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Investigating Kinetics and Mathematical Modeling of Batch Clarification Process for Non-Centrifugal Sugar Production

Authors : Divya Vats, Sanjay Mahajani

Abstract : The clarification of sugarcane juice plays a pivotal role in the production of non-centrifugal sugar (NCS), profoundly influencing the quality of the final NCS product. In this study, we have investigated the kinetics and mathematical modeling of the batch clarification process. The turbidity of the clarified cane juice (NTU) emerges as the determinant of the end product's color. Moreover, this parameter underscores the significance of considering other variables as performance indicators for accessing the efficacy of the clarification process. Temperature-controlled experiments were meticulously conducted in a laboratory-scale batch mode. The primary objective was to discern the essential and optimized parameters crucial for augmenting the clarity of cane juice. Additionally, we explored the impact of pH and flocculant loading on the kinetics. Particle Image Velocimetry (PIV) is employed to comprehend the particle-particle and fluid-particle interaction. This technique facilitated a comprehensive understanding, paving the way for the subsequent multiphase computational fluid dynamics (CFD) simulations using the Eulerian-Lagrangian approach in the Ansys fluent. Impressively, these simulations accurately replicated comparable velocity profiles. The final mechanism of this study helps to make a mathematical model and presents a valuable framework for transitioning from the traditional batch process to a continuous process. The ultimate aim is to attain heightened productivity and unwavering consistency in product quality.

Keywords : non-centrifugal sugar, particle image velocimetry, computational fluid dynamics, mathematical modeling, turbidity
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