

ENVIRONMENTALLY-FRIENDLY INITIAL CLEANING: Derouging and passivation of stainless steel equipment

pH-neutral care treatment for stainless steel surfaces

Stainless steel is far more sensitive than the colloquial name suggests. Stainless steel surfaces in the pharmaceutical, chemical, food industry or medical applications require special attention, both in new plants and after longer periods of use, in order to maintain the surface quality required for the processes. Contamination, foreign bodies and even hot water or ultra-pure steam impair the protective passive layer (chromium oxide-rich surface), the iron content of the surface increases, causing reddish-brown to black areas to form. This phenomenon, called rouging or blacking, can lead to particles detaching and affect the quality of the products. The preservation of an intact surface protection layer is now guaranteed by a patented environmentally-friendly process that ensures cleaning, derouging and passivation take place without disposal problems. Even when removing stubborn blacking, it replaces the aggressive pickling solution with more compatible substances.

Stainless steel surfaces are used preferentially in food technology, pharmaceuticals and parts of industry where hygiene and corrosion resistance are important. The robust material resists cleaning and disinfection media as well as steam jets, superheated steam and aggressive reagents in the plant. However, stainless steel itself is not inert. Just as with anodised aluminium, the optimum protective effect is only achieved by a sealed surface layer, in this case rich in chromium oxide, the passive layer. Unfortunately, this is not permanently stable and is not sufficiently thick "by design". It must therefore be regenerated or replenished for new installations and conversions or after a longer period of use. The specialists from Ateco Tobler AG Rheinfelden in Switzerland have now further improved their proven, environmentally-

About Ateco

Since 2004, Ateco Tobler AG has been engaged in the sector of high purity media in the pharmaceutical industry.



With extensive experience in planning, qualification and validation of high purity media systems and the know-how for treating high-quality stainless steel surfaces, Ateco provides consultation for removing of rouging and for the use of passivation methods. The execution of assignments with simultaneous documentation of the work as per the standards of the pharmaceutical industry, saves not only time and money but also gives the assurance that all regulations for complex cleaning processes are complied with.

For operations carried out independently, Ateco delivers also high quality cleaning products. With headquarters in Switzerland, the company is most flexible in the European market and can quickly and easily help clients in resolving their rouging problems.

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friendly cleaning and derouging process with subsequent passivation, so that stubborn rouging can now also be removed in the presence of atmospheric oxygen. In collaboration with the Belgian company Technochim, a patented process has also been developed that can even remove blacking without using aggressive pickling solutions.

Pore-deep clean and free of flakes

Inert surfaces for aggressive media or hygiene applications must be machined as smoothly as possible, forming a firmly-adhering protective surface layer. In stainless steel, this is a chemically inert, chromium oxide-rich top layer (passive layer) that protects the underlying matrix of iron and other alloying elements. However, the chromium of the protective layer is in dynamic equilibrium with the base metal and the fluids processed in the plant, so that even with pure water and temperatures above approx. 40 °C, the chromium content in the layer gradually decreases and the iron content increases. Heat accelerates this process. A red-brown rouging layer forms (Fig. 1), which consists of iron oxides, in the case of rouging mainly of haematite, i.e. red-brown iron (II) oxide (Fe_2O_3), or in the case of so-called blacking mainly of magnetite (Fe_3O_4) (Fig. 2). The latter forms preferentially at high temperatures, e.g. under the influence of pure steam, and is very difficult to dissolve again due to its stable crystal structures. Particles can be released from the blacking and rouging layers and contaminate the contents of the plant.

However, the surface protection is not only worn out during operation. Even with new systems or conversions, oil, grease or mineral and metallic impurities can permanently disrupt the formation of the passive layer and must therefore be removed before commissioning.

Conventionally, for this so-called initial cleaning and passivation process, the complete system, including all pipes, vessels and fittings, was cleaned with alkali and/or acids, any rouging etched off by mineral acids, rinsed and then passivated with oxidising nitric acid. All substances must be produced in a certified manner and must be disposed of in an environmentally-friendly manner at the end, because in addition to iron, parts of chromium and nickel etc. are also dissolved by the acids. Ateco has now developed an environmentally-friendly, pH-neutral alternative for this. This means that neither the reagent solutions nor the rinsing water need to be disposed of in a complex and expensive manner; discharging them into a normal wastewater treatment system is sufficient.



