International Journal of Environmental Monitoring and Analysis
2014; 2(6-1): 23-34
Published online October 15, 2014 (http://www.sciencepublishinggroup.com/j/ijema)
doi: 10.11648/j.ijema.s.2014020601.14
ISSN: 2328-7659 (Print); ISSN: 2328-7667 (Online)

Coagulation and chlorination of NOM and algae in water treatment: A review

Djamel Ghernaout[1, 2, *], Saad Moulay[2], Noureddine Ait Messaoudene[3], Mohamed Aichouni[3], Mohamed Wahib Naceur[2], Ahmed Boucherit[2]

[1]Department of Chemical Engineering, College of Engineering, University of Ha'il, PO Box 2440, Ha'il, Saudi Arabia
[2]Chemical Engineering Department, Saad Dahlab University of Blida, PO Box 270, Blida 09000, Algeria
[3]Department of Mechanical Engineering, College of Engineering, University of Ha'il, PO Box 2440, Ha'il, Saudi Arabia

Email address:

djamel_andalus@yahoo.fr (D. Ghernaout), polymchemlab@hotmail.com (S. Moulay), naitmessaoudene@yahoo.com (N. A. Messaoudene), m.aichouni@uoh.edu.sa (M. Aichouni), wnaceur@hotmail.com (M. W. Naceur), boucherit_ah@yahoo.fr (A. Boucherit)

To cite this article:

Djamel Ghernaout, Saad Moulay, Noureddine Ait Messaoudene, Mohamed Aichouni, Mohamed Wahib Naceur, Ahmed Boucherit. Coagulation and Chlorination of NOM and Algae in Water Treatment – A Review. *International Journal of Environmental Monitoring and Analysis.* Special Issue: Environmental Science and Treatment Technology. Vol. 2, No. 6-1, 2014, pp. 23-34.
doi: 10.11648/j.ijema.s.2014020601.14

Abstract: Due to health concerns of natural organic matter (NOM) and algae presence in surface water and difficulties encountered in their removal in the water treatment, this paper reviews coagulation and chlorination processes which are largely used in water treatment technology. In the conventional water treatment, coagulation and slow filtration treatments have better efficiency to reduce the NOM in water especially for the hydrophobic portion than the hydrophilic one. However, the pre-chlorination treatment for raw water has been proved to increase the dissolved organic carbon concentration due to the lysis of algae cells and disinfection by-products formation. The impact of water treatment processes on disinfection by-products formation remains complex and variable, as demonstrated by recent literature. It is concluded that no pre-, no inter-, only post-chlorination preceded by optimised coagulation for NOM and algae removal is the best available technology for the conventional water treatment which would be reinforced by at least adsorption on powdered activated carbon or nanofiltration in the short terms. Finally, the conventional water treatment will not remain a viable solution for drinking water from source waters containing NOM as their quality deteriorates and water quality standards become more difficult to achieve.

Keywords: Coagulation/Chlorination, Natural Organic Matter (NOM), Algae; Disinfection by-Products (DBPs), Water Treatment

1. Introduction

Coagulation and disinfection are the main units in the drinking water treatment technology in both developing and industrialised countries [1,2]. Coagulation is expected to eliminate particles and colloids via a coagulant, like alum or ferric chloride, while disinfection is applied to inactivate pathogens by disinfectants like aqueous chlorine ($HOCl/OCl^-$). During disinfection, chlorine can react with natural organic matter (NOM) and bromide in raw water to produce halogenated disinfection by-products (DBPs) [3-6]. Many halogenated DBPs have been verified to possess potential genotoxicity and carcinogenicity to human beings [7-11]. Therefore, improving removal efficiency of NOM through "enhanced coagulation", which is usually operated by decreasing pH to ~ 6 and/or increasing coagulant dosage [11], has received great attention from the environmental community [12]. The United States Environmental Protection Agency (USEPA) specifies the required NOM removal in terms of total organic carbon (TOC) by enhanced coagulation under different TOC and alkalinity levels [13]. For instance, for raw waters with alkalinity levels of > 60-120 mg L^{-1} as $CaCO_3$ and with dissolved organic carbon (DOC) levels of > 4.0–8.0 mg L^{-1} as C, the required TOC removal is 35.0% [13].

Effects of coagulation or enhanced coagulation on DBPs formation during chlorination have been largely studied [14]. In drinking water treatment plants, trihalomethanes (THMs) are a common parameter to evaluate the effectiveness of