Using fluorescence-PARAFAC analysis for assessing disinfection by-product formation and removal efficiency in synthetic waters subjected to adsorptive precursor removal

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Introduction
The complex and diverse characteristics of organic molecules that constitute natural organic matter (NOM) and its potential to form disinfection by-products (DBPs) during water treatment pose major challenges to DBP control. Parallel factor analysis (PARAFAC) was used to characterize components of NOM removed by several adsorptive treatments and the relationship to DBP formation.

Methodology
Fluorescence excitation emission matrices (EEMs), parallel factor analysis (PARAFAC) and free chlorine DBP formation potential (DBPfp) tests were used to investigate the organic matter and DBP formation characteristics of; raw, alum enhanced-coagulated (EC), and EC followed by adsorbent treated synthetic waters. Synthetic water samples were prepared with Suwannee River NOM isolate at dissolved organic carbon (DOC) concentrations of approximately 3-12 mg/L, with halides, carbonate, and calcium and magnesium salts added to mimic natural waters. Adsorbents investigated were powered activated carbon (PAC), MIEX® resin, granular activated carbon (GAC) and 0.1% silver impregnated activated carbon (SIAC). Under standard jar test conditions MIEX® and PAC were investigated, at a dose of 10 ml/L and 60 mg/L respectively. GAC and SIAC were assessed using the Rapid Small Scale Column Test (RSSCT) at an empty bed contact time (EBCT) of 10 minutes. The DBPfp test was performed using standard THMfp methodology (Clesceri, et al., 1998) with a 3 day, rather than 7 day, reaction time.

Results
- Strong correlations were found between the maximum intensity of humic-like fluorophores and the following DBPs: trichloromethane (TCM), bromodichloromethane (BDCM), dichloroacetonitrile (DCAN), chloral hydrate (CH) and 1,1,1-trichloropropanone (111-TCP).

- PARAFAC component (1 & 2) correlations with DBPs were stronger than correlations to DOC or SUVA (higher R2 adj.)

Conclusion
These results indicate that the fluorescence-PARAFAC approach could provide a robust analytical tool for DBP formation prediction, and for evaluating the removal of organic matter fractions relevant to DBP formation during water treatment.