

## Chlorine vs. Ozone

Ozone is a stronger disinfectant than chlorine dioxide as a disinfectant but both are able to inactivate cryptosporidium. However, ozone will form bromates, a carcinogen, in waters containing bromide. Currently, research is under way to use chlorine dioxide to reduce bromate formation in water plants using ozone. The USEPA MCL for bromates is currently set at 10 ug/l and will likely be lowered in the future to 5 ug/l. Chlorine dioxide is able to inactivate cryptosporidium without forming the bromates. The ozone costs of installation, operation, and maintenance are higher than chlorine dioxide. Pretreatment is required for high organic loads when using ozone but is not required for chlorine dioxide. Operational control is difficult with ozone because of its high reactivity with organics in water and short-lived residual. Residual measurement difficult at higher pH levels for ozone. Sometimes TTHMs are increased using ozone but chlorine dioxide can prevent TTHMs and with sufficient dose can reduce TTHMs.

In comparing disinfection efficiency, Ozone is effective 25 x more than Hypochlorous acid (HOCl), 2,500 x more than Hypochlorite (OCl) and 5,000 x more than Chloramine (NH<sub>2</sub>Cl). This is measured by comparison of CT constants - the Concentration & Time needed to kill 99.9% of all microorganisms. Chlorine reacts with organic materials to form Chlorine containing organics such as Chloroform, Carbon Tetrachloride, Chloromethane and others, generally known as Trihalomethanes (THMs).

Ozone reacts with Organics to break them down into simpler compounds. These (e.g. Oxalic Acid) do not readily break down all the way to Carbon Dioxide with just ozone, but if subjected to bacterial degradation on activated charcoal, they will be removed. This water can be later treated with a low level of Chlorine say 0.2 - 0.3 ppm to maintain sanitation in the distribution system. This way no THMs will be formed. This has been implicated as carcinogens in the development of Kidney, Bladder and Colon Cancer. The regulatory authorities are again decreasing the levels of THMs that can be in Community water systems. At the present time the limit is 0.05 ppm. Based on the scientific research, the level will be most likely soon lowered to 0.01 pips.

Ozone does not react significantly with THMs as they are more resistant to oxidation - it takes a very long time to achieve full oxidation. Some THMs are removed as a result of physical sparging by the aeration action of the ozone/air mixture.