

# Basic Science of MMS

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## Definition of terms, important to know:

- ▶ **MMS stands for "Master Mineral Solution"** this is the name of a mineral solution used to help un-well people recover their health.
- ▶ **MMS** is a 22.4% solution of 80% sodium chlorite powder or flakes ( $\text{NaClO}_2$ ) in water.
- ▶ **MMS1** is activated MMS. It is MMS plus an activator; when the two are mixed together they produce chlorine dioxide ( $\text{ClO}_2$ ).

## What this document is about

The purpose of this document is to show basic scientific proofs and logic of MMS. Scientific references are given where ever possible. MMS is not a bleach, MMS is an oxidizer that kills the pathogens of many different diseases. The chemical of MMS has been used to kill pathogens for 100 years, and to purify water. This paper gives the chemical formula of MMS, explains how it works and explains the simplicity of making it. The basics of oxidation is explained, as that is necessary to understand how MMS works. MMS kills viruses in a different manner than oxidation. That too is explained. Information is also given on MMS2.

## MMS are the initials for Master Mineral Solution

This solution consists mostly of water with chlorine dioxide as a very weak solution - along with regular table salt and several other trace neutral chemicals, such as sodium hydroxide, sodium carbonate, and sodium bicarbonate - none of which are considered poisonous. The trace chemicals are neutralized by the acid that activates the chlorine dioxide.

### **Chemical Structure of MMS**

It starts off as a 22.4% solution of sodium chlorite, made by adding sodium chlorite to water. The sodium chlorite can be bought from chemical companies already in water, or it can be bought as a powder. However, it is with the sodium chlorite from which chlorine dioxide is generated and diluted in water, thereby making MMS1. The chemical formula of sodium chlorite is  $\text{NaClO}_2$ . Sodium chlorite is a very stable chemical. It has been stored in airtight containers for more than 20 years, and solutions of sodium chlorite are fully usable after being stored for 5 years in a closet out of the light.

### **Chemical formula of chlorine dioxide**

Chlorine dioxide is the active ingredient in MMS after it is activated by acid (see below). The Chemical formula of chlorine dioxide is  $\text{ClO}_2$ . That formula shows that there is one atom of chlorine (Cl) and 2 atoms of oxygen ( $\text{O}_2$ ) in a molecule of chlorine dioxide. These 3 atoms are held together by electrons to form the molecule of chlorine dioxide. Chlorine dioxide is a gas, and MMS are in most cases used as a gas dissolved in water. The  $\text{ClO}_2$  gas can be used at times directly on the skin, or even in the mouth. Chlorine dioxide is one of the most effective killers of pathogens such as bacteria, molds, fungus, viruses, bio-film and other disease-causing microorganisms, which includes the vast majority diseases of mankind. [1]

### **Making chlorine dioxide**

Chlorine dioxide is generated from sodium chlorite, which is  $\text{NaClO}_2$ . Sodium chlorite has a pH of 13 which means it is highly alkaline. When citric acid or most any other acid is added, they bring that pH down towards the acid condition, causing the sodium chlorite to become unstable and thus begin to release chlorine dioxide ( $\text{ClO}_2$ ) from the sodium chlorite ( $\text{NaClO}_2$ ). The more acid that is added, the more chlorine dioxide is released, and at a faster rate. That is until all of the chlorine dioxide is released. You can see that sodium chlorite is an unusual chemical that is made largely of chlorine dioxide, but the chlorine dioxide does not become available until the acid is added. As it was stated above, chlorine dioxide is a gas, but it dissolves in any water that is present or that it is mixed with. Normally there is water present when the acid is added, and most of the gas will remain right in that water. Just use the right number of drops with the instructions and you are OK.

