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Characterizing the Taylor-Couette Reactor

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1 Introduction

In this contribution we will describe recent progress on understanding the mixing characteristics in pre-turbulent Taylor-Couette flows, and our progress in characterizing flows in the eccentric Taylor-Couette geometry. We are interested in the eccentric geometry because we expect mixing to be more homogeneous there.

Some years ago Kataoka proposed time-independent Taylor vortex flow as an ideal plug flow mixing system [1]. Since then other applications have been proposed as well as studies to parameterize the mixing properties [2, 3, 4, 5, 6, 7]. For the engineer it comes something of a surprise to discover that the mixing in three-dimensional time-independent Taylor vortex flow is not very good. In the next flow regime, wavy Taylor vortex flow, the mixing is much better, but the ideal plug flow property is lost. That is, there is significant axial transport. Even though the mixing is better, it is not always homogeneous throughout a vortex. These results come from the recent studies of chaotic advection by Ashwin and King [8] and Rudman [2]. A fundamental understanding of the mixing properties of wavy vortex flow has recently been achieved [9] based on the approach described in Ref. [10].

After describing the results in Ref. [9], we turn our attention to the eccentric Taylor-Couette system. First the basic result in Ref. [11] will be described which shows that near homogeneous mixing can be achieved in eccentric Taylor vortex flow. Unlike the concentric geometry, there are few results on the structure of flows in the eccentric geometry. As a result our experimental programme has the aim of studying the evolution of flows with increasing Reynolds number for different eccentricities. Our progress using the UVP will be described.

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