Technical sheet No. 4

Conservation service®

STATIC ANOXIC TREATMENTS: general information

GENERAL PRINCIPLE

Oxygen scavengers are intended for packaging objects in gas-tight bags in order to limit oxidation phenomena during long-term storage or to fight against harmful insects by asphyxiation.

EXECUTION INSTRUCTIONS

Oxygen scavengers must be used in sealed packaging made from a special heat-sealable film. There are several types of oxygen scavengers, designated (regardless of brand name) by a reference indicating the amount of oxygen that each sachet is capable of absorbing.
The calculation of the number of sachets to be placed in a bag is based on the volume of air trapped divided by five (since ambient air contains 20.9% oxygen and the actual volume is reduced by the presence of the items to be treated).

When the seals are tight and the film of good quality, oxygen absorption is effective for long enough to achieve the insecticide treatment without controlling the oxygen concentration inside the bag. It is generally considered that a period of three weeks is sufficient to eradicate any type of infestation at a temperature equal to or greater than 20°C. When the temperature is lower it is desirable to increase the duration (or to heat the storage room). As a general rule, objects can be left in the bags as long as it is not necessary to take them out, provided that the ambient climate remains stable enough to avoid any significant hygrometric variation inside (it is desirable to wrap the objects with tissue paper and possibly place an adequate quantity of silica gel in the bags to avoid this risk). For long-term storage, apart from the question of hygrometry, it is also necessary to control the long-term effects of the relative oxygen permeability of the film used. This is indicated by the manufacturer and certified by a public testing laboratory. The calculation of the number of sachets to add to the bag to compensate for the infiltration of oxygen depends on the permeability of the film, the volume of the bag and the duration of storage.

To visually check the importance of the infiltrations, it is possible to insert a colored indicator in the form of a pellet which turns from pink to blue when the oxygen concentration exceeds 0.1 to 0.3%. This precaution is theoretically useless, given that a good correctly welded film actually corresponds to the advertised characteristics (the quantity of oxygen absorber necessary to compensate for the losses can therefore be estimated exactly). This device also requires the use of a transparent film that is much more expensive than the opaque films made in France. It is possible to provide transparent windows in opaque bags, but the melting temperature of the films being different, the welds are of lower quality. Finally, it should be noted that oxygen indicators are not very reliable (they must be stored in the refrigerator and be less than six months old when used).

As for the process intended to pierce the bag with the needle of an oximeter, it is not admissible for the following reasons:

- The oximeters available for this purpose have insufficient precision, so that the measurements are not as reliable as those of the micro-trace analyzers used for dynamic treatments. If we want to be sure that we are really below 0.1% oxygen, the accuracy of the sensors must be ± 10 ppm.
- Drilling through the film to measure oxygen concentration is risky, even through supposedly waterproof foam pellets.

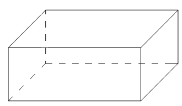
STATIC ANOXIC TREATMENTS: procedure

EXECUTION INSTRUCTIONS

- **Never open the packaging of scavengers without special permission from the manager.**

- Only duly trained people are authorized to handle them, respecting the following instructions:
  - Plan the quantity needed in advance and try to use the maximum number of sachets contained in the vacuum packaging units to avoid unnecessarily exposing unused scavengers to the open air.
  - To do this, package as many objects as possible in advance in order to limit the number of unused scavengers and quickly replace them in packaging that will be heat-sealed.
  - As soon as the vacuum packaging is opened, spread the sachets out on a table (leaving them piled up would cause a chain reaction which would cause them to lose their absorption capacity).
  - Most scavengers (such as ATCO LH for example) have a slow enough reaction time to allow one hour exposure of the sachets to the open air (try to limit yourself to a shorter duration).
  - Never put the scavengers in direct contact with the objects kept in the pockets (risk of localized rise in temperature).

