



SCOTTISH
MUSEUMS
COUNCIL



THE EFFECTS OF STORAGE AND DISPLAY MATERIALS ON MUSEUM OBJECTS

Many materials that may seem suitable for storage or display purposes can cause serious damage to museum collections. They can cause corrosion, discolouration or deterioration of objects, either because they give off harmful vapours or because they are in direct contact with the museum object. These processes of corrosion, discolouration and deterioration are sped up by high temperature and/or high humidity levels.

Harmful volatile substances include formaldehyde, acetic acid, formic acid, sulphuric acid, carbon dioxide, sulphur dioxide, nitrogen dioxide, ozone, chlorohydroxide and ammonia gas.

Sources of these substances may be wood products, acrylic resins, paints, lacquers and varnishes, glues and adhesives, pesticides, insecticides, fungicides, furnishing fabrics, adhesive tape and other sticky materials such as "Blu-tack". Electrical machinery such as electrostatic air cleaners and some photocopying machines may produce ozone. Burning fossil fuels can produce harmful vapours and air-borne particles.

WHAT DOES THIS MEAN FOR THE OBJECTS IN A MUSEUM COLLECTION?

All **metals** are affected by harmful vapours released by wood, although some more than others. Lead objects stored in oak cabinets have shown considerable corrosion. Silver and copper objects, metal embroidery threads, sequins and silver photographic images will tarnish as a result of sulphur gases, released by wool.

Paper objects, books, maps, prints, drawings, watercolours, letters and charts will suffer from discolouration and deterioration when mounted on cheap, acidic mountboard. Adhesive tape (sticky tape, masking tape, etc.) will contract and eventually separate from the paper it is used on, leaving a sticky yellow stain that is usually difficult or impossible to remove. Some watercolour pigments are sensitive to acidic and other vapours.

Photographic material, slides, prints and negatives are affected by the vapours and plasticisers used in polyvinyl chloride (PVC) and some other plastics. Sulphur gases tarnish the metal plates on daguerreotypes and paper prints are affected by oxides, which results in a bluish metallic sheen called "silver mirroring".

Textiles will deteriorate more rapidly when they are in contact with acid-releasing materials, such as cheap mount board and acidic cardboard rolls. New fabrics for displays may have been treated with dyes, fire retardant treatments and waterproofing or other finishes. The

materials used for these treatments may cause fading and other damage to historic textiles. Pins and tacks used for mounting and framing will rust when in contact with **textiles** or other materials with a natural moisture content. The rust may cause deterioration of the pinned or tacked object.

Bone, ivory and many other materials are adversely affected by the vapours from rubber and urethane foam ("foam rubber", vinyl tiles, flooring adhesives and rubber-backed carpets). Volatile sulphur compounds from rubber will cause a yellow or orange discolouration in ivory and cellulose acetate ("celluloid") artefacts. The plasticiser in PVC is also an excellent plasticiser for celluloid objects.

Magnetic tapes (cassettes, reel-to-reel and computer) are affected by magnetic sources, such as catches on doors.

Objects made of **rubber** and **modern plastics** can be very unstable and are easily affected by plasticisers released by some wrapping materials (such as PVC bags, sleeves and sheeting). Ozone, which is naturally present in the air and can also be generated by electrical machinery, speeds up the deterioration of rubber. Metals can also have an effect on rubber when in direct contact with it.

Pigments in **feathers** and **ethnographic objects** will fade when affected by sulphuric acid (air pollution, wool felt and fabric).

Formaldehyde, present in many types of wood and composite board, reacts with many different materials to form formic acid, which can be harmful to a variety of museum objects.

HOW TO CHOOSE SAFE MATERIALS

1. Materials used to protect, shape or support the object.

In storage these materials are the first layer of protection against dirt, dust and other harmful influences. They are often in direct contact with the object, and should therefore always be as chemically stable as possible, as any harmful substance in them will directly effect the object.

Acid-free tissue paper is made out of cotton or linen rags, or highly purified wood fibre materials. It should be lignin free, because lignin will cause the paper to become very acidic. Lignin free paper is usually sold as "acid-free", "museum quality" or "archival quality". It is always important to check whether the material is "buffered". Some acid-free tissues contain buffering alkaline compounds. These buffers can help prevent migration of harmful acidic products onto paper objects. Buffered acid-free tissues are safe for use with most collection items. However, they should never be used for photographic material and textiles. For these materials only unbuffered acid-free tissue should be used. Acid-free tissue is used as interleaving tissue when rolling or storing flat items, and as a wrapping or "padding" material for three-dimensional objects.

