21st International Conference **ENGINEERING MECHANICS 2015**
Svratka, Czech Republic, May 11 –14, 2015
Paper **#197, pp. 106–107**

Study of Surface Quality and Mechanical Properties of Composite Material Based on Natural Reinforcement

Zuzana Hutyrová[1, 2a]*, Dušan Mital'[2,b], Marta Harničárová[1,3,c], Jozef Zajac[2,d], Ján Valíček[3,4,5 e]

[1]Nanotechnology Centre, VŠB – TU Ostrava, Czech Republic

[2]Faculty of Manufacturing Technologies of TUKE with seat in Prešov, Slovakia

[3]Institute of Physics, Faculty of Mining and Geology, VŠB – TU Ostrava, Czech Republic

[4]Institute of Clean Technologies for Mining and Utilization of Raw Materials for Energy Use, VŠB – TU Ostrava, Czech Republic

[5]RMTVC, Faculty of Metallurgy and Materials Engineering, VŠB – TU Ostrava, Czech Republic

[a]zuzana.hutyrova@vsb.cz, [b]dusan.mital@tuke.sk, [c]marta.harnicarova@vsb.cz, [d]jozef.zajac@vsb.cz, [e]jan.valicek@vsb.cz,

Keywords: metrotomography, composite material with natural fiber, mechanical properties

Abstract: The term WPC refers to any composite material containing 2 basic components → natural fibers (used as reinforcements because of their: relatively high strength, rigidity, low cost) and plastics (the key indicator in their manufacture is to establish a sufficiently effective link of components). From the point of view of machinability, WPCs are classified as easy to work materials – as shown in the studies [1-4], etc. However, in machining, the heterogeneity of material plays an important role. Any surface defects arising as a result of "incorrect" machining lead to additional costs for repair. During machining, not only set parameters of the technology of machining process are relevant, but also mechanical properties and compatibility of the material. As an experimental material, wood filled plastic was used with a volume ratio: 30/70 % – HDPE/wooden filling. The profile was subjected to non-destructive testing method by X-rays (inspection by overexposure – to control volume defects) and testing to mechanical properties (tensile and bending test according to ISO 6892, or ISO 178).

Quality of the resulting machined surface is closely linked to the characteristics of the material (whether mechanical or physical). The values of studied mechanical properties change along the extruded profile – as demonstrated by the carried out tests (tensile test and triaxial bending test). The values of ultimate strength of individual samples differ by less than 10 MPa, despite the fact that they have been taken from the central part of the profile parallel to the axis of extrusion (differences are recorded in Tab. 1). The set deformation work is very low as for both uniaxial compressive load, and the tensile load – which may be under selected conditions in practice

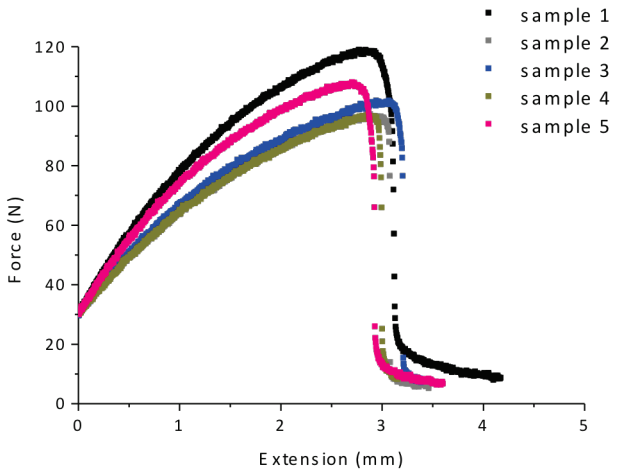

Fig. 1: Load diagram – triax bending test of samples: 1 – 5

Table 1: Values of mechanical properties after tensile testing

No. of sample	Yield point [MPa]	Elogation [%]	Reduction [%]	Deformation work [mJ]
1	24	2.8	2.0	20.4
2	15	2.9	0.4	12.4
3	24	3.4	0.8	24.1
4	15	5.1	0.4	13.5
5	* defect			

*Probably because of the occurrence of a defect, the test sample 5 was already broken at 200 N, so the result is not mentioned.

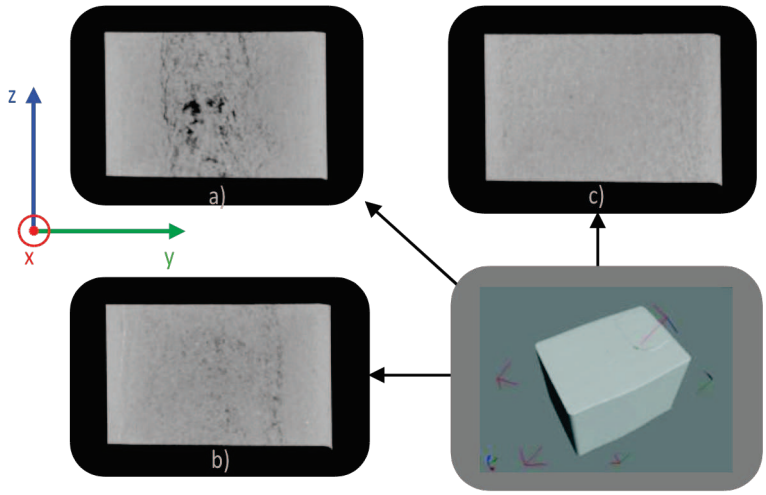

Fig. 2: Cuts in the direction of plane movement in the z-axis at a distance of:
a) 40.5 mm, b) 30.5 mm, c) 20.5 mm (after X-ray inspection)

problematic. The non-destructive examination method using X-rays helps to visualize internal defects in a material – Fig. 2 (porosity, course and shape of cavities). The presented images show changing compatibility of the material (in different cuts). The material compatibility increases from the axis of extrusion (material core) to the edges of the profile. The improper positioning of the turned profile into the area with a high density of "air" bubbles caused their transfer to the surface in a form of cracks, which adversely affected the surface quality and appearance.

Acknowledgement: This research has been elaborated in the framework of the project Institute of Clean Technologies for Mining and Utilization of Raw Materials for Energy Use, Reg. No. CZ.1.05/2.1.00/03.0082, the IT4Innovations Centre of Excellence project, reg. no. CZ.1.05/1.1.00/02.0070 supported by Operational Programme 'Research and Development for Innovations' funded by Structural Funds of the European Union and state budget of the Czech Republic, the project RMTVC No. LO1203 and the project New creative teams in priorities of scientific research, reg. No. CZ.1.07/2.3.00/30.0055.

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