ANOXIC TREATMENT OF A MOTH-INFESTED SADDLE

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Pest insects pose a continuous and serious threat to museum objects that are organic in origin. Traditionally various chemical substances have been used for insect control, but in recent decades there has been increased concern about the disadvantages of this type of control strategy (Dawson 1988). Among the alternative control methods developed for museum use in recent decades, low oxygen treatment (Gilberg 1991) is of special interest. Using nitrogen or argon to replace oxygen, produces no residues and allows a conditioning of the gas regarding temperature and relative humidity.

The first practical application of this method took place at Skokloster Castle in Central Sweden.

Skokloster Castle was built by Field Marshal Carl Gustaf Wrangel in the 17th century. Today it is owned by the Swedish state and serves as a museum with a unique collection of works of art, weapons, books and textiles. No central heating system has ever been installed in the house. The indoor climate follows, though moderated and delayed, the variations of the outdoor climate.

Since 1980 several infestations of the common clothes moth, *Tineola bisselliella* (Hummel) (Lepidoptera: Tineidae) have been observed around the collection of old saddles. The moth has four development stages (egg, larva, pupa and imago). The larva eats wool, feathers, hair and other animal products and is one of the few organisms which can digest the

protein keratin. The number of generations depends on the availability of food and on the ambient temperature and varies from 4-5 in one year to one generation in four years (Åkerlund 1991).

The collection contains 23 saddles, many of which are from the 17th century. They are all very complex regarding material and construction, and it seems that the moths primarily use the upholstery (wool, hairs etc.) as their main source of food. Several attempts to eradicate the moths through treatment with dichlorvos have not been successful. Other control methods have been discussed but rejected for various reasons. One problem in choosing a method is the complexity of the objects as mentioned above; leather, wood, metal, textiles and

120 other materials are found in the saddles.

In 1997 low oxygen treatment was considered as a possible solution to the problem and a case study was designed.

Low oxygen treatment could be carried out either by evacuating air without replacing it (vacuum treatment) or by replacing the atmospheric oxygen with some other gas, preferably carbon dioxide, argon or nitrogen. Combinations of carbon dioxide and the other gases have also been used. There are now several examples of successful anoxic treatment (Gilberg 1991; Newton et al. 1996; Reirson et al. 1996). Vacuum, however, is not recommendable, as there is an obvious risk of dehydration during the treatment. There was also a possibility that it would be impossible to achieve the low pressure values needed for a successful result in the inner parts of the saddle.

As nitrogen is a comparatively low cost gas it was regarded as suitable for use in the experiment. When working with the low oxygen levels needed for successful treatment (less than 0.3%) it is necessary to isolate the object from the adjacent air by means of a barrier with low oxygen diffusion rate properties to avoid oxygen leaking into the gas volume surrounding the object. Several types of laminates with such qualities have been developed.

METHODS AND MATERIALS

The saddle was placed on a wooden stand and encapsulated in a Rentokill™ bubble by heatsealing, leaving one corner unsealed. Before sealing, a small vial with a perforated lid, containing clothes moths was placed on the floor of the bubble right under the saddle. The moths were

taken as larvae from the Danish Pest Infestation Laboratory in August 1997 and had been stored at room temperature (+20 - 25°C, 20-40 % RH) until the start of the experiment on December 4. The only food source during this time was woollen cloth. A few imagines (<10) were observed alive at the starting date. The sensor of an oxygen analyzer (Analox Oxygen Analyser) was placed in the bubble and nitrogen from a gas bottle was fed into the bubble through a Rentokill™ humidifier. The humidifier is equipped with one waterfilled and one dry bottle. By closing or opening valves it is possible to control the relative humidity of the inflowing gas. The ambient temperature and relative humidity at the start of the experiment was +19° C, 33-35%. Flushing with nitrogen was started and after about 20 minutes the oxygen level was 4.4% . Fifteen bags of Ageless™ Z100 (an oxygen absorber) were introduced into the bubble and heatsealing was completed. During the first hour four flushings were performed. After each flushing the gas pressure was reduced by evacuating gas through the outlet valve using a vacuum pump. The oxygen reading after four flushings was 0.3%. An hour and a half after the start of the experiment the oxygen level within the bubble was 0.24%; the temperature was 17.9°C and RH 38.4%.

The oxygen level was checked daily and nitrogen was added if the reading exceeded 0.3%. A datalogger remained inside the bubble allowing the continuous recording of temperature and relative humidity. During the period of the experiment 4.12 - 23.12 the temperature varied from 15 to 16.5°C and RH was

kept between 39 and 42 %.

After the 19 days exposure time, the bubble was opened and the vial of moths removed. Survival was checked after one week and once more after about one month, when the moths were also counted. To monitor any surviving moths in the saddle, a sticky trap with moth pheromones was placed inside the bubble, which was then sealed and kept in room temperature (16-20°C). The bubble was opened three months later for inspection.

RESULTS AND DISCUSSION

The low oxygen treatment had no visible influence on the saddle. No moths were observed in the pheromone trap. Fifty-five eggs and 37 larvae, all dead, were found in the vial. No live imagines could be seen.

Our conclusion is that the treatment was successful and that the method is very suitable for the type of infested museum objects represented in this study. There are few disadvantages to the method, it must, however, be stressed that a well ventilated room has to be available during the flushing phase, to avoid low oxygen levels in the atmosphere inhaled by people.

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SAMMANFATTNING

Skokloster slott byggt under 1600-talet på initiativ av Carl Gustaf Wrangel har unika samlingar av konst, vapen, böcker och textilier. Det ägs numera av svenska staten. Sedan 1980 har klädesmal observerats vid de gamla sadlar, som ingår i samlingen. Tidigare bekämpningsåtgärder av mer traditionellt slag har inte visat sig vara effektiva, och man beslöt att prova en i museisammanhang relativt ny teknik, nämligen kvävgasbehandling. För att denna metod skall fungera bra krävs en syrehalt på högst 0,3 %, något som kan uppnås om föremålet innesluts i diffusionstät plast. För att testa metoden behandlades en sadel i en s.k. bubbla från Rentokill®. Exponeringen pågick i 19 dagar i 15 -16,5°C och en relativ fuktighet av 39 and 42 %. Av de klädes-

- 122 malar, som i en rymningssäker burk hade placerats intill sadeln, överlevde ingen. Ej heller fångades någon mal i den feromonfälla, som efter exponeringstiden fanns vid sadeln.

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