Silver nanoparticles in beneficial reuse waste materials

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Introduction

Silver nanoparticles (AgNPs) are commonly used in consumer products and pose a risk of release to the environment. The purpose of this research was to assess the chemical transformation of AgNPs in aged, fresh, and incinerated biosolids and composted municipal solid waste in order to provide information for AgNP life cycle analyses.

Discussion of Results

In the biosolids system [1], silver nanoparticles were introduced to the influent of a pilotscale wastewater (WW) treatment system consisting of a primary clarifier (PC), aeration basin, and secondary clarifier. The partitioning of the AgNPs between the aqueous and solid phases in the system was monitored. The speciation results show that AgNPs are converted to Ag-sulfur (as sulfide and sulfhydryl) species in fresh and aged biosolids, which is in agreement with other studies on AgNPs in biosolids. Results from linear combination fitting of the X-ray absorption spectroscopy (XAS) data for incinerated biosolids show that a significant proportion of the spiked silver (30-50%) is converted to elemental Ag in the incineration process.

The compost study [2] evaluated the impact of polyvinylpyrrolidone (PVP) coated silver nanoparticles (PVP-AgNPs) on the composting of municipal solid waste. The results suggest that there was no statistically significant difference in the leachate, gas, and solid quality parameters and overall composting performance between the treatments containing the AgNPs, Ag^+, and negative control. The data also indicate that while the surface transformation of AgNPs to AgCl and Ag2S can reduce the toxicity, complexation with organic matter may also play a major role. The results of this study further suggest that at relatively low concentrations, the organically rich waste management systems' functionality may not be influenced by the presence of AgNPs.

[1] Impellitteri *et al* (2013) *Water Res*. **47**, 3878-3886. [2] Gitipour *et al* (2013) *Environ Sci Technol*. **47**, 14385-14393.