Virtual Prototyping for Curing Control and Distortion Prediction of a Wind Leading Edge Manufacturing of the Horizontal Tail Plane.

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Abstract including:
The manufacture of new and complex aeronautical components made of composite materials with thermoset resins produces difficulties in the predicting the final distortion due to the curing process. In the present analysis, we will show how to use the PAM-Composites- simulation solution to create a Virtual Twin of the manufacturing process to understand and control the filling and curing process and predict the final distortion of the manufacturing of a Wind Leading Edge of the Horizontal Tail Plane.

The control of curing distortions in composite components for aerostructures is not included, to date, as an essential design tool in early design phases of the components to adjust the design layup or the manufacturing process parameters. The simulation will take into account all the injectors, heating system (hot plates), tooling and physics involved both in the RTM filling process and in the curing and demolding, to know the heat exchange and temperature distribution in order to optimize the curing process and the energy consumption and to ensure the resin supplier´s curing recommendations.

The whole process is chained in an end to end process to facilitate the data transfer and try out studies. With this information, the solution is able to know the phase change of the resin (liquid, rubbery and glassy state) to accurately simulate the mechanical behavior of the composite material and predict the deformation of the composite part during curing, and after the different demolding steps considering the strains due to the shrinkage and thermal expansion of the composite part and mold.

The simulated results will be validated with the experimental results of the manufacture of a demonstrator where the filling evolution, temperature evolution from the thermocouples and the displacements after demolding will be measured. The works described in this article belongs to the Clean Sky 2 LPA program ; CS2-WP1.4.1 HLFC - Hybrid Laminar Flow Control Demonstrator.

Keywords:

Energy consumption, RTM Porcess, Thermoset resin, Virtual Prototyping, Warpage, Spring-in, Distortion, Thermal control, PAM-Composites, Leading Edge.