Using COMSOL Multiphysics® for Theoretical and Experimental Validation of Critical Properties of Composite Process

A. Häberle[1], P. Fideu[2], A. Herrmann[1]

[1]CTC GmbH, Stade, Lower Saxony, Germany
[2]Airbus Operations GmbH, Hamburg, Hamburg , Germany

Abstract

During the manufacturing of CFRP components one of the most critical process steps is the vacuum bagging. In this process several layers of material are draped separately over complex part shapes. The specific properties of each material, which are needed for the process (i. e. breather, release property, air tightness), result into a complex overall behaviour with respect to the process curve.
Whilst developing a new generation of vacuum bagging the necessity to simulate and to understand a new process prior to implementation has been exercised with COMSOL Multiphysics®. More precisely COMSOL Multiphysics® has been used to determine HTC by an inverse calculation and to describe appropriate boundary conditions.
The following contribution will start with the description of the implementation approach in COMSOL Multiphysics® and ends with a comparison with physical test results. The features been used are the heat transfer module with a main focus on heat radiation and conductivity as well as the optimization module. The temperature dependency has been used to simulate realistic behavior.
This paper presents the thermo-mechanical analysis performed in order to include the multiphysics character of the problem (Including motion of the heat source). It is complete with a presentation and discussion of the inverse method applied to determine the heat transfer coefficient, a dimensioning parameter of an industrial process.
In order to ensure good comparison between physical trials and simulation results, capabilities of COMSOL Multiphysics® to generate parameter based geometrical models as well as function based definition of variable properties and customized report function have been used in combination with predefined model libraries.
The results can now be related to the material conditions (E.g. moisture content, additives). From this knowledge this can be used to drive to design optimized process layout and conditions such as storage areas, exposition time or sizing of equipment.
The presented model is a generic platform for parametrical based material selection for the process step of vacuum bagging. Furthermore the calculated temperature distribution can be used to define more specific optimization targets.