Effect of Humic Acid and Sunlight on the Generation of aqu/C_{60}

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Abstract

Little is known about the effect of sunlight and natural organic matter, such as humic acid, on the aqueous suspension of fullerene C_{60}. This knowledge gap limits our ability to determine the environmental impact of potential environmental releases of these materials. Aqueous suspensions of C_{60} nanoparticles (aqu/C_{60}) were generated by stirring in the presence and absence of sun light in deionized water, 0.1, 1.0, and 10 mg/L Suwanee River Humic Acid (SRHA) (adjusted to 1 µS/cm ionic strength with NaCl and pH 7 with NaOH) and in a water collected from a Call's Creek, a primary tributary of the Oconee River, Athens GA (pH 8, conductivity 26 µS/cm, TOC 2.8 mg/L and TSS 35 mg/L).

For both light and dark suspensions the mass of C_{60} suspended increased over the course of 400 hours with sunlight generating significantly more concentrated aqu/C_{60} suspensions than the dark treatments. For suspensions generated in the absence of sun light with 10 mg/L SRHA, the aqu/C_{60} concentration reached a maximum of 160 ± 21 µg C_{60} / L, while the aqu/C_{60} concentration in dark suspensions generated in 1 mg/L, 0.1 mg/L SRHA and deionized water were lower and the differences between them were not statistically significant at the 0.05 confidence interval, 71 ± 18, 55 ± 12 and 66 ± 20 µg C_{60} / L , respectively. Interestingly, for the dark suspension generated in Call's Creek

water the C_{60} concentration reached a maximum concentration of 16 ± 4.2 µg C_{60} / L which was significantly less than the concentrations measured above.

For suspension generated in the presence of sun light, the C_{60} concentrations were greater than the dark controls with 0.1, 1,0 and 10 mg/L SRHA suspensions having C_{60} concentrations of 310 ± 88, 461 ± 120 and 384 ± 110 µg C_{60} / L, respectively. Sun light suspensions generated in de-ionized and Call's Creek water were lower and the difference between them was not statistically significant, 150 ± 20 and 150 ± 40 µg C_{60} / L, respectively. Batch dynamic light scattering size determinations of aqu/C_{60} aggregate hydrodynamic diameters (D_h) generated in sunlight and dark suspensions indicate that sunlight only effected the size for the aqu/C_{60} aggregates generated in deionized water. While the concentration of humic acid did not effect aggregate size, the presence of humic acid resulted in reduced aggregate size, 170 – 180 nm D_h, compared to suspensions generated in deionized water, 200-250 nm D_h. Additionally, aggregates generated in Call's Creek water were larger than those generated in deionized water or in the presence of humic acids, 250-300 nm D_h.

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