Stainless steel upkeep & cleaning

Though Stainless Steel is a remarkable material in view of its intrinsic corrosion resistance brought over by its alloying content, primarily Chromium in excess of 11%, care is necessary to maintain it “stain-less” in all circumstances of usage. Indeed, cleanliness and stainless steel are closely related notions and, in many applications, each is dependent upon the other. In the handling of food, chemicals, pharmaceuticals and in the use of stainless steel in architectural & decorative applications, stainless steel provides the degree of corrosion resistance that is necessary to prevent product contamination or surface ”rusting”. However, stainless steel performs best when clean: cleanliness is thus essential for maximum resistance to corrosion. We will cover in this technical note the most important recommendations pertaining to stainless steel cleaning and upkeep, with particular emphasis on stainless steel wire and mesh when appropriate, as follows:

- Design & fabrication factors and incidences on corrosion resistance

- Recommended routine upkeep guidelines

- Remedial cleaning

I – Design, fabrication and corrosion resistance considerations:

The issues of surface corrosion-related deterioration in stainless steels often originate from either an improper choice of stainless grade vis a vis the usage or more or less trivial mistakes in design or fabrication of the stainless components. First and foremost, the durability of a structure, a fabricated stainless steel equipment and the maintenance costs are dependent on the decisions made early in the design stage in consideration of the corrosivity of the environment of the stainless steel.

sadevinox
2 allée des Faisans
Z.I. de Vovray Seynod
74600 ANNECY, France

EMAIL sales@sadevinox.com
WEB www.sadevinox.com
TEL +33 (0) 450 33 70 71
FAX +33 (0) 450 33 70 38

This durability and the integrity of the stainless as well as the “cleanability” depend on this proper grade selection, but also on choice of surface finish and the geometry of the element. Corrosion onset generally appears as light rust often called “tea staining” especially in decorative/architectural uses of both sheet products but also stainless steel cables and wire rope.

This reflects often usage of stainless grades with limited resistance to localized corrosion (i.e. so-called pitting corrosion and crevice corrosion) such as ferritic grade 430 and standard austenitic grade 304. When noticeable amounts of chlorides or Sulphur dioxides are to be expected in the usage environment, Mo-bearing austenitic grades such as austenitic 316/316L and sometimes 317L are mandatory to avoid any instances of “tea staining”: examples are marine environments, boat rigging, pool side balustrades and ancillary equipment involving stainless steel wire/mesh, etc…

Design, in keeping with the proper grade selection, does play an important role in the avoidance of unnecessary cleaning of stainless steel surfaces. For instance, the type of surface finish is important and rougher surfaces will mandate more regular cleaning. In the extreme cases of harbor/ marine side equipment, crevice corrosion is more frequent and can not only generate large occurrence of localized rust, but also lead to deep corrosion threatening the physical integrity of the equipment.

Design also has to take advantage of geometries permitting self-cleaning vs geometries conducive to accumulation of dirt or residuals favoring underlying localized corrosion.

Finally, design has to insure that no possible galvanic corrosion can arise: as an obvious example, galvanized fasteners or clamps should not be used to fasten stainless steel panels or any stainless steel equipment.

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Fabricators & installers must be fully aware of the pitfalls of improper grade selection and designs discussed here above. In addition, they have to be fully knowledgeable of precautions related to their own work, most noteworthy:

-- weld treatment: whatever the type of proper weld , pickling treatment is a must afterwards. This chemical treatment, preceded by light brushing with a stainless brush, removes the welding oxides and restores the “passive layer”. This is usually done with nitric acid (hydrochloric acid should not be used under any circumstance). In some instances, electropolishing is used to insure smooth surfaces such as in frying baskets, etc…

-- cutting of stainless steel can be done with aluminium oxide cutting wheel or blade, reserved for stainless use only. Any contamination by non-stainless steel will lead to very detrimental rust and must be eliminated by nitric acid treatment. This avoidance of contamination by regular steel must also be watched for in all handling and storage instances.

II – Guidelines for the routine upkeep of Stainless Steel :

Once proper grade selection is made and design + fabrication considerations are indeed duly taken in consideration, normal maintenance/upkeep of stainless steel surfaces can be put in place, with appropriate variances depending on the applications and environments. We will hereafter provide established and recommended guidelines to keep stainless steel at its best for good aesthetic appearance but mostly its optimum resistance to corrosion.

Stainless steel “passive surface layer” integrity must be preserved from surface contamination such as dirt, outside particles or residuals from processing. It is important to identify properly the contaminants in order to use adequate cleaning procedures. We will illustrate these in several cases:

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-- Exterior/interior decorative uses of stainless steel: main issues come from airborne particles, soil and mortar projections, oil and grease marks resulting from handling and assembling .In interior decorative uses, fingerprints can also be an issue, though generally without any effect on corrosion resistance.

