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Anoxia Seminar

8th November 2007, Natural History Museum, London

David Waterhouse, Assistant Curator of Natural History
Norfolk Museums and Archaeology Service

Simon Moore (Hampshire County Council Museum Service)
Hampshire Museums Service's anoxic treatment regime on a tight budget

The total cost for Hampshire Museums Service anoxia project was about £1,200, but it is easy to use and required very little time to set up. It is basically a fibreglass tank, 3 feet deep, with nitrogen canisters and an oxygen meter. The most expensive part of the set-up was the oxygen meter at about £1,000. Clip seals on a Neoprene gasket make sure it is all airtight. Objects are loaded in to the anoxia chamber by putting them in collapsible crates and lowering them in using cord handles. A second, smaller chamber has since been constructed (which saves on nitrogen gas if only small objects need to be treated).

The nitrogen from canisters passes through de-ionised water chambers (to add humidity to the 'dry' gas). Nitrogen poses little, to no health and safety risk, as it is a very high percentage of the atmosphere anyway.

Pests are killed by a mixture of asphyxiation and being dried out as the gas opens their spiracles. As the nitrogen passes through a water tray it bubbles and this is lets the operator know when the gas has run out.

At Hampshire Museums Service this method has been 100% effective (all pests have been killed when treated). The penetration of the gas has been tested through quite thick feathers to a depth of 13cm. The nitrogen gas is also relatively cheep. Specimens are put into the chamber for a week at a time (if treating woodworm it needs to be for a month). The chamber has to be at temperatures above 20°C for the process to work. Relative humidity needs to be about the same as the object was in originally, so as not to damage the specimen by drying it out or moistening it too much (a general guide is 45% humidity for taxidermy specimens). However, the lower the humidity the more effective the treatment is (as it dries out the insects). It is the fluctuation in humidity that is really harmful for specimens rather than sustained periods of high or low relative humidity.

Advantages of anoxia over freezing are that some materials can de-nature during the freezing process – such as very old glass eyes splitting, *etc*. This does not happen in an anoxic environment.

Dr. Agnoko Michèle Gunn (Musée Quai Branly, Paris)
Advances in anoxic treatment at the Quai Branly Ethnographic Museum, Paris

The Quai Branly Museum collections consist of a library, archives, photos' and ethnographic objects. All the collection was treated before moving them to the new museum in 2006. The process took three years and 300,000 objects were treated.

Nitrogen was produced *in situ* from the air (an oxygen separation unit was used, then the nitrogen was pumped into chambers in with the objects). As the nitrogen is 'dry' when is comes out of the separator, a reservoir of water is used to re-humidify the gas.

Objects were loaded into the chambers wrapped loosely in card or plastic boxes and put into metal trolleys.

The whole process is computer controlled, with onscreen read-outs of humidity, percentage oxygen, temperature, *etc*. Although the temperature was just recorded, and not controlled by the computer; so the room had to be heated separately.

All new objects and loans to the museum are treated in this way (except now they have moved into the museum they have a similar, smaller system). The new system is smaller than the old one, but it has a bubble chamber that can be added to increase its size for larger objects, bigger loads, *etc*. The major difference with the new system (apart from size) is that temperature is controlled directly using a computer instead of relying on the room being heated separately.

The system was tested using both insect eggs and larvae (of a species of long-horn beetle):

- After 7 days of treatment there was 100% mortality of both larvae and eggs;
- After 5 days there was 100% mortality of larvae, but 64% of eggs were still able to hatch.

During actual treatment the objects are left in for (on average) 14 days (3 weeks in the bubble chamber).

The initial, large unit cost €200,000 (about £140,000) and the small unit still in use cost €50,000 (*c.* £35,000). The system was chosen over freezing because there is much less packing involved and problems arising from condensation are avoided.

Adrian Doyle (Natural History Museum, London)
Recent research into barrier films with practical considerations encountered with the film Escal®

Film bags (Fig. 1) can be used as barriers against high levels of relative humidity, stopping things like pyrite rot (which can happen in as little as 45% humidity). Bags can also be used to stop sub-fossils from drying out (they need a high relative humidity). In theory, two objects needing completely different atmospheric conditions can be stored next to each other using barrier film bags.

Heat welders are good for sealing bags for humidity control, but are not so good for oxygen level control. *Stewarts®* Boxes are the same (no good for controlling oxygen). *Escal* is very useful as it is transparent and is designed specifically to be an oxygen barrier. It is always the heat seal that is the weakest point in the bag. As an alternative method of sealing, *Escal* clips can be purchased, but as they rely on a mechanical process, they don't work so well after a few times (the same with *Weloc* clips). There is no real recommended temperature for heat-sealing these bags. The inside layer has a lower melting point than the outside and it is this layer that welds the bag shut. This layer melts at around 120°C.