### **Is MMS a bleach?**

MMS (drops of chlorine dioxide mixed with water) is not a bleach. Every single chemical known to man can be poisonous when taken in too large of quantities. Recently - a girl died from drinking too much water. [2] Ninety five percent of the medicines known to man are extremely poisonous when used in large quantities. About 15 aspirins can kill a person. One half of a cup of most of the chemicals under your sink would kill a person. I am very very sorry that no scientist or scientific laboratory has ever written up and

signed a scientific paper stating that MMS is not a bleach. The fact is, no laboratory ever thought that it would be necessary to come out and say that. It never occurred to any of them that someone would be dumb enough to start calling dilute solutions of chlorine dioxide a bleach. (Industrial strength Chlorine dioxide solutions has absolutely nothing to do with MMS.) MMS1 is only a few drops of Chlorine dioxide (or even just Sodium chlorite) diluted in plenty of water - it simply does not have the potential to bleach anything at all. That is ridiculous - to push the idea that MMS is a bleach, as no one has ever used MMS for a bleach. [\[3\]](#)

However, let me state this: 60% of the water companies in the USA are now using chlorine dioxide to purify drinking water. Chances are very high that if you believe that MMS (again, diluted Chlorine dioxide) is a bleach, then my friend you are now drinking bleach in your own home. Do you think then it is logical, to start a campaign saying: "STOP USING BLEACH TO PURIFY OUR WATER." Well, the girl that has it figured out and is now telling the world that MMS is bleach, just might start another such campaign with water. I am using a bit of sarcasm here, but I hope you understand that someone pushing the idea that MMS is a bleach is highly illogical, and probably wouldn't state so unless they were paid to do it.

Sunlight can bleach. Even lemon can bleach. However, we don't really think of sunlight or lemon as bleach (and certainly not three drops of lemon diluted in a glass of water.) Would you start avoiding the sunlight just because a so called skeptic told you that sunlight is a bleach and therefor bad for you? Or, would you go out and enjoy the sun in moderation as to not get burned? Again, the point of it is: Anything in excess, or anything that is used in too high amount -- can be bad for anyone. This paper is written for the layman to understand. Sometimes, scientific proof of things exist only in logic. For example, scientists have never come out with a written and signed paper saying that ocean ships don't fly, or that one cannot fly a Piper Cub to the moon. Many highly obvious things are simply left to logic and there are no scientific papers making many obvious statements. Another example would be that there is no scientific written paper that states that the water will run out of a glass of water if the glass is held upside down. Obvious things are just assumed in this written paper here, and in civilization as a whole. I hope you understand this point, because one woman assumed for some unknown reason that MMS is a bleach - thereby causing irreparable harm to many people by continuing to push the idea, as there will be those with autistic children that will walk away without giving their children a chance to be [cured this way](#).

### **What our critics do that makes them dead wrong**

The critics all make the same mistake. They start talking from a total ignorance of the entire subject of MMS - and what ever it is they think they have found wrong with our

handling of MMS. In every case they do much damage when people believe them and go away thinking that MMS doesn't work. This means that many people lose their chance to overcome their suffering (and possible death), or in the case of autism, they lose their chance to recover their children. The worst part is that the critics continue to insist that they are right and they refuse to study the literature concerning the subject.

No critic can remain a critic if he studies the subject. The facts are in the chemistry and literature. We work directly with the facts. Why wouldn't we. Why would we, after a period of 15 years not know the facts. I am sorry to say this, but the woman that has been parading out the data and idea that MMS is a bleach, is making those statements like she knows what she is talking about - and therein is the lie. She doesn't know what she is talking about and thus she is trying to sell us with the idea that her opinion is the truth. And that is the lie.

No one has ever used MMS as a bleach, as it cannot possibly bleach anything. But she says everything with such confidence, that she knows when she cannot know. Something that cannot do what a bleach should do, cannot be a bleach. Vinegar is a weak solution of acetic acid, which in much stronger mixtures, is used to clean toilets and other messes. Are we going to say then that vinegar is a toilet cleaner and quit using it for cooking? Likewise baking soda, sodium bicarbonate, is used in small amounts for baking -- do we quit using it for baking because it is used in large amounts to clean toilets?

