Application of numerical simulation for lightweight design

Marcel Graf
Birgit Awiszus

TU Chemnitz, Professorship of Virtual Production Engineering, Chemnitz, Germany

ABSTRACT

Due to the continuous efforts to make components lighter and lighter in order to save CO_2 in the application, the use of light metals or high-strength steels is an option, because the primary components of a vehicle (chassis parts) as well as secondary parts (tank, brakes etc.), for example, can be lighter and/or smaller. Based on the good processability and property profile of light metals, they are currently used wherever weight reduction plays a significant role and steel applications are oversized. Hitherto, the corrosion resistance (especially with magnesium), which was classified as critical, can be improved by the production of hybrid materials. The production of aluminum and magnesium is more energy-intensive in primary production than for steel, but the weight advantage of lightweight components is the lower energy consumption and reduced emissions during the use. Therefore, the aim is to link energy-intensive process chains by the combination of two or more sub-processes in one single stage. Strategies for the utilization of casting heat for subsequent hot forming processes or the use of stored forming heat for finale heat treatment are represented. In order to deterimine the effect of production history on the material, the tools and the machine under consideration of the whole process steps numerical methods are often used. Nowadays, these methods even allow to predict the resulting mechanical properties in the component, if the process chain is completely modelled and simulated. For this, it requires the very sensitive thermo-dynamic and thermo-mechanical material data as well as the microstructural model coefficients of the investigated material. In this paper, the numerical and experimental challenges on combined processes or hybrid materials for bulk forming as well as for additive manufacturing are presented.

Keywords: *numerical simulation, FEA, bulk forming, additive manufacturing, aluminium, magnesium, polyamid*