MEASUREMENT OF COAGULATING SILVER AND CARBON AEROSOLS USING A TANDEM DIFFERENTIAL MOBILITY ANALYZER

Matthew P. Simones

Dr. Sudarshan K. Loyalka, Dissertation Supervisor

ABSTRACT

One of the unresolved technical issues associated with the high temperature gas-cooled reactor (HTGR) is the production of carbonaceous dust (e.g. by abrasion, corrosion, radiation damage, gas-to-particle conversion) and the subsequent transport of sorbed fission products via aerosol transport. Diffusion charging and/or self-charging of these aerosols is likely to occur which will affect how the aerosol evolves in time and ultimately deposits on surfaces. At present, nuclear reactor safety codes, such as MELCOR, do not account for these electrostatic effects and there is currently no consensus on their importance. Further experimentation and modeling of these effects are therefore important and ongoing to resolve these issues. The purpose of this research is to experimentally investigate the coagulation of charged aerosols closely associated with HTGRs by measuring the evolution of size and charge distributions over time and to compare the experimental results with available numerical models. Measurements have been completed for both silver and carbon ultrafine aerosols using a tandem differential mobility analyzer and an open flow coagulation chamber with a residence time of nearly 400 seconds. Results for both aerosols indicate that coagulation occurs faster than predicted by the model, at times differing by an order of magnitude. Overall, the apparatus developed here will support future coagulation studies of charged ultrafine aerosols at the Nuclear Science and Engineering Institute by providing data for validation of computer codes and guiding model development.