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LIQUID PHASE METHANOL LAPORTE PROCESS DEVELOPMENT UNIT: MODIFICATION, OPERATION, AND SUPPORT STUDIES. TASK 2.3, TRACER STUDIES IN THE LAPORTE LPMEOH PDU: TOPICAL REPORT, REVISION NO. 1

AIR PRODUCTS AND CHEMICALS, INC.
ALLENTOWN, PA

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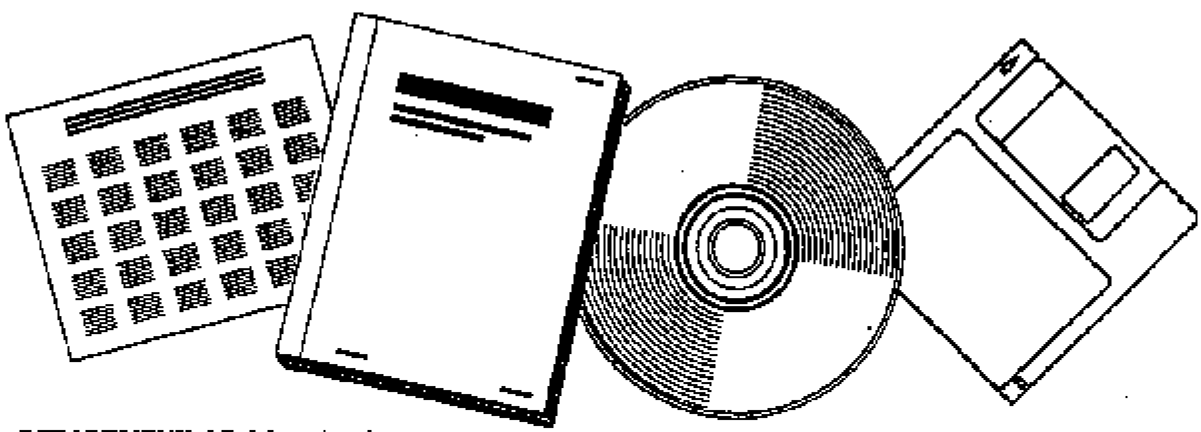

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LIQUID PHASE METHANOL LAPORTE PROCESS DEVELOPMENT UNIT: MODIFICATION, OPERATION, AND SUPPORT STUDIES

Topical Report Revision #1

Task 2.3: Tracer Studies in the LaPorte LPMEOH PDU

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By
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and

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Tarrytown, New York

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Topical Report
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Task 2.3: Tracer Studies in the LaPorte LPMEOH PDU

Contractor

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Prepared for the United States Department of Energy
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ABSTRACT

A gas phase and a slurry phase radioactive tracer study was performed on the 12 ton/day Liquid Phase Methanol (LPMEOH) Process Development Unit (PDU) in LaPorte, Texas. To study the gas phase mixing characteristics, a radioactive argon tracer was injected into the feed gas and a residence time distribution was generated by measuring the response at the reactor outlet. Radioactive manganese oxide powder was independently injected into the reactor to measure the slurry phase mixing characteristics.

A tanks-in-series model and an axial dispersion model were applied to the data to characterize the mixing in the reactor. From the axial dispersion model, a translation to the number of CSTR's (continuous stirred tank reactors) was made for comparison purposes with the first analysis. Dispersion correlations currently available in the literature were also compared.

The tanks-in-series analysis is a simpler model whose results are easily interpreted. However, it does have a few drawbacks; among them, the lack of a reliable method for scaleup of a reactor and no direct correlation between mixing in the slurry and gas phases.

The dispersion model allows the mixing in the gas and slurry phases to be characterized separately while including the effects of phase transfer. This analysis offers a means for combining the gas and slurry phase dispersion models into an effective dispersion coefficient, which, in turn, can be related to an equivalent number of tanks-in-series. The dispersion methods reported are recommended for scaleup of a reactor system.

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I. INTRODUCTION

A gas phase and a slurry phase radioactive tracer study were performed on the Liquid Phase Methanol (LPMEOH*) Process Development Unit (PDU) in LaPorte, Texas. The LPMEOH reactor is operated as a three phase slurry bubble column with an internal diameter of 22.5 inches and an L/D (Length over Diameter) of approximately 10. The slurry phase is operated batch and contains an inert hydrocarbon oil and a powdered methanol catalyst. Synthesis gas is bubbled through the slurry via a gas sparger. A freeboard section is present above the slurry to allow for oil disengagement. To study the gas phase mixing characteristics, a radioactive argon tracer was injected into the feed gas and a residence time distribution was generated by measuring the response at the reactor outlet. Radioactive manganese oxide powder was independently injected into the reactor to measure the slurry phase mixing characteristics.

Two separate analyses were done on the data. The first employed a tanks-in-series model and the second an axial dispersion model. From the axial dispersion model, a translation to the number of CSTR's was made for comparison purposes with the first analysis. Correlations currently available in the literature are also compared. However, since most of the literature correlations are based on air-water bubble columns, these data and analyses provide an interesting comparison.

This report summarizes the experimental testing methods used, the two models studied and those available in the literature. A recommended procedure is offered for calculating the number of CSTR's from a dispersion model which is applicable for reactor scaleup.

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