Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 63 (2014) 781 – 786

Energy Procedia

GHGT-12

Intensification of CO_2 Stripping from Amine Solutions by Ultrasonic

Jiru Ying*, Dag A. Eimer, Anette Mathisen, Henriette Sørensen, Hans Aksel Haugen

Tel-Tek, Porsgrunn 3918, Norway

Abstract

Ultrasound was introduced to enhance CO_2 stripping from loaded amine solutions in this work. The effects of ultrasound on desorption of CO_2 from loaded amine solutions, i.e. MEA (Monoethanolamine) and MDEA (Methyldiethanolamine), at various temperature, amine concentration, CO_2 loading and energy input of ultrasound were investigated at ambient pressure. Energy consumption of CO_2 stripping assisted by ultrasound was estimated. The data are useful as a platform for further ultrasonic related research in CO_2 capture plant.

Peer-review under responsibility of the Organizing Committee of GHGT-12

Keywords: Ultrasound; CO_2 stripping enhancement; Amine solutions

1. Introduction

One of the main challenges for post combustion CO_2 capture is the large energy consumption in the regeneration unit. This contributes to high capture costs and is considered to be one of the main economical challenges for large scale post combustion CO_2 capture. Ultrasound can be used for medical imaging, detection, measurement and cleaning, and also for enhancement of mass transfer rates in biological and other industrial field [1-4].

In the present work, ultrasound was introduced to enhance CO_2 stripping from loaded amine solutions.

* Corresponding author. Tel.: +4735574000.
E-mail address: ying.jiru@tel-tek.no

Peer-review under responsibility of the Organizing Committee of GHGT-12
doi:10.1016/j.egypro.2014.11.087

Ultrasound leads to cavitation and nucleation in the liquid and thus the formation of bubbles. Once formed, it could be relatively easy for bubbles to grow as more gas diffuses to the bubbles and becomes part of the bubble. In this way ultrasound makes it easy for gas to escape in the form of bubbles. Using ultrasound is expected to contribute to a significant reduction of the CO_2 loading in lean amine absorbent without increasing the specific energy input in reboiler (kg steam/kg CO_2 desorbed). Therefore a reduction of equipment sizes is expected, and the enhanced desorption at lower temperatures which will lead to a reduction of the CO_2 capture cost. Furthermore the problems related to degradation of amine solvents may be reduced.

In this work, the effects of ultrasound on desorption of CO_2 from loaded amine solutions (MEA (Monoethanolamine) and MDEA (Methyldiethanolamine))at various values of parameters (temperature, amine concentration, CO_2 loading, energy input) were investigated at ambient pressure.

Nomenclature

α	CO_2 loading in amine solution, (mol CO_2 / mol amine)
MEA	Monoethanolamine
MDEA	Methyldiethanolamine

2. Experimental Section

2.1. Experimental set-up

A semi-batch rig, seen in figure 1, was employed to investigate the effect of ultrasound on desorption of CO_2 from amine solutions. In the rig, the loading of amine solution is a batch operation and CO_2 outlet is continuous. 50mL CO_2 loaded solution in the flask is heated by an oil bath to a desired temperature, and then treated by an ultrasonic processor (Hielscher, UP200Ht) with a frequency 26 kHz. The desorbed CO_2 from the solution passes through a condenser and a buffer/scrubbing bottle, where vapours of water and amine are removed, and the gas temperature drops to room temperature. Then the degassed CO_2 flow rate is measured by a digital mass flow meter (Top-Trak, Sierra 820). All these data including degassing flow rate, liquid temperature, room temperature, and the gas pressure in the flask are recorded by a data logger and collected by a computer. Lastly, the degassed CO_2 is collected into a gas bag which can be used to verify measurement of the rate of CO_2 desorption. Liquid analysis can be conducted by the method from Weiland and Trass [5] for determining the CO_2 loading before and after the experiment. The rig is easy to operate, it has good accuracy and repeatability, low solution requirement implying quick preparation of runs thus enabling many runs. Its operation is low cost, and results can be obtained quickly.

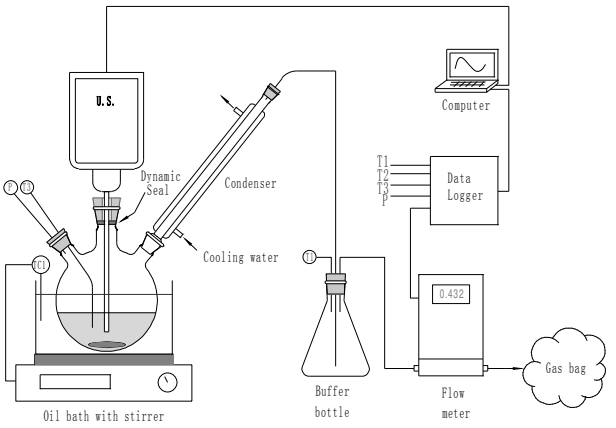

Figure 1. Semi-batch apparatus for ultrasound assisted stripping of CO_2.