



## **Ozonation Bacterial Reduction Program**

Holten Meat's continued efforts to produce the safest high quality ground meat products available has resulted in the introduction of a new bacterial reduction system for our value-added ground meat products.

An ozone-added water delivery system introduces ozonated water directly into the meat products prior to grinding. Ozonated water is created by the addition of oxygen with an additional oxygen atom ( $O_3$ ) directly into water ( $H_2O$ ). The resulting product,  $H_2O_4$ , is a natural bacterial reduction agent because it is an unstable compound, and as the extra oxygen molecule oxidizes any pathogenic bacteria that come into contact with the ozonated water will be eliminated.

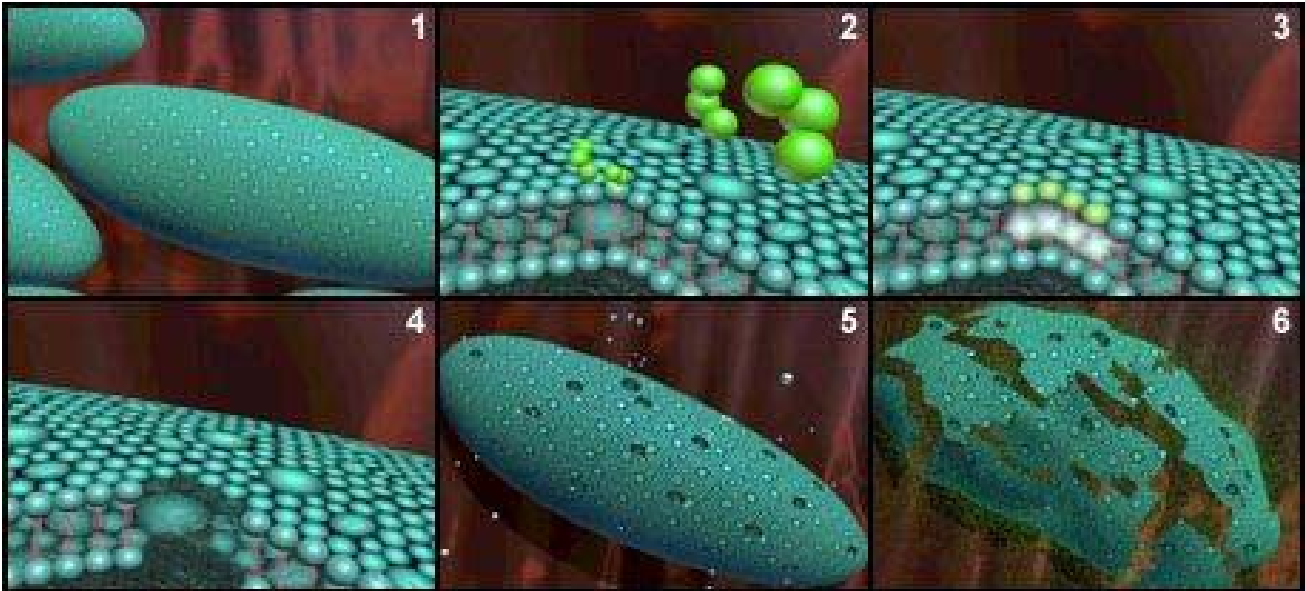
No labeling requirements exist for ozonated water other than "Water". The extra oxygen molecule has a short life span of 22 minutes. Once the life span has elapsed or the ozonated water comes into contact with a protein product containing bacteria, no residue of the ozone exists, thus no labeling. The ozonation effectiveness is much greater when the ppm is at its highest, immediately after being created. Direct addition of ozonated water allows the introduction of the most recently created ozonated water, improving the effectiveness of bacterial reduction.

Holten Meat has observed a pathogenic bacteria reduction of 1-2 log 10. What this means is if the bacterial level is 1,000 cfu, the treated product would have a reduced level on average of 10 to 100 cfu.

While the ultimate bacterial reduction of any ground beef product is through cooking to 160°F, reducing the pathogen level of the ground meat improves the overall safety of our products without sacrificing quality or flavor.

# OZONE AND FOOD SANITATION

## Effect of Ozone on Bacteria



### SEQUENCE OF DESTRUCTION OF BACTERIA CELL BY OZONE

1. Computer generated image of a bacteria cell
2. Close-up of ozone molecule (green) coming into contact with bacterial wall
3. Ozone penetrating and creating hole in bacterial wall
4. Close-up effect of ozone on cell wall
5. Bacterial cell after a few ozone molecules come into contact
6. Destruction of bacteria cell wall after multiple contacts with ozone (cell lysing)

As a comparison based on 99.99% of bacterial concentration being killed and time taken:

Ozone is 25 times of that of HOCl (Hypochlorous Acid)

2,500 times of that of OCl (Hypochlorite)

5,000 times of that of NH<sub>2</sub>Cl (Chloramine).

