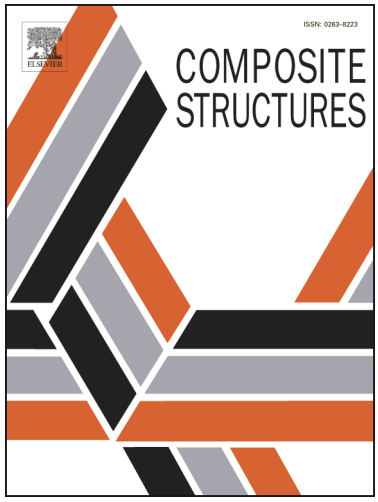

Influences of fabric density on mechanical and moulding behaviours of 3D warp interlock para-aramid fabrics for soft body armour application

Mulat Alubel Abtew, François Boussu, Pascal Bruniaux, Carmen Loghin, Irina Cristian, Yan Chen, Lichuan Wang

PII: S0263-8223(18)31241-8
DOI: https://doi.org/10.1016/j.compstruct.2018.07.101
Reference: COST 10019

To appear in: *Composite Structures*

Received Date: 2 April 2018
Revised Date: 14 June 2018
Accepted Date: 29 July 2018

Please cite this article as: Abtew, M.A., Boussu, F., Bruniaux, P., Loghin, C., Cristian, I., Chen, Y., Wang, L., Influences of fabric density on mechanical and moulding behaviours of 3D warp interlock para-aramid fabrics for soft body armour application, *Composite Structures* (2018), doi: https://doi.org/10.1016/j.compstruct.2018.07.101

Influences of fabric density on mechanical and moulding behaviours of 3D warp interlock para-aramid fabrics for soft body armour application

Mulat Alubel ABTEW[1, 2, 3, 4], François BOUSSU[1,2], Pascal BRUNIAUX[1, 2], Carmen LOGHIN[3], Irina CRISTIAN[3], Yan CHEN[4] and Lichuan WANG[4]

[1]University of Lille 1, North of France,

[2]ENSAIT, GEMTEX, 2 allée Louise et Victor Champier, 59056 Roubaix Cedex 1, France

[3]Gheorghe Asachi Technical University of Iaşi, Dimitrie Mangeron Bd., 53, Iasi -700050 Romania

[4]Soochow University, College of Textile and Clothing Engineering, Suzhou 215021, China

Corresponding author email: mulat-alubel.abtew@ensait.fr or mulat_a@yahoo.com

Telephone: 0033758215158

Postal address: Mulat Alubel ABTEW, 2V avenue Verhaeren, Appt. 245, 59000 Lille, France

Abstract:

For the past many decades' enormous research has been done on mechanical and moulding properties of 2D woven and non-woven fabrics. The current paper presents a comprehensive investigation of the tensile, bending and moulding behaviours of 3D orthogonal warp interlock fabrics with different fabric densities. Four 3D warp interlock fabrics with different areal density made from 168Tex linear density p-aramid Kevlar yarn were manufactured on dobby loom in GEMTEX laboratory. Based on the investigation both fabric density and yarn density shows a significant effect on bending and tensile properties of the fabrics. The bending rigidity in the warp and weft directions become higher in preforms with denser weft and warp yarn densities respectively. In general, as the yarn density in the respective warp or/and weft direction increases, the maximum tensile load with maximum strain increases. Moreover, the fabric and yarn density has also shown a great impact on various mouldability characteristics of 3D warp interlock preforms while deformation. The study finally elucidated that, like other parameters, fabric and the yarn density of 3D warp interlock influenced greatly the tensile, bending and moulding properties where those parameters should be considered carefully while applying in various technical textile applications i.e., soft body armour.

Keywords:

3D warp interlock fabric; Mechanical behaviour; Mouldability Property; Fabric density; Soft body armour; High performance fibre.

1. Introduction

The current research trend in the most textile technical application is to familiarise low-cost manufacturing techniques for advanced material without compromising the overall performances. For the past many years, 2D textile fabrics have been utilised in different technical applications [1][2][3][4]. However, recently 3D woven fabrics were developed in advanced textile weaving techniques to extensively substitute 2D fabrics. Moreover, 3D warp interlock fabrics provides various advantages in most applications including soft body armour compared to conventional 2D high-performance fabrics. According to researchers, the ballistic and impact resistances along good flexibility is improved by introducing through-the-thickness binder yarns in the 3D fabric construction [5][6]. This is due to fibres inserted the 3D fabric structure and integrated without any major degradation that increase the resistance both in warp and weft directions [7]. It was also revealed that weft layers inside 3D warp interlock fabrics are greatly interconnected together through binding yarn to produce thick reinforcement for different technical applications [8][9]. The binding yarn also helps to disintegrate loads in different directions and keep the yarns by stabilizing the integrity of the entire structure [10]. In 3D warp interlock structure, the location of a binding yarn [11] ensures better mechanical properties both in structure and in the thickness as compared to stacked 2D fabrics. Besides, 3D textiles are also involved in the ballistic protection due to the enhanced mechanical