"Melinex" sleeves, made of transparent polyester sheeting, come in various sizes and are very useful for the storage of photographic material (prints, negatives, slides, plates) and work on paper (prints, drawings, letters, documents, posters and pamphlets). They should not be used for pastels, charcoal drawings and other works with delicate images as the particles of these can migrate onto the sleeve due to static forces. "Melinex" can also be purchased as a continuous film, which can be heat-sealed into custom-sized sleeves. (At least one side of the sleeve should be left unsealed.)

Polyethylene sheeting is free from coatings or plasticisers and is inert. It is useful as a covering material over shelves, pallets and boxes to prevent dust or water damage. It doesn't allow the passage of air though, so can create a harmful microclimate beneath it.

Polyvinyl chloride (PVC) or other plastics that contain chloride or nitrate should not be used, as they give off harmful vapours.

"Tyvek" sheeting is made of high-density polyethylene fibres and prevents the passage of water in one direction (from the smooth outside to the rough inside), but allows the passage of air in both directions. It can be used to make dust covers for costume, (upholstered) furniture and rolled textiles.

"Evolution" sheeting is made of spun bonded polypropylene that can be used for wrapping large objects.

"Bubblewrap" is polyethylene sheeting with bubble padding on one side. It is used as a protective wrapping when transporting museum objects. The bubbles should always face away from the object and an isolating layer of acid-free tissue should be placed between the objects and the Bubblewrap. It should not be used for the long-term storage of museum collections.

For the mounting of prints, drawings, and other (small) flat objects **acid-free mount board** is a good choice. Acid-free board is also used for the fabrication of **storage boxes**, some of which may be buffered to protect the contents from migrating acids. As with acid-free tissue, these buffered boxes should not be used for vulnerable items such as photographs and textiles, as the buffering substance itself may cause damage to the objects.

"Ethafom" and **"Softlon"** are stable polyethylene foams. They can easily be cut into supporting mounts for three-dimensional shapes. They are available in a range of colours, but only the black and white versions are safe for use, as the colorants used in the others may stain or damage objects.

"Perspex" (polymethylmethacrylate) can be made into stands for (small) glass, ceramic and other solid objects in good condition. It can be rather difficult to process, and attention should be paid to ensure that adhesives used do not contain any harmful vapours.

2. Materials used for shelves, cupboards, cabinets and display cases.

These materials are used to create safe environments (cases, cupboards, cabinets) to protect the objects inside from the damaging effects of air pollutants, dust, fluctuations in temperature and humidity, light (in storage) and enthusiastic museum visitors. It is important that, although they are not in direct contact with the objects, these materials do not give off any harmful substances. The levels of harmful substances can rapidly build up within the closed case or cupboard, creating a damaging environment for the objects rather than protecting them.

Metal is the preferred material for display cases and storage shelving or cupboards. It is strong, smooth, inert, non-flammable and does not emit any harmful vapours. However, to prevent rusting in situations with high humidity levels, it should always be covered with a protective layer, preferably a baked enamel finish rather than a paint.

Woods produce harmful vapours such as formic and acetic acid and peroxides, although some

are worse than others. Freshly cut and unseasoned wood produces the greatest quantities of these vapours. Oak, Western red cedar, Cypress and Douglas fir are some of the woods most commonly associated with damage to collection items through the emission of harmful vapours. If wood is to be used, try to use: Kauri pine, Hoop pine or a soft wood and make sure the wood is sealed with a paint-on sealant or a barrier foil (see below).

Composites, such as plywood, chipboard, particleboard, fibreboard and masonite all cause problems. Marine grade hoop pine plywood uses a higher grade of adhesive than other composites and so is more stable if a wood composite must be used. It does however still emit some formaldehyde.

The release of harmful vapours by wood and wood products is a normal chemical process that cannot be prevented entirely. The only way to minimise the emission of any harmful gases is to seal the wood with either a **paint-on sealant** or a **barrier foil**.

