Study of Mechanical Properties of Natural and Hybrid Fibres Reinforcements

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Summary
The present work focuses on the development and studies of mechanical properties of natural fibers in woven reinforcements made from hemp and flax as well as hybrid (glass/ hemp) yarns. Natural fibers such as hemp and flax are biodegradable, have low weight and show good flexibility properties. Glass fiber is widely used in the industry when low cost and good performance are required. Hemp yarns (100 Tex and 1186Tex), flax yarns (678Tex) and hybrid yarn from hemp/glass fibers (1644Tex) were used to develop woven reinforcement structures with surface density ranging from 90 g/m^2 to 813.5 g/m^2. The breaking load in warp /weft direction is 229.4 N/ 205.9N for fabric of 100 Tex hemp yarns; 1261.1N/1437.3N for structures of 1186Tex hemp yarn in warp and 1644Tex hemp/glass yarn in weft direction as well as 1035.4 N/1930.8N for hemp/ flax structure.

Introduction
The interest in natural fiber-reinforced polymer composite materials is rapidly growing in industrial applications and fundamental research. They are renewable, cheap, completely or partially recyclable, and biodegradable. Natural fibers are increasingly used for the reinforcement of composites in transportation, military applications, building and construction industries, packaging, consumer products, etc. [1] Production of natural fibers mainly depends on solar energy, fiber pre-processing and processing requires relatively small amounts of fossil fuels. Energy requirements are 54.7 MJ/kg for production of glass fibers and 9.55 MJ/kg for flax fibers [2] while the price of polymer composites reinforced with natural fibers is 2 - 3 times lower than that of polymers reinforced with glass fiber [3]. 30,000 t of natural fibers (17% flax and 5% hemp of total volume 80,000 t) in 2012 year were produced in the EU Automotive Industry [4].

Materials and weaving technique
Hemp yarns with the yarn density 100Tex (HA-1; Germany) and 1186 Tex (HA-2; Latvia), flax yarn of 678 Tex (LI; Latvia) and hemp/ glass fibers hybrid yarns of 1644 Tex (HE/GF; JSC, Valmieras stikla skiedra, Latvia) were used. For production of samples using 2D weaving technique, the industrial loom СТБ-175 (Soviet Union) was used.

Testing of woven structures
Tensile strength, tensile elongation and tensile stress of reinforcement of hemp, flax and hybrid yarns in warp and weft directions were tested

corresponding to LVS EN ISO 13934-1-2001 on INSTRON dynamometer (Intron Ltd, UK). Measurements of fabric thickness were carried out by ATLASS thickness meter (SDL Atlas Inc. USA), according ASTM D1777 – 96(2011) e1standard.

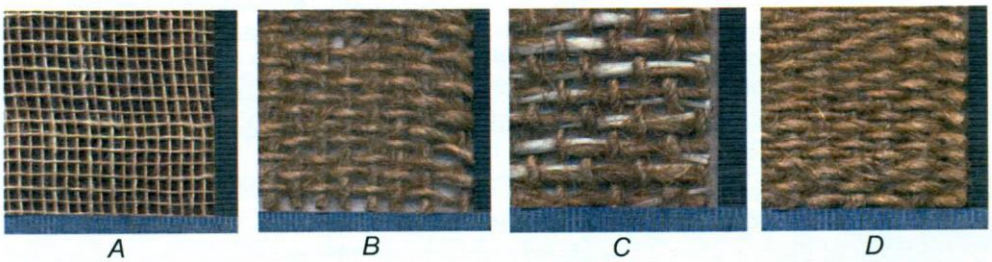

Fig.1. Woven structures of HA-1 yarns (A) and HA-2(B) on both directions; hybrid structures of HA-2 on warp direction and HA/GF yarns (C) as well as flax yarns (D) on weft direction.

Conclusion

Nowadays a lot of attention is paid to environmentally friendly materials. Woven structures (Fig.1) from hemp yarns and hybrid sructures from hemp / glass fiber and flax yarn were produced.

The surface parameters and strength properties of reinforcements are dependent on density and threads ratios aspect of the yarns used.

The negative characteristic of natural fiber reinforcement is tensile elongation. The smallest elongation could be achieved in warp and weft direction by using 100Tex hemp yarn. In weft direction for all reinforcements elongation was higher.

Finally, small elongation and high tensile strength of natural fibre reinforcements are the most important aspects to ensure stability of the parameters of the composite material.

References

[1] Singh A., Vishvendra Meena S., Study of Mechanical Properties of Hybrid Natural Fiber Composites, A Thesis for Degree of Bachelor of Technology In Mechanical Engineering, Rourkela, 2011).

[2] Bast and Other Plant Fibres Edited by Franck R.R., Woodhead Publishing Ltd, 2005, pages1-376.

[3] Wladyka-Prybylak M. Bujnovicz K., Natural Fibres Reinforced Polymer Composites, Presentation of Workshop FP7 -Research and Development Programme for Advanced SMEs, Zagreb, 2011-08-12.

[4] Carus M. World-wide Market Data on Hemp and Other Bast Fibres, Presentation of11th EIHA conference, Wesseling, 2014-21-05.

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