E-THERM, INC.

# TURN UP THE HEAT!

ThermaPureHeat®

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## Does ThermaPure® Work?

*The question of whether or not ThermaPure® works is a recent and frequent topic in trade journals, chat rooms and among environmental professionals. New technologies need to be the subject of controversy, questions and challenges until they have met the standards of the profession and answered the challenge of the professionals. This is important.*

*One of the ironies of the current challenges is that the focus seems to be on the wrong elements. The ThermaPure® process is analogous to pasteurization. Rather than pasteurization of food products, soils, timber, or sewage, ThermaPure® is the pasteurization of structures.*

*Pasteurization is not a "new" process. This is the irony. Pasteurization of microbes to provide a pathogen-reduced medium is not new, in fact , it has been practiced for 150 years. It provide s us with food products that will not transmit disease and foods that will have longer shelf life. It has been used to protect timber from pathogens including fungi and insects. Plants have been protected from pathogenic fungi and bacteria through soils pasteurization. Solid wastes have been treated to reduce a vast number of human pathogens including bacteria, protozoa, rickettsia, and helminthes. Today, ThermaPure® is used to pasteurize structures.*

*Over the next two issues of "Turn Up The Heat", we will respond to the question "Does ThermaPure® Work?" This issue will primarily focus on the application of high temperatures to kill microbes.*

***Inside this issue:***



## The World of Microbes—19th Century

The population of Europe had recovered from the "Black Plague" by the 19th century. However, death rates were beginning to reach those levels seen in the 14th century. There were many theories of causation, and the beginnings of links to sanitation. This was the backdrop for Louis Pasteur, Joseph Lister, Robert Koch and a host of scientists that together would formulate what would later become known as the "germ theory of disease."

Koch and his associates isolated the bacteria of tetanus, . diphtheria, pneumonia, meningities, and various streptococci and staphylococci. They made the association between these microbes and human disease and laid the foundation for pasteurization.

*A 19th century cartoon urging the cleanup of the River Thames*

One of Koch's great discoveries was an intestinal bacterium, *Cholera vibrio*, which he found in 1884. He also discovered the bacterium that causes typhoid fever. Typhoid was most often associated with armies in the field, where sanitation facilities are primitive. It is said that during the Boer War of 1899-1902 more soldiers died of typhoid than by gunfire. Ironic that a process to take lives would drive the science to develop a process to save lives.

### New ThermaPure Licensees

**California**

**The Green Team**
Contact: Richard Gray
Phone: (831) 655-9706
Email:
Rich@GreenTeamCA.com

**Orkin Pest Control**
Contact your local Orkin office for details.

* The data in these charts do not necessarily reflect the temperatures and durations used in the ThermaPure® process.

# Pasteurization—150 Years of Application

*"There does not exist a category of science to which one can give the name applied science. There are science and the applications of science, bound together as the fruit of the tree which bears it."*
*Louis Pasteur*

*One hundred years before Louis Pasteur discovered the process to be named after him, Nicolas Appert discovered a method to keep foods from spoiling. Appert found that by placing foods in a sealed container and soaking the container in hot water for a few hours the food would be preserved. Today, we know this process as "canning". The history of using heat to reduce the growth of pathogens had begun.*

*Pasteurization dates back to the mid-1800s with the concepts developed by Louis Pasteur. Pasteur determined that by heating food products to a temperature of approximately 60°C for several minutes, bacteria, viruses, protozoa, molds and yeasts in the food would be reduced to levels that would no longer cause spoilage to the food or be harmful to the health of the consumer. Pasteurization improved shelf-life of food products and more importantly, provided reduced levels of contamination allowing for safe consumption without damaging the food product.*

*By 1900 the germ theory of disease was accepted and physicians had begun using disinfectants for surgical tools and preparations. During these formative years, research in human pathogens was generally performed to resolve disease rather than to prevent it. However, in their quest to understand the biology of bacteria, scientists researched the thermal death of known human pathogens. Studies of tuberculosis and anthrax developed a better understanding of the thermal resistance of the affecting pathogens.*