Frequently warm water with or without a gentle detergent is sufficient, with nylon bristles or stainless steel brushes for imbedded particles which could generate crevice corrosion. Severe oil and grease marks can be removed with alcohol based products & Chlorine-free solvents.

It is advisable to apply clean solvents several times with a clean, non-scratching cloth. This can also apply to fingerprints removal with sometimes also gentle rubbing of soda ash paste. In all cases, warm water rinsing is recommended as a finishing touch.

-- Food processing, whether industrial, professional or even in household kitchens, is a large user of stainless steel in all forms and shapes, including wire and mesh.

There again, surface finish and condition is essential to insure that hygiene requirements are met. Regular cleaning starts with flushing with hot water or possibly steam. Hard and adherent deposits might require mechanical scrubbing with stainless steel wool, accompanied by adequate alkaline scouring powders and detergents.

Organic solvents such as acetone as well as alkaline solutions can be used to remove grease, fats or other non-water soluble substances. Great care must be given to this upkeep process in industrial food processing equipment where the product contains salt and the ever detrimental Chloride ions, even if the proper grade type 316 is used.

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FAX +33 (0) 450 33 70 38

-- Stainless steel wire screens and meshs are a particularly demanding type of stainless steel equipment from the standpoint of regular and thorough upkeep, especially for the finer wire cloth used in filtering systems.

In the handling of delicate chemicals, cosmetics, food and pharmaceuticals products, cleanliness is obviously of utmost importance. For the finer wire mesh clean warm water eventually under pressure is a safe way to start. This can be followed by ammonia, various types of alkali-containing detergents and, in the case of oils or fats accumulation, use of mineral spirits, methyl alcohol.

Coarser screen mesh may require some amount of surface brushing with bristle or stainless brushes, then non-abrasive scouring pastes. In all cases, the maintenance cleaning ends with a good rinse in warm water, often followed by gentle air blast for drying.

In all the above routine upkeep procedure, under no circumstances should concentrated bleach be used, nor any detergent likely or suspected to contain hydrochloric acid or its derivates: failure to respect this will result in contamination by chloride ions, initiators of localized corrosion.

III – Remedial Cleaning:

“Remedial” cleaning, by opposition to “routine” cleaning, is a more complex and hopefully much less frequent procedure. It can be the consequence of localized corrosion-prone designs, improper grade selection and most often lack of regular upkeep cleaning.

It generally manifests itself by discoloration of the stainless steel surface, rust-like surface deposit often surrounded by a brownish halo commonly referred to as “tea staining”.

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All these are indicative of incipient or already in progress localized corrosion, essentially “pitting corrosion” or “crevice corrosion”. It is then no longer sufficient to remove visible stains by means of usual cleaners: in tiny pits, hardly perceptible to the unaided eye or hidden from view(such as in wire rope), corrosive media or corrosion products may be trapped and will generate new stains as well as threaten integrity of the equipment.

Another example is the incomplete removal by cleaning of salt containing foods which could lead to severe crevice corrosion. Remedial cleaning is heavily dependent on the extent of corrosion.

In contrast to the neutral or alkaline agents used for routine cleaning, the products for remedial cleaning are acidic. The compositions are such that they completely and safely dissolve corrosion products while leaving the basic stainless steel unaffected.

This generally involves a multi-steps approach:

-- brushing of the corroded area with nylon bristles in conjunction with stainless brushes as needed

-- use of acetic, citric or eventually phosphoric acid detergents

-- power rinse and drying

-- finishing with nitric acid containing detergents or pastes Obviously, utmost care has to be given to the root causes of the localized corrosion which in some cases will point out to correcting improper grade selection and replacement by higher corrosion resistant grades such as Mo-bearing grades 316/316L or Duplex stainless steel grades.

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IV – Summary :

As emphasized in the introduction of this Technical Note, stainless steel can best exhibit its remarkable corrosion resistance properties if it is kept clean through appropriate upkeep procedures, applied regularly and as often as the specific usage mandates: it is essential, as explained in detail here above, not to rely blindly on the corrosion resistance intrinsic of the stainless steels, but to "take care" of stainless steel through a proper upkeep.

This proper upkeep uses "mild" procedures relying mostly on

-- warm water and steam cleansing

-- ammonia and alkali-containing detergents

-- organic solvents for grease & fats

-- nitric acid solutions & pastes, to restore surface passivity.

The "remedial" cleaning, when localized corrosion has unfortunately started requires a more aggressive approach, with possible additional use of acids (citric, acetic) as described here above. In all cases, coarse scouring powders have to be avoided and cleaning with chloride-containing cleaning agents has to be absolutely prohibited. Thus great attention is needed before using standard household detergents which often contain bleach. Fortunately, there is a wide array of professional cleaning products specifically designed for stainless steel cleaning, which are readily available in the market.

Contributed by Philippe Maitrepierre – Doctor of Science (PhD) in Materials

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