A Study on the Characteristics of Natural Organic Matter and Disinfection By-Product Formation in the Juam Reservoir

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Abstract

This study aims to identify the relationship between characteristics of aqueous organic matter and chlorination by-products formation potential according to temporal effect of Juam reservoir in Sun-Choen.

The molecular weight distribution and chemical composition of precursors and their relationship with disinfection by-products(DBPs) were investigated.

Most of the organic matters was responsible for the major DBP precursors in the raw water are small compounds with a molecular weight less than 1KDa.

Aromatic contents determined by SUVA correlated well with DBPs, THMs, and HAAs formation. Especially, THMFP/DOC showed better correlation with SUVA than HAAFP/DOC and DBPFP/DOC with SUVA in Juam reservoir.

Therefore, effective removal of small molecules or hydrophobic organic matter prior to disinfection process will significantly reduce the DBP concentration in the finished water.

Introduction

Natural organic matter(NOM) has become a major regulatory concern due to the formation of disinfection by-products. The source and occurrence of NOM should be evaluated to determine if NOM could be effectively excluded from the raw water source

Most drinking water treatment plants have mainly focused on turbidity measurement as an indicator for process evaluation. However, most serious problems in front of us are DBPs such as HAAs, THMs produced by NOM. this organic precursor's behavior through treatment processes cannot be evaluated in terms of turbidity.

The objective of this study was to make suggestions concerning processes evaluation techniques with respect to NOM removal using existing NOM characterization methods, which included the determinations of NOM MW distribution, NOM structural constituents. NOM charge density, and NOM reactivity for HAA formation.

Materials and Method

3.1 NOM characterization

General characters of NOM for every tested sample were analyzed in terms of DOC (Dohrmann, DC-180), UVA254 (Shimadzu, UV/VIS-160-A).

All samples were pre-filtered with a 0.45 ㎛ filter (MFS, MFS-13) prior to measurement. Specific UVA (SUVA) was defined as (UVA254/DOC*100), representing an index of aromaticity of NOM

3.2 NOM Size Analysis

NOM RMM distribution was measured by SEC-HPLC method with HPLC(Waters 510), autosampler (Waters 717 plus), UV detector and protein pack column (Waters, Protein Pak 125). Polystyrene sulfonates(200, 1800, 4600, 8000, and 18000 daltons, Inc.) standards were used to provide relationship between retention time (RT) and RMM prior to every measurement.

3.1.3 NOM Structure Analysis

The fractions of hydrophobic, transphilic, and hydrophilic NOM were determined by XAD-8 followed by XAD-4 adsorption tests; hydrophobic and transphilic NOM are adsorbed on the XAD-8 and XAD-4 resins.

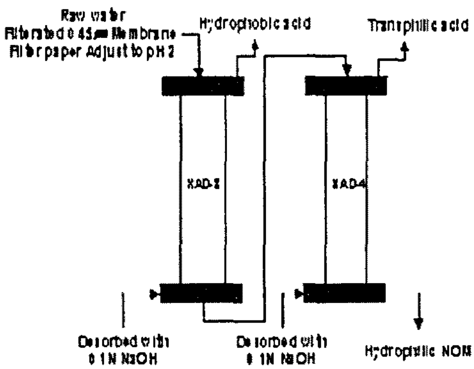

Fig. 1. Schematic diagram of XAD-8/4 resin.

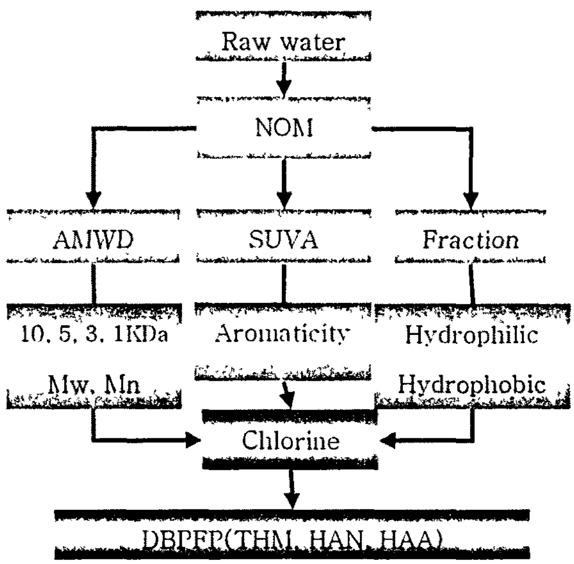

Fig. 2. Flow Chart of experimental fractionation procedures.

Results and Discussion

HAA reactivities of non-fractionated and fractionated (by XAD-8/4 resins) NOM for raw and treated water samples are depicted in Fig. 3.