Chlorine dioxide is used for thousands of things in our society, mostly in industry. It is used in hospitals to sterilize the floors and benches, it is used in stock yards to purify the beef, once slaughtered. It was used in government buildings to kill anthrax. It is used throughout the US to purify water. A search of the literature will turn up hundreds of these things in any city. One of the things is that it might have been used somewhere as an industrial bleach for an industrial process, but that would have to be a solution 1000 times stronger than that of MMS. The fact is however, that MMS has never been used in homes anywhere in the world as a bleach of any kind. And so what if it has been used as a bleach -- does that somehow change the chemistry of it? Once a critic spends a few hours studying the chemistry of MMS, they simply have to give up being a critic as they find that we remain with the chemistry to the technology. Chemistry is chemistry and the laws of chemistry are often as well defined as gravity. So please, if you know a critic that is unintentionally spreading misinformation, please ask him to spend some time studying the literature - or, the chemistry of chlorine dioxide. It will be good for all of us. [4]

### **Oxidation as used to kill microorganisms**

Chlorine dioxide kills most microorganisms through the process of oxidation. Oxidation is not always understood, with many people thinking that oxidation is the process of

adding oxygen to other substances. That is not the case. Oxidation is the process by which substances are destroyed. The electrons that hold a substance together are pulled off by the oxidizing chemical and thus the substance then comes apart, which of course, destroys it.

Chlorine dioxide is unique in the chemical world because the chlorine dioxide molecule has a chemical characteristic that changes and makes it selective for pathogens. The change happens when the chlorine dioxide molecule pulls one electron from a pathogen, which normally is not enough to damage the pathogen, but that electron then comes over to the chlorine dioxide molecule and changes it. When this happens a thousand times or a hundred thousand times, the pathogen is destroyed, mainly because this process blows a hole in the side of the pathogen. [5]

Just for your information, there is another oxidation process which is called "chlorination", which involves the chlorine coming over and combining with the item to be oxidized, thus making new compounds. When this happens with chlorination, many times, one of the new compounds, because of the chlorine involved, is carcinogenic (cancer causing). This information is just added for reference. Chlorination has nothing to do with MMS, but it might confuse some of the critics who happen to use Clorox bleach in their laundry. But again, chlorination has nothing to do with MMS. [6]

### **Killing viruses**

In the cases of viruses, oxidation is not the process. When chlorine dioxide is present in the environment of the virus, the special proteins of which the virus is constructed, are prevented from forming. The virus cannot grow, and thus it dies. From experiments it appears that it takes a virus several hours, and up to several days of the presence of chlorine dioxide before it dies. [7]

### **Oxidation potential**

The chemical  $\text{ClO}_2$  is a weak oxidizer with an oxidation potential of 0.95 volts. The oxidation potential determines the strength of the ability of an oxidizer, to oxidize other compounds. Chlorine dioxide is the weakest of all the oxidizers that are ever used in the human body. For your reference, oxygen has an oxidation potential of 1.28 volts, hydrogen peroxide has an oxidation potential of 1.80 volts, and the strongest oxidizer ever used in the body, ozone, has an oxidation potential of 2.07 volts. [8]

(Any good chemistry manual will show you that there are only a small number of oxidizers. The only ones that could possibly be used in the body - are the 4 listed here in this paragraph.)

