

Impact of ozone on disinfection by-products: comparison of three surface waters with differing character

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ABSTRACT

The provision of microbiologically safe drinking water is still commonly achieved by chlorination in most water treatment plants. The discovery of chloroform and many other halogenated organic compounds in drinking water as a result of chlorination has sparked public concern and the introduction of stringent regulations on maximum contaminant levels of these disinfection by-products in treated water. Water utilities overseas, and possibly Australian utilities in the future, are being compelled to adopt alternative water treatment regimes in order to reduce the level of these chlorinated disinfection by-products. The use of ozone in water treatment for the management of various water quality issues including disinfection by-product control has increased in popularity and is becoming a widespread practice.

Ozone is shown to react with natural organic matter present in water to form lower molecular weight oxygenated compounds such as aldehydes, ketoacids and carboxylic acids. Analytical procedures for the determination of these classes of ozonation by-products were optimised and validated in this work. Bench scale ozonation experiments were performed on waters collected from the Myponga, Hope Valley and Tod Reservoirs. Doses of 0.5, 1, 2, 3 and 5mg of ozone per mg of dissolved organic carbon content were applied and aldehydes, ketoacids and carboxylic acids were found to generally increase with increasing ozone dose. The formation of these compounds was shown to depend on the organic and inorganic character of the water. Bacterial regrowth potentials were determined and the biodegradability of the organic matter was shown to increase in ozonated waters.

Raw waters and their ozonated samples were subsequently chlorinated to determine the effects of pre-ozonation on the formation potentials of trihalomethanes, chloroacetic acids and other chlorinated disinfection by-products. The effects of ozone dose on chlorinated byproduct formation following chlorination differed in each water, illustrating the dependence on source water characteristics. The character of the organic matter and high bromide levels are shown to significantly contribute to the outcome of halogenated by-product formation.

Finally, water samples were collected at each stage of the water treatment process from the Edenhope water treatment plant in Western Victoria, Australia. The plant utilises advanced treatment technologies such as ozonation and biologically activated carbon. Aldehydes, ketoacids, chlorinated disinfection by-products and other water quality parameters were monitored throughout the treatment process and the observed distribution of the various products is discussed.