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3D woven structures of flax fibres for composites reinforcements

Three-dimensional (3D)-fabrics were developed in the 1970's and are characterised by yarns oriented not only in-plane, but also in the through-thickness direction resulting in higher through-thickness strength and stiffness of the final composite material [1]. In the course of time rapid development of applications took place and nowadays it is hard to imagine economic branch without exploitation of fibres reinforced polymer composites FRP. Fabric reinforcements are used for improving FRP bent and stroke resistance. The other advantages of FRP are comparative low density and cost effectiveness, as well as plasticity of textiles. For FRP production high modulus fibres (aramide, carbon and glass fibers) are mainly applied due to high physical and mechanical properties, close to corresponding steel properties, while its density is less. As disadvantages of high modulus fibre could be mentioned comparative high costs and low recyclability [2]. The natural fibres are renewable, environmental friendly sources of raw materials with a low density. The disadvantages of natural fibres are lower modules and low heat resistance, but production mainly depends on solar energy. Fiber pre-processing and processing requires relatively small amounts of fossil fuels. For production of glass fibers requires 54.7MJ/kg energy, whereas flax fiber processing requires only 9.55 MJ / kg [3]. The local fibres resources flax and hemp fibres are preferable for Latvia economy, due to broad range of application.

Reinforcing textile structures in form of 2D or 3D fabrics could be produced by weaving, knitting, braiding, sewing, nonwoven or laminating technology. Weaving technology allows produced fabrics for composites starting from plain weaves (2D fabrics) till intricate composite 3D structures with interwoven and straight threads. Composites made from three-dimensional textile preforms can reduce the weight and manufacturing cost of advanced composite structures within e.g. aircraft, naval vessels and blades of wind turbines [1].

The aim of present work is focused on development of 3D woven structures and studies of mechanical properties of flax yarns woven reinforcements. The natural fibers like flax bear biodegradability, low weight and good flexibility properties. Local flax yarns (68/2 tex and 683 tex) were use to develop woven 3D reinforcement structures in 2 layer plain weave, 2-3 layer overlaid weave, multi layer overlaid weave technique. The results of physical- mechanical tests of used yarns and developed reinforcements will be discussed in research paper.

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