### **Why the chlorine dioxide does not harm the body**

Chlorine dioxide has the weakest oxidation potential (0.95 volts) of all the oxidizers. Oxygen has the next highest oxidation potentials of 1.28 volts. Those oxidation potentials of 0.95 and 1.28 volts can do very little damage to the human body. This is because these voltages cannot overcome the opposing oxidation potentials in the human cells and tissues. And as you can see, if oxygen does very little or no damage, then the lesser oxidation voltage of chlorine dioxide is not likely to do any damage at all. [9] Chlorine Dioxide is highly selective and does not harm stomach and intestine useful microorganisms: Chlorine dioxide is highly selective for pathogens that cause diseases in the body, and does not kill the various useful flora of the stomach and intestines. This is due to the unique properties of the chlorine dioxide molecule. Please see several explanations given in the references. [10] [11]

### **Why chlorine dioxide is more effective than oxygen**

Oxygen does kill pathogens when it contacts them, but oxygen has other jobs in the body as well. It oxidizes various body poisons generated during the course of the day. These poisons have an oxidization potential that allows oxygen to destroy them, but oxygen becomes neutralized in the process of destroying the poisons - of which there are many. As the poisons are often released deep in the tissues, they work their way outward and oxygen destroys them by working its way inward towards the poisons. When they meet, the poison is destroyed and the oxygen is neutralized. However, because chlorine dioxide does not destroy much of the poisons that oxygen does destroy, it can go deeper into the tissues where many of the pathogens hide from the oxygen, because the oxygen is used up by the poisons before it reaches the pathogens. But since the chlorine dioxide is not used up by these particular poisons, it can go much deeper into the tissues and thus the pathogens cannot hide from the chlorine dioxide. Chlorine dioxide has 2.5 times more capacity to kill pathogens than oxygen. What this means is that a small amount of chlorine dioxide is equal to a much larger amount of oxygen and other oxidizers. It may not be as strong, but it has a larger capacity to do what it does. [12]

### **Treatment of diseases and training**

Actually - we don't consider that we treat diseases. We believe that our product MMS brings health to all, and especially those who are sick. With the thousands of testimonies with most known diseases represented, we believe that MMS brings health to those who are sick regardless of what they may be sick from. Each person is expected to know and use MMS for himself, and his children. We have the literature and we provide seminars that covers MMS data thoroughly, giving each student the opportunity to do each protocol so that he knows it. The data is provided online, and many different emails addresses bring in hundreds of letters daily that are answered so

that people can use MMS safely. Our non-religious church, the Genesis 2 Church of Health & Healing, has more than 500 Ministers of Health & Healing and 35 Bishops of Health & Healing (as of June 2012). These Ministers and Bishops help anyone who might ask them, with information on how to use MMS, and often providing the MMS for free.

### MMS2

MMS2 is made from calcium hypochlorite, which is a water purifier used for swimming pools and many other water purification uses - including some public water works. When calcium hypochlorite is dissolved in water, it becomes hypochlorous acid with the formula of HOCl. This formula means that one atom of hydrogen, one atom of oxygen, and one atom of chlorine is held together with electrons, creating a molecule of this acid. Normally this acid, hypochlorous acid, will do most of the things that MMS will do. It is usually used in combination with MMS in bringing health to those with what is normally called incurable diseases. It has consistently been proven that MMS2 aids the action of MMS (MMS1) towards health.

The hypochlorous acid molecule is an oxidizer that is a little bit more powerful than oxygen. It can pull 2 electrons away from a substance that is oxidizable. These electrons then come over and destroy the balance of the electrons of the hypochlorous acid which destroys it, releasing all the components which, are of course, HOCl. The H (hydrogen atom) just becomes part of the water of the body, the Cl (chlorine atom) becomes part of the salt in the body, and the O (oxygen atom) then acts as what it is, an oxidizer, and it will then draw two more electrons from the oxidizable substance which could be a pathogen's side. When this happens in the thousands of times, a hole is created in the side of the pathogen - and the pathogen dies. The electrons that are drawn from the pathogen come back to the oxygen - causing it to become neutralized and then, eventually, breathed out of the body as carbon dioxide. [\[13\]](#)

### Handling of Malaria in the Human Body with MMS

When a female anopheles mosquito infested with malaria bites a person the malaria parasite (sporozoite) makes its way to the person's liver within 1 minute to 30 minutes time, where it must grow for six days. This is always the process and does not change. During these six days the parasite is the most vulnerable to MMS1. Every time you take a drink of MMS1 the MMS1 is carried to the liver in the same amount of time, 1 minute to 30 minutes. This is because the blood system that carries the parasite to the liver obviously also carries the MMS1 to the liver. The MMS1 is very healthy for the liver as it kills parasites and pathogens and some poisons while doing no damage to the liver, because of its low oxidation potential (0.95 volts) it can't do damage. There is little or no chance that the parasites in the liver will survive the MMS1, especially if you are taking it every day while in a malaria infested area.

