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Coagulation-flocculation Process with Metal Salts, Synthetic Polymers and Biopolymers for the Removal of Trace Metals (Cu, Pb, Ni, Zn) from Wastewater

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Abstract : As a consequence of their potential to cause harm, there are strong regulatory drivers that require metals to be removed as part of the wastewater treatment process. Bioavailability-based standards have recently been specified for copper (Cu), lead (Pb), nickel (Ni) and zinc (Zn) and are expected to reduce acceptable metal concentrations. In order to comply with these standards, wastewater treatment works may require new treatment types to enhance metal removal and it is, therefore, important to examine potential treatment options. A substantial proportion of Cu, Pb, Ni and Zn in effluent is adsorbed to and/or complexed with macromolecules (eg. proteins, polysaccharides, aminosugars etc.) that are present in the colloidal size fraction. Therefore, technologies such as coagulation-flocculation (CF) that are capable of removing colloidal particles have good potential to enhance metals removal from wastewater. The present study investigated the effectiveness of CF at removing trace metals from humus effluent using the following coagulants; ferric chloride (FeCl3), the synthetic polymer polyethyleneimine (PEI), and the biopolymers chitosan and Tanfloc. Effluent samples were collected from a trickling filter treatment works operating in the UK. Using jar tests, the influence of coagulant dosage and the velocity and time of the slow mixing stage were studied. Chitosan and PEI had a limited effect on the removal of trace metals (<35%). FeCl3 removed 48% Cu, 56% Pb and 41% Zn at the recommended dose of 0.10 mg/L. At the recommended dose of 0.25 mg/L Tanfloc removed 77% Cu, 68% Pb, 18% Ni and 42% Zn. The dominant mechanism for particle removal by FeCl3 was enmeshment in the precipitates (i.e. sweep flocculation) whereas, for Tanfloc, inter-particle bridging was the dominant removal mechanism. Overall, FeCl3 and Tanfloc were found to be most effective at removing trace metals from wastewater.

Keywords : coagulation-flocculation, jar test, trace metals, wastewater
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