NST 1_Effect of Preoxidant on The Changing of Low Molecular Weight of Natural Organic Matter

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Effect of Preoxidant on The Changing of Low Molecular Weight of Natural Organic Matter

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Abstract

Natural organic matter (NOM) is a complex organic compound that have been exist water sources. The presence of NOM in water, especially the aromatic compound, could trigger the formation of disinfectant by-products (DBPs). Low molecular weight of NOM, one of the characterisctic of organic based on their molecular weight, is quite difficult to be removed in coagulation process. Preoxidation is one the effort to reduce carbon structure of organic matter and it has been known as pretreatment before coagulation process and advanced ones. The objective of this research is to track the changing of low molecular weight of NOM through preoxidation with pottasium permanganaate ($KMnO_4$). Low molecular weight of NOM is presented by synapic acid. Detection of NOM properties was observed quantitatively by using total organic carbon (TOC) and qualitatively by using fourier transform infrared (FTIR). The results shown that KMnO4 could increase the concentration of TOC. According to FTIR analysis, the increasing of TOC concentration is proably due to the transformation of low organic matter into lower organic compound. FTIR showed the increasing of % transmitance of all functional groups of organic matter.

Keywords: preoxidation, total organic carbon, and low molecular weight.

INTRODUCTION

The concentration and reactivity of the NOM present in any given water source can be influenced by the characteristics of the watershed, seasonal changes in temperature and precipitation, long term climatic changes, and human and animal activities (Delpla et al., 2009). Investigations have been conducted to explore the components and characteristics of organic matter to determine its behavior in water and how to effectively remove it during treatment (Edzwald & Tobiason, 2011). NOM should be removed in water because NOM will cause some problems, including the formation of disinfectant by-products (DBPs) as mostly problems (Bond et al., 2012). Molecular weight is one of the classification to determine the properties of natural organic matter (NOM). According to its molecular weight, NOM has been classified into high molecular weigh (HMW), intermediate moleculaer weigh (IMW), and low molecular weight (LMW) (Sillanpaa, 2015). HMW is indicated as main precusrsors for the formation of DBPs (Hidayah et al., 2012), however LMW could be a precursors as well (Bond et al., 2012).

Experimental studies have been conducted in order to know the behaviour, pattern and characteristic of NOM before and after chlorination (Bond et al., 2012). Recently, preoxidation is widely used to destroy the organic matter coating and various kind of preoxidants have been developed, such as permanganaate, chlorine, persulfate, peroxide, etc. (Xie et al., 2016; Hidayah and Cahyonugroho, 2019). Preoxidant has different capability to oxidize organic matter, even to destroy its organic coating of HMW, IMW, an LMW. Therefore, this study aimed to observe the

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effect of preoxidant permanganaate and prechlorination chlorine in the changing of characteristic low molecular weight organic compound.

METHODS

Batch jartest was used to conduct experimental study. Artificial sampel sinapic acid ($C_{11}H_{12}O_5$) 10 mg/L with molecular weight 224.21 g/mol was used as main material. Permanganaate ($KMnO_4$) with doses 0.5; 1; 1.5; 2 mg/L and chlorine ($CaOCl_2$) with doses 20; 30; 40; 50 mg/L was used as preoxidant and prechlorination to oxidize sinapic acid. Raw sampel and treated sample was filtered through 0.45 um filter paper before further measurement. Sample was measured for TOC and UV_{254} to know organic concentration and FTIR was used to know the changing of functional group of organic sinapic acid (APHA, 2012).

RESULT AND DISCUSSION

The results shows that preoxidant permanganaate and prechlorination could change the quantity of organic matter. Figure 1 shows that TOC value increase after preoxidation, while UV_{254} decrase. It indicated that organic matter which may contain aromatic compound, even low molecular weight, was oxidized and transformed into different compound. According to UV_{254} analysis, sinapic acid may contain aromatic compound. Figure 2 also shows the similar trend with Figure 1.

