Impacts of Aerosol Nuclei on Amine Emissions from Pilot Plants

Matt Beaudry¹, Korede Akinpelumi¹, Gary T. Rochelle¹

¹ The University of Texas at Austin, McKetta Department of Chemical Engineering, Texas Carbon Management Program, 200 E Dean Keeton St. Stop C0400, Austin, TX 78712-1589 USA

Abstract

Amine emissions are an environmental and economic concern for amine scrubbing CO₂ capture plants. Aerosol nuclei, including hydrolyzed SO₃ and fly ash, can lead to amine aerosol emissions. Aerosol grow by collecting water and amine while passing through the absorber column; current mitigation techniques are ineffective at capturing the aerosol prior to atmospheric release. This work measures the varying impacts of aerosol nuclei on amine emissions at multiple pilot plants. Aerosol emissions were quantified by the use of Fourier Transform Infrared Spectrometry (FTIR). FTIR quantifies the absorption of infrared light and determines the concentration of each component in the sampled stream.

MEA emissions were measured at the National Carbon Capture Center (NCCC) Slipstream Solvent Test Unit (SSTU). The effect of baghouse pretreatment of the inlet flue gas on the aerosol emissions rate was observed through FTIR and Phase Doppler Interferometer (PDI) analysis; these tests were performed before and after the installation of a pulsed-jet baghouse designed for flue gas mercury control. The baghouse resulted in a ten-fold reduction of amine aerosol emissions, due to the collection of SO₃ aerosol nuclei through adsorption onto injected activated carbon. This emissions reduction was due to a decrease in the inlet SO₃ content from a max of 9 ppm to 0.5 ppm. FTIR quantification of this emissions reduction is shown in Figure 1. PDI analysis confirmed the absence of aerosol at diameters greater than 0.1 μm.

Aerosol generation was performed through the injection of sulfur trioxide into the process inlet at the University of Texas Separations Research Program (UT-SRP) Pilot Plant. SO₃ was generated by the oxidation of sulfur dioxide in air over a 520 °C vanadium pentoxide catalyst bed. The 8% SO₂/Air mix was fed at flow rates up to 6 liters per minute, and resulted in up to 110 ppm of SO₃ at the absorber inlet. The generator converted an average of 94 % SO₂ into SO₃, with production rates up to 1.7 grams per minute of SO₃.

The injected aerosol were allowed to grow within the absorber and water wash. SO₃ was found to increase PZ emissions by up to 7.6 mol PZ per mol SO₃. Increasing inlet SO₃ correlated with increasing PZ emissions, as shown in Figure 2. Figure 3 presents visual confirmation of the aerosol produced from SO₃ addition.
**Figure 1:** MEA emissions at NCCC SSTU water wash outlet, before (12/12/2015) and after (10/10/2016) baghouse installation

**Figure 2:** PZ emissions at UT-SRP water wash outlet, as a function of inlet SO$_3$. 
Figure 3: Aerosol emissions from SO$_3$ injection at UT-SRP pilot plant.