

Online in situ viscosity determination in stirred tank reactors by measurement of the heat transfer capacity

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Abstract

Viscosity plays an important role in a variety of biotechnological and chemical processes, such as in the production of biopolymers and in fermentations with filamentous microorganisms as well as in some dissolution, crystallization, and hydrogenation processes. Most of the established online methods for measuring the viscosity, however, struggle with the complexity of multiphase liquids like aerated liquids or suspensions and fermentation broths. This work presents a method to consider the viscosity of the whole reactor content regardless of its composition by means of calorimetric measurement of the heat transfer capacity (UA) and the use of a heat transfer model. Measurements were carried out with polyvinylpyrrolidone (PVP) model solutions (0–110 g/L) in a 50 L pilot scale stirred tank reactor with different viscosities (0.001–0.12 Pa·s), mechanical power input (0.04–27 kW/m³), and aeration rates (0–2 vvm). The heat transfer capacity (UA) measurement by means of a calibration heater (1.25–12.5 kW/m³) was found to be very precise (