# Popular Science Writing

## Serviceability of plate heat exchanger gaskets bonded with various adhesives

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Imagine a factory, a power plant or even the heater of your own flat stopped working. The reason? A tiny rubber gasket that has come loose. It might sound like a joke but behind that small piece lies a fascinating science and major industrial challenge. This master's thesis dives into this invisible and little-known world: how and why adhesives hold critical components together and what happens when we use them for one of the most common devices in the world, heat plate exchangers. Adhesively bonded gaskets are the unknown heroes of plate heat exchangers, devices essential to industry and daily life. They allow two liquids to exchange heat without mixing, making them suitable for all kinds of applications, from building climate control to food production. At the heart of these exchangers are dozens of metal plates, each with a rubber gasket glued along its edge, preventing leakage and ensuring a good sealing. If even one gasket fails, the system can lose efficiency, contaminate fluids, or even break down entirely.

But why not just weld the plates together? The answer is rather uninspiring, but it is the reality. Over time, especially when seawater is involved, plates can become clogged and need to be cleaned in order to restore its efficiency. Adhesively bonded gaskets, unlike welded heat exchangers, allow the system to be opened and cleaned, but this exposes the adhesive joints to mechanical and thermal stresses that can compromise the bond. Here is the challenge: how do we ensure these gaskets keep working after repeated cleanings?

Sticking two materials together might seem simple, but the science behind adhesion is surprisingly complex. There is not a single theory that explains why adhesives work, in fact, it is a combination of all of them: mechanical interlocking, electrical forces, chemical reactions, diffusion and more. This research focuses on how these mechanisms operate between the metal plate and the rubber gasket and how different adhesives respond to the stresses of industrial cleaning.

During my thesis in Alfa Laval, a world leader company in heat exchangers, I studied two types of rubber: NBR and EPDM. Each has unique chemical properties, which affect how well they bond with adhesives and how durable that bond is. The result? A wide range of adhesive-gasket combinations, all of which need to be tested under extreme conditions to find out which ones stand after cleaning. In order to test these bonds I subjected the gaskets to peel testing experiments combined with high-pressure water jets, simulating the industrial cleaning process. Then, I analyzed how and where the bonds failed. The goal is clear: to understand which adhesives and materials offer the greatest durability, and to set safe limits for cleaning procedures.

This project is not just about solving an industrial problem, it also contributes to a scientific field full of unanswered questions. Adhesion is fundamental to countless applications, from medicine to space exploration. Every step forward in understanding these mechanisms can help to improve the efficiency, safety and serviceability of technologies we rely on every day.

This thesis is a small step toward a world where machines run better and longer, thanks to a science as invisible as it is essential: the glue that holds everything together.