Towards industrial waste valorization – properties investigation of bio-based films with lignin

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INTRODUCTION

Due to the demand for the reduced exploitation of fossil fuels, there is an urgent need to develop sustainable alternatives based on biodegradable and natural resources that can be utilized to manufacture goods from daily use, in a further extended scale [1-2].

Lignin is the most abundant natural aromatic feedstock and its conversion to value-added products is currently of great interests of the researchers around the world. The use of lignin for the preparation of bio-based materials has many advantages because of its renewable properties and unique chemical composition. Lignin is generated in large quantities as a by-product of different industries (pulp and paper, bio-fuel extraction, etc). The annual production of over 50 million tons of industrial waste kraft lignin and scant utilization invites environmental concern. Currently, lignin is mainly burned as a low-energy fuel. Hence, it is justified to search for innovative solutions aimed at valorizing lignin as an industrial waste product and obtaining materials that fit into the trend of sustainable development and circular economy [3-5].

MATERIAL AND METHODS

In this work, lignins from different pretreatment methods and ethyl cellulose were introduced into the PHB matrix and the effect of additives in the system were studied in relation to the surface microstructure, thermal and mechanical properties of the obtained foils. The properties of the blends were examined by attenuated total reflectance infrared spectroscopy (ATR/FT-IR), differential scanning calorimetry (DSC), thermogravimetry (TGA) and mechanical tests. The morphology was examined using confocal microscopy and roughness parameters were determined by the means of optical profilometry.

RESULTS AND DISCUSSION

Using the research methods used, the properties of the obtained materials were thoroughly examined. It was confirmed that the addition of lignin had a significant effect on the surface of the obtained films and on their mechanical properties. With respect to the surface, an increase in its roughness was observed. An example micrograph of the tested surface is shown in Figure 1. The addition of lignin caused the creation of propagation centers, which translated into a decrease in the mechanical strength of the obtained films. Based on these observations it becomes advisable to further plasticize the system.

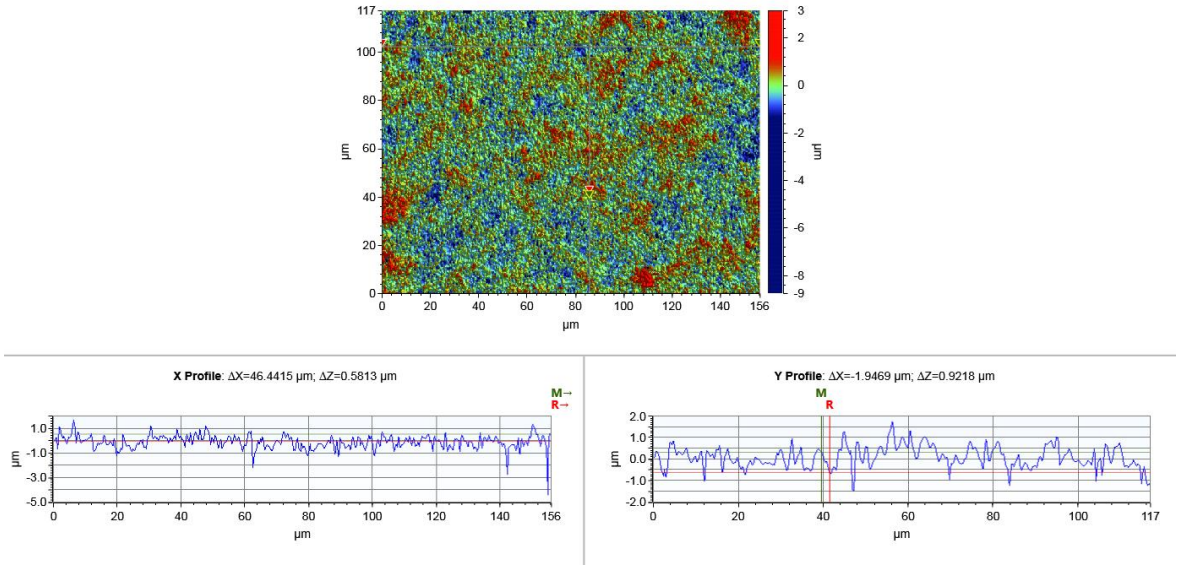

Figure 1. Optical profilometry investigations of tested sample.

CONCLUSIONS

The introduction of lignin to the structure of the films based on PHB contributes to the valorization of lignin as an industrial waste product highlights the importance of sustainable solid waste management through the promotion of safe practices aiming to accelerate the transition to the circular economy. The conducted research allowed us to understand the impact of lignin as an additive on the properties of the obtained films. Understanding these relationships is necessary in establishing changes in the processability conditions at a further stage of commercialization of the obtained product.

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