



How to Avoid Corrosion and Cracking of Plates

The Negative Effects of Using Non-Alfa Laval Adhesives

Case Story



Alfa Laval strongly recommends that only approved adhesives are used. This will make sure that potentially damaging elements are not conflicting with the products.

Background

After being in operation at a large fertilizer-producing facility for more than six years, two different types of plate heat exchangers (PHE), models V85 and V170, suffered extensive corrosion. The V170 unit was used in a urea plant to cool CO₂ with de-mineralized water; the V85 PHE cooled circulating water within the same system.

Examination

To determine the cause of the corrosion, two plates of V170 and one plate of V85 were sent for evaluation to the Materials and Chemistry Centre at Alfa Laval. The plates were visually inspected and photo-documented. Cross sections of the plates' cracked areas were investigated by means of light

optical microscopy (LOM). Glue residuals were tested for chloride content by means of a flame test and the composition of glue residuals were analyzed with EDS (energy dispersive spectrometry). Red dye penetrant was used to identify perforations.

All three plate pieces showed similar advanced corrosion and cracking. The damages were mainly located at the gasket grooves and on the non-media exposed surfaces, e.g. the leakage chamber. The laboratory examination included the following findings:

- EDS analysis of glue residuals used for fixing the gaskets in the gasket grooves revealed substantial amounts of chloride.
- The red dye penetrant applied to the V85 plate revealed several perforations in and near the gasket groove.
- The media-exposed surfaces were not affected by corrosion. It was noted that glue residuals were present in substantial amounts outside the gasket grooves.
- The metallographic cross sections revealed several branched cracks, characteristic of stress corrosion type of cracking (SCC).
- EDS analysis showed that there were substantial amounts of chloride present.
- The flame test gave clear, positive indications of the presence of chlorides in the glue, which also appeared in the EDS analysis.

What had happened

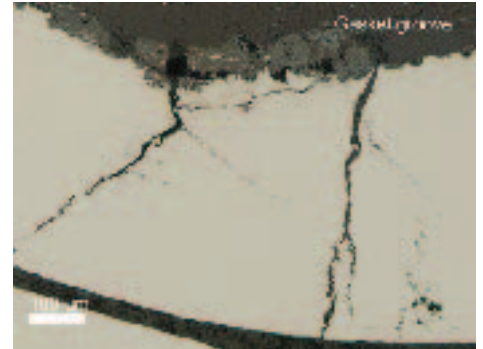
It was determined that the stress corrosion cracking and severe localized corrosion were caused by the use of chloride-containing glue used for fixing

gaskets in the grooves. The V170 plates and the V85 plate suffered from the same type of corrosion at the same locations despite different uses. The media-exposed surfaces were not affected by corrosion, proving that the cause of failure was not due to processes. The damages were located at the area of the plates with the highest temperature, in both cases about 95 degrees Centigrade. The heat caused the release of chlorides, which then resulted in localized corrosion and stress corrosion cracking.

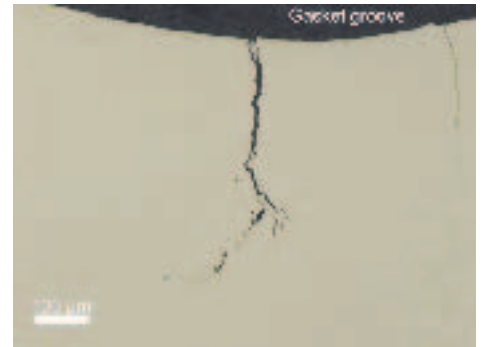
The consequences

As a result of the cracking, the user had to purchase entirely new plates, gaskets and glue. The lesson learned was clear; glues containing chlorides must not be used on stainless steel.

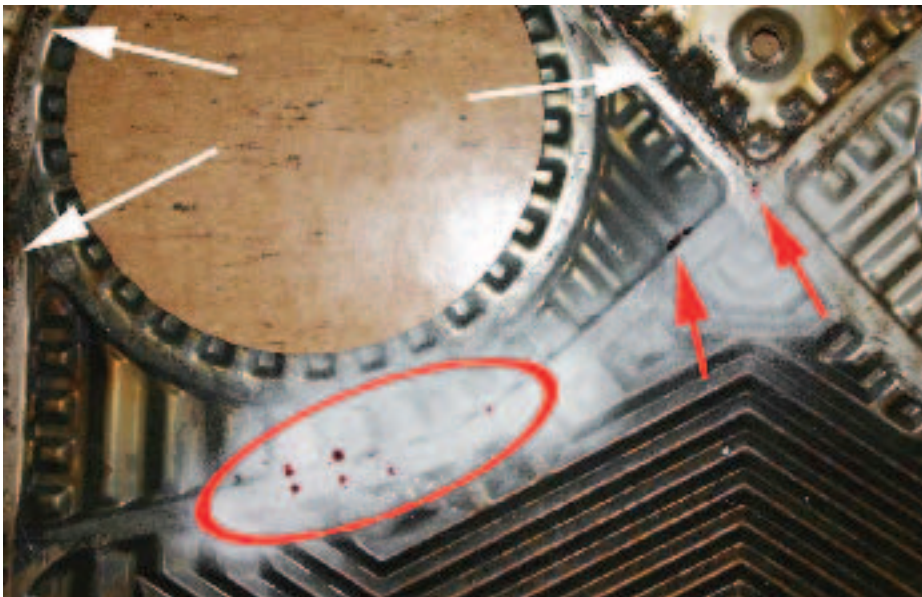
To ensure that the products work as efficiently, effectively and with as long a life as possible, it is strongly recommended that only Alfa Laval approved adhesives are used. This will make sure that potentially damaging elements are not conflicting with the products.



Stress corrosion cracks in the V85 plate. The dark grey objects on the upper side of the plate piece are corrosion products.



Stress corrosion cracks in one of the V170 plates.



V85 plate. In addition to the obvious and severe corrosion and cracking along the outer gasket groove (marked with arrows), the use of red dye penetrant revealed numerous perforations along the gasket diagonal, shown as red spots (highlighted by the red arrows and in the encircled area.)



V85 plate. The damages are mainly located in the gasket grooves.

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