dtc | dutch thermoplastic components

Internship / Graduation assignment

Prediction of Shape Distortions after Stamp Forming of Thermoplastic Composite Laminates

Background:
DTC is a highly specialized manufacturer of structural parts for aerostructures. Since the creation of the company in 1998, DTC has been making all its parts exclusively from thermoplastic composites. The first flying parts for aircraft that DTC manufactured were the landing flap ribs of the Dornier 328 jet. Today we manufacture more than 2.000 unique part numbers for 12 different types of large passenger aircraft and business jets. Parts are manufactured at our 5.000 m2 factory in Almere the Netherlands and exported worldwide.

All parts are manufactured using thermal forming of thermoplastic composite material. Through this process DTC produces high quality parts in short cycle times. Due to behavior of the material in the stamp forming process, distortion of the part occurs. This needs to be compensated in the forming tool. It is of great value if this compensation can be determined beforehand using virtual manufacturing tools.

Problem definition:
Currently the only virtual manufacturing tool DTC uses is Aniform. This application is used to assess the drapability of composite material but does not predict geometrical changes to the end product, which are partly caused by thermal shrinkage and partly by stresses build-up during the forming process. Corrections for the shape distortions are currently defined statistically from a measurement database. DTC would like to predict the shape distortions using Abaqus in order to be able to accurately model geometrical changes before tool design. For this purpose, accurate thermoplastic composite material models need to be defined, considering the various material properties and process influences in order to obtain a reliable shape prediction.

Description of assignment:
You will set up a material model and implement this into Abaqus with the aim to predict geometrical changes to a thermoplastic composite part after stamp forming.

This will be done through the following steps:

- Define material model for shrinking behavior (e.g. thermal shrinkage, crystallization shrinkage);
- Define what other factors (process related) impact geometrical change (e.g. tool temperature, friction). Possibly, this information needs to be transferred from AniForm;
- Implement a shape deformation model into Abaqus;
- Validate the model with measurement data of actual products (provided by DTC's database);

Organization:

This assignment is readily available and can be executed either as a graduation assignment or as a combination of an internship and graduation assignment. The work will partly be performed within the Research & Development department of Dutch Thermoplastic Components B.V. (DTC) and partly at the Production Technology group of the University of Twente. You require MSc level and any experience with composites and simulations are desired.

Dennis Lunenborg
Product Development Manager

Dutch Thermoplastic Components B.V.

* This assignment will contain proprietary information and may not be shared without written permission with third parties.