PROCESS OPTIMIZATION OF A BIOSOURCED COMPOSITE MADE OF FLAX FIBER AND POLYAMIDE 11

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Abstract: *Flax unidirectional (UD) fabrics and Polyamide 11 (PA11) were used to create a 100% bio-sourced composite. First of all, flax UD fabric A and PA11 in the form of powder were superimposed and placed in a mould to create a composite. The process used for the transformation of the composite was thermo-pressing. The process parameters: temperature and pressure moulding were varied in different configurations. An optimal configuration was found by mechanical and DMA tests. Then, flax fiber UD fabric B and PA11 in the form of film were used to create a composite by film stacking method using process parameters of 210°C and 65 bars. The composite made of UD flax B/PA11 film presents the highest Young's modulus. Finally, by applying pressure levels of 25, 40 and 65 bars on UD flax B/PA11, the Young's modulus remains unchanged and the failure stress is increased. These mechanical results are in good accordance with the DMA analysis.*

Keywords: *flax/PA11 composite, hot pressing, process parameters influence, properties*

1. Introduction

Green composites based on natural fibers have been gathering much attention from the stand point of protection of the environnement from plastic disposal problem and saving petroleum resource [1]. The introduction of natural fibers in polymer matrix can bring many advantages with regard to fibers used in traditional composites : biodegradable resource, low density, good specific strength and modulus, good acoustic and vibratory properties [2]. Various natural fibers are used as reinforcing material polymer-based composites : bagasse, flax, hemp … [3] In the majority of studies, flax fiber presents better properties than other natural fibers and is an abundant natural resource available in many countries [4]. Previous studies were focused on short natural fiber composites [5]: polymers reinforced by short hemp, cellulose or jute fibers [2,6–8]. However, numerous studies mention long natural fiber as reinforcements in composites. In general, long fiber have better properties than short fiber [9].

In this study, unidirectional flax fibers were associated with bio-based polymer matrix : Polyamide 11 to create a 100% bio-sourced composite. The Polyamide 11 is derived from castor oil, consumes less non-renewable ressources to be produced and has superior thermal resistance. This polymer has attracted the attention of many researchers because of it potential to substitute petrochemical derivates [10]. This polymer was produced by french chemical company and presents bacteriostatic, lighweight, thermos-regulating, endowed with high mechanical and chemical resistance. The combination of this high technical polymer with long reinforced fibers can produced a composite used for structural applications. As shown in the literature, investigations of long fiber reinforced composites were limited because of high viscosity molten thermoplastic [11]. Unlike thermoset polymers, thermoplastics have relatively higher