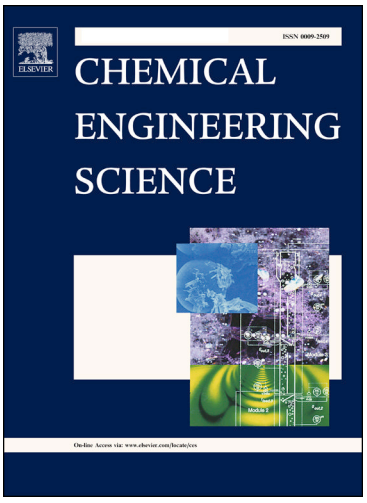

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Modeling Residence-Time Distribution in Horizontal Screw Hydrolysis Reactors

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Abstract

The dilute-acid thermochemical hydrolysis step used in the production of liquid fuels from lignocellulosic biomass requires precise residence-time control to achieve high monomeric sugar yields. Difficulty has been encountered reproducing residence times and yields when small batch reaction conditions are scaled up to larger pilot-scale horizontal auger-tube type continuous reactors. A commonly used naive model estimated residence times of 6.2–16.7 min, but measured mean times were actually 1.4–2.2× the estimates. This study investigated how reactor residence-time distribution (RTD) is affected by reactor characteristics and operational conditions, and developed a method to accurately predict the RTD based on key parameters. Screw speed, reactor physical dimensions, throughput rate, and process material density were identified as major factors affecting both the mean and standard deviation of RTDs. The general shape of RTDs was consistent with a constant value determined for skewness. The Péclet number quantified reactor plug-flow performance, which ranged between 20 and 357.

Keywords: residence-time distribution, screw-conveyed reactor, biomass

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