

Technical Information:

EnviroKlenz® For Mold-Generated Volatile Organic Chemicals (VOCs) Control

Understanding the long-term effects and risks of environmental exposures to a variety of chemicals is of paramount importance, as within the disaster restoration industry, professionals are routinely exposed to chemical compounds from a variety of sources. It is widely known that water jobs carry the risk of exposure to mold. Most people are aware of the allergic implications of mold exposure, but there are other chemical related risks on virtually all mold and water jobs that are often overlooked.

Background on mold-generated VOCs

Indoor mold growth has long been associated with a musty or earthy smell, which most people find offensive. This characteristic smell has been found to result from the production of VOCs by various molds, such as *Aspergillus* and *Penicillium* speciesⁱ. Many different indoor molds produce VOCs, and a large variety of VOCs may be produced depending upon the species of mold, the specific conditions under which it is growing, and the substrate it is growing on.

Health hazards

The VOCs produced by molds have been determined to be hazardous to healthⁱⁱ, since they can damage the olfactory system and even be transported into the temporal lobe of the brain via the olfactory bulbⁱⁱⁱ. Some mold-produced VOCs have been demonstrated to be neurotoxic^{iv} or to cause pulmonary inflammation^v. Persons exposed to indoor molds and mycotoxins (including mold-generated VOCs) have been shown to exhibit symptoms such as poor memory and concentration, in addition to the more commonly known symptoms of eye and throat irritation^{vi}. The CDC states "If mold is seen or smelled, there is a potential health risk..."^{vii}, and the U.S. EPA offers an entire pamphlet for physicians entitled "Guidance for Clinicians on the Recognition and Management of Health Effects Related to Mold Exposure and Moisture Indoors"^{viii}.

Mold-generated VOC control measures

Recommended mold-generated VOC control measures center around ridding the building of the source of the VOCs, namely the growing mold. Contaminated materials should be removed from the structure and disposed of, and the conditions which permitted the mold growth should be addressed.

Additionally, the air inside the building will contain VOCs generated by the mold during the course of its growth. To prevent the health effects of VOC exposure, the building air should be purified. Air purification may need to continue for an extended period of time to allow any VOCs absorbed into the building's interior surfaces, particularly porous surfaces, such as furniture or ceiling tile, to be released.

Mechanism of action

The enhanced chemical reactivity found in the EnviroKlenz Cartridge makes it ideal for removing harmful mold-generated VOCs, thus improving the indoor air quality in water and mold-damaged structures.

The proprietary EnviroKlenz formulation contains a blend of high surface area metal oxides. The large surface area to volume ratio of the metal oxides makes them highly chemically reactive, and particularly suitable for chemical reactions involving destructive adsorption. Microbial VOCs which contact the EnviroKlenz formulation are strongly adsorbed and removed from the air stream. Unlike the VOCs adsorbed by activated carbon filters, VOCs bound to EnviroKlenz will not be released by off-gassing later.

Effectiveness

The EnviroKlenz formulation was tested against 5 VOCs known to be produced by a number of different fungal species.^{ix} For this testing, 0.1 g of EnviroKlenz was placed into a headspace vial with ~ 3 µL of test VOC. The vial was capped and crimped, then vortexed to assure good contact between the EnviroKlenz formulation and the test VOC. After 24 h, the vial was subjected to headspace analysis by GC-FID. The results of this analysis are shown in Table 1.

Table 1: Efficacy of EnviroKlenz against Fungal VOCs

VOC	Odor Characteristic	Percent Removal by EnviroKlenz
3-methyl-1-butanol	Highly Disagreeable	99.0
1-octen-3-ol	Moldy/Meaty	50.0
DMDS	Unpleasant	61.6
2-pentanone	Acetone	98.2
ethyl acetate	Sweet Odor – associated with glues and nail polish remover	95.1

As seen in Table 1, EnviroKlenz demonstrates good activity against various selected fungal VOCs.

Summary

EnviroKlenz is a revolutionary, non-invasive, odor elimination process that can rapidly restore an odor-compromised property.

When a property has an acute odor issue caused by fire, water, trauma, or other nuisance odors or chemicals, EnviroKlenz can be immediately deployed to begin restoring the environment.

EnviroKlenz is the most environmentally friendly odor restoration process available. It removes the airborne odor-causing molecules without releasing chemicals into the air like hydroxyl, ozone, masking agents or thermal fogging processes.

ⁱ Pollizi V, Delmulle B, Adams A *et al.* "JEM Spotlight: Fungi, mycotoxins and microbial volatile organic compounds in mouldy interiors from water-damaged buildings" *J. Environ. Monit.* **2009** 11 1849.

ⁱⁱ Hope AP, Simon RA "Excess dampness and mold growth in homes: an evidence-based review of the aeroirritant effect and its potential causes" *Allergy Asthma Proc.* **2007** 28 262.

ⁱⁱⁱ Thrasher JD, Crawley S "The biocontaminants and complexity of damp indoor spaces: more than what meets the eyes" *Toxicol. Ind. Health* **2009** 25 583.

^{iv} Inamdar AA, Masurekar P, Bennett JW "Neurotoxicity of fungal volatile organic compounds in *Drosophila melanogaster*" *Toxicol. Sci.* **2010** 117 418.

^v Pestka JJ, Yike I, Dearborn DG *et al.* "*Stachybotrys chartarum*, trichothecene mycotoxins, and damp building-related illness: new insights into a public health enigma" *Toxicol. Sci.* **2008** 104 4.

^{vi} Kilburn KH "Neurobehavioral and pulmonary impairment in 105 adults with indoor exposure to molds compared to 100 exposed to chemicals" *Toxicol. Ind. Health* **2009** 25 681.

^{vii} Centers for Disease Control, "Indoor Environmental Quality: Dampness and Mold in Buildings", online at <http://www.cdc.gov/niosh/topics/indoorenv/mold.html>. Accessed January 11, 2011

^{viii} United States Environmental Protection Agency "Guidance for Clinicians on the Recognition and Management of Health Effects Related to Mold Exposure and Moisture Indoors" **2004**, online at

<http://oehc.uchc.edu/images/PDFs/MOLD%20GUIDE.pdf>. Accessed January 11, 2011

^{ix} Matysik S, Herbarth O, Mueller A "Determination of microbial volatile organic compounds (MVOCs) by passive sampling onto charcoal sorbents" *Chemosphere* **2009** 76 114.