Fig. 1. Roll of *Escal* Film (image from www.conservation-by-design.co.uk)

In tests, hairs, creases and dirt were all sealed along the heat weld, then dye was put inside and a weight put on top. Tensile strengths were also tested. The jaws of the heat sealers have a slightly different temperature along them (despite the manufacturers saying that they are even). When the *Teflon* tape along the jaws begin to fail, the temperature settings need to be different – so the tape needs to be replaced when this happens.

The wider the seal the better. Some heat sealers will give up to 10mm seals (which will hold longer if handled a lot). *Crosswelds* have a 2mm weld (which does the job well enough if not being handled too much). Double welds can be used to make sure of a good seal.

Gusseted bags can be bought to put more 3D objects in (however the outside layers are then being welded together at the top of the bag, so this seal may not be as good).

Super Escal is now available (which has a layer of Nylon in it as well). However, more work needs to be done on this as the Nylon may affect the melting temperature of the material.

Sharp objects needing to be packaged can be put into boxes to stop the object from compromising the *Escal. Escal* can be bought in the UK from a company called *Conservation by Design Ltd.*

More information about *Escal* from the *Conservation by Design* website (see Fig. 1).

***Escal*™ *RP System*, Ceramic Deposited Gas Barrier Film**

ESCAL™ is a ceramic deposited super barrier film developed especially for the protection of cultural properties, which is supplied in rolls. The material had been developed for use with the *RP System*. The user can unroll and cut the *ESCAL*™ film to a desired length and seal with a heat sealer or *ESCAL*™ *CLIP*. Each *Escal* ™ film roll includes a continuous data entry space with a white writable background.

ESCAL™ has a particularly outstanding ability to keep out moist air. It is therefore, very useful not only for the preservation of damp wooden artefacts but also for all other conservation or storage purposes. On the other hand, the RP agent works to keep the inside atmosphere of a container very dry, therefore it is not appropriate for conservation or storage of small quantities of paper/textile materials or wooden artefacts, which require a more normal pH.

Chris Collins (Natural History Museum, London)
Packaging and environmental control relating to anoxia

The Natural History Museum conservation unit is driven by research – not display or education. Anoxic environments are not a new thing and have been used for hundreds of years in the form of spirit collections.

Many specimens in the Natural History Museum collections are oxygen sensitive, so anoxic environments reduce the risk of loss and intervention needed, whilst maximising the resource. However, space can be a big issue in large collections.

An anti-oxidant (that doesn't effect humidity) is put in with the specimens to reduce the oxygen levels – the Natural History Museum use *RP System Agent*™.

Mechanical systems of reducing oxygen levels (pumps and the like) aren't as cost effective and are prone to breaking down eventually – so aren't recommended. The ideal system needs to be both low-cost and effective.

The aim of the Natural History Museum is to keep specimens in their anoxic environments for 20 years without needing to intervene. However they must also be accessible. Small, five-sided *Plastizote* enclosures are constructed to put specimens in.

The major problems with this system (especially for smaller museums) are the initial set-up costs and the costs of the *Plastizote* enclosure materials. The Natural History Museum has in the past helped out small museums that cannot afford the set-up costs. They may be able to help out again (if you ask – they can only say no!). Another problem with the system is the monitoring that needs to be done. The monitors that can be bought are expensive and sometimes inaccurate.

An atmosphere of 0.3% oxygen is needed for pest control, but the food industry, for instance used 2% oxygen (as the food is only stored for a matter of months, not years).

Types of oxygen monitor:

- *Ageless Eye* – effective up to two years
- Fluorescence (*O_2xyDot*®) – effective up to five years

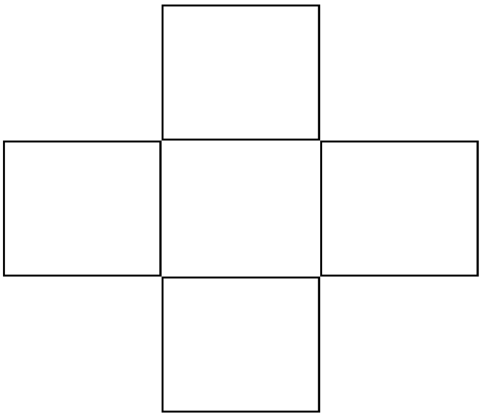
A monitor <u>does</u> need to be put in with every specimen, as the monitor failure rate isn't known. However, this can prove expensive.

