INTERSTAGE BACKMIXING OF A GAS-LIQUID MULTISTAGE, MECHANICALLY-AGITATED, COMPARTMENTED COLUMN

M.S. Takriff¹, W.R. Penney², J.B. Fasano³
¹ Department of Chemical and Process Engineering
Universiti Kebangsaan Malaysia, 43600, Bangi, Selangor, Malaysia
² Department of Chemical Engineering
University of Arkansas, Fayetteville, AR 72701, USA
³ Chemineer, Inc. 5870 Poe Avenue, Dayton, OH 45414, USA

Abstract

Interstage backmixing of an air-water system in a compartmented column was determined experimentally. The effects of impeller speed, impeller diameter and both superficial liquid velocity and superficial gas velocity through the interstage opening were investigated. Both counter current and co-current flow of air and water in the column were investigated. As air superficial velocity through the opening increased from zero, the interstage backmixing significantly decreased initially, reached a minimum, then increased slowly to a maximum after which it decreased continually with further increase in superficial gas velocity.

1. Introduction

Interstage backmixing in compartmented columns has been a subject of research since the 1960s, however, most of the pertinent literatures deal with single-phase liquids and liquid-liquid systems. The only work that investigated interstage backmixing of a gas-liquid system in a compartmented column was conducted by Sullivan et. al. [4],[5] in 1969. They found that interstage backmixing increased with liquid forward velocity for single-phase liquids, relatively unaffected by liquid velocity in gas-liquid systems and increased with increasing gas velocity at constant impeller speed. Their first conclusion is contrary to the findings of Magelli et. al. [2] and Xu [7]. These investigators found that the interstage backmixing decreased as liquid velocity increased. The present work investigates the effects of impeller

speed, impeller diameter, both superficial liquid velocity and superficial gas velocity through the interstage opening and flow directions on interstage backmixing with the objective of understanding the interstage backmixing phenomena in the presence of gas phase.

2. Experimental

The experimental investigations of this work were conducted in a two-stage column with 24.15 cm inside diameter. Each stage was 24.15 cm high with centre hole opening. Two opening diameters of 2.54 cm and 5.207 cm were used in these investigations. Each stage was fully baffled and agitation was provided by a centrally mounted 6-bladed disk impeller. Two impeller diameters were studied: 8.89 cm and 12.7 cm. A schematic of the experimental unit is presented in Figure 1.

![Experimental Setup](image)

_Figure 1: Experimental Setup._

At constant agitator speed and gas and liquid flow rates, 60 ml of 30 wt.% KCl was injected into the exit stage of the liquid phase. Twelve samples were taken from each stage at periodic interval. The KCl concentration in each sample was determined using an electrical conductivity apparatus. The Ideal Stage with Backmixing [7] model was employed in this