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CLEANING OF
STAINLESS STEEL

@CEDINOX. 2017



Cedinox was created on 17th June 1985 by the main Spanish stainless steel manufacturers and the main raw materials suppliers of the world. We are the Association for the promotion and technical advice about the stainless steel in the Spanish market. Our purposes are:

- To enhance promotion, applications and updating of stainless steels.
- To organise visits, courses and exhibitions in order to promote stainless steel applications.
- To inform about the latest technical developments and give technical support.
- To contact other similar international organisations specially within the European Community as for example Euro Inox.
- To create a technical and statistical documentation centre for our members.
- To publish technical brochures, magazines or any interesting publication that may contribute to the stainless steel market development.

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Cleaning of stainless steel
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Stainless steel is a material with numerous properties that make it ideal for many applications. One of these properties is its hygienic character.

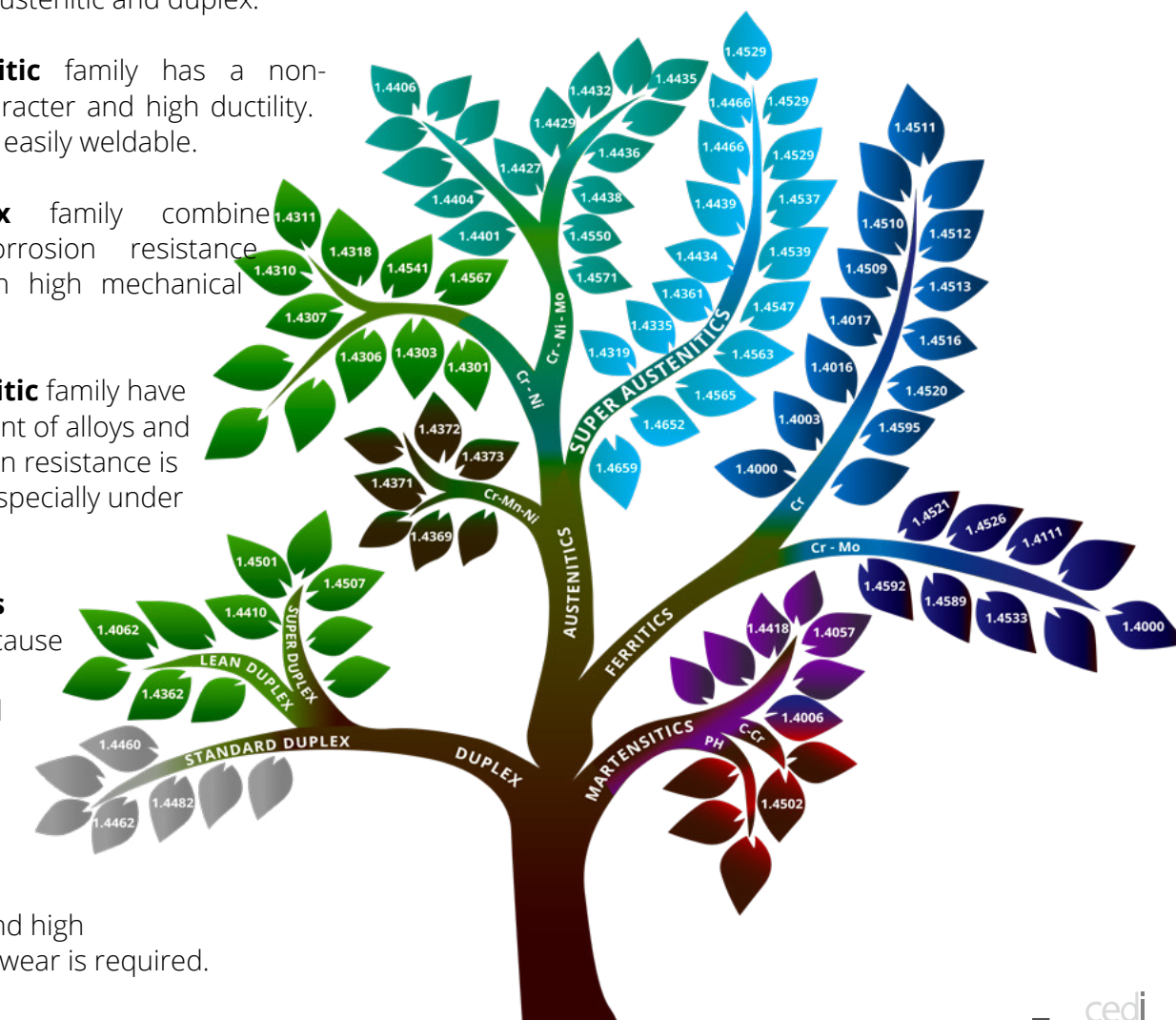
- High resistance to thermal variations.
- No need for protective coating
- Chemically Inert
- Good cleaning / removal of bacteria.