- The calculation of the number of scavengers needed must be done as follows:
  - Measure the volume of the pocket Vp in cm* (1 cm3 or cc = 1 ml): length (cm) x width (cm) x thickness or height (cm), for a pocket of 100cm x 50cm x 12cm, Vp = 60 000cc (60 liters of air).
  - Calculate the volume of oxygen Vo (cc) contained in the bag by dividing the volume of air by 5 (there is 21% oxygen in the air), for example: 60,000/5 = 12,000 cc or 12 liters of oxygen.
  - Divide Vo by the absorption capacity of the Ca sachets (cc), for example: for ATCO LH 3000 Ca 000/3000 = 4, 3000cc, the number of sachets required is equal to 12
  - Add one or more additional packages for safety for static anoxic treatments.

- For long-term storage, it is necessary to estimate the desired storage time to calculate the number of film packets required to absorb the oxygen transmitted through the film:
  - Measure the developed surface Sd of the pocket in m2: sum of each surface [length (m) x width (m)], in our example: 2x(1 x 0.5) + 2x(1 x 0.12) + 2x (0.5 x 0.12) = 1.36m - if the shape of the packaging is a parallelepiped: 
  - and 2x(1 x 0.5) = 1 m2 if it is of the flat envelope type: 
  - Calculer la quantité d'oxygène Qo (cc) transmis par le film pendant le temps de stockage prévisible Ts (jours) en fonction de la perméabilité du film à l'oxygène Po (cc/m-/24h): Qo = Po x Sd x Ts

    For example for a packaging of VALSEM S165, Po = 0.2cc / m2/24h,
    a pocket of 1.36 m2 will absorb in one year an additional quantity of oxygen Qo = 0.2 x 1.36 x 365 = 99.28 CC or approximately 0.1 liter, in 10 years = 1 liter, in 100 years 10 liters, etc.

- calculate the number of sachets n to add according to the absorption capacity of the sachets Ca (cc) to compensate for the quantity of oxygen transmitted Qo (cc): n = Qo/Ca, in our example for 100 years n = 9928/3000 = 3.30, it will be necessary to add 4 additional sachets of ATCO LH 3000, for a shorter duration this type of sachet can be replaced by a lower grade , for example we can take LH 100 whose capacity Ca = 100cc, we have 1 then for 1 year Qo 99.28 and n = 99.28/100 = 0.99 a single packet will suffice (so 10 for 10 years) ,

- Take the necessary precautions to avoid any risk of condensation:
  - Do not pack objects balanced at an RH > 65%,
  - Avoid storing packaged objects for a long period in an environment that is noticeably colder or more humid than the environment in which they were packaged,
  - Wait until the temperature of the objects has equilibrated with the ambient temperature before opening the packaging.

- Calculate the amount of silica gel needed to compensate for significant variations in relative humidity:
  - The quantity of air contained in the bag is generally negligible compared to the volume of the object and packaging in airtight film is an excellent barrier to fight against hygrometric variations, but for long-term storage it may be necessary to take into account the water vapor permeability of the film p (g/m2/24h):
  - The ARGELAC silica gel sachets distributed by Art et Conservation 33, av Trudaine 75009 PARIS, are packaged in the form of bags equivalent to half a unit for the following calculation:
  - t = storage time in months, Sd = developed surface in m2,
  - C= mass of wedging materials (wood, foam, etc.) in Kg, number of units required nU = (4p Sd x t/100) + (5C/2)
  - For storage in months, for example VALSEM S165 has a p= 0.4g/m2/24h, our packaging Sd= 1.36 m2, a storage of 6 months and a C = 0.2 Kg will require 4 x 0.4 x 6/100 + 5 x 0.2/2 = 0.596 or just over half a unit (i.e. one sachet),
  - For longer storage, the following formula is used with the time T in years: nU: 1/2 (pSd x T + 5C), i.e. for 10 years (0.4 x 1.36 x 10 + 1)/2= 3.22 or just over six sachets.

  NB: As you can see, this calculation is quite complex and can be avoided if you try to keep the packed objects under normal storage conditions by avoiding excessive variations in humidity and temperature.