

Watertec Engineering Pty Ltd

Information Sheet

Disinfection with Ozone Comparison with Chlorine

The disinfection action of ozone has been recognized for well over a century, and it is now widely used in Europe in the purification of water for human consumption.

Although the relative efficiencies of ozone and chlorine in water disinfection have not been extensively studied, there is no evidence in favour of chlorine being the more efficient of the two agents. In fact, ozone seems to be superior to chlorine in terms of all micro-organisms investigated.

Bacteria – In a comparison of the efficiency of chlorine and ozone for the inactivation of Escherichia coli, it was found that exposure to $0.4 - .05 \text{ mg O}_3 \text{ L}^{-1}$ for one minute gave less than 1% survival of E-coli whilst $0.3 \text{ mg Cl}_2 \text{ L}^{-1}$ needed 10 minutes for a similar result. It is shown E-coli is sensitive to ozone at concentration levels as low as 0.1 mg L^{-1} . All other bacteria tested (including mycobacteria) which are fairly resistant to chlorine, requiring hours of contact time were found to be sensitive to ozone, requiring but a few minutes treatment of $0.1 - 0.2 \text{ mg L}^{-1}$ ozone for virtually complete inactivation.

Viruses - Viruses are known to be much more resistant to chlorine than bacteria. Early work showed that exposure to chlorine residual of $0.5 - 1.0 \text{ mg L}^{-1}$ for 1.5 – 3 hours was needed for inactivation of poliovirus whilst at a concentration of ozone $0.045 - 0.45 \text{ mg L}^{-1}$ gave the same results after only 2 minutes. The short time required for poliovirus inactivation by ozone has been confirmed and extended to a variety of other viruses including storatitis and encephalomyocarditis viruses and Coxsackie virus. Indeed, the World Health Organisation recommends that treatment of water for the removal of viruses should involve exposure to a free available chlorine level of 0.5 mg L^{-1} maintained for 30 – 60 minutes or an ozone residual of $0.2 - 0.4 \text{ mg L}^{-1}$ maintained for 4 minutes.

Bacterial Spores – Chlorine is virtually ineffective against bacterial spores, six hours treatment with $100 \text{ mg Cl}_2 \text{ L}^{-1}$ only just preventing the swelling and germination of the spores of *Clostridium bifermantens*, *Bacillus subtilis* and *B. cereus*. However, exposure of the spores *B. cereus* and *B. megaterium* to ozone at a concentration of 2.29 mg L^{-1} results in inactivation of the spores within a few minutes.

Amoebic cysts – The cysts of *Entamoeba histolytica* (the pathogen responsible of amoebic dysentery) are fairly resistant to chlorine, requiring treatment with $0.5 - 1.0 \text{ mg Cl}_2 \text{ L}^{-1}$ for 30 – 120 minutes, for inactivation. Here again, ozone proves to be the more efficient disinfectant requiring a contact time of 2 - 4 minutes with 0.3 mg O_3 (residual) L^{-1} for inactivation. Using a higher concentration of ozone (0.7 mg L^{-1}), it was found that over 96% of cysts were inactivated within one minute and more than 99% in five minutes.