*There was considerable research during the late 19th century regarding the thermal death rate of bacterial species in food products. In the 20th century much of the research was to reach better understanding of food borne pathogens.*

*Today, ThermaPure® uses the same principles for structures. Structural pasteurization is a process in which the temperature of a building or portion of a building is increased to a level that will reduce the targeted organisms to acceptable levels while minimizing damage to the structure. Although more complex than other forms of pasteurization, this is the basis for ThermaPure® and what we define as "structural pasteurization".*

# Historic Thermal Studies of Pathogenic Bacteria

The "germ theory of disease" prompted a greater understanding of several human pathogens that had only recently been discovered. Early research on thermal death points determined these pathogens fell within a specific temperature range which corresponded to thermal conditions humans live in. These organisms were labeled as "mesophiles" because of the temperatures they were able to survive and be infective. It should be noted that these temperatures are within the range of ThermaPure treatments.

| Species | Temperature* | Duration* | Author/Scientist |
|---|---|---|---|
| *Bacillus coli* (*E. coli*) | 60°C (140°F) | 10 minutes | Loeffler, 1886 |
| *Bacillus typhosus* | 56°C (131°F) | 10 minutes | Sternburg, 1887 |
| Dysentery bacilli *(Shigella)* | 60°C (140°F) | 10 minutes | Runge & O;Brien, 1924 |
| *Vibrio cholerae* | 55°C (130°F) | 15 minutes | Kitasato, 1889 |
| *Mycobacterium tuberculosis* | 63°C (146°F) | 3 minutes | North & Park, 1925 |
| *Bacillus pestis (Yersinia)* | 60°C (140°F) | 2 minutes | Gladin, 1898 |
| Staphylococci | 62°C (144°F) | 10 minutes | Sternburg, 1887 |
| Streptococci | 60°C (140°F) | 30 minutes | Ayers & Johnson, 1918 |

Hampil, B. (1932). "The Influence of Temperature on the Life Processes and Death of Bacteria", *The Quarterly Review of Biology*, 7(2):172-196.

# Waste Management and Pasteurization

Other studies of the thermal death of micro-organisms have occurred in waste management. Human excreta are the principle vehicle for the transmission and spread of a wide range of communicable diseases. Some of these diseases are the leading causes of sickness and death in many of our third world countries. It has been estimated that several hundred diseases may be transmitted from animal to animal and more than one hundred and fifty may be transmitted from animal to man. Pathogens found in human excreta include bacteria, viruses, cysts of protozoa, and eggs of helminthes. All of these may cause disease in a new host.

*"...heating to pasteurization temperatures (generally 60°C ) for periods of minutes to tens of minutes will destroy most waterborne pathogens of concern."*
*World Health Organization*

Temperature is a more thorough intervention process in the inactivation of enteric pathogens. Typically, temperatures reached in composts range from 50-60°C. These temperatures are generally above the thermal death rate of mesophiles.

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# Literature Review –

## Ask Dr. Burge: Can We Use Heat to Remediate Mold Contamination?

Burge, H. *Indoor Environmental Connections*, January 2007.

Dr. Burge started this article by saying, "I have been asked this question at least five times during the past week, and my short answer is no. The reason is that while fungi can be killed by heat, as can every other living organism, there is no evidence to support the contention that heat treatment of a house will kill all the fungi present, nor will heat destroy all of the allergens and irritants that are a part of all fungal growth. "

*E-Therm: It is important to understand that there is no contention that heat treatment of a house will kill all the fungi present. Just as there is no contention that traditional remediation will kill all the fungi present. But, there is an abundance of evidence that impacted structures have been successfully remediated by a combination of heat treatment and removal of damaged materials, or by heat treatment alone. The evidence for this is post remediation clearance using the same standards that are used for any other mold remediation project.*

Dr. Burge: "A very small amount of research has been conducted that supports the killing of some fungi with heat such as is associated with currently used heat treatment technologies."