- High resistance to corrosion.
- Fully compact surface.
- High resistance to shocks and mechanical stresses.

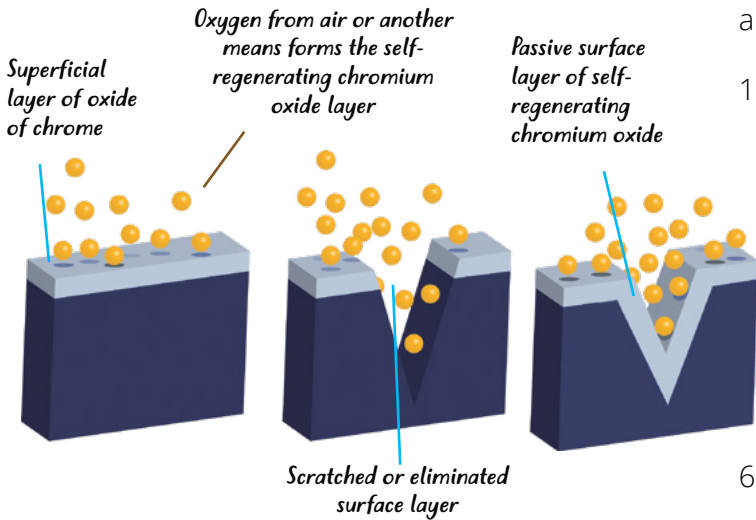
Stainless steel is a ferric alloy of at least 10.5% chromium and not more than 1.2% of carbon. Depending on the chemical composition or alloying elements that are included in the steel, we can distinguish four families: ferritic, martensitic, austenitic and duplex.

The **duplex** family combine excellent corrosion resistance together with high mechanical properties.

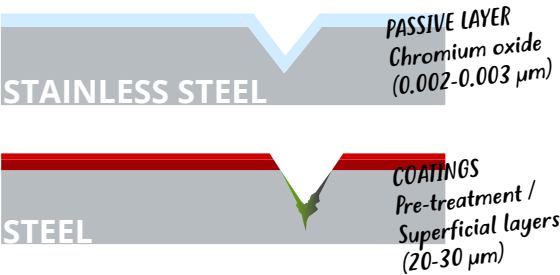
Martensitics stand out because of their high hardness and are ideal when the environment is not particularly aggressive, and high resistance to wear is required.



The fundamental element of stainless steels is chromium, which is the one that is going to oxidise in contact with the oxygen forming the passive layer that protects from corrosion.



The passive layer of stainless steels is extremely thin, so that if we wanted to reproduce other with the same efficiency ratio in carbon steel, we should use at least 3 layers of superficial coatings. Finally up to 200 microns coating may be needed to reproduce the stainless steel passive layer of 0.02.



The diversity of the types of stainless steels is high and each of them has its own degree of resistance to corrosion, but the behaviour of a steel for the medium that has been chosen will largely depend on the state of cleanliness in which its surface is located after having undergone the necessary operations of transformation, handling or installation.

The lack of surface cleaning from certain impurities can cause corrosion problems in the future, as well as causing an unsightly finish of the steel.

In order to maintain the innate qualities of the material, it is necessary to implement a series of cleaning and ordering procedures in workshops where drawing, machining, welding, handling processes and even during storage are carried out:

1. Keeping stainless steel in its original packaging until the moment of its use.
2. Storage should be indoors and dry.
3. Avoiding contact with carbon steel in storage.
4. To prevent stainless steel from being exposed to dust from the shop, or from chemical vapours.
5. In workshops, to avoid contact of stainless with building materials such as cement, plaster, debris, etc.
6. Do not step on stainless steel, if it is placed on the floor, protect it from below and above.
7. Coating with plastic, felt, paper, etc., to avoid contact of stainless steel with common steels or other softer metals such as bronze, copper, etc.
8. Do not store stainless steel near machines that may splash oil, grease or liquid.
9. To avoid, if possible, touching the stainless steel with hands. Gloves should be worn for handling.
10. If dirt is detected, an appropriate cleaning procedure should be followed.

