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Abstract

Silver Nanoparticles May Promote Antibiotic Resistance Gene Persistence in Wastewater Treatment Systems †

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Silver nanoparticles (AgNPs) rank as some of the most commonly utilized engineered nanomaterials and are known to enter wastewater collection and treatment systems through their creation, application, and disposal processes [1]. Understanding the effects of AgNPs on the performance of wastewater treatment systems, including treatment wetlands, is critical for safeguarding public health. This research assessed how increasing levels of AgNPs and Ag^+ ions influence the composition of microbial communities, the system treatment performance, and the elimination of antibiotic resistance genes (ARGs) in a pilot-scale hybrid wastewater treatment system. Shotgun metagenomic sequencing was employed to examine the microbial community's structure and the antibiotic resistome's diversity and composition. Quantitative PCR was used to assess the amount of ARGs. The findings indicated that heightened concentrations of AgNPs and Ag^+ ions only moderately altered the prokaryotic community structure in the biofilms of the filter material and did not substantially affect the system's overall purification capability [2]. The addition of $AgNO_3$ caused an increase in the genetic mechanisms responsible for silver resistance in microbial communities in the vertical flow filters compared to the collargol, suggesting that the microbial communities in these biofilms can resist or adapt to the presence of silver nanoparticles. Notably, increased levels of Ag in the system did interfere with ARGs' abundance and removal efficiency, leading to an increased discharge of these genes into the environment [3]. The study also found that the concentration of accumulated Ag in the filters had a more substantial impact on the absolute and relative quantity of ARGs in the treated water than the actual amount of Ag present in the water. The research documented a higher relative presence of tetracycline, sulfonamide, and aminoglycoside resistance genes, along with increased levels of plasmid and integron-integrase genes in the biofilms of the system units treated with AgNPs. These results emphasize the need for further comprehensive studies to unravel the intricate effects of AgNPs on the nature and behavior of microbes carrying antibiotic resistance genes in wastewater treatment systems, the understanding of which is crucial for devising effective strategies to mitigate potential public health risks. Additionally, it is important to consider that the wastewater entering treatment systems contains a mixture of various engineered nanoparticles. Due to this, future research must also explore how the combination of different nanoparticles influences

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the resistome within a wastewater treatment system and the dissemination of microbes possessing antibiotic resistance genes into the environment via a system effluent.

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