Popular science summary of a thesis in structural engineering, Lunds Tekniska Högskola.
In collaboration with JBT Marel.

Fatigue Life Anlysis of Welds in Conveyor Belts

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A single failure in an industrial conveyor belt can stop an entire production line. By understanding how tiny cracks develop in welded joints, engineers can design conveyor belt systems that last longer, require less maintenance, and reduce costly downtime.

Conveyor belts are essential in modern food processing industry, where products must be transported through freezing, cooking, or packaging systems. In spiral freezers, for example, conveyor belts operate continuously under varying loads caused by belt tension, product weight, and changing operating conditions. Although these loads may seem moderate, many repeated loading cycles can gradually weaken the structure through a process known as fatigue.

Figure 1: GYRoCOMPACT®freezer manufactured by JBT Marel, where the conveyor belt investigated in this study is used.

Fatigue occurs when small cracks form and grow over time due to repeated loading. In welded steel structures, these cracks often start at the welds, where stresses become concentrated. Eventually, a crack can grow large enough to cause a component to fail, leading to repairs and unplanned production stops.

This master's thesis investigated the fatigue performance of conveyor belts used in industrial freezing systems manufactured by JBT Marel. Using computer simulations and analytical calculations, the research examined how stresses develop in critical welded connections and how different design choices influence the expected service life of the belt.

The study revealed that weld geometry influences fatigue resistance. Larger welds were found to reduce the stress concentrations and improve the predicted fatigue life. The researchers also investigated an improved conveyor belt design that includes a tension link. This modification changes how forces are distributed throughout the structure of the conveyor belt and can reduce the stresses acting on critical welds, which leads to increased fatigue life.

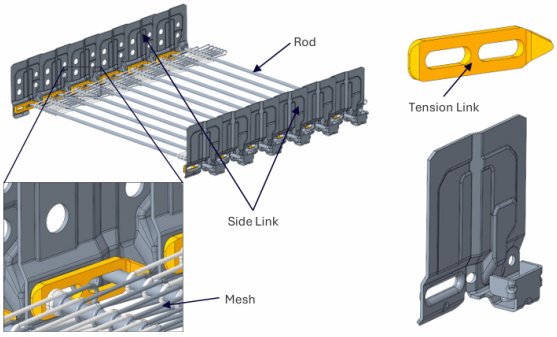

Figure 2: Overview of the conveyor belt, including tension link, side link, rods and mesh. With the tension link included in the conveyor belt.

Several established fatigue assessment methods were compared. The results showed that different methods can predict different fatigue lives because they focus on different aspects of the stress field. This highlights the importance of choosing an appropriate analysis method when evaluating welded structures.

The findings provide valuable insight into the fatigue behaviour of conveyor belt welds and can serve as a basis for future design improvements. By identifying critical locations and evaluating different design solutions, engineers can develop more durable and reliable conveyor belts for industrial food processing systems.

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