NANO HIGHLIGHT
Response of Aquatic and Terrestrial Microorganisms to Carbon Based Manufactured Nanoparticles

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The industrial production of Carbon-Based Manufactured NanoParticles (CMNP) is expected to increase by at least five-fold by 2007. Despite the impending increase in industrial production, and the certain releases of CMNP to the environment, little is known about their environmental impacts. In order to engage in a publicly transparent evaluation of risks and benefits, and to develop public policy and technology to manage potential risks, fundamental scientific research must be completed. Research on the response of aquatic and terrestrial microorganisms to CMNP is beginning to improve our understanding of the environmental fate of CMNP. The research group at Purdue University is addressing the role of natural biopolymers in selectively sequestering and extending the longevity of CMNP or in promoting bio- or chemical transformations of CMNP, developing baseline information on the toxic effects of CMNP on bacteria, obtaining information on soil and subsurface microbial community responses to CMNP, and determining the fate of CMNP in the presence of fungal populations. Our outreach program to high school juniors and seniors is beginning to provide educational materials so that the next generation of scientists and engineers have a better understanding of nanotechnology and societal issues.

The primary discoveries from this group include a determination of the solubility of C60 in mixed solvent system of tetrahydrofuran–acetonitrile important for HPLC analysis and a determination of fullerene's (C60) water solubility. We have determined the solubility of C60 in pure water using a generator column method and these preliminary studies suggest a value between 1 to 10 ng L^{-1}. Studies on octanol – water partitioning gave a value for log K_{ow} of 7.73 [(1,2)]. We have also adapted an existing method for suspending C60 in water. The method results in the formation of crystals (ranging in size from 40 to 120 nM) and they are termed nC60. Working with nC60 nano-material suspensions and normal strength bacterial nutrient solutions we have shown that early bacterial growth is suppressed but with time the cells are able to recover and function in the presence of nano-materials. Testing under nutrient limited conditions is on going. Preliminary soil and sediment work using both dry C60 and nC60 has shown the CMNP materials to have limited impact on respiration and population structure (aerobic or anaerobic systems), soil enzymes or the soils ability to transform other nutrient materials[(3)]. Fungal incorporation studies using ^{13}C-C60 are ongoing. The outreach portion[(4)] of the project has developed a web site to support both internal and external work (www.purdue.edu/ANE.)

References (10 point font)
(1) Kulkarni, P.P., Jafvert, C.T., "Solubility of Buckminsterfullerene (C60) in solvent mixtures", Presented at the 229th ACS National Meeting, San Diego, CA, March 13-17, 2005
(2) Kulkarni, P.P., Jafvert, C.T., "Solubility and partitioning studies of Buckminsterfullerene (C60)", Presented at the 230th ACS National Meeting, Washington DC, August 28-September 1, 2005
(3) Nyberg, L.M., Z. Tong, M. Bischoff, L. F. Nies and R.F. Turco, "Effect of carbon-based manufactured nanoparticles (CMNP) on microbial communities", Presented at the 229th ACS National Meeting, San Diego, CA, March 13-17, 2005
(4) Carroll, N., Nanotechnology and the Environment: Fate/Transport of Nano-structured Materials, oral presentation, Session: Nanotechnology and the Environment, Division of Industrial and Engineering Chemistry, ACS (American Chemical Society) National Meeting, in San Diego, CA, 3/16/05.