After a mosquito bites you, it takes six days for the malaria parasite to get into the blood stream, and at this stage, it does not yet make you sick. But if you are taking a maintenance drink of MMS1, the parasites will never get into the blood as they will be killed in the liver, and you will never know it.

If you have started taking MMS1 after the malaria symptoms began to show up, that means that the six day incubation time in the liver has passed, and the merozoites have erupted from the liver into the body, and have passed into the blood through the lung blood capillaries and invaded the red blood cells. Then it will be about two more weeks when the red blood cells begin to erupt creating the symptoms of malaria sickness. So you can see, if you were in a malaria infested area for a short period it could take up to three weeks (six days plus two weeks) before you would notice a thing.

When you do begin to get sick due to malaria, it's because the parasites are beginning to break out of the red blood cells, releasing poison into the blood which then creates the symptoms of malaria and of course will bring about anemia (deficiency in red blood cells) cause by the parasites. At that stage of the disease is usually when the victim will take the MMS1. The dosage used for adults with malaria is 15 activated drops of MMS, although the Red Cross used 18 activated drops in their 100% success rate [MMS1 vs Malaria study in Uganda, december 2012](#).

When MMS1 is swallowed it passes into the stomach. Providing the person does not take orange juice, coffee, tea, or extreme antioxidants, the MMS1 will pass to the lower stomach where the food is being digested with stomach motion and stomach acid (HCl). The MMS1 along with the food will be routed to the top of the intestine where an enzyme coming from the pancreas re-adjust the pH all the way up to 7.2 along with any food that might have been in the stomach with the MMS1. The MMS1 will then be adsorbed into the side walls of the intestine where the pH is again adjusted to 7.4, the exact pH of the blood at that location in the body. This is the point where the MMS1 will begin that attack on the blood cells that are stuffed with malaria parasites. An amazing thing happens at this point. The parasites are killed and the blood ejects the dead parasites into the intestines which are carried out through the waste system. The MMS also kills the poisons that cause the malaria sickness and sickness is gone in less than 4 hours. The sickness is gone and the victim feels normal.



### **Proof that FDA does not consider chlorine dioxide poisonous**

Obviously, if the FDA approves of the use of Chlorine dioxide on food, it does not consider Chlorine dioxide to be poisonous. See below: [\[14\]](#) [\[15\]](#) [\[16\]](#)

- **21 C.F.R. § 173.300 Chlorine dioxide.**

Title 21 - Food and Drugs I have quoted the FDA regulation here in a few sentences, but if you want to read more, just put the 21 C.F.R. and numbers in the search engine, Google or others, and you can read it all. Keep in mind that Acidified Sodium chlorite produces chlorine dioxide.

- **21 .C.F.R § 173.300 Chlorine dioxide.**

Chlorine dioxide (CAS Reg. No. 10049-04-4) may be safely used in food in accordance with the following prescribed conditions:

- **21 C.F.R. 173.325 Acidified sodium chlorite solutions.**

CHAPTER I: FOOD AND DRUG ADMINISTRATION, DEPARTMENT OF HEALTH AND HUMAN SERVICES (CONTINUED) SUBCHAPTER B: FOOD FOR HUMAN CONSUMPTION (CONTINUED) PART 173: SECONDARY DIRECT FOOD ADDITIVES PERMITTED IN FOOD FOR HUMAN CONSUMPTION Subpart D: Specific Usage Additives 173.325 - Acidified sodium chlorite solutions. Acidified sodium chlorite solutions may be safely used in accordance with the following prescribed conditions: READ MORE BY GOING TO THE INTERNET AND PUTTING THE C.F.R. § 73.300 NUMBER INTO GOOGLE.

