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Structural Pasteurization

Mold Remediation With Heat

By Mike Geyer

Recently there has been considerable attention to high temperature, structural drying and the concept of structural pasteurization for the mitigation and remediation of bacteria, viruses, mold and other indoor biological contaminants such as insects.

Structural pasteurization, a process patented by ThermaPureHeat, consists of structural heating that essentially pasteurizes a building, or a portion of the building. Much more complex than simply applying heat to a structure or an architectural element, the process heats a structure either directly, via propane-fired heaters, or indirectly via boilers outside the structure that heat a transfer fluid that is plumbed and piped to heat exchangers placed within the structure.

In addition to heating, the process employs a large number of fans and ducting to evenly distribute heated air within the building and/or treatment area, heat-tolerant fan units equipped with high-efficiency particulate air (HEPA) filters to scrub the air clean and physically remove biomass and aerosols, heat sensors to record the process of heating and cooling, and highly-trained technicians to set-up, execute, and manage the process to ensure efficacy.

Structural pasteurization is most often used at 160 F (57 C) and the heated area is kept at that temperature for a minimum of two hours, preferably four hours or more.

ThermaPureHeat is very scalable, i.e., it can be used on small areas, such as under a kitchen cabinet where a dishwasher's waterline popped loose, or it can be used to heat entire structures (e.g., a single family dwelling) or individual floors of structures (e.g., a multi-story health-care facility or multi-family building). It can be scaled to heat at lower temperatures for longer durations if the project warrants drying (i.e., moisture removal or "Dry-Out"), if the project warrants the removal of volatile organic compounds (i.e., accelerate off-gassing or "Bake-Out"), or if the project involves heat sensitive materials, finishes, or equipment that cannot tolerate typical pasteurization temperatures.

It can also be scaled to heat higher temperatures where the benefits of controlling harmful human pathogens exceed that of marring and defacing of architectural elements from the exposure to elevated temperatures. In summary, structural pasteurization is very flexible in application and execution.

Reaching Inaccessible Spaces

One of the biggest benefits is the ability to heat interstitial and inaccessible spaces, and penetrate into architectural elements, therefore drying and killing biological organisms in their place; something that conventional mold abatement methods cannot do.

While conventional mold abatement is premised on physical removal, it cannot remove all sources of mold, nor does it actively dry architectural elements to stop biological growth. Without the use of harmful chemicals, structural pasteurization may be the best available control technology (BACT) for mitigating biological contaminants.

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ThermaPureHeat is best used in conjunction with the gross removal of contaminated architectural elements, cleaning accessible surfaces, and leaving sound elements in place and inaccessible surfaces undisturbed. Once gross removal and surface cleaning is complete, treatment will dry-out moist building materials, oxidize odors, kill most biologicals, and physically remove aerosols and biomass associated with the event that caused the mold to initially colonize and grow.

Another benefit is the ability to kill and control biological organisms without the use of toxic chemicals. Chlorine, chlorine dioxide, sulfuryl fluoride, and methyl bromide represent some of the toxic chemicals currently used to control biological organisms. In occupied structures, it seems ironic that harmful molds are often “cleaned and killed” using harmful chemicals prior to the structure being deemed “safe” for re-occupancy.

Structural Pasteurization

Structural pasteurization is based on the age-old science that as you increase temperature the number of viable organisms decreases. This is why we cook our food, pasteurize our milk, and keep cooked foods above 140 F at the buffet line. Structural pasteurization uses this foundation, along with modern equipment (direct and indirect fired heaters, heat tolerant HEPA units, thermal imaging sensors, etc.) and highly trained technicians, to achieve a level of cleanliness heretofore unavailable, until now.

There are limitations, however. It cannot sterilize a structure. To reach sterilization levels, autoclave temperatures of 250 F (121 C) held for 60 minutes are necessary. Even at these temperatures, some thermophilic microorganisms may survive (e.g. anthrax spores); they are amazingly hardy creatures. Moreover, if thermal remediation is not performed diligently, some areas may not be sufficiently heated, and if left at reduced temperatures (e.g., 110 F) conditions may be such that mold growth will be promoted.

