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# Mixing behavior of a model cellulosic biomass slurry during settling and resuspension

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**Abstract**

Thorough mixing during biochemical deconstruction of biomass is crucial for achieving maximum process yields and economic success. However, due to the complex morphology and surface chemistry of biomass particles, biomass mixing is challenging and currently, it is not well understood. This study investigates the bulk rheology of negatively buoyant, non-Brownian $\alpha$-cellulose particles during settling and resuspension. The torque signal of a vane mixer across two distinct experimental setups (vane-in-cup and vane-in-beaker) was used to understand how mixing conditions affect the distribution of biomass particles. During experimentation, a bifurcated torque response as a function of vane speed was observed, indicating that the slurry transitions from a "settling-dominant" regime to a "suspension-dominant" regime. The torque response of well-characterized fluids (i.e., DI water) were then used to empirically identify when sufficient mixing turbulence was established in each experimental setup. The predicted critical mixing speeds were in agreement with measured values, suggesting that secondary flows are required in order to keep the cellulose particles fully suspended. In addition, a simple scaling relationship was developed to model the entire torque signal of the slurry throughout settling and resuspension. Qualitative and semi-quantitative agreement between the model and experimental results was observed.

*Keywords:* Biomass, Cellulose, Resuspension, Settling, Mixing, Rheology

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