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Controlled Atmosphere/CO2 - Treatment Fact Sheet

Controlled Atmosphere / CO2

Brief description of treatment

Controlled Atmosphere Treatment is sometimes inaccurately referred to as an anoxic or fumigation treatment. Because CO2 is an inert, atmospheric gas the preferred term is Controlled Atmosphere Treatment or CAT. Another associated term is hypercarbia which refers to excessive carbon dioxide as opposed to low oxygen. During the treatment process, carbon dioxide gas (CO2) is used to displace oxygen within a sealed enclosure to a percentage low enough to kill all stages of the insect life-cycle: adults, larvae, pupae and eggs. Oxygen deprivation (anoxia) leads to an increase in mortality rates, but it is desiccation, or dehydration due to increased respiration which specifically accounts for physiological death. Treatment time is typically four-weeks in the 'kill zone' range: 8.2%- 4.8% oxygen, 60% CO2 at 20-29ºC (68-84ºF). Updated methods show that treatment times can be reduced by increasing the initial CO2 to 80% within the first five days. From this point on, 14 days are necessary to kill all species. During this period it is imperative that the CO2 does not fall below 60% and temperatures do not fall below 80º F

What materials can be treated this way?

This treatment is appropriate for all materials. Some concerns have been expressed about the formation of carbonic acid- H2CO3 within higher concentrations of CO2, and the potential for damage to sensitive surfaces, including some dyes and pigments. However this is very unlikely since carbonic acid forms in water, not in moist air. Even in water the majority of the carbon dioxide is not converted into carbonic acid and stays as CO2 molecules, as it requires a catalyst to reach equilibrium.

General procedures

Procedures vary depending upon the particular set-up and system. In general, the procedure entails sealing collection objects within a proprietary vapor-proof enclosure. Air is evacuated from the enclosure with a vacuum system, and then the enclosure is filled with CO2. The pressure of the entering gas is controlled through a series of valves and meters. This process of vacuuming and filling is repeated until the CO2 level stabilizes at 60%. Typically, temperature and relative humidity inside the enclosure are monitored throughout the process. After 3-4 weeks, the CO2 gas is evacuated from the enclosure. (See Case Studies for examples).

Pros and Cons of this treatment

Pros
• Safe for all collection objects
• No 'residual' effects from treatment
• Highly effective at killing all museum pests at all stages of life cycle
• Cost effective once set up is in place

• Once the set up is in place there is no additional material waste
• Various sizes and types of enclosures can be created
• Can be set up in-house

Cons
• Long treatment times required - up to four weeks
• Large, sophisticated systems can be expensive to purchase
• May require a special permit or operator's license, depending upon local regulations
• Requires additional, special equipment to safely operate and monitor - to provide for safe evacuation of CO2 gas
• Although CO2 is an inert gas, it does pose human health hazards

• The treatment must be monitored requiring staff time (e.g. to check for leaks, CO2 levels and equipment malfunctions)

Selected web resources

Selwitz, Charles and Shin Maekawa. 1998. Research in conservation: Inert Gases in the Control of Museum Insect Pests. The Getty Conservation Institute.
http://www.getty.edu/conservation/publications/pdf_publications/inertgases.pdf

Product suppliers

Because of the specialized procedure involved with CAT systems, material suppliers and manufacturers may also be the vendors.
• EXPM supplies "Anoxia De-Infestation Chambers" http://www.expm.com.pt/en/
• Maheu & Maheu Pest Management supplies and installs CAT systems
http://www.maheu-maheu.com

Material Safety Data Sheets (MSDS):

CO2 gas - http://www.ri-research.com/techinfo/prodsafe/pestcontrol/SDS473.pdf