

# MASTER INTERNSHIP

## MANUFACTURING AND CHARACTERISATION OF HYBRID COMPOSITE LAMINATES

### Context:

Nowadays, composite materials are being exhaustively used in the transport sector, in order to improve fuel efficiency and decrease the environmental impact. In terms of materials, glass fibers are mostly used due to their low cost, whereas in terms of mechanical performance, these composites are no match to carbon fiber composites, which are stronger, lighter but relatively costlier. In order to overcome the issue of cost-effectiveness, hybridization of composites is usually adopted where the carbon and glass fibers are either interlaminated or intermingled, and then the composites can be either manufactured using traditional processes like Liquid Composite Molding (LCM) using dry preforms or consolidation of prepregs using Autoclave. During resin impregnation, the flow mechanisms at the macro and micro scale are well understood in the case of pure carbon or glass preforms but the parameters influencing the resin flow in a hybrid structure are not sufficiently documented in the literature. For instance, the void formation due to air entrapment during the impregnation largely depends on the impregnation velocity in neighboring yarns. As the local impregnation mechanisms are not the same in glass and carbon yarns, the void formation mechanisms can differ. An in-depth understanding of the contribution of the process variants will be useful in the design of hybrid composites. The purpose of this project is to investigate the influence of different parameters such as constituent fiber volume fraction ratio, stacking sequence, and injection pressure/velocity and thereby relate them to the final part quality in terms of void content, void morphology and mechanical properties of the laminates.

### Objectives:

1) **Collection of experimental data with hybrid preform characterization:** the permeability of the real hybrid preform is measured and characterized to define the influencing parameters on the predicted flow behavior.

2) **Manufacturing of hybrid composite specimens:** specimens are manufactured using RTM. Each specimen is characterized to determine the void content as well as final fiber volume fraction using microscopic observation and density evaluation.

3) **Mechanical properties of hybrid composite specimens:** the manufactured coupons are mechanically tested to relate the processing conditions, void content and microstructure to the mechanical properties.

### **Conditions:**

The internship will be carried out in the Department of Materials and Processes (CERI- MP) of IMT Lille Douai. The internship addresses a master's student with a strong knowledge in manufacturing and characterization of composite materials. A high level of proficiency in written and spoken English is mandatory. The duration of the internship is six months. The amount of the gratuity is 577.50€/month. The official application must include a copy of your curriculum vitae, cover letter, transcript(s), and recommendation letter(s).

### **Contacts:**

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