Automotive view on the processing simulation of chopped fiber reinforced composites

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Résumé

In the automotive industry, high material costs reduce the implementation of fiber reinforced composites. This is emphasized by the lack of knowledge of local material properties which must be compensated by the use of important security factors during part design. A main challenge for an efficient design of fiber reinforced composite parts is thus to predict these local material properties and to consider them when validating the part compliance to its mechanical specifications.
In order to avoid cost and time intensive trial and error design phases, an approach relying on simulations is mandatory. Considering the local material properties can basically be resumed as a link of process and product simulations. This link is done using a mapping tool which can include a step of homogenization of local material properties.

The approaches on continuous fiber reinforced composites are rather well investigated in academics [1] and start to become applied in industrial research and part development [2]. However there is still an important lag in the development of similar approaches for chopped fiber materials as SMC which find mainly use in semi-structural parts.

According to the author of this paper, multiple roadblocks on the entire simulation chain are currently hindering the application and use of such an approach for SMC materials:

> Eventually most critical is the process simulation. Generally software implementations are based on standard rheological models as for example Jeffery's Model or the plug flow model which are at least sometimes not able to predict the material behavior observed during real material compression, see also the short shot in figure 1. However, to the authors knowledge, there is no model which allows to predict the correct behavior for each element of the large material family SMC which includes multiple fiber configurations and resins based on sometimes more than 10 different constituents.
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> The functional mapping and homogenization phase, must be based on an exhaustive identification of the local material properties which have the most important impact on the mechanical properties.
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> Some material models, implemented in commercial software codes as MAT157 in LS-Dyna can be used to model locally varying material properties. However a main challenge is to characterize these material cards in a cost efficient manner.

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The goal of this work is to present give an insight of the industrial challenges, which can be encountered when trying to simulate the SMC material in a most realistic configuration.

B. Van Den Broucke et al., Determination of the mechanical properties of textile-reinforced composites taking into account textile forming parameters, International Journal of Material Forming (2010) 3 (Suppl 2):S1351-S1361

B. Eck, G. Le Lan, R. Schaefer, Linking process & product simulation for considering local material properties in crash simulation, German LS-Dyna Forum 2018 Bamberg

Mots-Clés: SMC, Simulation, Product, Process simulation link, Local material properties