Characterization and coagulation performance of covalently bound organic silicate aluminum hybrid coagulants: effects of Si/Al, B value and pH

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ABSTRACT

Covalently bound inorganic–organic hybrid coagulants are believed to be the goal of coagulant development for water treatment. In this study, covalently bound organic silicate aluminum hybrid coagulants were synthesized by employing γ-aminopropylmethyldiethoxysilane (APDES) as silicon source with different Si/Al molar ratios (Si/Al = 0.1, 0.2, 0.3, and 0.4) and basicity values (B = 0.5, 1.0, 1.5, and 2.0). The APDES–Al hybrid coagulants (HC-As) were characterized by the measurement and analysis of pH, zeta potential, Al species distribution, and morphology. The results indicated that Si/Al and B played important roles in aspects of the physical structure, the Al species distribution, and the electrochemistry characteristics. Specifically, the HC-A with Si/Al = 0.4 and B = 2.0 featured the highest content of Al₁₃β, the reticulated aggregate and the largest pH range for high zeta potential. The coagulation performances of HC-As were also investigated by treating synthetic water. At a low dosage, the HC-A with Si/Al = 0.4 and B = 2.0 exhibited the best coagulation behavior in terms of humic acid removal and turbidity removal. Besides Si/Al and B, the effect of pH on the coagulation performance of HC-A was also studied using an additional hybrid coagulant with tetraethoxysilane as the Si source for comparison. The results showed that HC-A has a larger pH range for simultaneous humic acid and turbidity removal.

Keywords: Hybrid coagulants; Covalently bound; γ-aminopropylmethyldiethoxysilane; Organic silicate aluminum

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