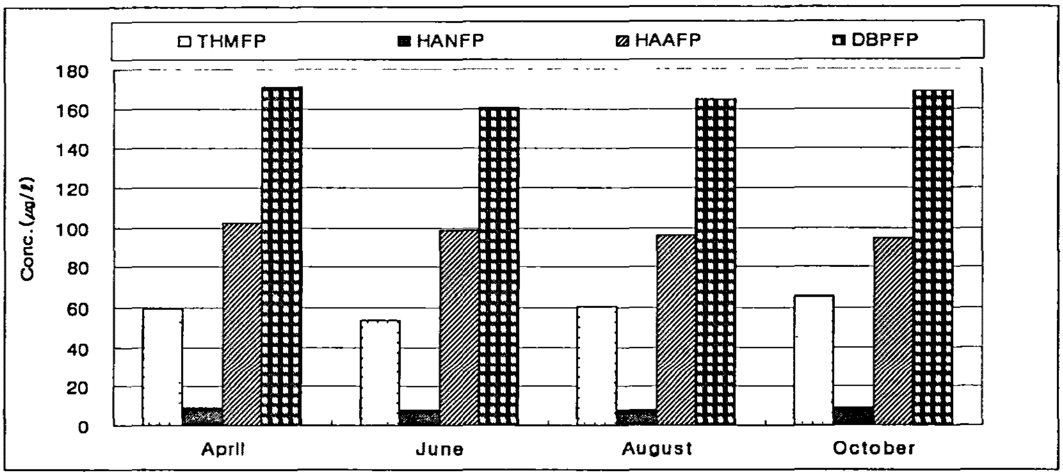

Fig. 3. The variation of DBPs formation potential in juam reservioir.

Hydrophilic NOM exhibited the high HAA reactivity (HAAFP/DOC; μg/mg C) compared to hydrophobic NOM fractions for the raw water sample.(Fig. 4)
Most of the organic matters was responsible for the major DBP precursors in the raw water are small compounds with a molecular weight less than 1KDa.(Fig.5)

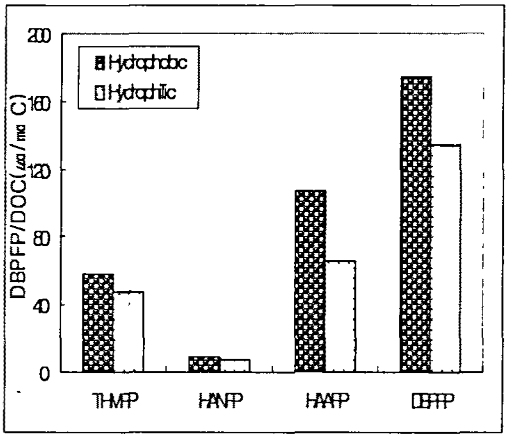

Fig. 4. The DBPFPs/DOC for each fraction.

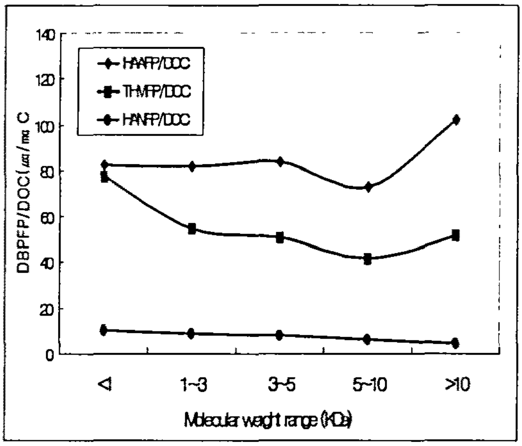

Fig. 4. The variation of DBPFP/DOC for each molecular weight.

Aromatic contents determined by SUVA correlated well with DBPs, THMs, and HAAs formation. Especially, THMFP/DOC showed better correlation with SUVA than HAAFP/DOC and DBPFP/DOC with SUVA in Juam reservoir.

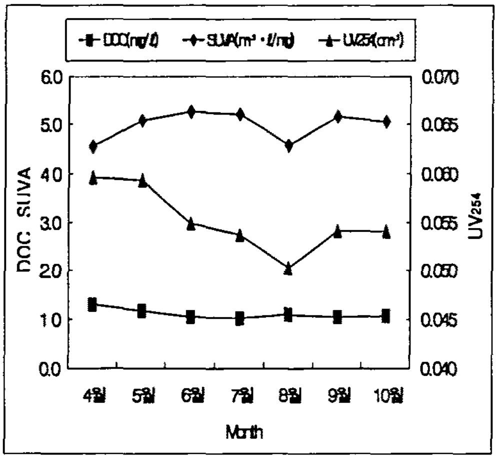

Fig. 5. The monthly variation of SUVA.

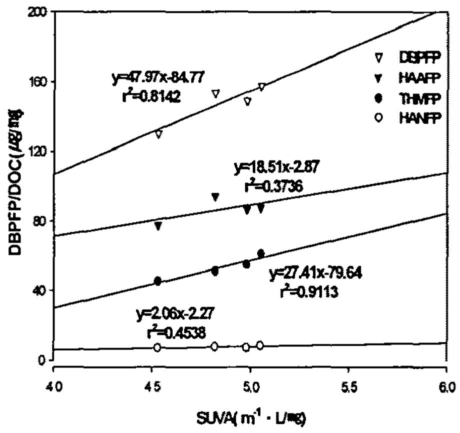

Fig. 6. The relationship between the SUVA and DBPFP/DOC of the Juam reservoir.

Conclusion

The conclusions are as following;

1) Most of the organic matters was responsible for the major DBP precursors in the raw water are small compounds with a molecular weight less than 1KDa.
2) The SUVA was correlated well with DBPs, THMs, and HAAs formation. Especially, THMFP/DOC showed better correlation with SUVA than HAAFP/DOC and DBPFP/DOC with SUVA in Juam reservoir.

Acknowledgements

This work was supported by GwangJu Regional Environmental Technology Development Center.

Reference

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