International Congress on Science and Engineering
HAMBURG – GERMANY
March 2018

Study of Physical Absorption of Carbon dioxide in imidazolium-based Ionic liquids

Abbas Mohammadian *

1. Department of Chemical Engineering, Faculty of Engineering, Islamic Azad University-North Tehran Branch, abasmohammadian@yahoo.com

Abstract

In this study, the solubility of CO_2 in imidazolium-based ionic liquids with different anions has been compared at 323.15 K in mole fraction and molality scals. The anions considered in this study are $[PF_6]^-$, $[OTf]^-$, $[BF_4]^-$, $[TF_2N]^-$. Results show that solubility of CO_2, expressed in mole fraction scale, in the following sequence: $[C_8mim][TF_2N]$ > $[C_4mim][OTF]$ > $[C_8mim][PF_6]$ > $[C_2mim][OTF]$ > $[hC_2mim][BF_4]$ $[C_2mim][BF_4]$. When the concentration is switched to molality scale, the solubility of CO_2 in the ionic liquids in the following sequence: $[C_8mim][TF_2N] \approx [C_8mim][PF_6]$ > $[C_4mim][OTF]$ > $[C_2mim][OTF]$ > $[C_2mim][BF_4]$ > $[hC_2mim][BF_4]$. The experimental data at 323.15 K were correlated by using the Pitzer's model. The Pitzer's model has a good predict for Ionic Liquids + carbon dioxide systems in this work.

Key words: carbon dioxide, ionic liquids, gas sweetening, acid gas, modeling

1. Introduction

In recent years, elevated carbon dioxide (CO_2) levels have caused serious pollution problems worldwide. As more and more CO_2 are released into the atmosphere, it is of great urgent to control and reduce CO_2 so as to alleviate the global warming and greenhouse effect. For achieving such a goal, capturing CO_2 is indispensable. Global warming had been a serious environmental problem, and the increasing accumulation of CO_2 in the atmosphere is believed to be one of the major contributors. Thus, developing efficient methods for capturing CO_2 from gas streams in chemical processes is critically important. The use of aqueous solutions of alkanolamines is one of the most widely applied technologies for removing CO_2 industrially via chemical absorption [1]. Although these aqueous alkanolamine solutions are industrially effective on CO_2 removal, this method has several serious drawbacks such as intensive energy consumption, cost increases, and corrosion problems. In this regard, it is necessary to find a new kind of sequestering agent, and to this end, a new class of solvents, referred to as room-temperature ionic liquids. Ionic liquids (ILs), as nonvolatile solvents [2]. Ionic liquids possess physical properties (vapor pressure, melting point, and solubility) that can be systematically designed by selecting the proper cation and/or anion to achieve a given goal, hence the name "designer solvent"[3]. One of the most commonly investigated ionic liquids are the imidazolium-based ionic liquids along with other sulfonium, ammonium, and phosphonium derivatives. Room temperature ionic liquids (RTILs), also known as liquid