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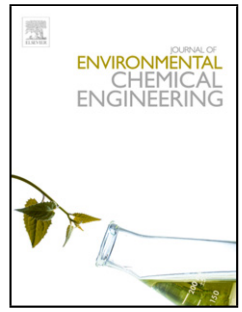

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Experimental Analysis of the Hydrodynamics, Flow Pattern and Wet Agglomeration in Rotor-Stator Vortex Separators

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Abstract

The effect of the stator geometry, cavity gap and fluid volume on the turbulent aggregation, hydrodynamics and flow pattern in rotor-stator vortex reactors have been investigated using a digital 2D Particle Image Velocimetry (PIV) and visual observation. The results of the study showed a more uniform distribution of the quantified flow parameters—velocity and vorticity in the continuous reactor when compared to the batch reactor. In addition, a high velocity recirculating jet which creates a diverging flow as the jet hits the reactor wall was observed in the batch reactor creating two distinct vortex structures (core and marginal vortex). Frictional losses across the cavity account for much of the difference between the theoretical and measured values of the hydrodynamic parameters. The stream pattern obtained from the PIV analysis unexpectedly shows a fairly good correlation with the flow pattern created from the digital video recordings of the pellet motion from the wet agglomeration experiments.

Keywords: Pelleting flocculation; ; ; ; , PIV, turbulence, hydrodynamics, velocity profile

1. Introduction

Efficient particle separation is of utmost importance for the process industry operators as it facilitates compliance with stringent regulatory requirements and enhance cost control. The optimization of the floc structure to improve their setting and dewatering properties is a key requirement in water and wastewater industry. Over the past decade, several empirical and theoretical studies of fluid flow in reactors with different geometries and mass transfer rates have been conducted [1–3]. It has been shown by several studies that the efficiency of the floc structure formation process as well as the floc structural attributes (size, shape, density, porosity, dewaterability etc.) can be significantly improved by pelleting flocculation when compared to classical flocculation as illustrated in Table 1 [1,4,5]. Pelleting flocculation has been suggested to be a function of the polymer and suspension concentration, flocculant molecular weight and charge density as well as the intensity of mixing [6]. In fact, pellet flocs are formed within a narrow range