It is essential to make a good selection of stainless steel, since each has particular characteristics and limits.

When choosing a particular one, the following points should be taken into account:

- Nature and composition of the corrosive agents to which the stainless steel will be subjected.
- The temperature and pressure of these agents.
- Efforts and tensions that material should resist.
- The most suitable surface condition of the stainless steel.

In addition to the choice of steel type, the choice of surface finish must also be made, which according to Euronorma and ASTM are the following:

EN 10088-2	ASTM	FINISHES
HOT ROLLED		
1D	No 1	Annealed and pickled material
1M	No 1 L	Hot rolled, embossed, annealed and pickled material
1U	BLACK COIL	Black coil
COLD ROLLED		
2D	2D	*Annealed and pickled material
2B	2B	Annealed and pickled, wet skin-passed material
2R	BA	Final BA annealing, dry skin-passed material
2G	No 3	*2B or BA finish material, grinding with 80-120 grain wet or dry
	No 4	*2B or BA finish material, grinding with 150-400 grain wet or dry
	No 4- SB- VF	*2B or BA finish, grinding with 180 grain and a very fine satin wet or dry
2K	SB- VF	*2B or BA finish, very fine satin with a combination of tape appropriate for wet or dry
		*2B or BA finish, belt satin finish, wet skin-passed material
		*2B or BA finish, grinding with 400, very fine satin wet or dry
2F	No 4 - RLD Rolled-on	*2B or BA finish, embossed wet skin-passed material
EMBOSSED		
2M	Embossed	BA finish, roll-embossed, final BA annealing without skin-passed
HARD TEMPERED		
2H	1/4, 1/2, 3/4, 4/4 hard	2D finish material with reduction of 10-45% to increase mechanical resistance

*Special for laser cutting, on request.
Information courtesy of ACERINOX (www.acerinox.com)



ACERINOX finish 2D



ACERINOX finish 2B



ACERINOX finish BA



ACERINOX gritt 220

There are other conditions that although not considered fundamental, in certain cases, can be causes of problems. For this reason, in case of doubt, it is always recommended to consult a specialist for prior advice (*)

(*) Cedinnox

1 Basic procedure

Stainless steel material, provided that the correct type has been correctly selected and a correct periodicity of maintenance has been defined, it can be easily cleaned.

The basic process is common and simple, not requiring the use of specific products, simply cleaning with water surface dirt can be removed.

If more washing aggressiveness is needed, use water plus neutral soaps and may increase the aggressiveness using hot water.

In some cases the use of high pressure water is recommended. If the surface finish allows it, it can be rubbed with a brush (check previously in hidden areas that the brush does not scratch the surface). It is always advisable to finish with a rinse with plenty of water.

To achieve better final appearance to dry with soft cloth sliding can be made, from top to bottom. This is always better than an air drying with which watermarks can remain

2 Specific procedures

On many occasions, whether due to the origin of the spots or their evolution, it becomes necessary to apply a more aggressive cleaning method specific to each case.

To make it easier for the reader to distinguish among different cleaning methods, these have been classified into three main groups according to their cause

- 1. Inadequate maintenance program.
- 2. Inadequate manufacturing, handling and / or installation procedure.
- 3. Vandalism.

Naturally, on occasion the appearance of the spots can be included in more than one group.

2.1 REMOVABLE STAINS WITH ADEQUATE MAINTENANCE

Fingerprints

It is one of the most common spots, as it is sometimes produced by mere contact with the material. The amount and scope of these prints depends largely on the finish of the material, the brightest finishes being most likely to exhibit these types of stains.



FINGERPRINTS	CLEANER TO BE USED		
	Water / soap (detergent)	Acetone, alcohol	Abrasive cleaner
Cleaning method		Soft cloth.	Wet and soft cloth
Recommendations	Rinse with plenty of water and dry adequately.	Mix acetone, alcohol with mild detergent and water. Rinse with plenty of water and dry thoroughly.	Rinse thoroughly removing additives that cause spots.

Water stains

These stains are due to particles present in dilution in the water, which upon drying, settles on the surface of the material

They are usually given in faucet installations or where splashing may occur. The colour of the same will depend on the different waters but are generally whitish.

WATER STAINS	CLEANER TO BE USED		
	Concentrated acetic acid	Cleaners with phosphoric acid	Vinegar diluted in water to 25%
Cleaning method	Rub-scrub with soft cloth. Wait for 5-10 minutes before rinsing and dry.	Pre-wash with water filling. Apply and rub with a soft cloth.	Rub with <i>scotch brite®</i> type cloth or similar.
Recommendations	Valid for any finish.	Rinse thoroughly with water.	

