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Drying of cellulose studied by Nuclear Magnetic Resonance

Tuesday, 1 June 2021 19:00 (1 hour)

Cellulose has a very large range of applications in many aspects, and the drying of cellulose are widely adopted in many industrial processes. The deformable property of cellulose fibers, along with water adsorption capacity, add complexity to its drying mechanisms. In this work, we study the global mass loss and the spatial evolution of the internal water content of cellulose during its convective drying. Two complimentary approaches were adopted for this objective: macroscopic drying manipulations and nuclear magnetic resonance (NMR) For cellulose slurry, different concentrations of water-cellulose suspensions are dried under constant convection boundary conditions. Two obvious regimes are observed, corresponding to constant drying rate and decreasing drying rate. Meanwhile, the Magnetic Resonance Imaging results present three stages during the whole process: firstly, free water extracted accompanied with shrinkage of structures; followed by a second stage of homogeneously desaturation of all the bulk water; these stages correspond to the constant drying rate period. The last stage is assumed to be the confined water extraction, during which a slightly further shrinkage is observed as well. Complimentary experiments are carried out starting the drying test from cellulose powder prepared at saturated relative humidity, in order to capture the drying mechanism for confined water (possibly bound water). The profiles of NMR signal intensity, which is equivalent to water content inside cellulose, evolve in time in a way which appears consistent with a process of diffusion of vapor all along the sample interior (down to its bottom), in contrast with drying processes with liquid present inside the sample.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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