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ORIGINAL RESEARCH

Effects of the coagulation bath on the properties of regenerated carboxymethylated cellulose films

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Abstract Cellulose can be an abundant and sustainable raw material for the fabrication of plastic-replacing products. However, many traditional and modern production processes are polluting and expensive. Recently, a new route has been identified to obtain films out of mildly carboxymethylated cellulose pulps that have shown very promising properties. Films are produced by dissolving the modified pulps in alkaline solution and by subsequently regenerating the dope in an acid bath. Here, we investigate the effects of the composition of the acid bath on the key properties of the film, as well as the influence of the degree of substitution of carboxyl groups in the pulp. Films are characterized through optical microscopy and X-ray diffraction. The mechanical properties of the films have been measured as well as their porosity. The results clearly indicate that bath composition and degree of substitution play a role in determining the final properties of the film. In particular, it has been found that the regeneration bath influences the degree of orientation of the biopolymer along a preferential direction, and that it also affects the final porosity of the film as a result of a different drying rate. This evidence provides solid basis for the optimization of the properties and production process of these films, towards the obtainment of more sustainable and affordable materials.

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Introduction

The pollution caused by petroleum-based non-degradable plastic is one of the largest and most pressing environmental threats affecting the planet. Several million metric tons of plastic are disposed to the environment every year without being reintegrated in any biogeological cycle, thus persistently accumulating in the atmosphere, soil, hydrosphere, and biosphere as micro- and nano-sized particulate plastics (Mitrano et al. 2021; Gontard et al. 2022). This results into an incommensurably deleterious impact on ecosystems, life forms and societies. This

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