# Hybrid biobased composites with natural pyrophyllite

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INTRODUCTION: Biocompatible wood-plastic composites (WPCs) typically consist of up to 80% wood fibres and particles, often sourced from industrial waste wood, along with a reduced amount of thermoplastic polymer, primarily polyethylene (PE). Hybrid WPCs, in addition to the main components, incorporate additional elements to enhance the overall properties of the final material. Incorporating biodegradable natural fibres into hybrid wood-plastic composites offers numerous benefits, including low density, high specific strength, excellent impact and flexural properties, eco-friendliness, and cost-effectiveness. Their environmentally conscious and resilient nature has led to widespread application in various industries, including the automotive sector, civil engineering, and interior and exterior design, successfully replacing inorganic fibres polymer composites. In this work influence of hybridization of matrix and introduction of natural pyrophyllite on the moisture resistance and mechanical properties of composites were investigated.

EXPERIMENTAL: Three series of samples were blended in a high-speed mixer: S1 (HDPE - 60 wt%, wood - 36 wt%, FB – 4 wt.%), S3 (HDPE - 60 wt.%, wood - 26 wt.%, FB - 4 wt.%, PHY - 10 wt.%) and S7 (HDPE - 30 wt.%, wood - 26 wt.%, FB – 4 wt.%, PHY - 10 wt.%, WP - 30 wt.%). The starting materials was: HDPE = High-density polyethylene (HIP Petrohemija, d.o.o., Pančevo, Serbia), Wood = Oak wood flour from sawmill, FB = Fusabond Du Pont WPC-576D, PHY = Pyrophyllite powder ($Al_2Si_4O_{10}(OH)_2$) supplied by AD Harbi B&H (www.adharbi.ba), WP = waste HDPE from HIP Petrohemija, d.o.o., Pančevo, Serbia dump site. The mixture was extruded through a screw extruder, forming composite bars, then granulated with a universal cutting machine. All sample series were processed consistently. The WPC composition was shaped using a steel mold under isostatic pressure. Half of the synthesized samples were immersed in water, while the other half underwent STA (DSC and TGA simultaneously (Perkin Elmer TGA7)) tests and DMA analysis (DMA 242 E Artemis (Netzsch Gerätebau GmbH))

RESULTS AND DISCUSSION: The study's findings illustrate how processing and usage conditions influence the results from moisture absorption resistance tests indicate that the addition of pyrophyllite powder leads to decreased water absorption and swelling. SEM analysis revealed that water absorption impacts the microstructure of composites due to their hydrophilic properties. Thermal analysis revealed that composite 3 has sown the highest Tg and Tm. According to DMA dependence of storage modulus (E`) on the strain showed that highest E` showed composite 3 with the lower strain, while with the higher strain composite 7 showed higher E`. Composite 7 has shown the highest value of tan δ which characterizes the mechanical damping and visco - elastic properties of material.

CONCLUSIONS: The comparative analysis presented in this study concludes that reinforcing WPC with PHY particles significantly enhances weather resistance thermal and mechanical properties. Samples containing PHY exhibited reduced water absorption, increased thermal stability and improved mechanical properties.

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