*E-Therm: Clearly, more research needs to be done, but there are numerous examples of heat treatment projects where post remediation testing determined that most and in some cases all the fungi were destroyed.*

Dr. Burge: "However, the research has been done only in the laboratory, and documentation that hidden mold in houses is killed by whole-house treatment is not available. In fact, some anecdotal studies indicate that hidden growth in walls remains culturable after heat treatment."

*E-Therm: Sterility is typically not a goal of any mold remediation project The goal of heat treatment is that of structural pasteurization—reduce fungi by order of magnitude to acceptable levels.*

Dr. Burge made additional remarks about research that had been conducted but was incomplete. She commented about the benefit of drying but cautioned about needing sufficient ventilation.

*E-Therm: When ThermaPure is properly applied, air exchanges will be significant. Aerosol generation by thermal dynamics and air exchange will provide better air quality with filtration. ThermaPure projects utilize considerable HEPA filtration devices for scrubbing and maintaining air balances.*

Dr. Burge: "The bottom line is this: Based upon the information and evidence that I have reviewed, if you want to prevent exposure to fungi and the agents they contain that may affect human health, you must physically remove any growth that is likely to lead to any human contact."

*E-Therm: We agree, but removal is not always possible or practical. It is interesting to note that Dr. Burge in a Nov 2005 article supported leaving mold in walls. She said, "The ideal situation for complete removal is when the risk of leaving the mold far outweighs the risk of removal. I know some of you will say -'there is no risk associated with removal.' I will say the opposite: there is little risk associated with dried mold in walls, and significant financial and emotional risk associated with its removal." Again, we agree.*

*E-Therm is very appreciative of Dr. Burge's work and her comments. We would argue that her article hinges around what was not known. We have provided Dr. Burge with additional information about the efficacy of ThermaPure including project examples and research performed.*

## Pasteurization of Soils for Plant Pathogens

Soil pasteurization is another application of high temperatures to manage unwanted micro-organisms. The practice of soil pasteurization increased during the 1960s after research determined it was effective in reducing plant pathogens, including bacteria, actinomycetes and fungi. Research by Bollen (1968) determined that of these soil micro-organisms, fungi were the most sensitive to soil pasteurization. Bollen performed seven trials and determined the results by species to be fairly consistent. There were too few isolates to determine exact thermal death points, but maximum survival temperatures were determined.

Following are some of Bollen's results. In this table the thermal death point of these species was attained and the species did not survive 30 minutes at these temperatures. In the second table, the thermal death point was not attained, but it is estimated that it would fall within the next 5 degrees as this was the highest temperature recorded that the species survived for 30 minutes.

| Species | Temperature* | Species | Temperature* |
|---|---|---|---|
| Oomycetes | 50°C (122°F) | *Trichoderma lignorum* | 55°C (131°F) |
| *Preussia fleischhakii* | 60°C (140°F) | *Cladosporium herbarum* | 60°C (140°F) |
| *Sordaria* spp. | 60°C (140°F) | *Stachybotrys chartarum* | 60°C (140°F) |
| *Sporormia aemulans* | 65°C (149°F) | *Fusarium oxysporum* | 60°C (140°F) |
| *Sordaria carbonaria* | 65°C (149°F) | *Rhinocladiella mansonii* | 60°C (140°F) |
| *Zygorhynchus moelleri* | 55°C (131°F) | *Myrothecium verrucaria* | 60°C (140°F) |
| *Chaetomium* spp., | 55°C (131°F) | *Fusarium redolens* | 60°C (140°F) |

| Species | Temperature* | Species | Temperature* |
|---|---|---|---|
| *Stemphyium botryosum* | 60°C (140°F) | *Penicillium funiculosum* | 70°C (158°F) |
| *Phialaphora mustea* | 60°C (140°F) | *Phoma herbarum* | 75°C (167°F) |
| *Penicillium corylophilum* | 60°C (140°F) | *Penicillium lapidosum* | 70°C (158°F) |
| *Aspergillus fumigatus* | 65°C (149°F) | *Trichocladium piriformis* | 80°C (176°F) |

