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Real-time Aerosol Measurements in Pilot Scale Coal Fired Post-combustion CO_2 Capture

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ABSTRACT

Coal fired plants account for nearly 40% of the world's electric power generation and are a large source of CO_2 emissions. Post-combustion CO_2 capture using amine based solvents is a relatively mature technology. Recent pilot plants test data indicate that amine and its degradation produce emissions in the form of aerosols, which must be controlled for commercial success of this technology. In this study, the aerosols from CO_2 depleted flue gas at the National Carbon Capture Center (NCCC) Pilot Solvent Test Unit (PSTU) and Slipstream Solvent Test Unit (SSTU) were measured using an isokinetic probe and a Dekati Electric Low Pressure Impactor ($ELPI^{+TM}$). Multiple tests were conducted to quantify the effects of different process changes. PSTU measurements demonstrated sample sensitivity to transient intercooler start-up conditions, dilution gas temperatures and absorber beds in operation. During this test, the typical concentration (expressed in number of particles per volume) ranged from E+06 to E+07 cm^{-3} and the peak occurred near 0.12 µm with an observed increase in sub 0.01 µm aerosol concentration during transient intercooler start-up conditions. The measurements also demonstrated sample sensitivity to dilution gas temperatures by showing that aerosol size and concentration peaks shifted at higher diluter operating temperatures, especially above 100°C. Several tests were also conducted at the absorber inlet and wash tower outlet of the SSTU with varying dilution ratios and temperatures. Comparison of SSTU and PSTU results are presented in this paper. The stage cuts for different impactor stages of different $ELPI^{+}$ instruments are calibrated which showed minimum deviation in the range of 0.02% to 0.70% from original calibration. Generally, the concentrations were higher at the absorber inlet compared to the wash tower outlet. Also, a higher concentration was observed for the smallest size fraction at the wash tower outlet compared to the absorber inlet. Similar to the PSTU, the concentration measured at the SSTU was in the range of E+06 cm^{-3}. These results are promising and will enable the development of process control strategies to mitigate solvent losses and reduce operational and maintenance expenses.