

Corrosion Behavior of CS1018 in Various CO₂ Capture Solvents

Authors : Aida Rafat, Ramazan Kahraman, Mert Atilhan

Abstract : The aggressive corrosion behavior of conventional amine solvents is one of main barriers against large scale commercialization of amine absorption process for carbon capture application. Novel CO₂ absorbents that exhibit minimal corrosivity against operation conditions are essential to lower corrosion damage and control and ensure more robustness in the capture plant. This work investigated corrosion behavior of carbon steel CS1018 in various CO₂ absorbent solvents. The tested solvents included the classical amines MEA, DEA and MDEA, piperazine activated solvents MEA/PZ, MDEA/PZ and MEA/MDEA/PZ as well as mixtures of MEA and Room Temperature Ionic Liquids RTIL, namely MEA/[C4MIM][BF₄] and MEA/[C4MIM][Otf]. Electrochemical polarization technique was used to determine the system corrosiveness in terms of corrosion rate and polarization behavior. The process parameters of interest were CO₂ loading and solution temperature. Electrochemical results showed corrosivity order of classical amines at 40°C is MDEA > MEA > DEA whereas at 80°C corrosivity ranking changes to MEA > DEA > MDEA. Corrosivity rankings were mainly governed by CO₂ absorption capacity at the test temperature. Corrosivity ranking for activated amines at 80°C was MEA/PZ > MDEA/PZ > MEA/MDEA/PZ. Piperazine addition seemed to have a dual advantage in terms of enhancing CO₂ absorption capacity as well as nullifying corrosion. For MEA/RTIL mixtures, the preliminary results showed that the partial replacement of aqueous phase in MEA solution by the more stable nonvolatile RTIL solvents reduced corrosion rates considerably.

Keywords : corrosion, amines, CO₂ capture, piperazine, ionic liquids

Conference Title : ICCBEE 2014 : International Conference on Chemical, Biological and Environmental Engineering

Conference Location : Paris, France

Conference Dates : December 30-31, 2014