Technical Guide

Passivation of New Stainless Steel Equipment

DISCUSSION

New stainless steel process equipment will normally have surfaces coated in oils or other hydrocarbon-based materials. These oils can be intentionally applied to control corrosion, or they are the result of various metalworking processes like polishing with rouges or forming parts with pressure/lubricating compounds. Undesirable residues on new equipment can also include elemental or free iron. Iron left on surfaces can initiate generalized surface rusting or worse, generate galvanic cells on the stainless steel, promoting pitting of the metal.

Both oils and iron can promote surface corrosion via galvanic effects. Improper or ineffective removal of either will eventually result in multicolored surface discolorations, pitting, and streaking. Ineffective removal of the hydrocarbon-based materials will also directly prevent passivation of the surface beneath the oils, as the acid will not be able to contact the stainless surface to solubilize the iron.

To clean new stainless steel equipment, standard alkaline products used for cleaning in place (CIP) are not the best choices. More specialized products that contain solvents and/or carefully selected surfactants should be used. A product such as Alkadet NP is suggested. Other products can be used, but first consult with an R&D specialist before proceeding with an alternative. The normal CIP considerations of flow and temperature are also important. Surfaces must have flow and/or impingement to be properly cleaned. For the removal of oils and waxes, higher temperatures are also needed. Ideally, temperatures should be above the melting point of the residues. As this exact temperature will rarely be known, the highest practical or equipment-limited temperature should be used.

Before and After Passivation

PREPARATION:

Before cleaning and passivation, review the manuals and technical literature provided by the manufacturer. Carefully note any restrictions with regards to chemicals, concentrations, and temperatures. Verify that all wetted surfaces are stainless steel or are, more critically, resistant to high acid concentrations. Plastics used as spaces, baffles, paddles, or bearing blocks should be suspect. An equipment-specific checklist should be prepared for the inspection, and a senior or technical person from the customer's facility should assist. Any problems should be noted along with their locations. Photographs can be helpful in documenting problems and are recommended. New equipment should be inspected inside and out for areas of pre-existing corrosion, or other problems such as bad welds, dents, rough surfaces, damage, forgotten tools, misplaced fasteners, filings, etc. These items can contribute to future corrosion problems and should be corrected when and where possible. If filings are present, they should be manually removed rather than relying on the CIP process. Once the inspection is completed and actions are agreed to, both parties should sign and date the checklist.

Have available all applicable product safety information. Assure the personnel have the appropriate PPE and that the eyewash stations and showers are identified prior to the cleaning/passivation.

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CLEANING

If the equipment has not been previously used, fill with water and circulate to locate any leaks prior to cleaning/passivation.

Initial Cleaning Procedure

1. Add 4 – 6% vol./vol. of Alkadet NP or another appropriate cleaning product to wash.
2. Circulate for one hour at a minimum of 140°F (60°C). Lower temperatures may generate excessive foam and require use of a defoamer. If possible, circulate at 160°F (71°C).
3. Drain alkaline CIP cleaner from equipment.
4. Rinse equipment thoroughly with potable water until foam is no longer present. Measure pH of water at equipment outflow to assure that it is the same as the water supply. If pH is higher, continue to rinse until pH matches that of the supply water.
5. Check cleaned equipment surfaces for "water break." Clean, oil-free surfaces will drain slowly and evenly, leaving few, if any beads of water on the stainless surfaces. If surfaces are not water break free, repeat the cleaning and rinse steps.

Passivation

1. After thoroughly cleaning equipment surfaces, prepare a 5 – 10% wt./wt. solution of citric acid. A variety of citric acid sources both liquid and dry can be used for this purpose. GF Acid Clean 9011L can be used.
2. Heat the solution to 140°F (60°C). Circulate for one hour.
3. Flush acid solution to drain. Measure pH of water at equipment outflow to assure that it is the same as the water supply. If pH is lower, continue to rinse until pH matches that of the supply water.
4. Rewash equipment with an alkaline cleaner at a low concentration to assure neutralization of any acid residues. Rinse thoroughly, check via pH.
5. Allow cleaned, drained, dry surfaces to be exposed to the atmosphere for at least 48 hours. This will fully passivate the stainless steel. This step is especially critical when using citric as the passivating agent as, unlike nitric acid, it is non-oxidizing and depends on atmospheric oxygen to complete the passivation process.

After equipment is allowed to stand open for the required period, rewash and sanitize. For those wishing to verify that their surfaces are passivated or that the free iron has been removed, a variety of test methods are available. There are devices available from Koslow Scientific that indicate the degree of passivation. They also carry a kit that detects the presence of free iron. This is different than measuring passivation but is an indicator of how effective the cleaning/passivation procedure was.

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