
# web handling of thin foils at high temperatures.

DEMCON MULTIPHYSICS

## CORE COMPETENCIES

1. Industrial machinery
2. Structural mechanics
3. Flow and thermal engineering
4. Process optimization

**Goal**

Web handling involves the processing of thin materials through a processing setup using industrial machinery. Common types of web handling processes include coating, laminating, and metallizing. However, thin structures are hard to handle. Enhanced web handling will help to make better products and contribute to accelerate the transition towards renewable energies. Product become lighter, thinner, more powerful and more flexible.

During the production of semi-finished products, layers are deposited at high temperatures on a substrate material to create thin foil structures.However, as the foils get thinner and wider, especially web handling becomes an issue.

Thin foils can start to crack as the handling forces are relatively large when materials are getting weaker at high temperatures. Moreover, thin foils are getting extremely flexible at high temperatures possibly causing the foil to buckle or wrinkle.

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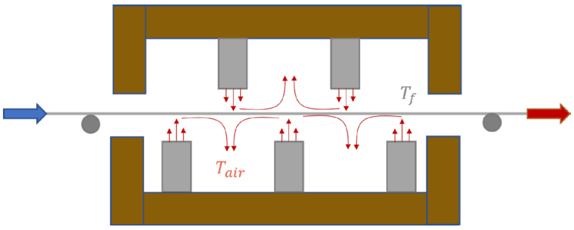


**Figure 1** Schematic representation of a flotation oven used to heat up foils to a desired temperature

## Approach

The process of web handling at high temperatures can be modeled employing simulation software. First, temperature profiles of the foils can be determined by including thermal contributions such as heaters, insulators, and heat distributors. Second, the deformations can be determined which are caused by thermal expansions and web handling forces such as web tension controllers, roller interaction, spraying processes, or air nozzles.

In this way existing processes can be investigated and critical process parameters can be determined from sensitivity analyses. Moreover, new designs can be realized from scratch, for example based on web rollers, a flotation oven, or a vertical oven concept. Concept choices can be made based on fundamental insight and processes can be optimized.

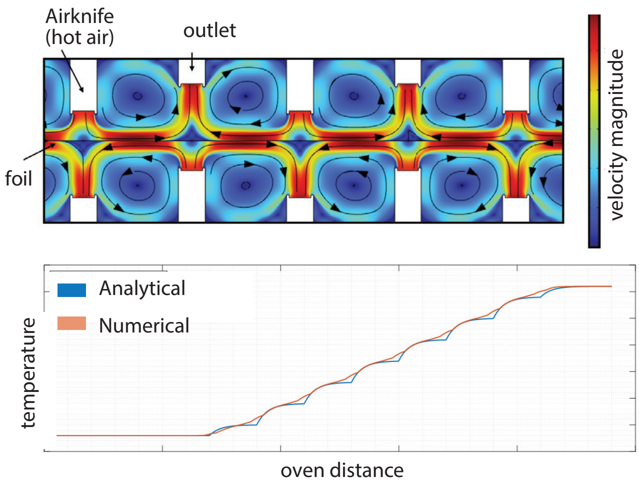


**Figure 2** The air and foil temperature inside a flotation oven is designed using comprehensive simulation models

## Result

One type of project included the optimization of an existing system. For example, a sensitivity study was performed how a thin film can be deposited on a foil employing a spraying technology. It included comprehensive fluid flow simulations showing how the spray heated up the foil and which impact it had on the buckling behavior of the foil. These simulations were used to optimize the system.

Another type of project included feasibility studies to determine the advantages and disadvantages of different concepts. Different concepts were selected and they were examined based on different criteria, amongst others, robustness, size of the system and maintenance. Especially the robustness criterion involves extensive engineering work. It starts by fundamental hand calculations to create an initial design. Subsequently, simulations will help to demonstrate its feasibility and finetune the design. Based on this work a concept choice was recommended to realize.

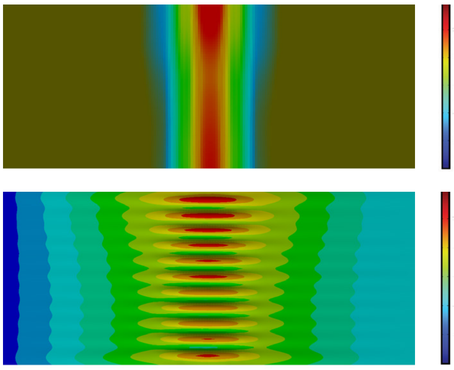

**Figure 3** Pressure profile on the foil determined by flow simulations resulting in wrinkles at elevated temperature of the foil

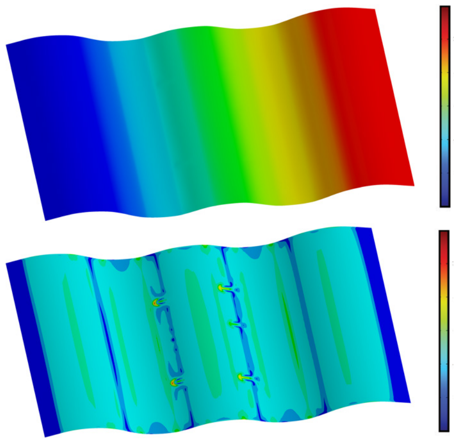

**Figure 4** Designed temperature profile for a flotation oven concept resulting in stresses which initiate wrinkling behavior

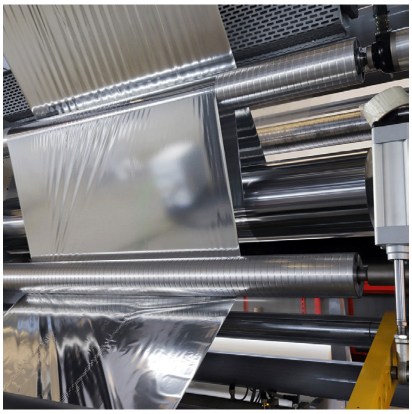

**Figure 5** Web handling