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Short-term impacts of Cu, CuO, ZnO and Ag nanoparticles (NPs) on anammox sludge: CuNPs make a difference

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Abstract

The increasing application of engineered nanoparticles (NPs) has posed an emerging challenge to wastewater treatment processes. The short-term impacts of CuNPs, CuONPs, ZnONPs and AgNPs on anaerobic ammonium oxidation (anammox) process were investigated firstly in this study. CuONPs, ZnONPs and AgNPs up to 50 mg g^{-1} suspended solid (SS) did not affect anammox activity, reactive oxygen species (ROS) production or cell membrane integrity. However, 1.25 mg g^{-1}SS CuNPs significantly inhibited the anammox activity and the loads that caused 50% inhibition were 4.64 ± 1.24 and 3.27 ± 0.79 mg g^{-1}SS for anammox granules and flocs, respectively. 5 mg g^{-1}SS CuNPs caused serious accumulation of the toxic intermediate N_2H_4. Furthermore, CuNPs interacted with extracellular polymeric substances by specifically bonding to tyrosine or tryptophan-containing groups, C-O-C in polysaccharides and -OH in polymeric compounds. Therefore, this study calls for more attention to the risks of NPs to the anammox-based processes.

Keywords: Anammox; Nanoparticles; Toxicity; Sludge; Extracellular polymeric substances