

# MuseumPests.net

A Product Of The Integrated Pest Management Working Group

## Controlled Atmosphere/CO<sub>2</sub>Treatment Fact Sheet

### Brief description of treatment

Labeled as a *Controlled Atmosphere Treatment*, and sometimes inaccurately referred to as an anoxic or a fumigation treatment. Because CO<sub>2</sub> is an inert, atmospheric gas the preferred term is *Controlled Atmosphere Treatment or CAT*. During the treatment process, carbon dioxide gas (CO<sub>2</sub>) 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 and pupae. Oxygen deprivation (anoxia) leads to an increase in mortality rates, but it is desiccation, or dehydration which specifically accounts for physiological death. Treatment time is typically four-weeks in the 'kill zone' range: 8.2%- 4.8% oxygen, 60% CO<sub>2</sub> at 20-29°C (68-84°F). Updated methods show that treatment times can be reduced by increasing the initial CO<sub>2</sub> 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 CO<sub>2</sub> does not fall below 60% and temperatures do not fall below 80° F

### What collections materials can be treated this way?

This treatment is appropriate for all collections materials. There are some circulating concerns about the formation of carbonic acid- H<sub>2</sub>CO<sub>3</sub> within higher concentrations of CO<sub>2</sub>, 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 CO<sub>2</sub> 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. First the air is evacuated from the enclosure with a vacuum system, and then filled with CO<sub>2</sub>. The pressure of the gas entering is controlled through a series of valves and meters. This process of vacuuming and filling is repeated until the CO<sub>2</sub> level reaches 60%, and then stabilized. Typically, temperature and relative humidity inside the enclosure are monitored throughout the process. After 3-4 weeks, the CO<sub>2</sub> 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
- Efficient and cost effective, carbon dioxide gas is relatively inexpensive although initial set up can be costly
- Many different types of systems can be created, from small to large
- Can be set up in-house

#### Cons

- Longer treatment times required- up to four weeks
- Larger, 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 CO<sub>2</sub> gas
- Although CO<sub>2</sub> is an inert gas, it does pose human health hazards

### **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](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 are many times the vendors.

- EXPM company supplies Anoxia De-Infestation Chambers <http://www.expm.com.pt/en/>
- Maheu & Maheu Pest Management company supplies and installs CAT systems <http://www.maheu-maheu.com>

### **Material Safety Data Sheets (MSDS):**

CO<sub>2</sub> gas - <http://www.ri-research.com/techinfo/prodsafe/pestcontrol/SDS473.pdf>