Redox properties of black carbon in promoting the degradation of contaminants in the environment

KAI DING[1] AND WENQING XU[1]

[1]Department of Civil and Environmental Engineering, Villanova University, Villanova, PA, 19085

Anthropogenic organic pollutants have been released to the environment via human activities during their applications as pesticides, flame-retardants, and explosives. These compounds tend to associate with black carbons in soils and sediments, where high concentrations of sulfide co-exist. Due to their hydrophobicity, they are often bioaccumulative and toxic, and therefore pose risks to ecosystems and human life. Traditionally, environmental scientists assume that black carbon serve as passive sorbent, sequestering contaminants from biotic or abiotic transformation. However, chemical reactions mediated by black carbon are possible in the presence of sulfide.

In this study, we characterized the reactivity of black carbon toward facilitating different categories contaminants transformation. Our results indicate that both oxygenated functional groups and conductivity of black carbon are important. Nitroaromatics are transformed via reduction pathway in the presence of sulfide, where black carbon serves as electron shuttle passing electrons from sulfides to sorbed nitroaromatics. Interestingly, both RDX (1,3,5-Trinitroperhydro-1,3,5-triazine), DDT (1,1,1-trichloro-2,2-di(4-chlorophenyl) ethane), and DDD (1,1-dichloro-2,2-bis(4-chlorophenyl) ethane) require surface intermediate formed from the reaction between black carbon and sulfides. Lower toxicity products are generated for all contaminants evaluated, which lays the groundwork for developing an alternative *in-situ* remediation technique for rapidly decontaminating soils and sediments under environmentally relevant conditions.