Further more, ozone is at least 10 times stronger than chlorine as a disinfectant. Chlorine reacts with meat, forming highly toxic and carcinogen compounds called THMs or tri-halomethanes - rendering meats lesser quality products. THMs are also implicated as carcinogens in developing kidney, bladder, and colon cancers. Chlorine also results in the production of chloroform, carbon tetrachloride, and chloromethane besides THMs. On the other hand, ozone does not even leave any trace of residual product upon its oxidative reaction.

[http://www.ozonesupplies.com/Effect\\_of\\_ozone\\_on\\_bacteria.html](http://www.ozonesupplies.com/Effect_of_ozone_on_bacteria.html)

# OZONE AND FOOD SANITATION

## FAQ about Ozone

### WHAT IS OZONE?

Ozone, (O<sub>3</sub>), sometimes called "activated oxygen", contains three atoms of oxygen rather than the two atoms we normally breathe. Ozone is the second most powerful sterilant in the world and can be used to destroy bacteria, viruses and odors. Interestingly ozone occurs quite readily in nature, most often as a result of lightning strikes that occur during thunderstorms. In fact the "fresh, clean, spring rain" smell that we notice after a storm most often results from nature's creation of ozone. However, we are probably most familiar with ozone from reading about the "ozone layer" that circles the planet above the earth's atmosphere. Here ozone is created by the sun's ultra-violet rays. This serves to protect us from the ultra-violet radiation.

### HOW DOES OZONE WORK?

The third oxygen atom of ozone makes it extremely reactive. This atom readily attaches itself to other odor molecules. When contaminants such as odors, bacteria or viruses make contact with ozone, their chemical structure is changed to less odorous compounds. As more ozone attacks the remaining compounds, the odor is eventually destroyed. This process is called oxidation. Ozone essentially reverts back to oxygen after it is used. This makes it a very environmentally friendly oxidant.

### HOW IS OZONE PRODUCED?

There are basically two methods of producing ozone...ultra-violet and corona discharge. Corona discharge creates ozone by applying high voltage to a metallic grid sandwiched between two dielectrics. The high voltage passes through the dielectric to a grounded screen/plate and in the process, creates ozone from oxygen present in the chamber. Ultra-violet (UV) light creates ozone when a wavelength at 254 nm (nanometers) hits an oxygen atom. Both processes split oxygen molecules into single oxygen atoms (O). These atoms combine with another oxygen molecule (O<sub>2</sub>) to form ozone (O<sub>3</sub>).

### HOW LONG DOES THE OZONE LAST?

As soon as ozone is formed in the generator and dispersed in a room, it will start to revert back to oxygen. This step occurs by several processes including the following: **Oxidation** reactions with an organic material such as odors or smoke. Reactions with bacteria etc., which again consumes ozone by oxidation reactions. Additionally ozone breaks down thermally. Higher temperatures destroy ozone quicker than lower temperatures. The ozone that remains is referred to as Residual ozone.

"Residual" ozone created will return to oxygen usually within 30 minutes, in amounts equal to half its level. What this means is that after each subsequent 30 minute period there would be half as much residual ozone left at the end of the period as was present at the beginning of the period. This is similar to a geometric progression of 16;8;4;2;1. In practice the half life is usually less than 30 minutes due to temperature, dust, and other contaminants in the air. Therefore, ozone, while very powerful, doesn't last long. It does its job and then disappears back into safe oxygen.

Temp (C)	Half-life in water (minutes)
15	30
20	20
25	15
30	12
35	8

### WILL THE ODOR COME BACK?

No. If ozone is applied properly it destroys the source of the odor. Treatment times may vary depending on the strength of the odor but 98% of ozone treatments are successful. In the case of mildew the odor will return if you are unable to get rid of the moisture that is the source of the mildew.

### WHAT IS THE RIGHT LEVEL OF OZONE?

The right level is when all the generated ozone is being consumed. This only applies to continuous ozone use in occupied environments – not for shock treating. However, this is difficult to attain because it becomes a balancing act. Initially the machine's output is set high to get rid of the problem odor as quickly as possible. As this is being accomplished less ozone is required for the diminishing odor etc., thereby leaving some residual ozone in the air. If the machine output is not turned down, then more residual ozone will remain. If a strong smell of ozone is noticed, then there is more ozone present than is required. Simply decrease the rheostat (output level control). With ozone, MORE IS NOT CONSIDERED BETTER! One must be careful when using ozone in an occupied environment.

NOTE: It is not necessary that ozone be detected by humans for it to be effective. Ozone can work even when humans are not able to smell it.

