

It is a commonplace experience to observe the deterioration of objects and materials which are exposed to the effects of our everyday environment – metals rust; paper becomes yellow and brittle; wood dries and splits; paint cracks, etc. It may seem inevitable that chemical and physical changes must befall all types of materials, but if we understand how objects deteriorate and anticipate the causes of such deterioration, then it is often possible to slow down these changes. Specific steps can be taken to modify the environment that an object is in (whether in storage, on display or while in transit to another location), so as to cushion the negative effects arising from the various deterioration factors.

The environmental factors which affect artworks include light, temperature, humidity, pollution, insect damage, micro-biological growth, use of inappropriate materials, and inappropriate handling of objects. These damages have a cumulative and usually irreversible effect. Hence, it is crucial that preventive measures be adopted to reduce the risks of such damages.

It has been accepted that materials will suffer less damage when their surrounding environments are maintained at a certain range of optimal conditions. This range will vary from material to material. Metals are usually most stable in dry conditions, while a more humid environment will be more suitable for unseasoned or freshly cut wood. Fugitive colours on textile will not do well in strong lighting while most oil paintings can tolerate a higher level of exposure to light. The rate of fluctuations in the ambient environment of an artwork is also a major contributing factor in how materials deteriorate. Materials will undergo less physical stresses when there is very little or very gradual fluctuation, in terms of the relative humidity and temperature levels.

LIGHT

The use of illumination, whether from artificial or natural sources, is an integral part of any building. However, it has long been known that light, as a form of high-energy radiation, can do irreversible damage. Light is considered to be an initiating cause of many deterioration processes in materials (also known as photo-oxidation). This can be observed in the yellowing of newsprint paper when exposed to strong sunlight. Colours will also fade in the presence of light. Such changes are especially drastic in natural organic materials (which are primarily derived from plants, animals and insects), such as colouring materials made from such sources

The most harmful part of the light spectrum is the invisible ultra-violet (UV) portion, as well as the bluer end of the visible spectrum. This is because the energy level of this part of the spectrum is higher in comparison. The elimination or reduction of this band of the light spectrum will greatly slow down deterioration in artefacts.

The use of light is an integral function in a building. Therefore, it is important that light sources, whether artificial or natural, must be made safe for the long-term preservation of artworks. This protection can take several forms :

- 1) Lowering the light level;
- 2) Removing the more harmful UV radiation by means of filters;
- 3) Using a light diffuser for artificial light source which will reduce the intensity of light falling on objects; and
- 4) Reducing the amount of time that artworks are exposed to light.

Of the different light sources that are commonly encountered, unfiltered natural sunlight is the most harmful. Other artificial light sources, although less harmful, must still be monitored for their intensity and UV level.

Usually, the presence of light alone is less of a detrimental factor compared to when it is combined with other factors, such as the presence of oxygen and moisture, which can generate chemical reactions leading to the breakdown of materials. Hence, the control of light damage must be done in conjunction with other means of environmental control.

HUMIDITY

The presence of moisture in the atmosphere is a prevalent phenomenon and it is constantly exchanged in a cycle of absorption and de-sorption. Materials made from organic materials – such as wooden panels, plant fibres in natural textiles, wood pulp in paper, and leather – retain a high capacity to take in and release moisture.

The constant cycle of absorbing and releasing moisture from materials can also set up continuous physical stress, which can build-up to become irreversible damage. Different materials will react to the amount of moisture in the surrounding air by absorbing or releasing moisture. This cycle of change can damage the structure of materials by introducing physical stresses and tensions. This is especially obvious in the network of cracks in wood and ivory, as well as the planar distortion (or warping) observed in some wooden panels. The loss of tension in painted canvases is also a result of such a cyclic fluctuation in humidity levels.

The presence of moisture can also accelerate other chemical and biological deterioration processes. Water acts as a crucial component in starting many chemical reactions, such as the corrosion of metals

and the formation of acids in the degradation of natural fibres. Moisture is also needed in generating micro-biological growth, such as mold and mildew, which can cause staining and surface disfiguration of materials.

Besides relying on the control of RH levels, collections need to be regularly inspected and checked for early signs of deterioration. The early detection of a high level of relative humidity can be carried out with the help of thermo-hygrometers. Of all the various hygrometers available, the most accurate is the wet-dry bulb thermometer, which measures directly the evaporative rate of moisture into the surrounding air.

POLLUTION

Pollution in the air is usually carried by air-borne particles or spread as gaseous products. Solid particles can be filtered through an air-conditioning system for an indoor environment, while chemical by-products in the air can be removed with the use of appropriate reagents incorporated into the filtration and air-handling system.

Common pollutants in an urban setting include, sulphur dioxide and nitrogen dioxide from industrial sources. Indoor pollutants are often given off as by-products of a variety of materials such as rubber, products derived from protein-based materials, some synthetic polymers, and ozone production by mechanical equipment. The accumulation of dust on artefacts can lead to a rather disfiguring appearance. Nicotine present in cigarette smoke can also adhere to surfaces of objects to cause a pronounced discolouration.

The varied nature of pollutants present in both indoor and outdoor conditions makes it difficult to recommend a blanket safeguard. Furthermore, different materials will be sensitive to different

pollutants present in the atmosphere. Therefore, the control of indoor pollutants has to rely on the vigilant detection of signs of problems and identifying the root of the problem. The detection of potential pollutants can be carried out by using sampling tubes which are then analysed in specialist chemical laboratories for the presence of harmful pollutants.

OTHER CONSIDERATIONS

It cannot be stressed enough that regular and active inspection of the overall condition of the collection, whether on display or in storage, has an important role in ensuring that potential problems are identified as early as possible and properly rectified.

Timely and appropriate intervention is often crucial in the long-term preservation of cultural collections. However, ill-considered and inappropriate actions undertaken, even with the best of intentions, can cause irreparable damage to artworks.

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FACTORS OF DETERIORATION

AFFECTING WORKS OF ART