Osorno Enterprises Inc.

Mission:

The Osorno pledge is to provide affordable environmental solutions for the sustainable development of the nations of our world.

976 Elgin Ave.
Winnipeg MB R3E 1B4

Water Oxidation and Disinfection With Chlorine Dioxide

Chlorine dioxide is applied in domestic and industrial water treatment for the following reasons:

a) to eliminate bacteria, protozoans, and viruses;
b) to reduce unpleasant odours or flavours;
c) to oxidize non-organic and organic compounds;
d) to oxidize and remove certain metals;
e) unlike ozone or UV, chlorine dioxide has a measurable residual.

Chlorine Dioxide Water Disinfection

- First used at the beginning of 20th century **(Osten Belgium)**
- Implemented for water disinfection in the 1950s
- Can be used as a primary and secondary disinfectant because it **carries a measurable and stable residual**
- Used for: **colour & turbidity enhancement** in primary disinfection, control of THM and HAA in primary disinfection, **taste and odour** control (control of phenolic compounds), and for **iron, manganese, and hydrogen sulphide** removal (1.2 mg ClO_2/mg Fe, 2.5 mg ClO_2/mg Mn, 5.8 mg ClO_2/ mg H_2S).

Chlorine Dioxide Water Disinfection

Strong Oxidant = Disinfectant

Measurable Quantity: ORP

$ClO^- \Rightarrow\Rightarrow Cl^-$ + 900 mV

$ClO_2 \Rightarrow ClO_2^-$ + 954 mV

Source: CRC Handbook of Chemistry and Physics, 58th ed., p. D-141

Chlorine Dioxide Decomposition

Table 4-2. Surface Water Chlorine Dioxide Demand Study Results

Dose (mg/L)	Time (min)	ClO_2 (mg/L)	ClO_2^- (mg/L)	ClO_3^- (mg/L)
1.4	3	0.47	0.76	0.05
	10	0.30	0.98	0.06
	20	0.23	1.08	0.07
	40	0.16	1.11	0.07
	60	0.11	1.11	0.07

Source: DeMers and Renner, 1992.
Note: *Raw water sample, 23°C, 8.5 pH.

Chlorine Dioxide Features

- The hydrolysis rate in water is 10 million times less than the hydrolysis rate of chlorine: **chlorine dioxide provides long-lasting protection.**
- It is efficient at low concentrations: **less chemicals in the drinking water and at a lower cost.**
- Does not react with ammonia: **fewer byproducts and consequently better taste.**
- pH independent **(at higher pH, efficiency against giardia, cryptosporidium, and viruses increases).**
- Chlorine dioxide is never stored as such, but rather generated by automatic equipment on demand: **operational safety and ease of operation.**

Chlorine Dioxide Features

- Does not form chlorine or chlorinated byproducts: **no THM or TAA formation.**

- Only two disinfection by-products: **chlorite 70%** of injected chlorine dioxide, and **chlorate is the remaining 30%**.

Disinfection Power of Chlorine Dioxide

	Chlorine Dioxide 0.40 mg/L	Hypochlorite 1.00 mg/L
Bacteria	Yes	Yes
Protozoa	Yes	Largely no
Virus	Yes	Largely no

Oxidation Power of Chlorine Dioxide Examples

raw 0.8 mg/L 1.6 mg/L 2.4 mg/L