THE MECHANISM AND PREVENTION IN CORROSION PROTECTION FOR SELECTED SYSTEMS AND DEVICES MADE OF AUSTENITIC STAINLESS STEEL

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Corrosion problems arising from various factors continue to pose major environmental and technological challenges in many industrial sectors. The article presents a detailed analysis of various corrosion phenomena observed in piping systems and devices made of austenitic chromium-nickel stainless steels operating in aqueous environments within the food industry and district heating processing. The study explores the mechanisms underlying pitting, crevice, and sub-sedimentary corrosion occurring in chloride-rich water conditions, affecting the integrity of stainless steel components. Numerous case studies are provided, illustrating corrosion damage under defined environmental parameters, supported by photographic documentation, with particular emphasis on heat exchangers. The article highlights the importance of corrosion mitigation strategies, specifically through chemical pickling and passivation treatments. These procedures are conducted in baths designed to simultaneously remove existing deposit layers and regenerate protective passive films on the surfaces of chromium-nickel stainless steels.

The obtained results based on the discussed selected examples of the fundamental mechanisms and causes of systems and devices corrosion made of austenitic steels, indicated that the corrosion resistance of these steels in water installations is limited and depends on various factors. These include e.g. material-related (chemical composition), environmental conditions (chemical composition of the surrounding environment), ambient temperature, hydraulic flow, welding method and shielding gas, lack of etching and passivation of the surface after assembly. Other difficult to define factors, such as microbiological corrosion, may also play a significant role. Moreover austenitic steels used in water installations are particularly susceptible to corrosion. The occurrence of a specific type of corrosion, such as pitting, crevice and under deposit corrosion, is determined by many factors, as mentioned above. However, a damaged passive layer surface and environmental conditions, mainly the presence of chlorides, elevated temperature and lack of steel surface preparation after installation, mainly promote these forms of corrosion.

Among all the cases considered, the most favourable effect of austenitic steels protection against corrosion was recorded for both 304 and 316L AISI steel grades. In aqueous environments, effective protection involves initial or periodically repeated surface regeneration in baths where etching and passivation occur in acidic solutions of oxidizing acids, with the addition of a strong oxidizer, preferably hydrogen peroxide.