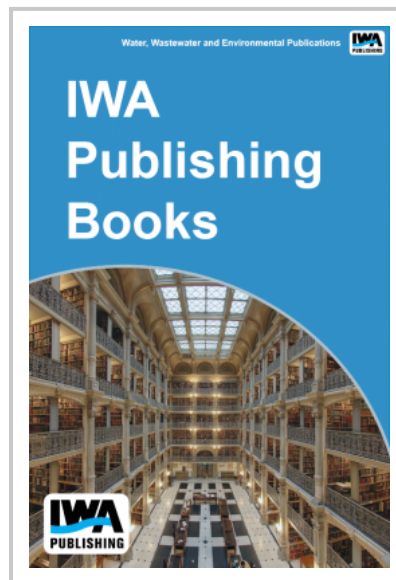


# Fate of Engineered Nanomaterials in Wastewater Biosolids, Land Application, and Incineration

Laboratory experiments were conducted using two types of well characterized ENMs, including ENMs of similar size but different surface functional group and ENMs contained in consumer products. A sorption protocol was developed to study the sorption behaviors of hydrophobic, cationic organic molecules and ionic silver on fresh and freeze dried biomass. Partition coefficients of model ENMs with wastewater biomass were determined in a series of batch experiments.

In order to assess the occurrence of ENMs in biosolids and biosolids amended soils, field samples were collected from WWTPs, a set of EPA biosolids composite samples and full scale biosolids handling facilities. ENMs were found to be present in biomass, biosolids and soils receiving land-application of biosolids. The most common ENM observed was titanium dioxide. Other metallic particles in micro meter size were identified in biosolids, including precious metals such as gold and silver. This study is among the first to conduct in-depth and extensive characterization of metallic materials in biosolids, using scanning (SEM) and transmission (TEM) electron microscopy. To support these full-scale observations that ENMs accumulate in biomass, the laboratory work explored ways to predict the presence of ENMs in biosolids in the future as more ENMs are used by industry, commercial sectors and residences.



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