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LIGNIN AS A MAJOR COMPONENT OF AN INTUMESCENT FIRE RETARDANT SYSTEM FOR BIOPOLYESTER

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This work is focused on the preparation and the optimization of a biobased intumescent fire-retardant system (IFR) which was applied to a biopolymer such as PLA. This aliphatic biopolyester is obtained from agricultural plants and is renewable and compostable in specific conditions. However, it has a poor thermal stability [1] and is very sensitive to hydrolysis [2]. In order to respect fire security standards, an IFR was elaborated using ammonium polyphosphate (APP) which is a common fire retardant and lignin which is a biobased by-product of the paper industry. Lignin has a good thermal stability and the ability to retard fire in composite materials by promoting the formation of char in association with APP [3]. The aim of the study is the optimization of the IFR and the chemical modification of lignin in order to prevent a trans-esterification between PLA and lignin that may break the polyester macromolecule.

The first part of the study shows that an optimized ratio between APP and lignin is situated around 17/3. At this ratio, the IFR is more efficient with a significant reduction of the heat release rate (HRR) and a good fire retardancy capability (Figure 1). In addition, an encapsulated APP was also tested with lignin. The encapsulant improved the flame retardancy of the biocomposite with a better dispersion in the matrix and an enhancement of the char promotion. Finally, the last part of the work was focused on the chemical modification of lignin with esterification or phosphorylation. Chemical treatments showed an improvement of the quality of the PLA/lignin interface, due to the modification of the surface properties of lignin. The incorporation of phosphorus with lignin may help the intumescent reaction and the char promotion directly on the lignin particle.

As a conclusion, lignin in association with APP was found to be efficient as IFR component for PLA, and beneficial as reinforcement for this polymer, applying adequate treatments to improve lignin surface properties and then the compatibility with PLA.

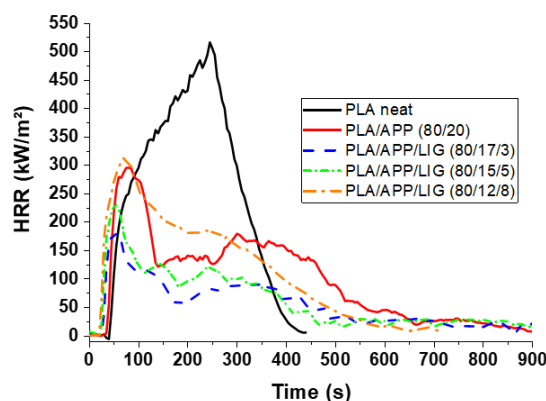


Figure 1: Heat release rate of different biocomposites [3]

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