Design and manufacture of advanced textile structural composites by automated layups and tufting

Jingshu Lu[1,2], Gildas L'Hostis[1,2], Peng Wang[1,2],

1. University of Haute-Alsace, Ensisa, Lpmt, F-68000 Mulhouse, France
2. University of Strasbourg, France

INTRODUCTION

The textile structural composite which is a kind of composite with textile structure as the reinforcement has been widely used in practical applications. Based on the objective of the project, a design solution incorporating automated tape lay-up and tufting techniques is proposed to fabricate an advanced textile structural composite. The study of the mechanical properties of Twill fabric 2-2 linen/PA12 is a guide for the design and application of textile structural composites. Therefore, The mechanical properties of Twill fabric 2-2 linen/PA12 reinforcement preforms were tested so that the defective condition of its during thermo-forming could be analyzed and an optimized design solution could be proposed.

MATERIALS AND METHODS

The Linen/Polyamide 12 commingled yarns with 64% Linen yarns and 36% PA12 yarns used in this study were provided by Schappe Techniques. These strands of Linen, placed in the core, are covered by a second Polyamide12 (Fig. 1).

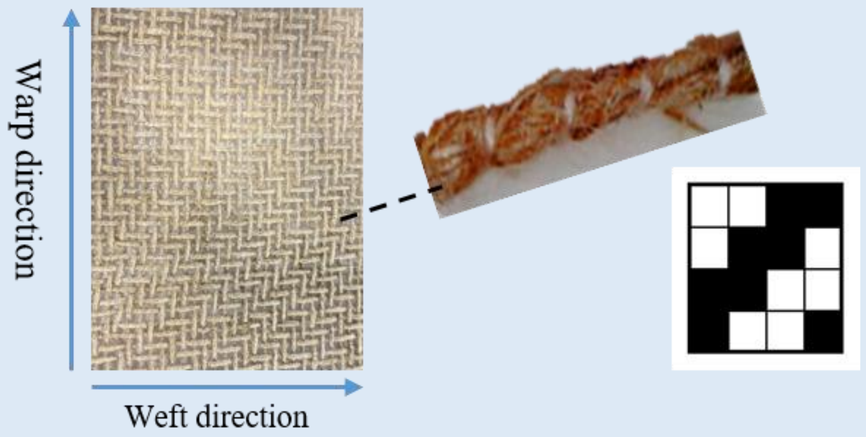

Figure 1. Tested taping fabric

Table 1.The main properties of the tested textile fabrics

Type of fabric	Area density (g/m2)	Thickness (mm)	Threads (warp/weft)	Number of yarns per cm
Biaxial twill 2-2	380 ± 5	2.0	500 tex /500 tex	3.8

During tensile test, both ends of the specimen were fixed in the tensile machine, and a stretching force was applied at a uniform speed (30 mm/min) along the axial direction of the fabrics. The length of the specimen was 150/100 mm excluding the gripped zones.

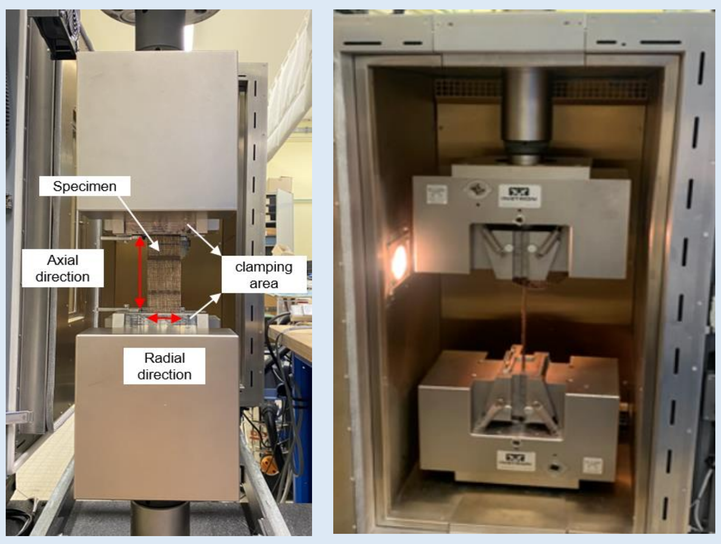

Figure 2. Experimental device

TYPES OF SAMPLE

1. the samples are classified by warp, weft and bias direction:

