

# Simulation of the Forming Process of Liquid Filled Packages Using Coupled Eulerian-Lagrangian Approach

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*Abstract: This study concerns simulation of the forming process of a carton-based package for liquid food (for example, milk or juice), and how the packaging material interacts with the fluid during the forming. The carton-based package is formed inside a filling machine while the fluid is being filled into the package. The carton-based package is thin with low bending stiffness and is thus deformed significantly at small loading. This implies that the forming of the package to a large extent depends on the dynamics of the fluid inside the package. In the filling machine, the filling pipe enters the tube where the carton-based web is partly shaped into a longitudinally sealed tube. The package is formed and transversally sealed below the fluid surface. When forming the transversal seal of the package, the cross-section of the tube changes from open circular to closed in a short period of time, which causes considerable pressure waves inside the package. In order to control the pressure waves and thereby the forming of the package, a pressure flange is mounted on the filling pipe inside the carton-based tube. A coupled Eulerian-Lagrangian approach in Abaqus/Explicit is used in order to study both the deformation of the packaging material and the fluid and the interaction between them entirely within a single finite element model.*

*Keywords: Packages, Forming, Coupled Eulerian-Lagrangian, Fluid-Structure Interaction and General contact.*

## 1. Introduction

Carton-based packages are increasingly becoming common to store, transport and distribute liquid food such as milk or juice. Such packages are durable and lightweight and offer the advantage of an efficient and economical distribution – from the manufacture of compact cartons to the distribution and handling of fluid filled packages all the way to the consumer's waste recycle bin.