Paint-on sealants that can be used are water-based polyurethane sealants, as well as good-quality acrylic latex emulsions and epoxy-resins. Enough time must be allowed for them to dry thoroughly (check the manufacturer's specifications on how much time needs to be allowed for this). This is particularly important for water-based sealants, which will form a skin that is dry to the touch hours before all the water has escaped. When wooden or composite pieces painted with these sealants are enclosed in a case or cupboard too soon the humidity level inside the case will rise. In general a period of 10 days should be allowed after painting for the sealant to completely dry, and for any volatile organic compounds in the sealants to off-gas.

Barrier foils consist of a metal foil, which is impermeable to gases, sandwiched between layers of inert plastic. They can be heat-sealed onto the wood with an iron and are an effective barrier as long as the foil is intact. Nailing, stapling or drilling holes destroys its effectiveness. It is important to seal the edges of boards as these emit vapours at a higher rate than the other surfaces. As an alternative, aluminium foil coated on the back with PVA (Aquadhere) can be used, but it is much more vulnerable and can very easily be damaged.

Fabrics should be chosen carefully. Wool and all fabrics coated with fire retardants or finishes and foam or adhesive-backed fabrics have been found to give off harmful vapours and are therefore not recommended.

Undyed and unbleached cotton or linen fabrics are safe to use, but they have to be thoroughly washed and rinsed before use. Dyed fabrics and synthetic blends should always be tested before use. The fastness of dyes can be checked by rubbing the fabric with a piece of white cotton, first dry and then repeated with damp cotton.

Glass is safe for use near museum objects. It is scratch resistant, gas impermeable and is available laminated or coated with UV-filters. Weight may be a disadvantage though, and its low surface temperature may cause condensation and mould growth on the glass and also on organic materials that become damp as a result of the condensation.

Attention should be paid to **cleaning agents** used for glass: they should not contain vinegar or any other harmful substances.

Polymethylmethacrylate ("Perspex/Plexiglass") and **polycarbonate ("Lexan")** sheets are also acceptable materials, particularly when they have built-in UV absorbing properties. They are lighter than glass and have a higher surface temperature. They have good impact resistance and crack rather than shatter. Disadvantages are permeability to gases, a relatively soft surface that is easily scratched and less rigidity (which may cause large pieces to bend). When used in framing, static can be generated during cleaning, causing parts of the object to

stick to the inner surface.

Other materials, such as **adhesives** that may be used to join several of the above components and **labels** should always be checked for the presence of one of the harmful substances mentioned on page one. Hot melt glues (polypropylene type) and Tyvek or acid-free paper labels are good materials to use.

MUSEUM OBJECTS

It should be remembered that museum objects themselves react in similar ways to the materials described in this factsheet. Modern organic materials are most likely to release harmful gases. For instance, badly processed photographs may give off acidic or sulphidic gases that cause embrittlement and discolouration of the paper, and cellulose nitrate ("celluloid") objects release vapours that speed up their own deterioration. These processes particularly occur when the objects are kept in a confined space (such as a display case, polythene bag or plastic box), where a concentration of the harmful vapour is allowed to build up. Modern organic materials are therefore best displayed in cases that allow air-exchange. In storage they should be wrapped in acid free tissue paper that will absorb the emitted gases, and they should be stored in a separate part of the storage area where there is adequate air exchange.

SUMMARY

It is good practice to always use materials which are as inert as possible in displays and stores, so that they can be re-used when exhibitions are taken down or stores are reorganised. When working with a limited budget the unsafe materials may be replaced gradually, starting with the ones that are used near the most vulnerable items. If there is any doubt about the use of a certain material check with a conservator.

By using safe display and storage materials a safe environment is created for museum objects, which helps preventing further deterioration. This preventive part of conservation is important in the on-going care for museum collections.

FURTHER INFORMATION AND ADVICE

Further information on material that should and should not be used in the storage and display of museum collections can be found in *Museum Methods* (Museums Australia (NSW) Inc) and in *ReCollections* (Heritage Collections Council). *ReCollections* is available on-line www.amol.org.au/recollections

Museums Australia (Vic) can provide assistance with the location of further information on collections care and conservation for small museums. Contact: 03 8341 7344 or mavic@mavic.asn.au

Further conservation information can be found on the Australian Institute for the Conservation of Cultural Materials (AICCM) website www.aiccm.org.au

This factsheet has been adapted for use in Australia by Sarah Slade for Museums Australia (Victoria) with kind permission from the Scottish Museums Council.