Bollen, G. (1969)."The selective effect of heat treatment on the microflora of greenhouse soil." *Neth. Journal of Plant Pathology.* 75(1969) 157-63

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ThermaPureHeat®

E-Therm, Inc. is the licensing company for ThermaPure-Heat®. E-Therm is headquartered in Ventura, California and currently has licensees across the nation.

The patented **ThermaPureHeat®** process utilizes clean, dry, odorless heat to create an environment that is lethal to the targeted organism. The process is implemented for the disinfection of structures, enclosable areas, and objects. Used in treating entire structures for more common contamination such as mold, bacteria, termites, dust mites, and other microorganisms; the same scientifically proven principles are effective on bacterial and viral hazards such as E. coli, Hantavirus, Anthrax and Smallpox.

*Act now to obtain information on how you can get in on the "hottest" environmental licensing opportunity.*

The right to market and deploy the proprietary **ThermaPureHeat®** environmental decontamination process has been long awaited by the global environmental community. Visit us at http://www.thermapure.com to learn more about licensing or contact Patrick Medina, Marketing Manager of E-Therm, Inc. at (805) 641-9333.

# Project Profile: Mold Impacted Warehouse

Health Canada had issued a report regarding air quality in the basement of a warehouse structure at the Department of National Defence (DND) facility in CFB, Gagetown, NB. The report indicated that the facility had a mold problem that was related to increased vapor loads in the basements of these structures. The vapor load was probably the result of a combination of improper ventilation and an exterior waterproofing failure. Apparently this problem repeats itself throughout a number of facilities in Gagetown.

The military approached DryAir to perform a test remediation project utilizing their DryAir Equipment. The concept was to utilize the ThermaPure® process with DryAir equipment to pasteurize the affected space. DryAir was provided an 1800 square feet space which is the basement of the B-6 building. No gross removal was performed.

Paracel Laboratories provided both pre and post remediation sample results. According to Paracel "The samples submitted were enumerated and representative isolates transferred to malt extract and Czapek agars for identification." These results demonstrate a successful pasteurization of this portion of the structure. Indoor levels of viable spores were reduced to levels lower than outdoor concentrations. The only species found indoors after the ThermaPure® treatment was *Cladosporium cladosporioides* which is commonly found in outdoor samples and is probably the result of infiltration from outdoor air or contamination from elsewhere in the building. This was an extremely successful project and the Canadian military wants to extend the test to three more facility types.

*"...man will occasionally stumble over the truth, but usually manages to pick himself up, walk over or around it, and carry on." Winston Churchill*

| Preliminary Results | CFU/m³ | Post Remediation Results | CFU/m³ |
|---|---|---|---|
| Outdoor Comparisons | 14 | Outdoor Comparisons | 19 |
| *Aspergillus ochraceus* | 5 | *Penicillium funiculosum* | 14 |
| *Aspergillus versicolor* | 5 | *Aspergillus fumigatus* | 5 |
| *Cladosporium cladosporioides* | 5 | | |
| Main Area Basement B-6 | 690 | Main Area Basement B-6 | 14 |
| *Aspergillus ochraceus* | 357 | *Cladosporium cladosporioides* | 14 |
| *Aspergillus versicolor* | 143 | | |
| *Penicillium chrysogenum* | 110 | | |
| *Cladosporium cladosporioides* | 33 | | |
| *Penicillium griseofulvum* | 19 | | |
| *Trichoderma viride* | 14 | | |
| *Eurotium herbariorum* | 10 | | |
| *Trichoderma longibrachiatum* | 5 | | |

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