Synthesizing attapulgite-graft-polyacrylamide flocculant and immobilizing microorganisms to treat low-ammonium water

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ABSTRACT

Low concentrations of ammonium are difficult to remove from surface water through traditional adsorption, air stripping, and biological techniques. Hence, we flocculate attapulgite-graft-polyacrylamide (ATP-g-PAM) and immobilize cells in this study to purify low-ammonia surface water. ATP-g-PAM was synthesized by grafting the polymerization reaction of ATP and acrylamide (AM). In this process, FeSO₄ and NaHSO₃ acted as initiators. The optimum reaction conditions were as follows: 15% AM monomer, 2% ATP, 1.5 × 10⁻⁴ mol/mol AM initiator concentration with a 1:5 molar ratio of FeSO₄ to NaHSO₃, and 5 h reaction time. The ATP-g-PAM structure was characterized further by Fourier transform infrared spectra, thermogravimetric analysis, scanning electron microscopy, and transmission electron microscopy. Results indicated that AM monomers were successfully grafted onto the ATP surface. Pellets of ATP-g-PAM-bound nitrifying bacteria were manufactured for surface water treatment. The ammonia-nitrogen removal rate ranged from 14.9 to 33.9% for adsorption and flocculation and from 69.4 to 82.6% under cell immobilization. Post-treatment, ammonia-nitrogen was less than 0.8 mg/L. Therefore, ATP-g-PAM can be an ideal carrier material of microbial fixations in water and wastewater treatment because the double-action of adsorption and flocculation induced by ATP-g-PAM can supplement the removal of pollutants.

Keywords: ATP-g-PAM; Flocculation; Immobilization; Ammonium removal

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