Abstract

TITLE: **Carbon Dioxide Separation from Flue Gas by Phase Enhanced Absorption**

AUTHERS: Liang Hu, Bin Wu, Victor Roberts, Jr., Monica J. Wood,
Hampton University
Hampton, VA 23668
(757) 725-1213
(757) 727-5189
Liang.hu@hamptonu.edu, lianghu59@yahoo.com
Grant Number: DE-FG26-04NT42128
Performance Period: 2004.7 -2007.6

OBJECTIVES

The primary objective of the proposed research is to conduct research on the simple system, CO_2-water system and CO_2-water-isooctanol layer system, to investigate the Phase Enhanced Absorption. The detailed objectives of each phase are (1) to study the mass transfer mechanism, (2) to study the kinetics, (3) to compare the absorption of the traditional absorption with Phase Enhanced Absorption to obtain the knowledge of the Phase Enhanced Absorption for further develop high efficiency, low cost carbon dioxide separation process.
The ultimate objective of proposed research is to search for the application of Phase Enhanced Absorption in the area of carbon dioxide separation from flue gas and other gas mixtures. The specific steps for the objective are (1) to select the organic layer to enhance the absorption, (2) to compare the carbon dioxide absorption of the traditional absorption with Phase Enhanced Absorption.

ACCOMPLISHMENTS TO DATE

Two systems, CO_2-water-n-haptane layer system and CO_2-water-isooctanol layer system, were studied to investigate mass transfer mechanism. Our study showed that the enhanced factor is highly depended on the liquid mass transfer coefficient. Because of the higher CO_2 absorption rate by organic layer or lower mass transfer resistant between the interface of gas and the organic layer, organic layer delivers CO_2 from the gas phase into water phase and enhances the absorption rate as long as sufficient mass transfer (agitation) between two liquid phases is provided. Four different flow patterns in the absorber were observed. Our study showed that the absorption rate was highly related to the flow pattern. In some flow patterns, the organic layer will cause the resistance for the mass transfer or decrease the absorption rate. In some flow patterns, the organic layer will enhance the absorption rate.

The kinetic study for above systems was also conducted. The influence of temperature on absorption rate and the influence of two liquid phase ratio on absorption rate were investigated. Our study showed that the influence of temperature on absorption rate was the same with the traditional absorption. The increase of the quantity of organic layer increased the absorption rate. The absorption rate increase was related to the liquid flow pattern.

The comparison of traditional absorption system, CO_2-water, with the Phase Enhanced Absorption system, CO_2-water-n-haptane layer system and CO_2-water-isooctanol layer system, indicated that the higher CO_2 absorption rate by organic layer and the sufficient mass transfer between two liquid phase were necessary to enhance the absorption rate.

In the search of application of Phase Enhanced Absorption in the area of carbon dioxide separation from flue gas and other gas mixtures, couple candidates were in tests. The further investigation is in progress.

FUTURE WORK

We continue on the screen of organic layer and evaluate the improvement by Phase Enhanced Absorption.

LIST OF PAPER PUBLISHED, U.S. PATENT/PATENT APPLICATION(S)

Phase enhanced gas-liquid absorption method
Liang Hu, U.S. Patent 6969418, Issue date: 11/29/05

CO_2 absorption into water enhanced by organic layer
Liang Hu etc. U. S. Patent pending, 2007

CONFERENCE PRESENTATIONS, AWARDS RECEIVED AS A RESULT OF SUPPORTED RESEARCH,

Honor of 2006 year by Hampton University

STUDENTS SUPPORTED UNDER THIS GRANT

Victor Roberts, Jr.
Monica J. Wood