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Synthesis and coagulation performance of composite poly-aluminum-ferric-silicate-chloride coagulants in water and wastewater

A.K. Tolkou, A.I. Zouboulis*

Laboratory of General and Inorganic Chemical Technology, Department of Chemistry, Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece, Tel. +30 2310 997794; emails: tolkatha@chem.auth.gr (A.K. Tolkou), zoubouli@chem.auth.gr (A.I. Zouboulis)

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ABSTRACT

The aim of this work was to study the combination of an inorganic pre-polymerized coagulant (polyaluminum chloride [PACl]) with ferric species and polysilicic acid in various mixing orders Al/Fe/Si and OH/Al molar ratios, by applying two polymerization techniques for the production of a unique reagent, representing a more efficient coagulant than the respective commercially available (PACl-18) or laboratory-prepared ($PACl_{lab}$) for water or wastewater treatment. Several of coagulants' derivatives were prepared and were examined by jar tests for the treatment of simulated surface water, contaminated by clay particles (turbidity) and humic acid (natural organic matter); pH, turbidity, $UV_{254\,nm}$ absorbance, and residual Al were measured in the treated water. $PSiFAC_{1.5:10:15}$ prepared by the co-polymerization technique was found to be the most efficient coagulant from all the tested compounds; in addition, no flocculant aid (polyelectrolyte) was required with this product. Low coagulant doses, about 1.5–2 mg/L were required for the reduction of turbidity values to lower than 1 NTU; furthermore, $PSiFAC_{1.5:10:15}$ resulted in low residual aluminum concentration (about 140 μg Al/L). The most effective coagulants obtained were also used for the treatment of tannery wastewater to evaluate their performance and it was observed that high turbidity removal (~99%) was obtained at doses of about 100 mg/L. The most effective coagulants are under study for their potential use to alleviate membrane fouling in MBRs.

Keywords: Water and wastewater treatment; Composite coagulants; Poly-aluminum-ferric-silicate-chloride coagulants (PSiFAC); Coagulation; Turbidity removal

*Corresponding authors.

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