Types of oxygen scavenger:

- *RPK* – works at 30% relative humidity
- *RPA* – works at 0% relative humidity
- *Ageless*, *Dustbuster* and *ATCO* all work at 60% relative humidity

You can also purge the oxygen out of a bag by using argon, carbon dioxide or nitrogen (only the latter is legal in the UK). Then one of the above oxygen scavengers is used just to mop up any excess oxygen.

For the purposes of pest control, cheaper, simpler barrier films can be used (as this is generally for much shorter periods of time). Other methods of sealing (apart from heat welding) are using adhesives such as: silicon, butyl rubber *etc*.
Plan of 'sweet packet' barrier design of *Escal* bag:



This method has the potential to be used as a field-collection device as the Natural History Museum has had a completely unprepared shrew in an *Escal* bag containing oxygen scavengers, for well over 10 years! However, this would probably only work for relatively small specimens. Due to the difficulty in heat-sealing in the field (lack of electricity, cumbersome nature of the sealers), the previously mentioned *Escal* Clips may be useful for temporarily sealing these bags.

Emma Sherlock and Lu Allington-Jones (Natural History Museum, London)
Anoxia as an experimental tool

There are many problems with the different substances used to seal microscope slides. Major problems include drying out and cracking. A standard microscope sealant must be able to cope with temperatures of between 18°C and 27°C and a relative humidity of between 37% and 67% (in other words, it needs to be pretty flexible).

As oxygen sensors are not small enough to be put into slides, an experiment for testing a number of microscope slide sealants was devised using sealed test tubes.

They found that Canada Balsam (used for over 120 years on slides) was by far the best medium to use (it survived a regime of freezing and oven heating without compromising and was chemically the most stable substance tested).

More information about Canada Balsam from Wikipedia (http://en.wikipedia.org/):
Canada Balsam

Canada Balsam, also called Canada Turpentine or Balsam of Fir, is a turpentine which is made from the resin of the Balsam Fir (*Abies balsamea*).

The resin is dissolved in essential oils, and is a viscous, sticky, colourless (sometimes yellowish) liquid, that turns to a transparent yellowish mass when the essential oils have been allowed to evaporate.

Due to its high optical quality, its refractive index (n = 1.55, very close to that of glass), and its purity, it is mainly used in optics as an invisible-when-dry glue for glass. It is soluble in xylene, amorphous when dried, and it does not crystallize with age, so its optical properties do not deteriorate.

Personal Conclusions
As always, it was a pleasure for me to attend a NatSCA event, and visiting London - the Natural History Museum in particular (Fig. 4) - is always an opportunity not to be missed! I must admit that, as well as the anoxia seminar I also came to see if I could pick up any new and exciting ideas from the NHM for gallery re-developments at Norwich Castle Museum – it is always interesting to see how someone else has approached a similar subject.

I came to the seminar not really knowing what to expect (partly because I was a last minute replacement), but thinking that the seminar would be all about anoxia as a means of pest control (being of that mind-set at the moment having just installed a room-sized freezer at Norwich Castle as part of our integrated pest management strategy). The thought that anoxia could be used as a preservative environment barely crossed my mind. However, I found the talks about the NHM's programme of packaging oxygen sensitive specimens in an anoxic environment interesting. Especially as we have a similar system of packaging our study skins in Norwich – albeit in plain bags to protect them from pests and dust rather than to preserve them in an anoxic environment. I was also interested when I heard about the potential of using *Escal* bags in the field when collecting small birds and mammals (Chris Collin's 'rat in a bag'!) – this possibility should certainly be explored further.

A couple of minor points - I thought for my needs (and perhaps the needs of most purely Natural History curators), the packaging talks in the afternoon (although very interesting) could have been a bit shorter. Personally I would have preferred to see more time spent on the subjects of the morning sessions - how to set up anoxia chambers for pest control, *etc*. but that's just my opinion! Oh, and the sandwiches were a bit weird (we simple country folk aren't used to the ciabatta rolls filled with cured meats and peppers that Londoners have every day!).

Anyway, that's enough criticism - overall, the seminar was very good and worthwhile. I certainly have a lot to report back about in Norwich and (hopefully) some ideas that may prove useful in the curation of our collections (even if we don't have €200,000 to spend on an anoxia chamber!).

September 2008.
GCG Workshop: Microclimates for your collections
Leeds City Museums Discovery Centre

A practical guide to dealing with your sensitive pyrites, delicate bones and fragile fossils in an individual tailor-made way.

With help from Caroline Butler, geological conservator from the National Museum of Wales and the in-house conservation staff at Leeds City Museums, you can learn how to create and maintain microclimates and the reasons why microclimates might be the best way to safeguard some of your geological specimens.

For further details, please contact Helen Fothergill at Plymouth City Museums & Art Gallery on 01752 30 4765. email: Helen.fothergill@plymouth.gov.uk