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Estimation of dissolved organic carbon in source and treated water to ascertain treatment efficiency and water safety with respect to trihalomethanes

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The use of chlorine as a disinfectant, although essential for pathogen control, leads to the halogenation of organic matter present in source water and produces trihalomethanes (THMs) and halo acetic acids¹ which have been identified as mutagenic and carcinogenic agents.² For this reason, the United States Environmental Protection Agency currently regulates THMs and halo acetic acids in drinking water.³ Therefore, it is necessary to optimise plant conditions to minimize dissolved organic carbon (DOC) content in drinking water. The objectives of this study are to find a reliable method to quantify the DOC in natural water sources, identify the characteristics of DOC in source and treated water with respect to potential of THM formation and water safety and to measure the efficiency of water treatment process, considering the removal of DOC from treated drinking water.

To quantify the DOC in natural water sources, standard solutions of humic substances were prepared using the commercially available humic acid powder (Sigma Aldridge brand) and a graph was obtained by scanning the different standard samples, against a series of wave lengths from 190 to 1100 nm. Thereafter, the wavelength range was narrowed down (230 nm to 630 nm), as the absorbance at the other wavelengths did not provide considerable variations. The concentration of the organic matter in the sample can be estimated by comparison of the unknown with results obtained from the standard graph. To identify the characteristics of DOC in water with respect to THM formation and water safety, specific ultraviolet absorbance (SUVA) was calculated. In addition, graphs were constructed by scanning the raw water samples and treated water samples from the water treatment plants on the same day for comparison to check whether concentrations of DOC is decreased or increased during the water treatment process.

This study reports on the development of a method to measure the concentration of DOC in water using

DR 5000 spectrophotometer by scanning the water samples against various wavelengths in the presence of standard DOC solutions. Once the concentration is estimated, SUVA can be used to evaluate the water safety with respect to THM formation. In a treatment plant, SUVA values of raw water and the treated water taken simultaneously can be used to assess the efficiency of the treatment process. According to the study, treated water SUVA values were generally lower than 2 L/mg-m. Therefore, as per the USEPA drinking water guidance on disinfection by-products, our potable water indicates a high fraction of hydrophilic non-humic matter with low UV absorbance, a low chlorine demand and low THM formation potential. Therefore, water can be assumed as safe with regard to formation of THM when chlorinated. However few water sources were contaminated with DOC, showing the highest value of 7.2 at Peradeniya University Water Treatment Plant where the Mahaweli River is the source of raw water. Furthermore, it can be concluded that water treatment plants operated by National Water Supply and Drainage Board at Kandy South Region are effective in DOC removal by the water treatment process.

Keywords

Natural Organic Matter (NOM), Dissolved Organic Matter (DOM), Trihalomethane (THM), Absorbance, Specific Ultra Violet Absorbance (SUVA)

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References

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