### **Document references**

1. 21 C.F.R. § 173.300 Chlorine dioxide. Title 21 - Food and Drugs I have quoted the FDA regulation here in a few sentences, but if you want to read more, just put the 21 C.F.R. and numbers in the search engine, Google or others, and you can read it all. Keep in mind that Acidified Sodium chlorite produces chlorine dioxide. Title 21: Food and Drugs • PART 173—SECONDARY DIRECT FOOD ADDITIVES PERMITTED IN FOOD FOR HUMAN CONSUMPTION (backup mirror) • Subpart D—Specific Usage Additives (backup mirror) • Browse Next (backup mirror)
2. 21 .C.F.R § 173.300 Chlorine dioxide. Chlorine dioxide (CAS Reg. No. 10049-04-4) may be safely used in food in accordance with the following prescribed conditions: 21 C.F.R. 173.325 Acidified sodium chlorite solutions. CHAPTER I: FOOD AND DRUG ADMINISTRATION, DEPARTMENT OF HEALTH AND HUMAN SERVICES (CONTINUED) SUBCHAPTER B: FOOD FOR HUMAN CONSUMPTION (CONTINUED) PART 173: SECONDARY DIRECT FOOD ADDITIVES PERMITTED IN FOOD FOR HUMAN CONSUMPTION Subpart D: Specific Usage Additives 173.325 - Acidified sodium chlorite solutions. Acidified

sodium chlorite solutions may be safely used in accordance with the following prescribed conditions: READ MORE BY GOING TO THE INTERNET AND PUTTING THE C.F.R. § 73.300 NUMBER INTO GOOGLE.

3. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1569027/pdf/envhper00463-0059.pdf> Controlled Clinical Evaluations of Chlorine Dioxide, Chlorite and Chlorate in Man. This is a report of a test where people were given Chlorine dioxide for months with no bad effects. Copy and paste in the internet address area if it doesn't work by click. By Judith R. Lubbers,\*Sudha Chauhan,\*and Joseph R. Bianchine
4. Masschelein, W.J. and Rice, R.G. editors. (1979) Chlorine Dioxide Chemistry and Environmental Impact of Oxychlorine Compounds. Ann Arbor Science Publishers, Inc., Ann Arbor, MI. p.98, 111-145.
5. <http://www.clordisys.com/WhatIsCD.pdf> What is Chlorine Dioxide? Where is it used? How does it work? This is a write up by a company that has been using chlorine dioxide for more than 20 years. It gives details about chlorine dioxide.
6. <http://chemistry.about.com/od/chemistryglossary/g/Oxidation-Definition.htm> There are many definitions of oxidation on the internet. Some are partly wrong and some are dead wrong. The one given here is correct. So click this link for more information on oxidation.
7. [http://www.epa.gov/ogwdw/mdbp/pdf/alter/chapt\\_4.pdf](http://www.epa.gov/ogwdw/mdbp/pdf/alter/chapt_4.pdf) The EPA (Environmental Protection Agency) sponsors a long accurate article concerning chlorine dioxide and its chemistry. PLEASE NOTE: THE FOLLOWING PARAGRAPHS HAVE BEEN COPIED FROM THE EPA ARTICLE THAT CAN BE SEEN AT THE ABOVE ADDRESS. THE UNDERLYING SENTENCES ARE OF SPECIAL INTEREST TO MMS. **4.1 Chlorine Dioxide Chemistry 4.1.1 Oxidation Potential** The metabolism of microorganisms and consequently their ability to survive and propagate are influenced by the oxidation reduction potential (ORP) of the medium in which it lives (USEPA, 1996). Chlorine dioxide (ClO<sub>2</sub>) is a neutral compound of chlorine in the +IV oxidation state. It disinfects by oxidation; however, it does not chlorinate. It is a relatively small, volatile, and highly energetic molecule, and a free radical even while in dilute aqueous solutions. At high concentrations, it reacts violently with reducing agents. However, it is stable in dilute solution in a closed container in the absence of light (AWWA, 1990).

