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Effect of the shaft eccentricity and rotational direction on the mixing characteristics in cylindrical tank reactors

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Abstract: Strategy of the shaft eccentricity is introduced to enhance the mixing characteristics in a flat bottomed cylindrical vessel without baffles. The mixing is ensured by a six-curved blade impeller. Three solutions which are models of food emulsions are used as working fluids. These solutions have a shear thinning behavior modeled by the power-law. The effects of fluid properties, stirring rates, impeller rotational direction and impeller eccentricity on the 3D flow fields and power consumption are investigated. Three values of impeller eccentricity are considered, namely 0%, 24% and 48% of the vessel diameter. It is found that the opposite clockwise rotational direction reduces the power consumption, compared with the clockwise rotational direction. Also, the obtained results show that an impeller placed at an eccentric position between 24-48% of the vessel diameter and at the third of the vessel height may ensure the best mixing characteristics.

Keywords: Numerical simulation; Hydrodynamics; Mixing; Impeller eccentricity; non-Newtonian fluids.

1. Introduction

Mixing is widely used in several industrial processes and it is generally performed in stirred tanks. Baffling of the stirred tank is an effective strategy to enhance the scale mixing by breaking the primary vortex [1-3]. However, there are processes where unbaffled tanks are