Biotex BigBag Simulation

LS-DYNA Airbag Tool - Unusual Application

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1 Introduction

With the focus on environmental aspects alternatives for synthetic high-stretchable polymers should be found in this work. The challenge here is to combine biological degradation and high-strength properties. The aim of this work is to establish their requirements and with this to develop a new high-stretchable biopolymer-compound.

The strategic intension of this project (heavy duty containers; FIBC - Flexible Intermediate Bulk Containers; BigBags) is the usage of industrial bags made of resource-saving biopolymers with comparable good high-strength properties as synthetic polymers.

To predict the performance of different tapes and types of textile fabric, a numerical simulation should be built up to check the existing bags and get a better understanding of the behaviour of such bags when they are loaded.

Figure 1: BigBag-Sketch

2 Simulation approach

From simulation point of view one of the challenges in this first step of the project was the creation of the geometry of the bag. As in most cases the geometry of parts, that should be structurally analysed by FEM, is given. In this case the geometry of the filled bag is not available, a pre-simulation of the filling is needed. During filling the fabric will buckle, the edges and corners will arise which cannot be assumed. Therefore, certain methods were tested, finally the airbag model (*AIRBAG_SIMPLE_AIRBAG_MODEL) as best practise tool was used.

Figure 2: Different states of bag deployment

2.1 Load application

For the application of loads two approaches were considered:

- Load application by the help of additional elements (DEM – discrete element method)
- Load application by an inner pressure applied on the affected elements

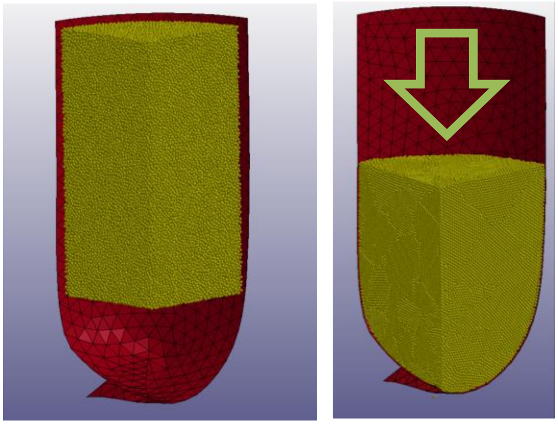

Figure 4: DEM Approach

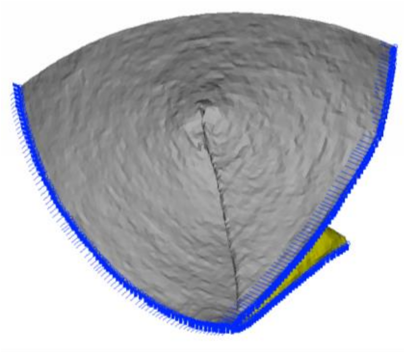

Figure 3: Quarter model of bag

3 Simulation results

Finally, best practice choice was to implement the load via inner pressure. The pressure was increased equal to a load from 0kg up to 3000kg. Stresses were evaluated both, in x (longitudinal) and y (circumferential) direction of the bag. Results from the FE analysis were compared to the test results.

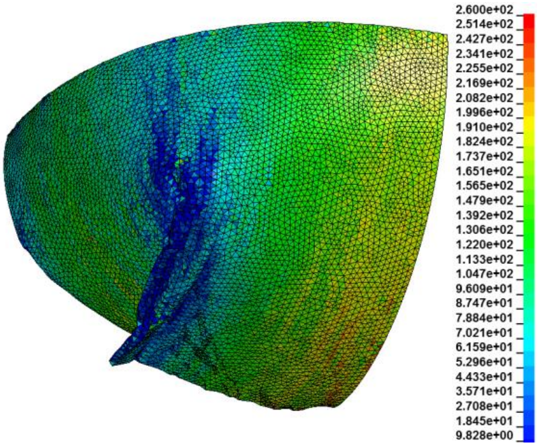

Figure 5: Calculated stresses in X-direction (longitudinal)

4 Summary & Outlook

It was shown that this complex geometry of filled bag could be realized by using the LS-Dyna Airbag tool. A filling of the bag by the help of DEM was calculated but it was too time consuming to get it done in this first project step, therefore a simple inner pressure was used to apply the load.

Considering the outer surface of the bag the FE results fit quite well to the tape test results. Comparing to what the bag is able to bear in reality, the FE results for this load shows stresses which are in the range of the tape tests. The scattering of test results among the different tapes gives a certain range for the maximum load.

The strength of the tapes has to be statistically secured by a higher number of tests, a clearer statement out of the FE analysis can be given afterwards.

When knowing the requirements of the tapes, the next step will be the consideration of biopolymer tapes which is the main aim of this project.