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Corrosion Behvaior of CS1018 in Various CO2 Capture Solvents

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Abstract : The aggressive corrosion behavior of conventional amine solvents is one of main barriers against large scale commerizaliation 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 absrobent 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 resulted showed corrosivity order of classical amines at 40°C is MDEA> MEA > DEA wherase 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 advanatge in terms of enhancing CO2 absorption capacity as well as nullifying corrosion. For MEA/RTIL mixtures, the preliminary results showed that the partial repalcement 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
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