



Research Article

Review of Coagulation's Rapid Mixing for NOM Removal

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Abstract

This review focuses on rapid mixing in the coagulation process for improved natural organic matter (NOM) removal in water treatment. Rapid mixing aims to instantly and efficiently disperse coagulant species into raw water, before flocculation, sedimentation, and filtration processes. Mechanical mixing with a longer retention time cannot guarantee an instantaneous and uniform coagulant dispersion. For this reason, the so-called pump diffusion mixer (PDM) has been proposed. Using various rapid mixing devices to test the sedimentation performance, it is showed that in-line hydraulic jet and static mixers are able to achieve performance equivalent to that of the mechanical mixing type at a lower coagulant dosage. On the other hand, the removal of NOM as disinfection by-products (DBPs) precursor by chemical coagulation (CC) has been extensively studied. It is well reported that enhanced coagulation (EC) by adjusting the pH downwards to 4-5 prior to coagulant addition will encourage the formation of soluble NOM-Al complex from low-turbidity waters. In case of most waters, therefore, acid must be added to maintain the desired coagulation pH for EC, and excess coagulant is required to improve the removal of NOM. However, CC using in-line hydraulic jet mixer such as PDM is a reasonable method for the improvement of coagulation process compared to EC, since it is possible to obtain good removals of NOM as well as turbidity using a lower dosages of coagulant without supplementary addition of chemicals for pH control and thus producing a smaller volume of waste solids.

Keywords: Rapid mixing; Coagulation; Charge neutralisation; Sweep coagulation.

Introduction

Rapid mixing (Cheremisinoff (2002), Asano et al. (2007), Mavros (2001)), in water treatment is to rapidly disperse the coagulant into raw water, followed by flocculation (Ghernaout and Naceur (2011)), sedimentation (Goula et al. (2008)), and filtration (Kurita (1999), De Zuane (1997), Xiao et al. (2008)). This

process has a strong influence on the overall treatment efficiency (O'connor et al. (2009)). Considering that the hydrolysis products, $Me_l(OH)_m^{n+}$ (Me: metal ions; OH: hydroxide ion; l, m, n : constants), of the coagulants such as alum or Fe(III) are produced within a very short time of 10^{-4} to 1 s and moreover, aluminium hydroxide starts to precipitate in about 7 s (Amirtharajah and Mills (1982)), it is