Compression Analysis of Primary & Secondary Package*

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***Abstract*— Beverage packages are often damaged when transported from manufacturer to consumer. To reduce this food waste, virtual package models has been developed for better understanding and fast-forwarding the development of the package resistance to transportation damages.**

I. Physical Compression test - Validates virtual models

In a computer environment, e.g. virtual testing, a mathematical approximation of the physical testing is implemented. Imperfections are needed to be implemented to the virtual models to make it imperfect. These imperfections is easy to find by watching the reality. The difficulties is to find the right ones needed. In a beverage package it exist several weaknesses such as, different material, geometry change or a new product liquid. To identify the important ones compression test were performed and the result was a model which captured the physical result, see figure 1. One of the most important factor for the validation of the virtual models was the package geometry and more importantly how the corners were folded [1]. To capture the variety in geometry between different packages the virtual models were folded in the same way as a package would have been folded by hand.

To understand the acting internal forces and how each individual package behaves in a full pallet distribution test an evaluation of an individual primary package was firstly performed. This gained knowledge about a package Box Compression Resistance, BCR, and how it depends on the direction of the external load [2]. A virtual model were then built in the computer software ABAQUS/explicit with a well-explained solution procedure and with all the assumptions discussed. The model's deformation behavior and it's BCR coincides well with the physical compressions tests.

Next step in the thesis were to assemble sixteen primary packages into one secondary unit. Physical tests were done and later compared to a created virtual model. The model with some additional assumptions were in well correspondence with the physical tests, see figure 1.

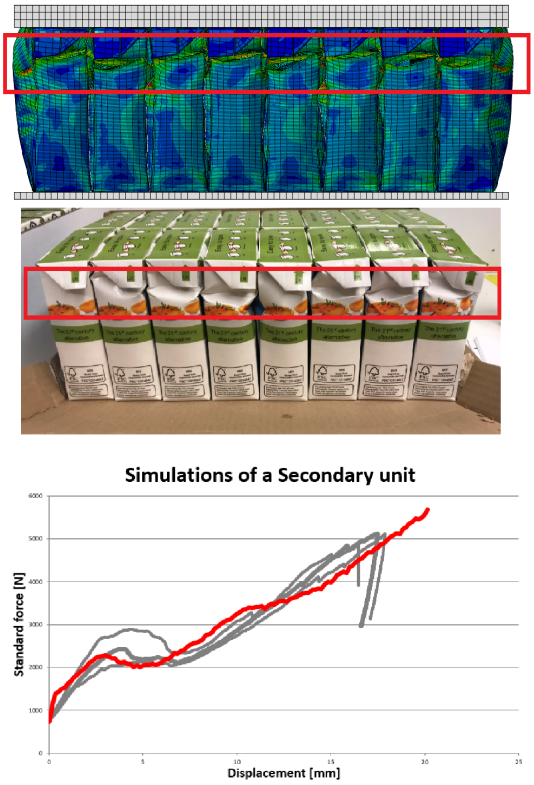

Fig. 1. Virtual compression test compared to a physical one. The force-displacement curve shows the comparison between the physical test data, grey lines, and the simulation, red line.

Creating a virtual model of a Secondary unit step-by-step has not previously been performed at Tetra Pak. Thus, this thesis contributes to well-explained information of how the primary package behaves on it's own and assembled in a Secondary unit. The model corresponds well to physical tests and could be of interest to use in Pallet distribution tests in the future.

To obtain a greater resemblance between the physical and the virtual testing improvements can be done. These are firstly to obtain more physical test data on the secondary unit, construct a folding simulation for the secondary package as done for the primary package and analyse and compare the same simulation with another material model.

References

[1] Nyberg, J. and Lotzke, F. 2018. Compression Analysis of Primary and Secondary Package, Division of Solid Mechanics, Lund University.

[2] Ottosen, N. S. and Ristinmaa, M. 2005. Analytical Prediction of Package Collapse Loads- Basic considerations, Division of Solid Mechanics, Lund University.

*This summary is refereing to a master thesis written at Tetra Pak.

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