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Comparitive study of Carbon dioxide absorption in aqueous mixture of various piperazine derivative

Anirban Dey
Pandit Deendayal Petroleum University, India

Carbondioxide (CO_2) is a major greenhouse gas responsible for global warming and fossil fuel power plants are the main emitting sources. Therefore the capture of CO_2 is essential to maintain the emission levels according to the standards. Carbon capture and storage (CCS) is considered as an important option for stabilization of atmospheric greenhouse gases and minimizing global warming effects. There are three approaches towards CCS: Pre combustion capture where carbon is removed from the fuel prior to combustion, Oxy-fuel combustion, where coal is combusted with oxygen instead of air and Post combustion capture where the fossil fuel is combusted to produce energy and CO2 is removed from the flue gases left after the combustion process. Post combustion technology offers some advantage as existing combustion technologies can still be used without adopting major changes on them. A number of separation processes could be utilized part of post –combustion capture technology. These include (a) Physical absorption (b) Chemical absorption (c) Membrane separation (d) Adsorption. Chemical absorption is one of the most extensively used technologies for large scale CO_2 capture systems. The industrially important solvents used are primary amines like Mono ethanolamine (MEA) and Diglycolamine (DGA), secondary amines like diethanolamine (DEA) and Diisopropanolamine (DIPA) and tertiary amines like methyldiethanolamine (MDEA) and Triethanolamine (TEA). Primary and secondary amines react fast and directly with CO_2 to form stable carbamates while Tertiary amines do not react directly with CO_2 as in aqueous solution they catalyzes the hydrolysis of CO_2 to form a bicarbonate ion and a protonated amine.

Concentrated Piperazine (PZ) has been proposed as a better solvent as well as activator for CO2 capture from flue gas with a 10 % energy benefit compared to coventional amines such as MEA .However, the application of concentrated PZ is limited due to its low solubility in water at low temperature and lean CO2 loading. So following the performance of PZ its derivative 2-Aminoethyl piperazine (AEP), 1,2-(Hydroxyethyl Piperazine) (HEP) and 1-Methyl Piperazine (1-MPZ) which are cyclic amine and can be explore as an activator towards the absorption of CO2. Vapour liquid equilibrium (VLE) in CO2 capture systems is an important factor for the design of separation equipment and gas treating processes. For proper thermodynamic modeling accurate equilibrium data for the solvent system over a wide range of temperatures, pressure and composition is essential. The present work focuses on the determination of VLE data for (AEP + H2O), (HEP + H2O) and (1-MPZ+H2O) system at 40^{o}C for various composition range.