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Layered Composites Based on Recycled PET/Functionalized Woven Flax Fibres

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Extended Abstract

Plastic waste is generated by a variety of sources including packaging, automotive, consumer goods, electrical and electronics industries, leading to a significant growth in the volume of waste and the impetuous need to reduce it [1]. Recycling of used products is considered one of the best ways to save money and protect the environment, although technologies must be designed and managed so as to avoid environmental pollution [2]. Global warming and diminishing oil reserves have prompted scientists to focus more on the use of natural fibers from renewable resources such as jute, hemp, cotton, flax, coconut fiber, fibers from pineapple and banana leaves [3-4], etc., for the reinforcement of composite materials [5]. Due to the high hydrophilicity of all natural fibers, adhesion to polymers most frequently used as matrix (hydrophobic) is rather problematic [6]. This problem can be solved by fiber surface modification through, physical, chemical, and mechanical methods or by changing the chemical composition of the polymer matrix.

The paper aims at developing new layered composite materials based on recycled thermoplastic polymer (PET-polyethylene terephthalate) from the food industry reinforced with woven flax fiber functionalized with nano (micro) particles of titanium or alumina and testing the composite in terms of physico-mechanical (tensile strength, bending, shock, etc.), morphological (SEM), structural (FTIR), and thermal (Vicat) properties. Based on this technology, the new composite will exhibit improved physical, mechanical and thermal properties, as well as resistance to mold attack. In this regard, in the first stage, the surface of flax fibers were chemically modified using aluminum (AlCl3), and titanium (titanium butoxide) precursors followed by precipitation. The woven flax whose surface was functionalized with nano (micro) alumina or TiO2 particles were subsequently used to obtain layered composite materials. Layered composite materials were obtained by alternating functionalized / not functionalized woven flax fiber with sheets made from recycled PET. The recycled PET sheets and layered composites based on recycled PET and functionalized / not functionalized woven flax fiber were obtained by press molding using an electrical press at the following optimum parameters: plate temperature - 254ºC, preheating time - 8 min; pressing time - 2 min; cooling time - 15 min; pressing force - 100 kN. Special attention must be paid to the pre-drying process (at 100-110ºC) to remove adsorbed water. In the absence of the pre-drying operation, the resulting sheets exhibit holes, porosity and discontinuities, making them unusable for the development of layered composite materials.

Physical, mechanical and thermal analyses results for specimens of layered composite materials based on recycled PET / functionalised woven flax fiber show significantly improved values compared with the control samples obtained from recycled PET / not functionalized flax fiber. Improved mechanical and thermal properties are due to links developed at the woven flax fiber / polymer phase interphase. Results have also been confirmed by SEM, while the degree of adhesion and the interpenetration of polymer phase / woven flax fiber are superior in the case of composites made of functionalized flax fibers in comparison with the unfunctionalized ones.

Keywords: PET, recycling, surface functionalization, natural fibers

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