Tea / Coffee stains

In general, tea and coffee stains do not affect stainless steel if they are removed at the time the stainless steel surface is stained, otherwise, they may stick to the surface of the material requiring a specific cleaner and procedure.

TEA / COFFEE STAINS	CLEANER TO BE USED	
	Sodium carbonate	Sodium bicarbonate
Cleaning method	Sodium carbonate for tea stains, soak with sodium solution.	For coffee stain, soak with sodium bicarbonate.
Recommendations	The water of the solution must be hot, you can also rub the surface with sponges or soft cloth.	

Dust and dirt

During the storage stage, or if the steel once installed is not subjected to periodic washing, it may accumulate dust and dirt on the surface.

Depending on the characteristics of the dust and how embedded it is, it should be used one or another cleaner.

ENVIRONMENTAL DUST	CLEANER TO BE USED	
	Steamed high pressure water or with detergent	Soft abrasive cleaners
Cleaned method	Apply to stain, rinse generously and dry thoroughly.	Use soft, damp cloth followed by plenty of water.
Recommendations	Follow the direction of the polishing.	Rinse thoroughly with a view to removing additives that cause stains or debris that may contain chlorine.

Rust and other corrosion products

These recommendations are valid when the process of corrosion of the material is not yet very severe. If this is the case, a superficial

mechanical treatment, such as polishing, sanding, blasting, etc., is recommended. Oxalic acid is also used to clean fats and heating stains.

Start of corrosion due to over-come at some point on the surface the stability of the passive layer	CLEANER TO BE USED	
	Soft abrasive cleaner	Phosphoric and oxalic acid cleaners
Cleaning method	Apply with a soft cloth.	Pre-wash required with plenty of water. Contact time depends on the severity of the stain.
Recommendations	Rinse thoroughly in order to remove the cleaning product.	<ul style="list-style-type: none">• Leave on for 10 minutes.• Rub with soft bristle brush or with a wet cloth.

Burnt remains of food / charcoal

Generally related to culinary activities, where burnt food remains and / or stainless steel may be affected by coal particles deposited on its surface, such as grills.

	CLEANER TO BE USED	
	Water and soap / detergent	
Cleaning method	<ul style="list-style-type: none">• Hot water spray with detergents or ammonium solution.• Remove deposits with a nylon brush and abrasive cleaning powders.• Repeat as many times as necessary and finish with plenty of rinsing.	
Recommendations	The use of abrasive powders on polished surfaces is not recommended.	

2.2 STAINS DUE TO FAILURES DURING DESIGN, MANUFACTURE, ASSEMBLY AND/OR INSTALLATION

Spots associated with iron particles

These may be due to material projections during work, to use on stainless steel, tools or materials that have been in contact with carbon steel, or to improper handling, transfer or storage in contact with such material.

As an example of this last one we could mention the action of brushing the stainless with brush of carbon steel bristles, the use of carbon steel shot-blasting on stainless, or even the use of tools of cutting and folding of carbon steel, among many others.

CONTAMINATION BY LOOSE OR EMBEDDED IRON PARTICLES	CLEANER TO BE USED	
	Pickling paste, passivation processes	Nitric Acid
Cleaning method	Follow recommendations of use of each manufacturer.	Immersion time between 15 and 60 minutes depending on the severity. The temperature of the acid must be between 50 and 70°C, concentration between 20 and 40%.
Recommendations	Rinse thoroughly and dry afterwards. Always follow safety recommendations.	

Scratches and mechanical damage

This type of defect has its main origin in the damages produced during the handling of the material and is usually a consequence of a blow against a cutting object that leaves its mark on the stainless.

	CLEANER TO BE USED	
	Fibre cleaners	
Cleaning method	Rub with the cleaner.	
Recommendations	<ul style="list-style-type: none">• Do not rub against the polishing lines.• Rinse thoroughly.• Depending on the finish, the repair may not result satisfactory.	

Heat colorations and heat stains

These types of stains are generally related to welding processes, in which high temperatures are reached.

Depending on the type of stainless steel and the temperature reached, these spots can be very different colours.

Stainless steel can become oxidized under high temperature conditions, forming different

shades depending on the temperature to which it has been subjected. Often in industrial equipment such as ovens or barbecues where the inner part reaches high temperature and stains appear on the outside.

