Alternative Energy

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Flow Characteristic of Mixing Impeller for Liquid-Liquid Mixing

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INTRODUCTION

A considerable number of industrial processes take place in stirred vessel and are characterized by features such as geometry of the impeller, presence of baffle, speed of the impeller during mixing processes. As a mean to attain effective mass transfer between and within liquids, impellers in vessels (with or without baffle) are used to increase interfacial contact and their suitability depends on their capability to induce certain fluid flow pattern in the vessel. Mixing of viscous fluids is mainly carried out in the laminar and transition regimes; fast chemical reactions where one of the reacting species is limiting takes place at turbulence. For industrial purpose impellers are generally classified according to the direction of pumping (axial, tangential or radial), power consumption, rheology related to important dimensionless parameters such power number, flow number, and Reynolds number, and shear force (Zlokarnik, 2000). For instance, axial impellers induce flow in the axial direction and have low shear force with down- and up-pumping action. Radial impellers induce flow in the radial direction of the impeller. Other types of impellers are mixed flow impellers which convey flow in the radial and axial flow direction of the discharge stream. The Pitch Blade turbine (PBT) is an example and particularly popular where increase in viscosity is predominant. As there has been considerable amount of information on viscous mixing in laminar and transient region (Mavros, 2001), the focus will be on turbulent mixing especially relating to fast chemical reaction (Farmer, Pike, & Cheng, 2005). Details of a PIV experiment to map velocity profile of the impeller are discussed.

METHODOLOGY

Physical dimension of reactor

A 2 L acrylic tank, 150mm in height, 65 mm diameter, and impeller 55 mm diameter and 45 mm blade height was used with a liquid volume of 500 ml.

Flow measurement by PIV

The 2-D velocity data of the liquid flow fields were obtained using PIV equipment at high spatial resolution using a full frame interline transfer CCD camera. A Nd:YAG laser was the illumination source