Validation and Material Modelling of Plastics

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The virtual estimation of physical product properties is only as good as the virtual description of the behaviour of its material. On the one hand there are well known material cards like *MAT_PIECEWISE_LINEAR_PLASTICITY in LS-DYNA© developed to describe a simplified behaviour of metallic materials. The reduced complexity of these material cards makes it possible to determine its parameters with less effort in actual material testing. Main advantages are high numerical stability and less machine time.

On the other hand complex material models like *MAT-SAMP-1 can also handle varying compression and tension behaviours by defining a load case dependent yield surface as well as unloading by using damage functions. With the exception of visco-elasticity the description of visco-plasticity fulfills many requirements to describe a realistic behaviour of thermoplastics. For acceptable use of the above mentioned models a higher amount of load cases like tension, compression, shear have to be carried out to determine the material parameters and to represent the thermoplastic characteristics in crashworthiness simulations.

At the moment there is no standardized method to determine material card properties for arbitrary material models from basic (i.e. tension, compression or shear) test setups.

4a impetus represents a standardized method, an efficient and reliable process starting with realistic test scenarios and finally ending up with a validated material card. The method of reverse engineering is used behind this process to generate material cards like *MAT_PIECEWISE_LINEAR_PLASTICITY as well as more complex *MAT_PLASTICITY_COMPRESSION_TENSION with regard to easy and favourable testing.

We have compared different ways to determine and validate material cards with the example of PA6. Limits and opportunities of different test methods and material card implementations are shown and compared to each other especially focused on typical polymer behaviour.

Keywords:
Thermoplastics, Polyamide, PA6, Material Modelling, Validation, 4a Impetus, *MAT_PIECEWISE_LINEAR_PLASTICITY, *MAT_PLASTICITY_COMPRESSION_TENSION, *MAT_SAMP_1, Reverse Engineering

