EFFECT OF MICROFIBRILLATED CELLULOSES ON PAPER BARRIER PROPERTIES FOR POLY(VINYL ALCOHOL)-BASED COATINGS

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ABSTRACT

The food industry relies on packaging materials to storage their products, with the fossil-based plastic being the predominant material of choice due to its excellent barrier properties and low cost. However, there is a growing interest in using cellulosic fibers-based packaging due to their abundant availability, biodegradability, renewability and recyclability. Despite its advantages, cellulosic fibers-based packaging has poor barrier properties, which make it unsuitable for moisture-sensitive foods. Its poor water resistance also restricts its use for foods that require high humidity protection. Therefore, to make cellulosic fibers-based packaging more suitable for a wider range of food products, extensive research is needed to develop enhancements that can improve its barrier properties and water resistance.

The aim of the study was to develop formulations that can improve the barrier performance when applied on the surface of the base paper. For that, coating formulations were developed using a unique blend of materials of poly(vinyl alcohol) (PVA), microfibrillated celluloses (MFCs) and clay, in different concentrations. PLA is biodegradable, and its low viscosity aqueous solution enabled to obtain homogeneous and high total solid concentration of PVA/MFCs/clay coating blend to apply on the paper surface. First, PVA films were prepared using solvent casting method and characterized for their barrier properties such as water and air permeability. Further, PVA was used as a host material, dissolved in distilled water at 90ºC for 2 h and a small amount of clay and MFCs were then added in the solution. A coating layer was applied to base paper surface using a film applicator for a pickup of 20-25 g/m^2. Coated papers were dried at the room temperature and characterized for their barrier properties (water and air permeability) and strength properties.

The results showed the significant improvement in the barrier and mechanical properties of the paper. The water vapor transmission rate of the base paper was decreased significantly after the application of a single layer coating because of the complete coverage of the base paper by the uniform PVA-based coating. Clay further reduced the water vapor transmission rate, whereas MFCs improved the oxygen barrier performance. The coated papers also showed excellent water resistance owing to its high-water contact angle and improved tensile strength. This study provided an effective and sustainable alternative of fossil-based plastic coating for the food packaging application using the blend of PVA/MFCs/Clay.

Keywords: Barrier properties, Clay, Microfibrillated celluloses, Poly(vinyl alcohol), Strength properties.