Impact of biomass sources and processing parameters on the properties of microfibrillated cellulose beads

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The NaOH/urea methodology for cellulose dissolution offers significant advantages over other approaches such as N-methylmorpholine-N-oxide (NMMO) and ionic liquids, that including environmental benefits, cost-effectiveness, improved solubility and stability, quality of regenerated products and versatility in cellulose types to use as raw material. To take advantage of NaOH/urea methodology is required to use the raw material with a relatively low molecular weight, which is possible to obtain apply pretreatments or using mechanical process as super mass collider, this last one is an effectively alternative to produce cellulose micribrillated reducing time, use of toxic reactions and again obtained environmental benefits. Integrating microfibrillated cellulose (MFC) produced by the Masuko super mass collider with the NaOH/urea dissolution methodology presents a compelling approach for regenerating cellulose. This combination offers significant advantages in terms of processing efficiency, environmental sustainability, and economic viability.

In this study, we explore the application of this method for microfibrillated cellulose (MFC) instead of conventional cellulose pulp, as MFC, known for its enhanced physicochemical properties and versatility, offers a promising alternative for producing high-performance cellulose-based materials such as films, fibers, hydrogels, and beads. This study focuses on the processing of beads with different MFC as raw materials and different acid coagulation baths. The MFC was obtained by mechanical methods using bleached softwood and unbleached and bleached soybean hulls as raw materials and were characterized by Fourier transform infrared (FTIR) and thermogravimetric analysis (TGA) and charge density. The MCF were then dissolved in cold NaOH/urea solutions, and each of the solutions was dropped through a multi-injector into different coagulation baths using nitric, sulfuric, and citric acids. The beads were then washed to remove excess acid present in the beads. The beads were characterized to determine yield, morphology (size and shape), water content, chemical structure and thermal stability by FTIR and TGA. The results demonstrated that all MFC from bleached softwood, unbleached, and bleached soybean hulls, when processed with the different acids, produced stable beads. Morphology was dependent on the raw material, with sulfuric acid formulations showing higher yields. The water content was influenced by the type of acid used, and

differences in chemical structure and thermal stability could be attributed to the processing methods. The applications of MFC beads range from drug delivery, water remediation, purification and fertilizer delivery, so they have a wide variety of uses.