### IS OZONE HARMFUL AND WHAT IF ANY ARE THE LONG TERM EFFECTS?

Ozone has been known for almost a century, so a great deal is known about it. Several regulatory agencies, including the Occupational Safety and Health Administration (OSHA), have stipulated that the safe allowable level of residual is 0.10-ppm (parts per million). Note that this permissible level is for continuous exposure throughout an entire 8 hour day. The temporary affects of such a low exposure would range from headaches, to sore throats, irritation in the eyes, and nose. No long term effects have ever been documented from ozone exposure. Ask Ozone Solutions for MSDS sheets if desired. [http://www.ozonesupplies.com/FAQ\\_Ozone.html](http://www.ozonesupplies.com/FAQ_Ozone.html)

# OZONE AND FOOD SANITATION

## Advantages of Ozone

- Ozone is the strongest oxidant and disinfectant available for the treatment of aqueous solutions and gaseous mixtures.
- Although ozone is only partially soluble in water, it is sufficiently soluble and stable such that its oxidation or disinfectant properties can be fully utilized.
- After ozone oxidizes or disinfects, it decomposes into oxygen
- Ozone reacts with a large variety of organic compounds resulting in oxygen-containing organic by-products.
- Although ozone is the strongest oxidizing agent commercially available, it is safe to handle. The primary reason is that it cannot be stored and, therefore must be generated and used on-site.
- Ozone in its gaseous phase is a proven deodorizer for a variety of odorous materials.
- In treating potable water, wastewater, and landfill leachate, ozone has the proven ability to convert biorefractory organic materials to biodegradable materials. As a result, combining ozone oxidation with subsequent biological treatment can produce water or wastewater with lower concentrations of problematic organic compounds more cost-effectively than either process used individually.
- Applying ozone to any medium (liquid or gaseous) does not add other chemicals.

[http://www.ozonesupplies.com/Advantages\\_of\\_Ozone.html](http://www.ozonesupplies.com/Advantages_of_Ozone.html)

### Ozone vs. Chlorine

Action in Water	Chlorine	Ozone
Oxidation Potential (Volts)	1.36	2.07
Disinfection: Bacteria Viruses	Moderate Moderate	Excellent Excellent
Environmentally Friendly	No	Yes
Color Removal	Good	Excellent
Carcinogen Formation	Likely	Unlikely
Organics Oxidation	Moderate	High
Micro flocculation	None	Moderate
pH Effect	Variable	Lowers
Water Half-Life	2-3 Hours	20 Min.
Operation Hazards: Skin Toxicity Inhalation Toxicity	High High	Moderate High
Complexity	Low	High
Capitol Cost	Low	High
Monthly Use Cost	Moderate-High	Low
Air Pre-treatment	None	Extensive

[http://www.ozonesupplies.com/Ozone\\_vs\\_Chlorine\\_in\\_Water.html](http://www.ozonesupplies.com/Ozone_vs_Chlorine_in_Water.html)

# OZONE AND FOOD SANITATION

## Ozone in the Food Industry

Because ozone is a safe, powerful disinfectant, it can be used to control biological growth of unwanted organisms in products and equipment used in the food processing industries. Ozone is particularly suited to the food industry because of its ability to disinfect microorganisms without adding chemical by-products to the food being treated, or to the food processing water or atmosphere in which food are stored.

In aqueous solutions, ozone can be used to disinfect equipment, process water, and some foodstuff. In gaseous form, ozone can act as a preservative for certain foods products and can also sanitize food packaging materials. Some products currently being preserved with ozone include eggs during cold storage, fresh fruits and vegetables, and fresh fish.

Until recently, the food processing industry limited its use of ozone mainly to the treatment of bottle water and wastewater because ozone was not approved by the FDA for food applications. Recent actions, however, have cleared away some major barriers to wider applications of ozone. In 1997, through efforts of the Electric Power Research Institute (EPRI), the FDA granted ozone with the status of "Generally Recognized As Safe" (GRAS) as a sanitizer and disinfectant for foods. EPRI accomplished this following guidelines set forth by the FDA. The process involved assembling a panel of experts on food, toxicology, and ozone to evaluate scientific and historic information on the use of ozone in food processing. The panel affirmed GRAS classification for ozone "as a sanitizer or disinfectant for foods when used at levels and by methods of application consistent with Good Manufacturing Practices." The FDA does not have to reaffirm the GRAS classification, and food processors now free to use ozone for sanitation or disinfection.

The GRAS classification for ozone was announced with a few months of the passage of a new Federal law which, for the first time, limits the presence of *E. coli* and *Salmonella* on meat and poultry. The timing of the GRAS classification is advantageous because ozone is particularly effective in inactivating these infectious agents.

Food processors and beverages manufacturers consume billions of gallons of water daily for food handling, washing, processing, and cooking and for cleaning equipment. All of this water must be free of contaminants. Even before ozone received GRAS status, the food and beverage industry had begun to recognize its potential as a disinfectant and as an alternative to chlorine, which traditionally has been used to treat food processing water. This is because ozone eliminates a problem associated with chlorine disinfection-the potential for the build-up of toxic residues of chlorine and chlorinated by-products in water that has been treated more than once.

Ozone is rapidly gaining acceptance as an alternative to chlorine for disinfection. Why? Because it works! Contact Ozone Solutions for your needs.

[http://www.ozoneapplications.com/food\\_processing/Ozone\\_in\\_the\\_Food\\_Industry.htm](http://www.ozoneapplications.com/food_processing/Ozone_in_the_Food_Industry.htm)

Information taken from [www.ozonesupplies.com](http://www.ozonesupplies.com) website of Ozone Solutions, Inc.