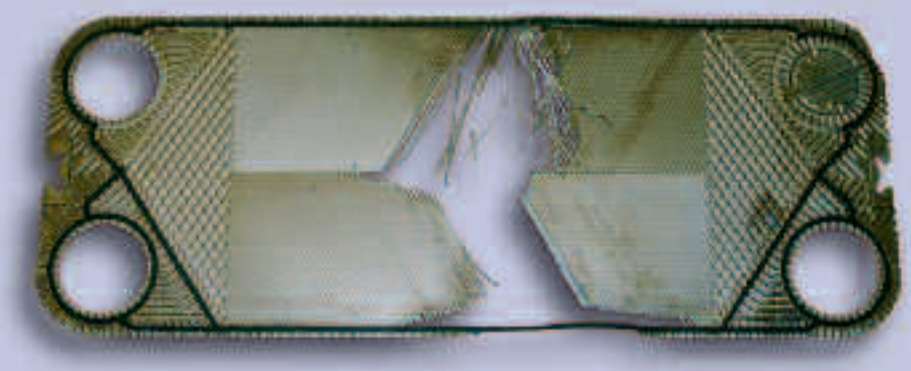
Cracking up under strain

Effects of non-genuine parts and wrong cleaning **Case story**



Background
A large Alfa Laval A15-BFM plate heat exchanger originally dating from 1984 is an important part of a geothermal heating installation, where it plays a key role in extracting approximately 6 MW of energy per hour, for use in district heating. The underground source of hot water has temperatures of about 78°C, but is very corrosive due to the presence of 3.5% sodium chloride and sulphur. The installation therefore features a total of 713 corrosion-resistant titanium plates.

In August 2003, after 19 years of problem-free service, this major geothermal installation was re-gasketed using non-genuine gaskets from a supplier of aftermarket gaskets. By the following month, leakages had already been detected in conjunction with more than half the plates.

Partly in response to this situation, the heat exchanger plates were then sent to the same service company for cleaning.

Examination
Seven out of a total of 380 titanium plates featuring leakages (along with the gaskets used) were subsequently examined by the Materials and Chemistry Centre at Alfa Laval to determine the reasons for such widespread, serious problems.

The plate surfaces were examined using a light optical microscope. To help identify the crack fracture mechanisms, cross-sections were metallographically prepared and examined under the microscope.

The gaskets were tested for hardness and the dimensions and specifications were checked.

What had happened
In brief, the laboratory findings included
- Fatigue cracks were found in all the plates examined, the result of excess mobility due to incorrectly fitting gaskets.
- The gaskets were too thick (12% thicker than specification) and too hard (by approximately 8%).
- The gaskets were made of an incorrect material (EPDM instead of NBR) with an IRHD hardness rating different from specifications.
- Three of the plates had been partly dissolved by chemical action. This was probably due to the service company having used incorrect cleaning procedures featuring an aggressive cleaning liquid such as hydrochloric acid.

The consequences

The fitting of non-genuine gaskets had substantial, costly effects that were reinforced by the consequences of unauthorized cleaning procedures.

- The oversized gaskets had prevented the plates from coming into proper contact with each other and had thus caused widespread leaks.
- The extra thickness and hardness of the gaskets made it impossible to assemble the heat exchanger correctly, adding 285 mm of extra material to the length of the plate pack.
- Insufficient contact between the plates meant that the plate pack lacked its full strength. Inadequate support resulted in plates flexing, causing fatigue and leading to numerous cracks.
- Non-branched fatigue cracks of different lengths were found in almost all the plates examined.

As a result, every single gasket had to be replaced, as well as many of the relatively expensive titanium heat exchanger plates.

The financial impact amounted to approximately EUR 350,000 – including the cost penalties incurred by operating downtime, repair and replacement.

Alfa Laval support ensured that the customer's heat exchanger was replaced with a new unit that has many more years of reliable service ahead.

Close-up image of crack found in a plate.

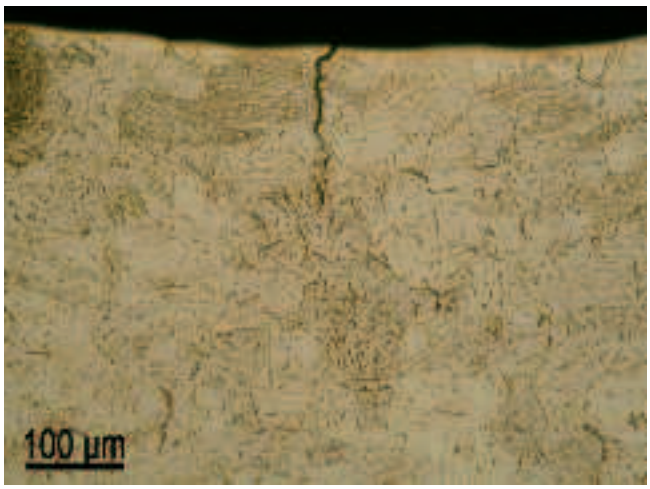


Image of the microstructure obtained from metallographic etching.

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- Full benefits from Alfa Laval sealing technology

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