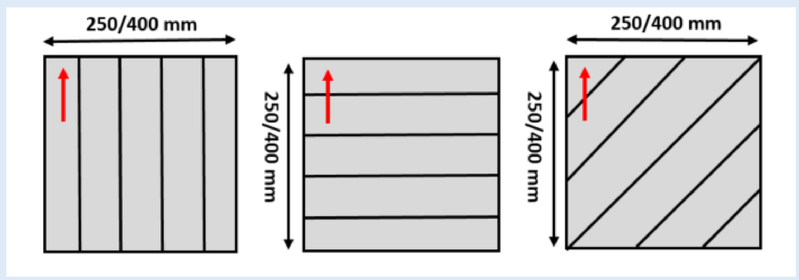

Figure 3. The Schematic diagram of the type of tape laying

2. The samples are cut in three directions:

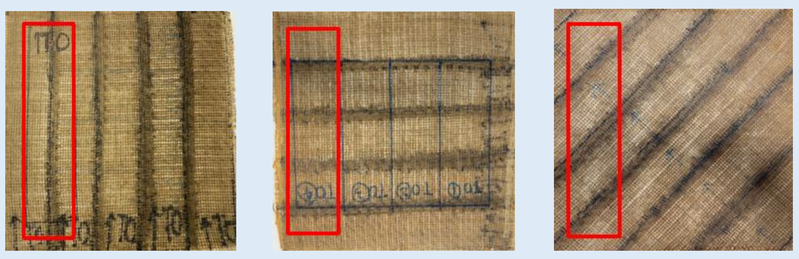

Figure 4. The different cutting directions for specimens

RESULTS AND DISCUSSION

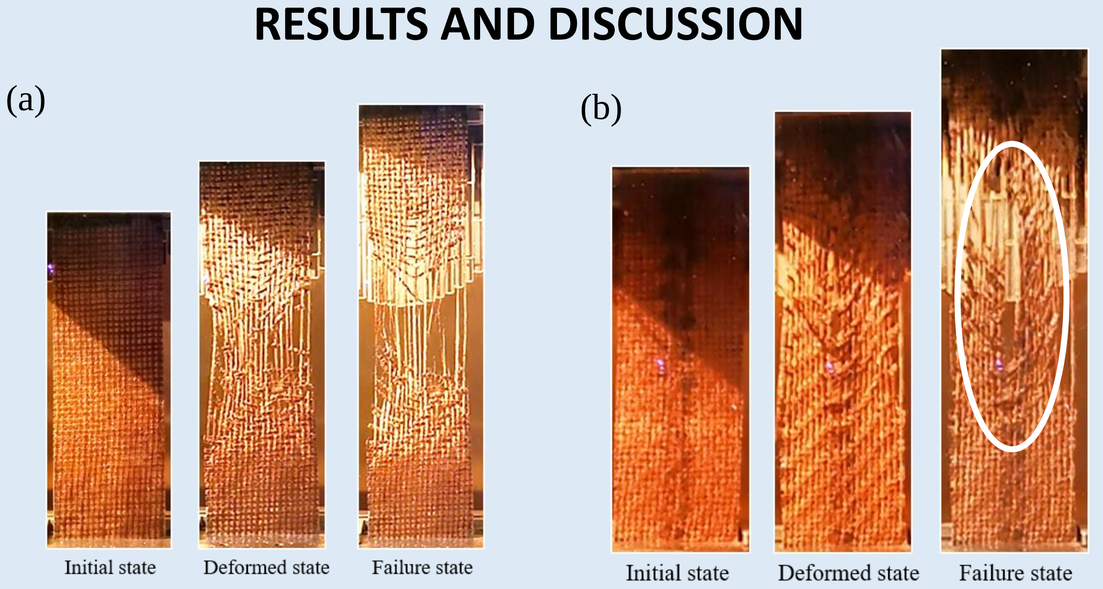

Figure 5. The results of the experiment

- The Linen/PA12 reinforcement preg will eventually show a radial shrinkage shape after the Temperature Tensile test. The shrinkage is increased along with the fabric extension, resulting in different degrees of tensile deformation area (Fig. 5a and 5b).
- The load-deformation curves (Fig. 5d) for Linen/PA12 reinforcement preg samples during extension tests can be divided into three parts before reaching the maximum shear load.
- The resolved results of the tensile condition of the different types of taped fabric pregs were compared with the experimental results, and the transversely cut samples had a higher ultimate tensile force (Fig. 5d).

CONCLUSION AND FUTURE WORK

- ➢ The overlap between the taping fabric preg is the first part to slip because they are not connected.
- ➢ Temperature and joints have an effect on the tensile stiffness of Linen/PA12 composites, requiring the incorporation of tufting technology to link joints.

- ☐ In future work, we will incorporate tufting technology to manufacture new tape-laying pregs to compare the tensile behavior of different samples under tensile loads and thus determine the design solutions.

Contact informations: ① peng.wang@uha.fr ② gildas.lhostis@uha.fr ③ jingshu.lu@uha.fr