obtained with different passivation techniques

Passivation Technique	Cr/Fe Ratio
Cleaning only	1.2
Cleaning + phosphoric acid	1.5
Cleaning + nitric acid	1.75
Cleaning + citric acid	2.0

Where to begin?

While passivation is an excellent investment for maintaining equipment, it does require additional effort and a rigorous process. It would be a shame to perform this treatment only to later realize that mistakes were made. For example, it is pointless to passivate equipment when work is being done nearby because the surfaces are likely to become contaminated quickly. Good planning and follow-up are therefore vital for successful passivation.

As in many areas, prevention is your best strategy. If you choose to ignore the warning signs, you could end up with severe corrosion problems that cannot be treated with traditional techniques.

In conclusion

Ask one of our experts to show you our Clean Steel™ passivation technology. They'll be able to tell you more about the restorative benefits of this technology, as well as its application protocol, so you can get a customized solution for your equipment.