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Deformation Optimization of Plate Heat Exchangers

Today it is more important than ever to reduce the waste of energy in order to minimize the environmental impact and reduce the costs of a process. A good way of doing that is to use heat exchangers.

The thesis was conducted in collaboration with Alfa Laval which is a global company operating in three key product areas: heat transfer, separation and fluid handling. One major product segment within the heat transfer area is the gasket mounted plate heat exchanger, which the thesis focused on.

In a plate heat exchanger (PHE) the different mass flows are separated from each other with corrugated plates, made out of sheet metal. The key part of the plate is the heat transferring area which often consists of a cross sectional wavelike pattern. When every other and other plate is rotated and mounted together contact points occur at the wave tops. When the equipment is pressurized deformations may occur in the contact points, see figure 1. The aim of the thesis was to understand how to optimize the wave pattern geometry to minimize the deformations.

The wave pattern was described with several parameters but it was seen that only two design parameters was defining the pattern's shape, an angle and a radius. With this knowledge a possible design space could be defined.

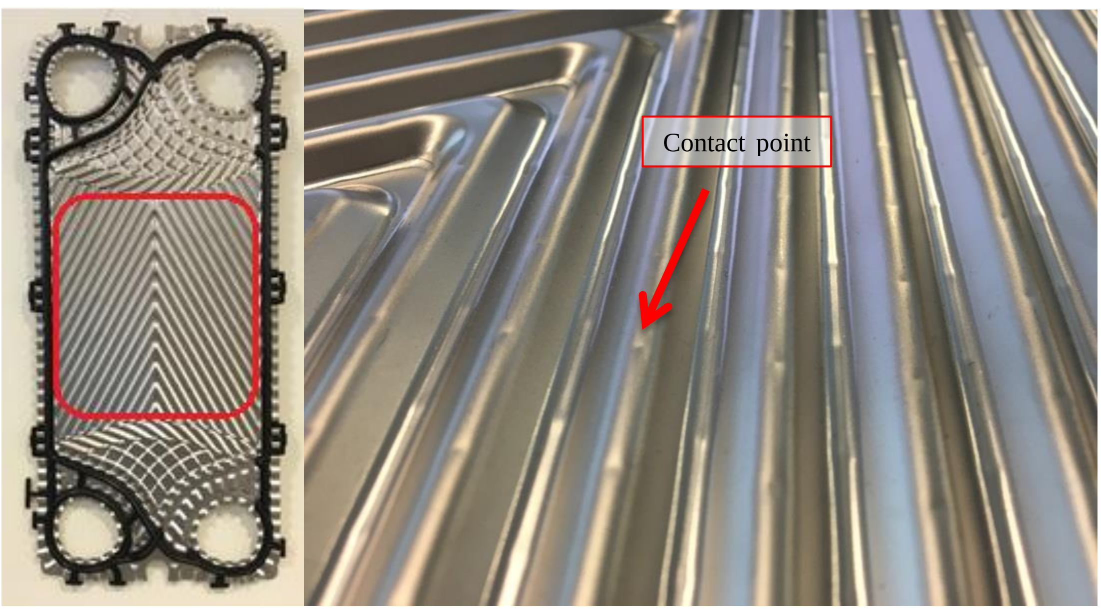

Figure 1. To the left the heat transferring area is marked on a plate for PHE. To the right the contact points are visible on the heat transferring area

The thesis was divided into three major parts: two parts with different simulation models and a third which consisted of laboratory experiments. The first simulation model was made with rough simplifications in order to obtain an automatized setup to scan the selected design space. That simulation model excluded the effects from the forming procedure and the plate was directly modulated in CAD which was a crucial to make it possible to automatize the simulations. The second simulation model was based on Alfa Laval's existing simulation procedure. It included more aspects to obtain realistic results, but was more time consuming since every simulation had to be prepared manually. This led to fewer simulated design points and each design point had to be chosen more carefully. The object of the experimental part was to validate the correctness of the simulation models.

The results showed that the geometry could be optimized in certain ways. The results did not give an exact optimum angle but gave an interval where the optimal angle should be. With a finer simulation mesh it might have been possible to find a more exact optimal angle. Concerning the radius was the results clearer. Due to the confidentialness of the results is it not possible to reveal any more precise results. The verification of the simulation models by the laboratory experiments showed that Alfa Laval's existing simulation model corresponds fairly well to the real results.