



Using aluminum-doped magnetic nanoparticles for total phosphorus removal in poultry processing wastewater

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ABSTRACT

Poultry processing wastewaters contain high levels of contaminants and need to be treated before being discharged. In this study, wastewater samples from a poultry processing plant were collected, characterized, and treated with aluminum-doped magnetic nanoparticle to remove phosphorus species. Each sample was taken from different points along the treatment process so that the efficacy of each operation could be assessed. This assessment was mainly focused on phosphorus (P) speciation analyses to monitor the changes and removal of P species after each treatment step. It was observed that the distribution of P species changed significantly along the wastewater treatment process. Total phosphorus (TP) ranged from 4 to 56 ppm and the percentages of total soluble phosphorus species varied from 40% to 94% of TP depending on the stage of the wastewater treatment process. Particularly, the bioavailable, soluble reactive phosphorus (sRP) varied from 0% to 42% of TP along the process. Treatment of wastewater samples with aluminum-doped magnetic nanoparticles (Al-MNP) reduced TP by over 90% in all samples. Al-MNP removed sRP preferably but also removed other P species effectively. In addition, the levels of other contaminants were removed by Al-MNP including chemical oxygen demand (COD) by 20%–87%, total suspended solids (TSS) by 50%–97%, and fat oil grease (FOG) by 78%–99%. Based on these removal efficiencies, the suggested application point of Al-MNP in the poultry wastewater treatment process will be to treat the effluent of dissolved air flotation, where the COD, FOG, and TSS have been removed significantly. The low cost of Al-MNP as well as their ease of application makes them promising materials for wastewater treatment.

Keywords: Phosphorus speciation; Adsorption; Magnetic nanoparticle; Wastewater treatment

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