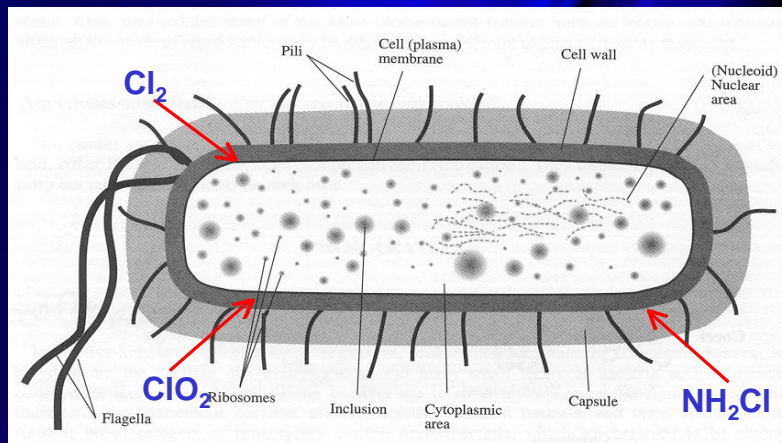


Chemical Disinfection



Structure of typical bacteria

Cryptosporidium parvum



- Protozoan Parasite
- 4-6 μm diameter
- Oocysts and 4 Sporozoites
- Human Pathogen
- Gastroenteritis
- AIDS
- Water transmission
- Oocysts resistant to conventional chemical disinfectants

Surface Water Disinfection (U.S. Environmental Protection Agency)

Surface Water Treatment Rule (SWTR)

- Implemented June 1993
- Has been adapted to several jurisdictions in Canada
- Requires surface water treatment facilities to achieve:
 - \$ 99.9% (3 log) removal/inactivation of *Giardia lamblia*
 - \$ 99.99% (4 log) removal/inactivation of viruses

SWTR (cont'd)

- Assume well operated plants that practice coag/floc./filtration achieve:
 - 2.0 log removal/inactivation of *Giardia*
 - 2.0 log removal/inactivation of viruses

Disinfection Must Therefore Supply:

1.0 log removal/inactivation of **Giardia**

2.0 log removal/inactivation of **viruses**

- Impractical and costly for WTPs to monitor for Giardia
- US EPA proposed "CT" concept to assure attainment of primary disinfection at minimal cost

$$C(\text{mg/L}) \times T(\text{min}) = \text{CT} (\text{mg/L}) \cdot \text{min}$$

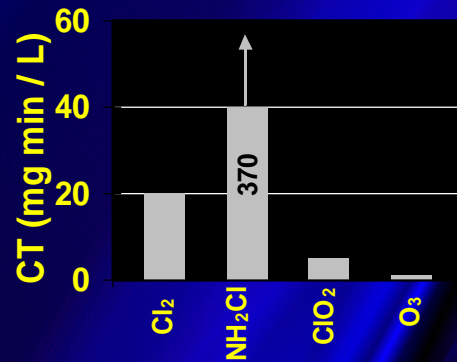
US EPA has prepared CT tables for ozone, chlorine dioxide, chlorine and chloramines at various pH, temp., to obtain a desired log reduction/inactivation.

CT values (mg/L · min) for **90% (1 log) Inactivation of Giardia**

	pH	Water Temp			
		0.5 C	5 C	10 C	15 C
Free Cl ₂	6	49	35	26	19
	7	70	50	37	28
	8	101	72	54	36
	9	146	104	78	59
Chloramines	6-9	1300	730	620	500
Chlorine Dioxide	6-9	21	8.4	7.4	6.3
Ozone	6-9	0.97	0.63	0.48	0.32

Disinfectant Strength

CT required for 1-log *Giardia* inactivation
(pH 7, 20°C)



If Time "T" = 15 min

Conc. "C" req'd:

ClO₂ 0.3 mg/L

Cl₂ 1.3 mg/L

NH₂Cl 25 mg/L

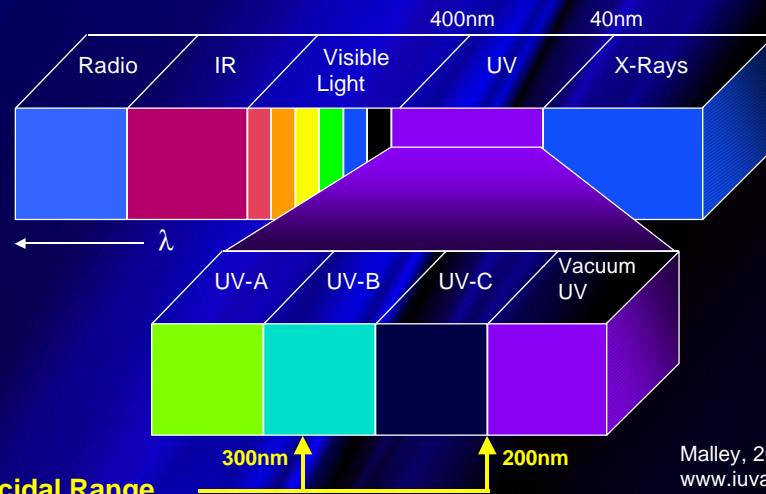
O₃ 0.02 mg/L

**"C" is often the
residual at effluent of
contact basin.**

UV Disinfection

- UV Dose (or fluence) is related to:
 - Hydraulics of reactor (i.e., amount of exposure time)
 - Lamp type
 - Low pressure
 - Medium pressure
 - Water quality
 - Fouling can be caused by inorganic material, turbidity or organic matter

UV Light Spectrum



Malley, 2000
www.iuva.org