Fig. 1: The chromium content of the protective layer is already depleted in pure water at temperatures above 40 °C. The increased iron content then forms rouge. (Author: Ateco)

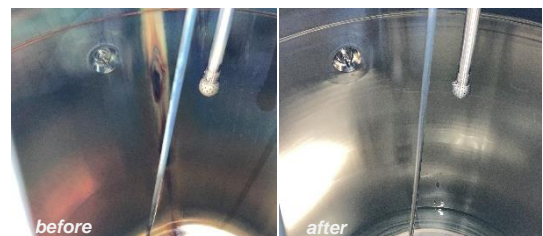


Fig 2: At higher temperatures, e.g. under ultra-pure water steam, blacking of magnetite forms, i.e. black iron (II/III) oxide (Fe_3O_4), which is difficult to remove. (Author: Ateco)

Environmentally-friendly and user-friendly treatments

The individual steps, i.e. cleaning, derouging and passivation, can be combined as required, but produce the best results as a complete package. All reagents are pure chemicals with their own certificates and are approved for all relevant certifications and validations in the food or pharmaceutical sector. In addition to the cleaning chemicals, the conditions for implementation are also important, i.e. the concentration of the cleaner, the temperature of the solution and the exposure time. The corresponding parameters can be adjusted to the process impurities occurring in the specific application. In order to wet the surfaces of large autoclaves, preparation, production and storage containers in a production-safe manner (Fig. 3), static, rotating and also orbital spray heads are used for distributing the pre-rinse, the cleaning solution and for rinsing; smaller systems can also be completely submerged. The seal materials approved in the pharmaceutical industry are resistant to the cleaning solution and usually do not need to be replaced. The chemicals for cleaning, derouging and passivation are available in concentrate form to allow the appropriate solution to be prepared. If desired, the Swiss provider can also take over the complete cleaning of the system and prepare the corresponding certificates and records. Experienced users can also carry out the work themselves; the necessary chemical certificates are included in the scope of delivery.



Fig. 3: Static, rotating and also orbital spray heads can wet all surfaces even in large autoclaves, preparation, production and storage vessels. (Author: Ateco)

For an extended range of applications

As the environmentally friendly agents only selectively remove the iron from the rouging layer, chromium, nickel etc. remain in the material matrix and do not contaminate the used solution.

Whereas in the past derouging solutions still required all parts to be cleaned to be inertised, the new, improved formulation can also be used in a normal atmosphere, i.e. under the influence of oxygen, eliminating the need for the nitrogen purging that was common in the past. This not only saves time and money, but also opens up completely new areas of application. This means that even large vessels such as spray drying towers, tanks or agitator vessels (Fig. 4) are now easy to clean. The derouging set sustainably improves the surfaces even of functionally non-inertisable or poorly inertisable equipment and machines, such as stainless steel washing machines in laboratories, hospitals, etc. This means that the passive layer can be restored to its new condition in these applications as well.



Fig 4: Even large vessels or stainless steel washing machines can now be cleaned without inertising. (Author: pixabay)

The environmentally-friendly and time-saving new derouging method offers a certified option for cleaning and re-passivating all stainless steel surfaces, either on your own or as a complete package.

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The clean surface significantly improves safety in the production process, and quality problems are prevented.

Powerful against iron oxide

As anti-rouging agents, environmentally-friendly solutions are already a good alternative. So far, however, they have not been able to do much about the altered crystal structure during blacking. In such cases, only pickling with aggressive chemicals remained as the remedy of choice.

With the new DIRUPURE LIQ +P in combination with SODEX LIQ +P and TECHNOPASS LIQ +P, this is now a thing of the past. The 3-step process can completely remove even the most stubborn layers of rouging/blacking. When derouging with DIRUPURE, water for cleaning is heated to the required temperature in an external tank, for example, and the liquid or solid components are added and dissolved (Fig. 5). The temperature of the cleaning solution must be kept constant for the entire duration of the process, max. 2 hours. For deblacking, after cleaning with SODEX solution, the DIRUPURE chemicals are also pre-dissolved and heated externally in a second step. After at least 90 minutes of constant circulation, the surface is clean once more. If the system does not allow circulation, it is also possible to fill and drain the system repeatedly to achieve the cleaning effect. Then the system is rinsed with water and passivated with TECHNOPASS solution. Here, too, the system is premixed externally and then re-passivated at approx. 90 °C for approx. 120 min.



Fig. 5: When derouging with DIRUPURE, water for cleaning is heated to the required temperature in an external tank, for example, and the liquid or solid components are added and dissolved. (Author: Ateco)

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