Chlorine dioxide functions as a highly selective oxidant due to its unique, one-electron transfer mechanism where it is reduced to chlorite (ClO<sub>2</sub><sup>-</sup>) (Hoehn et al., 1996). The pK<sub>a</sub> for the chlorite ion, chlorous acid equilibrium, is extremely low

at pH 1.8. This is remarkably different from the hypochlorous acid/hypochlorite base ion pair equilibrium found near neutrality, and indicates the chlorite ion will exist as the dominant species in drinking water. The oxidation reduction of some key reactions are (CRC, 1990):  $\text{ClO}_2(\text{aq}) + e = \text{ClO}_2$   $E^\circ = 0.954\text{V}$  Other important half reactions are:  $\text{ClO}_2 + 2\text{H}_2\text{O} + 4e = \text{Cl} + 4\text{OH}$   $E^\circ = 0.76\text{V}$   $\text{ClO}_3 + \text{H}_2\text{O} + 2e = \text{ClO}_2 + 2\text{OH}$   $E^\circ = 0.33\text{V}$   $\text{ClO}_3 + 2\text{H}^+ + e = \text{ClO}_2 + \text{H}_2\text{O}$   $E^\circ = 1.152\text{V}$  (The E with the little zero in the first equation above is the oxidation potential of chlorine dioxide which is .954 volts.) **4.4.1**

**Inactivation Mechanisms** Gross physical damage to bacterial cells or viral capsids has not been observed at the low concentrations of chlorine dioxide typically used to disinfect drinking water. Therefore, studies have focused primarily on two more subtle mechanisms that lead to the inactivation of microorganisms: determining specific chemical reactions between chlorine dioxide and biomolecules; and observing the effect chlorine dioxide has on physiological functions. In the first disinfection mechanism, chlorine dioxide reacts readily with amino acids cysteine, tryptophan, and tyrosine, but not with viral ribonucleic acid (RNA) (Noss et al., 1983; Olivier et al., 1985). From this research, it was concluded that chlorine dioxide inactivated viruses by altering the viral capsid proteins. However, chlorine dioxide reacts with poliovirus RNA and impairs RNA synthesis (Alvarez and O'Brien, 1982). It has also been shown that chlorine dioxide reacts with free fatty acids (Ghandbari et al., 1983).

At this time, it is unclear whether the primary mode of inactivation for chlorine dioxide lies in the peripheral structures or nucleic acids. Perhaps reactions in both regions contribute to pathogen inactivation **4.4.3.3 Virus Inactivation** Chlorine dioxide has been shown to be an effective viricide. Laboratory studies have shown that inactivation efficiency improves when viruses are in a single state rather than clumped. It was reported in 1946 that chlorine dioxide inactivated Poliomyelitis (Ridenour and Ingols, 1946). This investigation also showed that chlorine dioxide and free chlorine yielded similar results. Other studies have verified these findings for poliovirus 1 (Cronier et al., 1978) and Coxsackie virus A9 (Scarpino, 1979). At greater than neutral pHs (where hypochlorite ion is the predominant species) chlorine dioxide has been found to be superior to chlorine in the inactivation of numerous viruses such as echovirus 7, coxsackie virus B3, and sendaivirus (Smith and McVey, 1973). Sobsey (1998) determined CT values based on a study of Hepatitis A virus, strain HM 175. The study found 4-log inactivation levels are obtainable at CT values of less than 35 at 5°C and less than 10 at a temperature of 25°C.

