Stevens Institute of Technology

Nanotechnology Graduate Program

Nanomaterial exposure and environmental effects: Incorporating aggregation effects into a risk assessment framework

Wednesday March 2, 2011, Babbio 122, 11am

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The Center for the Environmental Implications of NanoTechnology (CEINT) is engaged in research that seeks to elucidate relationships between properties of nanomaterials and their environmental behavior. This presentation provides an overview of activities in CEINT and illustrates the methodology being applied to a wide range of nanomaterials in developing a framework for nanomaterial risk assessment. We consider exposure at consecutive stages in the value chain of nanomaterials production and incorporation into products, and the potential "leakage" from each node in the value chain and end-of useful life practices. The examples of nano silver and C60 are used to illustrate the CEINT research effort. Nanomaterial transport and relative affinity of nano Ag for solid phases is discussed as well as possible transformations of nano Ag in the environment and the impacts that these transformations may have at the scale of cells, organisms and ecosystems. The role of aggregation in modifying nanoparticle reactivity is discussed in the context of the fullerene C60. The need to take into account the heterogeneity and aging in aqueous suspensions of fullerene C60 aggregates (nC60) for the purposes of predicting nanomaterial transport, exposure and biological activity is discussed. Data on the production of reactive oxygen species, microbial inactivation, and the mobility of the aggregates of the nC60 in a silicate porous medium as a function of time a size fraction are presented. Size-dependent differences are attributed to an increasing degree of hydroxylation of nC60 aggregates with decreasing size. As the quantity and influence of these more reaction fractions may increase with time, experiments evaluating fullerene transport and toxicity endpoints must take into account the evolution and heterogeneity of fullerene suspensions.

Professor Mark R. Wiesner, Ph.D., P.E. received his BA in Mathematics/Biology from Coe College, Cedar Rapids, Iowa, an MS in Civil and Environmental Engineering from the University of Iowa, and a PhD in Environmental Engineering from The Johns Hopkins University. He conducted post-doctoral work at the Ecole Nationale Supérieure des Industries Chimiques in Nancy, France. Professor Wiesner's honors and awards include the NSF Research Initiation Award, the Association of Environmental Engineering Professors AWWA invited lecturer award (1993), the Rudolph Hering Medal from the Environmental Engineering Division of ASCE, the Charles Duncan Award for Scholarship and Teaching from Rice University (1998), the Pierre de Fermat Laureate and Chair of Excellence at the French National Polytechnic Institute, Toulouse, in 2004, and the AEESP Frontiers in Research Award in 2004. His research interests include membrane processes, nanostructured materials, transport and fate of nanomaterials in the environment, colloidal and interfacial processes, and environmental systems analysis.

Co-sponsored by the Department of Civil, Ocean, and Environmental Engineering

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