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Characterization of Aerosol Droplet in Absorption Columns to Avoid Amine Emissions

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Abstract : Formation of aerosols can cause serious complications in industrial exhaust gas CO2 capture processes. SO3 present in the flue gas can cause aerosol formation in an absorption based capture process. Small mist droplets and fog formed can normally not be removed in conventional demisting equipment because their submicron size allows the particles or droplets to follow the gas flow. As a consequence of this aerosol based emissions in the order of grams per Nm3 have been identified from PCCC plants. In absorption processes aerosols are generated by spontaneous condensation or desublimation processes in supersaturated gas phases. Undesired aerosol development may lead to amine emissions many times larger than what would be encountered in a mist free gas phase in PCCC development. It is thus of crucial importance to understand the formation and build-up of these aerosols in order to mitigate the problem.Rigorous modelling of aerosol dynamics leads to a system of partial differential equations. In order to understand mechanics of a particle entering an absorber an implementation of the model is created in Matlab. The model predicts the droplet size, the droplet internal variable profiles and the mass transfer fluxes as function of position in the absorber. The Matlab model is based on a subclass method of weighted residuals for boundary value problems named, orthogonal collocation method. The model comprises a set of mass transfer equations for transferring components and the essential diffusion reaction equations to describe the droplet internal profiles for all relevant constituents. Also included is heat transfer across the interface and inside the droplet. This paper presents results describing the basic simulation tool for the characterization of aerosols formed in CO2 absorption columns and gives examples as to how various entering droplets grow or shrink through an absorber and how their composition changes with respect to time. Below are given some preliminary simulation results for an aerosol droplet composition and temperature profiles. Results: As an example a droplet of initial size of 3 microns, initially containing a 5M MEA, solution is exposed to an atmosphere free of MEA. Composition of the gas phase and temperature is changing with respect to time throughout the absorber.

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