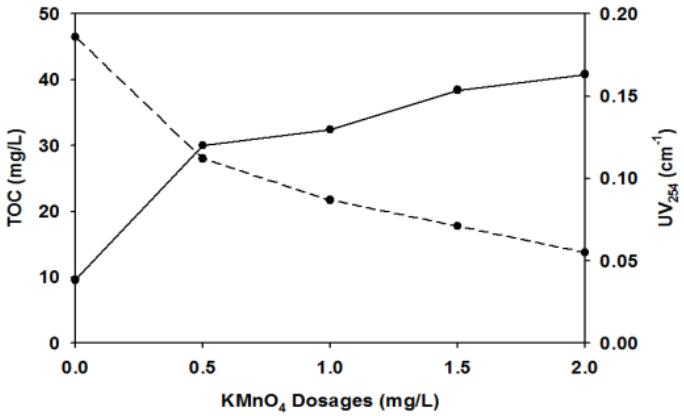

Figure 1. Effect of preoxidant permanganaate to organic matter concentration

Figure 2 describes that prechlorination will oxidize organic matter an transformed it into different compound as well. Comparison between those two oxidation process, it seems that chlorine or prechlorination has stronger power to change the molecular weight of organic matter. Chlorine has a higher electrovolt number (E^o) about 1.482 V than permanganaate (E^o=0.60 V) (Xie et al., 2016). Eventhough chlorine is a strong oxidant, chlorine usage as disinfectant or as preoxidant could increase the formation of disinfectant by-products in treated water (Hidayah et al., 2017).

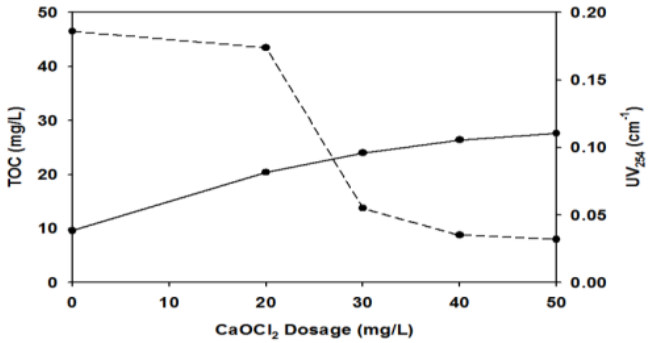

Figure 2. Effect of prechclorination te to organic matter concentration

According to FTIR, this study could reveal the changing of organic matter bonding, which is showed through its functional groups changing. Figure 3 shows the functional group of sinapic acid, including alcohol O-H stretching at wavelenght 3439 cm^{-1} (3% transmittance), phenol H bonding at wavelenght 2064 cm^{-1} (56% transmittance), alkena double bond C=C stretching at wavelenght 1634 cm^{-1} (12% transmittance). After preoxidation and prechlorination, it shows the changing of organic matter structure at different wavelength as presented through transmittance percentage. Based on the FTIR, it indicated that prechlorination gave a higher percentage transmittance than preoxidation permanganaate. All of functional groups has been removed slightly.

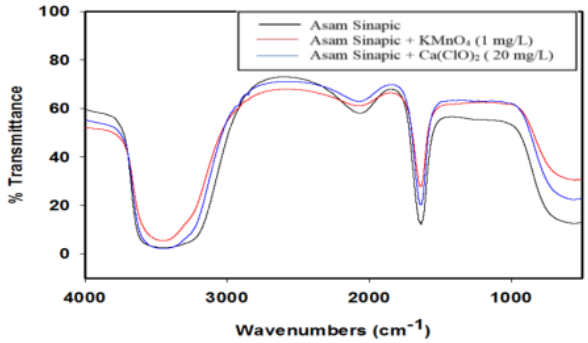

Figure 3. The changing of sinapic acid functional groupd through preoxidation and prechlorination

CONCLUSION

Preoxidation an prechlorination could change the characteristic of organic matter, especially low molecular weight aromatic compound. This study reveal that chlorination with chlorine has a higher oxidaztion, hence could give a significant changing of organic matter characteristic than preoxidation with permanganaate. However, effect of those oxidant could not generate new functional groups in treated water.

ACKNOWLEDGMENT

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