Analysis of Deformation of a Liquid Packaging Made with Board of the LPB Type

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Abstract

The liquid food product packaging are today predominantly made with board LPB type board (Liquid Packaging Board) composite formed by board, which offers mechanical strength, polyethylene, constituent responsible for protection against the passage humidity, and aluminum foil, which helps protect against oxygen flow.

On the day, paper and board are words used as synonyms for each other. Strictly, the paper is formed from the drainage of a fibrous suspension of pulp whilst the board it is generally comprised of several sheets of cellulose fiber material or linked starch adhesive, which also stresses the fact that the term board is used for high-papers grammage. Are considered as an orthotropic material, where their analysis in three orthogonal directions: Machine Direction (MD), corresponding to the longitudinal direction of the paper, Cross Direction (CD) corresponding to the direction perpendicular to the movement of the web on the paper machine and Z Direction (ZD), depending on the thickness of the sheet.

Usually stored in a stacked form both on the shelves and in deposits supermarkets, such packages deform plastically and elastic. In short, plastic deformation gives the lower packaging when compared to a package with elastic deformation, as seen in Figure 01.

Therefore, this study aimed to analyze the deformation profile of a simplified packaging made only with board without aluminum rolling and polyethylene through the use of the COMSOL Multiphysics® software. With the feature "parametric sweep" the values of the elastic properties of the material were parametrically varied in a specified range around the value found in the theoretical framework. The Structural Mechanics Module was used so the presence of the liquid would result inside the package using pressing tools without the physical presence of the liquid.

The structural model initially proposed, presented deformation as shown in Figure 2. This simulation was performed to ascertain the behavior if the package stayed open in the environment without any restrictions.

Then it was solved the volume restriction using the tool "Global Constraint" generating the strain profile shown in Figure 3.

Subsequently, the obtained strain was compared by simulation with the strain a real packaging, which presented deviation. Therefore, was varied the elastic constants of the

material in both the MD direction, the CD as well as the liquid density bottled in the packaging as shown in figure 04.

The results reveal that the strain profile is a function of the density of the liquid bottled in the packaging, of the elastic constants of the board, especially in CD orientation and Poisson's ratio. Equating proposed for the closed container, with restriction of its internal volume, was the potential equation that ruled the deformation profile. The results point to the study which is considered a composite board with polyethylene and aluminum, as well as the optimization of physical measurement method of the actual package.

Reference

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Figures used in the abstract

Figure 1: Deformations, a) Elastic, b) Plastic

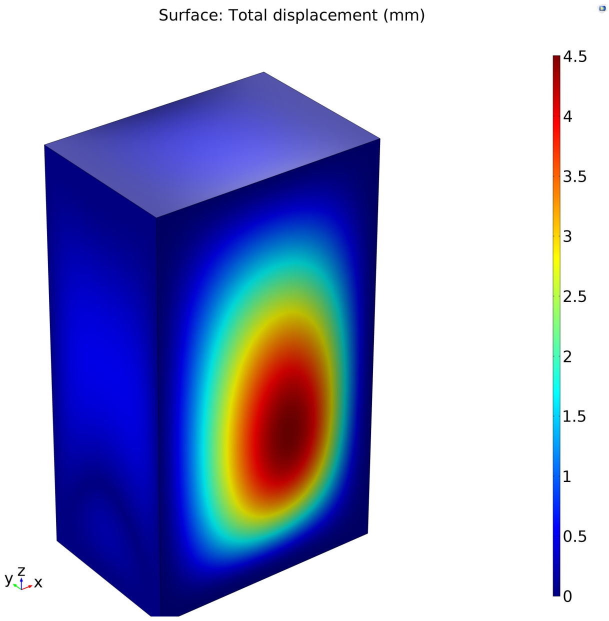

Figure 2: Initial Results

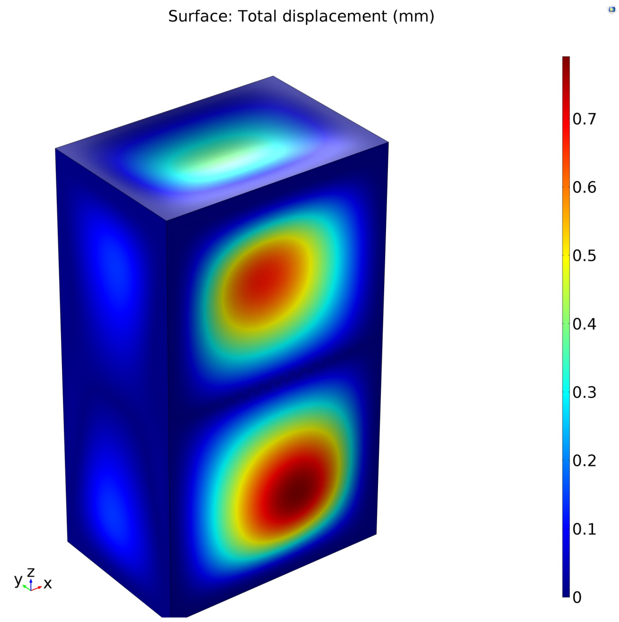

Figure 3: Strain profile with volumetric restriction

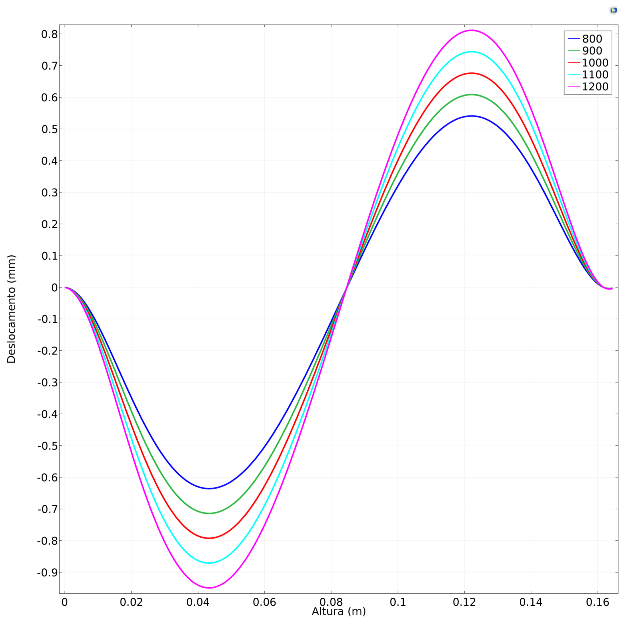

Figure 4: Strain in function of the varying of liquid density bottled the packaging (800 to 1200 kg/m-3)