8. <http://www.lenntech.com/processes/disinfection/chemical/disinfectants-chlorine-dioxide.htm#ixzz0wGZVFWL> Lenntech is one of the largest industrial companies specializing in chlorine dioxide technology of all kinds. Please use this article to learn the data of why chlorine dioxide is selective for certain microorganism and not others. (backup mirror) The paragraphs below have been copied from the Lenntech article found at the above address. Read the full article at the above address or just the applicable points below:

By comparing the oxidation strength and oxidation capacity of different disinfectants, one can conclude that chlorine dioxide is effective at low concentrations. Chlorine dioxide is not as reactive as ozone or chlorine and it only reacts with sulphuric substances, amines and some other reactive organic substances. In comparison to chlorine and ozone, less chlorine dioxide is required to obtain an active residual disinfectant. It can also be used when a large amount of organic matter is present. (added comment, the human body is organic matter that does not trigger chlorine dioxide) The oxidation strength describes how strongly an oxidizer reacts with an oxidizable substance. Ozone has the highest oxidation strength and reacts with every substance that can be oxidized. Chlorine dioxide is weak, it has a lower potential than hypochlorous acid or hypobromous acid. The oxidation capacity shows how many electrons are transferred at an oxidation or reduction reaction. The chlorine atom in chlorine dioxide has an oxidation number of +4. For this reason chlorine dioxide accepts 5 electrons when it is reduced to chloride. When we look at the molecular weight, chlorine dioxide contains 263 % 'available chlorine'; this is more than 2,5 times the oxidation capacity of chlorine.

Table 2: the oxidation potentials of various oxidants. oxidant oxidation strength oxidation capacity ozone (O<sub>3</sub>) 2,07 2 e<sup>-</sup> hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) 1,78 2 e<sup>-</sup> hypochlorous acid (HOCl) 1,49 2 e<sup>-</sup> hypobromous acid (HOBr) 1,33 2 e<sup>-</sup> chlorine dioxide (ClO<sub>2</sub>) 0,95 5 e<sup>-</sup> Does chlorine dioxide oxidize in the same way as chlorine? Contrary to chlorine, chlorine dioxide does not react with ammonia nitrogen (NH<sub>3</sub>) and hardly reacts with elementary amines. It does oxidize nitrite (NO<sub>2</sub>) to nitrate (NO<sub>3</sub>). It does not react by breaking carbon connections. No mineralization of organic substances takes place. At neutral pH or at high pH values, sulphuric acid (H<sub>2</sub>SO<sub>3</sub>) reduces chlorine dioxide to chlorite ions (ClO<sub>2</sub><sup>-</sup>). Under alkalic circumstances chlorine dioxide is broken down to chlorite and chlorate (ClO<sub>3</sub><sup>-</sup>):  $2\text{ClO}_2 + 2\text{OH}^- = \text{H}_2\text{O} + \text{ClO}_3^- + \text{ClO}_2^-$  This reaction is catalyzed by hydrogen (H<sup>+</sup>) ions. The half life of watery solutions of chlorine dioxide decreases at increasing pH values. At low pH, chlorine dioxide is reduced to chloride ions (Cl<sup>-</sup>).

9. <http://www.cdgenvironmental.com/content/chemistry> This is an article explaining chlorine dioxide and the selective ability of chlorine dioxide to select certain organisms over others. CDG Environmental is one of the largest users and sellers of chlorine dioxide.
10. [http://www.puricore.com/technology\\_humanbody.aspx](http://www.puricore.com/technology_humanbody.aspx) This article tells how the MMS2 or hypochlorous acid works in the body to kill diseases. The body always needs extra hypochlorous acid and although some critics have questioned this, the fact is, the chemical in the body from which hypochlorous acids is derived is called myeloperoxidase. This chemical has long been known to be deficient in many people. So this fact can be verified by simply putting myeloperoxidase into the google search engine.

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