

Effect of natural organic compounds on the removal of organic carbon in coagulation and flocculation processes

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Abstract Natural organic matter (NOM) in water contains organic compounds that are both hydrophobic and hydrophilic with a wide range of molecular weights. It is composed of non-homogeneous organic compounds such as humic substances, amino acids, sugars, aliphatic and aromatic acids, and other chemical synthetic organic matters. NOM in water is a major concern not only because of its contribution to the formation of disinfection by-products (DBPs) and taste and odor, but also its influence on the demand for coagulants and disinfectants, the removal efficiency of water treatment processes, etc.

This research aims at identifying the influence of NOM in coagulation and flocculation processes in order to optimize the coagulation and flocculation conditions. In this study, pretreated pond water was used as the source water. It was observed from the experimental results that:

- (1) The optimum pH for coagulation to remove NOM is around 7.
- (2) The optimum alum dose at this pH can vary from 125–1,225 mg l⁻¹ when the TOC is increased from 4 to 25 mg l⁻¹.
- (3) The presence of secondary compounds such as Ca²⁺, Mg²⁺ divalent cations had no significant effect on the removal of organic matter.
- (4) The presence of clay increased the organic removal by 15%.
- (5) The organic compound with higher molecular weight has higher removal affinity in coagulation process.
- (6) Floc size and settling velocity of floc and sludge production all increased with the increase in NOM concentration. From the results of Capillary Suction Time (CST) tests, the floc formed with lower TOC readily released the water to make the dewatering process easier.
- (7) The organic removal efficiency was significantly different for natural water containing non-homogeneous organic compounds compared to the synthetic water containing humic acid only (homogeneous organic matter).

For example, the NOM removal efficiency was 80% for the synthetic water containing humic acid with TOC of 7 mg l⁻¹ at pH 7; but the NOM removal for the pretreated pond water was 60%.

Keywords Coagulation; flocculation; natural organic matter (NOM); total organic carbon (TOC)

Introduction

Removal of organic contaminants from surface water becomes one of great importance in water treatment process because of health, aesthetic and operational problems. Types of organic contaminants that are present in natural water are shown in Figure 1. The three major components are natural organic matter (NOM), synthetic organic chemicals and others. The NOM is divided into four subgroups namely: humic substances, microbial exudates and dissolved organics from plant tissues and animal wastes. The higher molecular weight fractions of NOM such as hydrophobic acids (HPOA – e.g. humic acids and fulvic acids) and hydrophobic neutrals (HPON) can be extracted by XAD-8 resins and the lower molecular weight fractions such as transphilic acids (TPHA) and transphilic neutrals (TPHN) can be extracted by XAD-4 resins. The filtrate from these two resins will be of hydrophilic NOM (HPI).