Integrated Pest Management: Object Treatment Options

Prevention is always better than cure, but when pests are found in objects then some remedial action may be necessary. Eradicating insect pests in cultural heritage objects entails knowledge of two distinct disciplines: the **properties of the materials** under attack and the **insects** themselves.

Any treatment applied to objects must not compromise the integrity of the object, alter the **physical** and **chemical composition** of the object materials and must take into consideration **object condition**, whilst also ensuring the **efficacy** of the treatment process in targeting the insect pest species present. Poisonous gases such as methyl bromide and ethylene oxide pose health and environmental risks, and this has led to the use of these safe and effective alternatives:

- Low temperature
- High temperature
- Nitrogen anoxia, low oxygen
- Carbon dioxide fumigation

Insect structure

Knowledge of an insect's **physiology** helps in the design of effective treatment methodologies. Treatments can be targeted at the insects' respiratory and nervous systems.

Treatment options

Thermal treatment methods

Low temperature and high temperature treatments are lethal to insects. And they are effective in eradicating all stages of the lifecycle of insect pests. They do not cause damage to objects if procedures are carried out in accordance with recognised standards.

Low temperature- Freezing kills insects by rapid temperature change. It is a widely used treatment for many objects such as natural history specimens, books and textiles. Composite, fragile, or unstable materials should not be subjected to extremes of temperature. The process is quick and is safe for staff and most objects. Objects must be bagged, making it a time-consuming and labour-intensive process.

Heating- Heating will kill insects much more rapidly than freezing. Damage due to shrinkage and distortion must be eliminated by controlling the humidity surrounding the object. Many objects including books, furniture, textiles and natural history specimens have been successfully treated. As with low temperature, it is inadvisable to subject composite, fragile or unstable materials to extremes of (high) temperature.

Modified atmosphere treatments

Modified atmosphere treatments include low oxygen environments using nitrogen anoxia or carbon dioxide fumigation.

Anoxia

Anoxic conditions, the exclusion of oxygen, can be achieved by three methods: using cylinder nitrogen, nitrogen generators and oxygen scavengers.

Nitrogen anoxia- Nitrogen is an inert gas and is used to kill insects by anoxia, which is the exclusion of oxygen. For this eradication method to be effective, oxygen levels must be maintained at a very low concentration and at less than the 0.3% needed to kill insects. Nitrogen has proven to be a very effective and safe method for treatment of sensitive objects, but treatment takes some weeks and the kill speed dependent upon the pest species

and temperature. It is a very safe gas to use providing sensible precautions are taken. Nitrogen treatment can be carried out in a nitrogen chamber or in barrier film bags or bubbles.

Oxygen scavengers- anoxic conditions can be achieved in barrier film bags using scavengers which absorb oxygen. The dose is calculated by the volume of the enclosure.

Carbon dioxide fumigation- Carbon dioxide treatment is used in chambers or bubbles. It is a poisonous gas which kills insects when it enters the respiratory system. Treatment can take some weeks particularly at low temperatures, so some treatments heat the chamber to 30°C to increase insect metabolic rates, resulting in a faster kill. Treatments with carbon dioxide and nitrogen are regulated in some countries and it is important to check this before use.

Treatment	Advantages	Disadvantages
Low temperature	Quick process, 3 days at -30°C and 14 days at -18°C	Objects must be bagged
	Safe for many objects and staff	Not suitable for objects that are very fragile or under stress
High temperature	Very rapid, 24-hour cycle at 52°C	Needs control of humidity
	Objects do not need to be bagged	Not suitable for objects that are very fragile or under stress
	Safe for many objects and staff	Some materials are unable to be treated, such as some plastics
Cylinder nitrogen in chambers or bags	Inert, safe for objects and staff	Long (2-3 week) exposure required
		Maybe ineffective at low temperatures
		Large objects need large quantities of nitrogen and it can be difficult to maintain low oxygen levels
Oxygen scavengers	Very convenient for smaller objects	Long (2-3 week) exposure required
	Safe for objects and staff	Expensive for large objects, because of the large numbers of sachets needed
		May be some release of moisture
Nitrogen generator	Very convenient for smaller objects	High capital cost of equipment.
	Safe for objects and staff	Slow output of nitrogen may necessitate storage tanks
Carbon dioxide fumigation	Much lower hazard than other toxic gases	Long (1-2 week) exposure required
	Very safe for most objects	Large bulk of carbon dioxide required
	Useful for large objects in a chamber or under sheets	

After treatment

Objects should be checked to ensure that all insects have been killed. Objects should be cleaned to remove dead insects, larvae and any other evidence of infestation, such as frass and webbing. Care must be taken to prevent treated material becoming reinfested. Treated and pest free objects should be kept separately from actively infested materials, preventing reinfestation. All treatments applied to objects should be documented.

References

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