As an indication, the following table shows the different colorations that can be produced for each temperature range:

Appearing colour	Approximate temperature °C
Light yellow	290
Yellow	340
Dark yellow	370
Brown	390
Purple - brown	420
Dark brown	450
Blue	540
Dark blue	600

	CLEANER TO BE USED
	Pickling and passivating paste
Cleaning method	Pickling following the manufacturer's instructions
Recommendations	<ul style="list-style-type: none">Follow safety recommendations.Always rinse thoroughly.

Oil, grease and lubricant stains

These are generated by splashes during the manufacturing and/or storage processes. Depending on the type of grease a different cleaner should be used..

	CLEANER TO BE USED				
	Water/soap (detergent)	Solvents	Water, detergent soap and solvent	Abrasive cleaner	Sodium bicarbonate
Cleaning method	Use fibre brush, which is not contaminated by a previous use with other metals.			Apply wet cloth	
Recommendations	Dry normally	Fast drying to avoid staining.	Solvent can leave stains if used alone. For what it has to be combined with subsequent washing with detergent. Finally abundant rising and quick drying.	Abrasive powders with additives that can cause staining. They may contain chlorine so rinse thoroughly is required.	Rinse well.

Welding projections

The problems of stains caused by the temperature that can generate the welding have already been discussed previously, however, it may also be that during the same operation, projections are generated that are deposited on the contiguous surface of the

material. Generally they are produced in the arc welding processes of coated electrode. These projections may involve corrosion starting points.

WELDED WITH COATED ELECTRODE	CLEANER TO BE USED	
	Smooth abrasive cleaner	Non-stick welding products
Cleaning methods	Rub to remove embedded part.	Protective agents that prevent adhesion of projections in welding operations.
Recommendations	Always rubbing in the direction of polishing lines to avoid deposition of materials.	

Glue (adhesives)

Residues of glue usually appear as a result of glueing stickers or posters on the surface of the material.

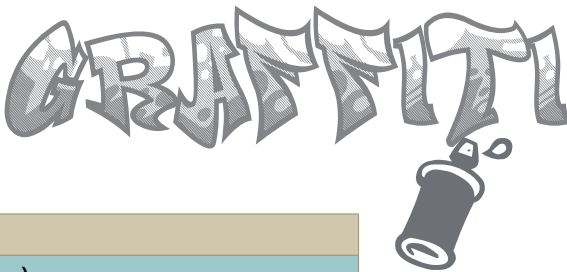
dirt that apart from worsening the aesthetic appearance, can lead to corrosion. Time is important for this kind of stains, the sooner the cleaning the better, since otherwise the glue is dried, incrusting needing the use a more aggressive cleaner.

Despite being torn, adhesive adheres to it, deteriorating the surface and accumulating

	CLEANER TO BE USED		
	Solvent	Abrasive cleaner	Hot water
Cleaning method	Rub with soft cloth rag.		Use soft bristle brush.
Recommendations	Wash thoroughly and dry fast to avoid stains.	Use only when adhesive has long time and not possible to eliminate it by the other methods.	<ul style="list-style-type: none">Rinsing and drying.Applying when the adhesive is not yet dry.

2.3 STAINS DUE TO VANDALISM

They may have different manifestations but all have in common that they are made after the manufacturing and installation process and are not the result of incorrect maintenance.



	CLEANER TO BE USED
	Solvents (acetone, toluene...)
Cleaning method	Rub the surface with a soft fibre brush, followed by water and plenty of rinsing before drying.
Recommendations	Use specific brush for stainless steel an do not scratch the surface.

3 Comments on façade cleaning

When establishing both the type of steel and the most appropriate cleaning procedure in each case, the environment where the building is located and environmental conditions it will suffer should be analysed.

Depending on the type of environment we can differentiate four cases:

1. Rural environment: it is characterized by being dry and with very clean atmospheres. They are the best environmental conditions, although not the most common.
2. Urban environment: in this type of environment the atmosphere may be conditioned by the exhaust gases resulting from the traffic of vehicles.
3. Industrial environment: although it is clearly influenced according to the different type of installed industry, the atmosphere will be affected generally by the presence of SO_2 , being able to affect and stain the surfaces of stainless steel.
4. Marine environment: the presence and quantity of salts in the atmosphere will be clearly influenced by the proximity to the coastal area.

Special care must be taken to avoid the deposition of salts on the steel surface, which will require the selection of a suitable finish and a greater frequency in the cleaning.