However, undercooked chicken, which has the possibility of containing harmful salmonella bacteria does not keep us from cooking chicken and eating it; we must be diligent in the kitchen. Similarly, ThermaPureHeat is a process using highly-trained technicians who are diligent, and who completely and effectively heat (cook) the area being treated in order to kill, not promote, microorganisms.

Sterilization is not the intent of the process. It’s structural pasteurization, and it’s performed to reduce target organisms by acceptable orders of magnitude to substantially reduce the concentration of harmful biological organisms, reduce the damaging effects those organisms may have on the structure, and improve indoor air quality for occupants.

A Complex Process

There is considerable effort in accomplishing structural pasteurization. The key is reaching a target temperature, sustaining that temperature for a specific amount of time, and maintaining an equal distribution of that temperature throughout the structure or portion of the structure being treated. Reaching and maintaining a temperature of 160 F for several hours is a complex task that requires highly skilled technicians. It requires a thorough knowledge of the heating equipment, treatment processes, building components, and thermal dynamics.

Heat technicians are thoroughly trained and experienced in heating structures. Buildings are complex and use a variety of building materials of varying physical properties, thermal mass, and conductivity. Some building components and contents are not tolerant of pasteurization temperatures, and must therefore be protected or removed prior to heating.

Safety for the structure, its contents, and the technicians applying heat is always a concern. Pasteurization requires a specifically engineered process applied in a safe and diligent manner that will vary according to the building, the environment, the target organism and extent of growth, distribution uniformity, air pressures, HEPA filtration requirements, temperature sensing, thermal imaging, humidity, moisture content, and a host of other relevant criteria.

What is the Efficacy?

Does ThermaPureHeat kill mold? Yes! Will ThermaPureHeat kill all the mold in all the spaces of a building and remove all the bio-mass associated with the mold growth and amplification?

No! Neither will conventional mold remediation methods or processes. Can it meet the same level of clearance as conventional mold remediation? Yes! The current standard of care for achieving clearance (i.e., a condition fit for re-occupancy) is based on the comparison of indoor mold spore concentrations to outdoors. There are hundreds of projects completed by consultants and laboratories providing post-treatment analysis of remediation projects using structural pasteurization, and most clearance results demonstrate that the process is more effective than traditional remediation; it achieved lower concentrations of both viable and nonviable microorganisms, and it resulted in lower concentrations of airborne biomass.

Still, some consultants question its efficacy for the mitigation of allergens and mycotoxins. These are both complex issues. Mycotoxins are chemicals (e.g., fungal metabolites) and, although high temperatures will oxidize some of them and air filtration will remove some of them, pasteurization temperatures will not mitigate all of them. Pasteurization temperatures will also impact allergens, reducing some of them, but not all of them. The research is preliminary and ongoing, and effective temperatures, durations, and order of magnitude reductions are not known due to the broad scope and type of substances that are considered allergenic.

It is interesting to note that these two issues aren't of great concern to all remediation methods, and few, if any specifications exist that require mycotoxins and/or allergens to be reduced to specific levels, nor are mycotoxin or allergen concentrations typically found in clearance standards.

It is important to look at the ThermaPureHeat technology as an additional tool, not as a replacement method. In situations where the BACT is needed, the addition of this technology to traditional remediation will provide significantly increased value and benefit. Whenever possible or practical, gross remediation should still be used to remove accessible biomass. The reality is that everyone and every method leave biological materials behind all the time, i.e., no living space is sterile post-abatement. We do this with knowledge and we measure the acceptability of occupancy by evaluating the indoor concentration of aerosols in air and compare results to practical standards.

If the indoor air concentrations are acceptable, we ignore what we left behind. This is logical because mold is ubiquitous and we cannot, nor would we want to, eliminate it entirely; it is not practical to do so. Moreover, structures that have had thermal remediation have a much lower concentration of viable spores left behind, and in the event that a subsequent water event occurs, the growth and amplification of mold colonization will be less than without thermal remediation.

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