

12 months post-doctoral position
Thermal behavior of thermoplastic composite preforms

Context

The Tailored Fiber Placement (TFP) is a preparation technique for textile preforms that has been optimized by Nobrak for the production of composite parts. Such preforms are made of commingled yarns, combining reinforcing filaments (glass, carbon, linen...) with thermoplastic filaments (PP, PA6...), arranged in an optimal way according to the expected performances in the final part. These preforms are then consolidated under a pressure of several bars above the melting temperature of the thermoplastic matrix ($T > 200^{\circ}\text{C}$) to obtain a near net-shape thermoplastic composite part.



Fig. 1 - TFP preform made of commingled yarns. The red and yellow lines show fiber orientation.

The consolidation stage in a hot press is however a time consuming and expensive step when it is initiated from a preform at room temperature. The pre-heating of textile preforms in an oven is therefore considered by Nobrak in order to reduce the cycle time of composite parts' consolidation. Among the different possible heating technologies, infrared heating is the most efficient way to rapidly heat up the preforms and is already commonly used in thermoplastic composite manufacturing processes. The DEIMOS collaborative project thus aims to support Nobrak in the introduction of infrared heating technology in its textile preform consolidation process.

Research topic

Controlling the temperature of a textile preform is challenging because the thermo-optical properties and heat diffusion within the preforms are strongly influenced by the commingled architecture and the porous microstructure. The research activities therefore consist in studying the heating of preforms made by TFP by characterizing and modeling the thermal and optical properties of these preforms.

The equivalent thermal conductivity of TFP preforms will be a particular point of interest of the post-doctoral study. Indeed, conventional techniques such as hot disk are not applicable to textile preforms that are compressible and new strategies must be developed for the assessment of this thermal property.

A specific bench is currently being developed for the determination of materials' thermal conductivity by inverse analysis. The work will consist in finalizing the set-up and in characterizing the properties of consolidated materials as well as porous textile preforms. The influence of commingled yarn composition (fiber and matrix), yarn orientation and stacking configuration will be investigated and their influence on the heating behavior will be analyzed.

Keywords

Thermoplastic composite materials, thermal conductivity, porous textile preform, infrared heating.

Laboratory environment

The project will be conducted at the Clément Ader Institute (ICA) and the candidate will be located in Albi (France) at the IMT Mines Albi, one of the sites of the ICA laboratory. The ICA laboratory is leading research activities on infrared heating of polymer and composite materials for more than 20 years.

Regular visits to industrial partners are to be expected (Toulouse, Montauban). The participation to national and international conferences is also intended during the duration of the project.

Supervision

Dr. Olivier De ALMEIDA
Pr. Fabrice SCHMIDT
Pr. Yannick LE MAOULT

Candidate profile

The candidate must have completed a Ph.D. in materials science, heat transfer or eventually in mechanical engineering. He/she must be familiar with composite materials and their processes and have an interest for experimental work as well as a basic knowledge of finite element simulation (Comsol Multiphysics).

The candidate must be able to demonstrate autonomy and rigor to achieve the ambitious objectives of this project. Communication ability is also an important skill expected from the candidate due to the industrial context of the project.

Starting date

The post-doctoral position is opened from January 2023 for a period of 12 months.

Application

Candidates are invited to apply directly on Recrutee website on the post-doctoral offer page: <https://institutminestelecom.recrutee.com/o/postdoctorant-specialite-comportement-thermique-des-preformes-textiles-composites-a-matrice-thermoplastique-cdd-12-mois>