For cleaning façades, and provided that the periodicity thereof is properly planned, washing with neutral soaps is sufficient to keep them in good condition. Remember that you should end up with an abundant rinse with water so that all cleaning agents used are eliminated.

If the surface of the façade has any debris or accumulations of dirt that can not be removed with a simple conventional washing, pressure water or brushes may be used, but always taking care not to damage the finish of the steel.

In relation to the finishing the following recommendations should be followed:

- On polished surfaces, clean in the same direction as polishing.
- Always clean from top to bottom of the façade.
- Use façade finishes that favour surface runoff and minimize retention.
- Protective plastics must be removed once the material is installed. Otherwise they may be altered by heat and remaining adhesive when removed.
- Always remove all glue when removing plastic. It is a retention zone of dirt and causes stains with the time.

Particular care must be taken not to affect other materials that are not stainless and are close to the cleaning work of a material.

The correct choice of stainless steel, its finish and type is the responsibility of the architect, who should consult in case of doubt with specialists such as the supplier, whether producer or transformer, and have experienced installers to work with this material.

An effective and fluid communication between all the parties is decisive, so that everything is clear from the beginning. A small mistake may affect aesthetically a facade, or have other more serious consequences.

Among the most common errors are:

1. Incorrect selection of stainless steel.

We have already commented that there are several types of stainless, each one designed for its specific application so that the parameters for the choice of the type must be clear. To help with this decision, different methods have been developed that help to choose, it is always better to have a specialist.

2. Incorrect selection of finish. Samples of the possible finishes to be installed must be known and available. On facades where homogeneity is required. It is important to be clear about the manufacturing methods of each one, as some may not be able to guarantee a homogeneous surface.

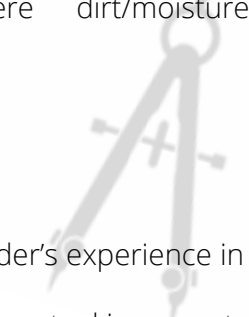
3. Inadequate design. A design that does not take into account the material to be installed is doomed to suffer problems sooner or later, or to require specific and expensive maintenance and cleaning protocols.

4. Incorrect selection of the installer who will carry out the works.

When carrying out an architectural project involving stainless steel we recommend taking into account the following 'decatalogue':

- Specify clearly the type of steel according to EN 10088-1.
- Specify, based on samples, the finish according to EN 10088-2.
- Guarantee the use of materials from the same batch in critical visible applications.
- Use a single supplier whenever possible.
- Take care that the decorative elements are aligned with the lamination direction.
- Make a design that avoids cavities or interstices where dirt/moisture can accumulate.

- Contrast the builder's experience in similar previous jobs.
- Verify that stainless steel is separated from carbon steel and that different tools are used.
- Ensure the use of stainless steel connecting elements.
- Check for possible galvanic pairs.
- Specify correct cleaning and maintenance.



4 Cleaning in some specific industries

There are certain sectors where cleaning equipment is a fundamental part of the process. Although each industry has its differential requirements, three specific cases are exposed: winery, brewery and olive-oil industries.

Cleaning in the wine industry

Stainless steel is widely used in the food industry for its excellent properties among which stands out its inalterability and its stable and antibacterial character.

In general, the normal cleaning procedure (water and neutral soap) is always applicable but in each industry it should be analysed the possible agents that can be found. In the case of wine it is the tartrates.

These agents will adhere to a greater or lesser extent to stainless steel depending on the type of finish, therefore a smooth finish is recommended.

If tartrates are strongly adhered, pressurized water may be used as discussed above in the case of façades. Bristle brushes may also be used to aid in the removal of debris, although these bristles should not affect the surface of the material.

When the layer of tartrates is very thick and is so adhered that it can not be removed with any of the above-mentioned methods, hot water steam and cold water jet under pressure, so that the dilations and contractions produced by the variation of temperature, end up breaking the layer of tartrates and causing them to be detached from the stainless.



Cleaning in the brewing industry

In this case, solutions containing gluconic acid contents between 4-5% followed by abundant washing with water. In this way we get rid of the acid and get a clean and shiny surface.



Cleaning in the olive-oil industry

In this industry, in addition to the basic process, pressurized water can be used to aid the removal of dirt. In very specific cases, very dilute solutions of soda can also be used to keep the surfaces clean, but always with subsequent rinsing with water at the end of cleaning.

Do not use products formulated with chlorine but, if there is no remedy, the contact should be minimal and should be followed by an abundant rinse with water.



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