Solvent Reclaiming by Sulfate Precipitation

Rafique, Humera A., Rochelle, Gary T.*

Department of Chemical Engineering, The University of Texas at Austin, 1 University Station C0400, Austin TX, 78712

humera@che.utexas.edu

Keywords: CO_2 capture, sulfate removal, solvent reclaiming, post combustion capture

Abstract

An important issue in post-combustion CO_2 capture is the accumulation of impurities in the lean amine solvent. In particular, trace amounts of sulfur dioxide (SO_2) can react with the amine to form a heat stable salt containing sulfate ions, which can accumulate and hinder the absorption and stripping capacity of the amine. Thus, sulfate removal is necessary to re-use the amine more efficiently. Crystallization reclaiming by precipitation of the sulfate is being studied for this purpose. K_2SO_4 solid solubility experiments were carried out for 2 m to 8 m PZ between temperatures of 25 °C and 80 °C, and an empirical model was developed for the solubility of K_2SO_4:

ln(Ksp) = 5.55*I0.3 - 1.17(eq. mol amine) - 4630/T + 8.96.

A similar equation for the solubility of Na_2SO_4 in PZ is also developed.

Excess salt was added to the PZ solution. The temperature of the solution varied between room temperature and 80 °C. Solution was sampled using a filtered syringe and diluted in DDI water to prevent crystallization. Experimental samples were analyzed for Na^+, K^+, SO_4^{-2}, CO_2, and PZ concentrations in the cation chromatograph, anion chromatograph, and TIC.

As shown in Figure 1, Na_2SO_4 is more soluble in PZ than K_2SO_4.

For both salts, the solubility has a greater dependence on amine concentration than temperature. If SO_4^{-2} is the main impurity in the CO_2 capture system, the amine removed for reclaiming can be concentrated to high

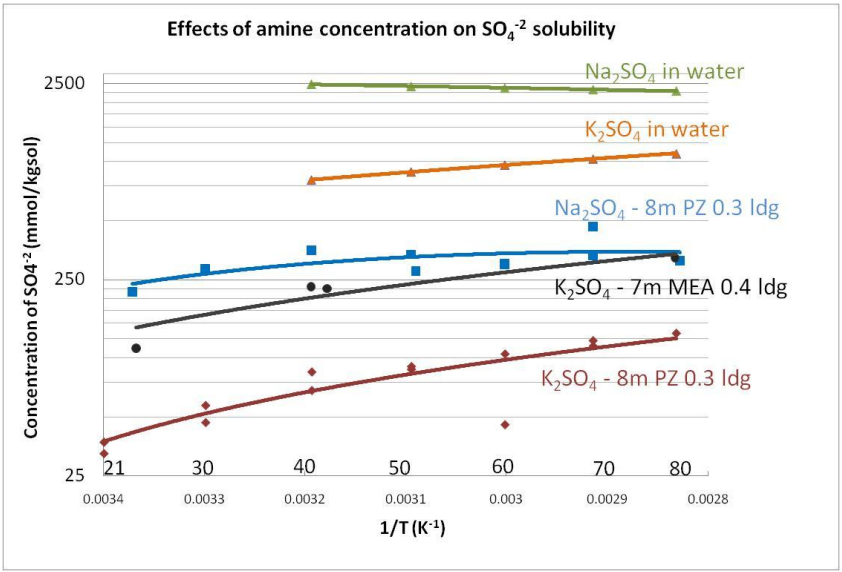

Figure 1 Comparison of Na_2SO_4 and K_2SO_4 solubility in 8 m PZ

PZ concentrations at high temperatures (without affecting the solubility of SO_4^{-2} in PZ). This way SO_4^{-2} along with the other heat stable salts present can be removed together in a single thermal reclaiming procedure.