



factsheet

Preservation of Cultural Heritage

Many cultural heritage items are threatened by biological attacks as some of their constituents such as cellulose or collagen may serve as food for insects or microorganisms. These attacks may be triggered by events such as floods but more often they are the result of long-term ambient storage conditions in religious buildings, museums or libraries. Irradiation can help preserve our cultural heritage.



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Alternative Treatments

Fumigation, liquid chemicals, anoxic atmosphere and irradiation are the main methods used to combat infestations. They all have their good and bad points but irradiation has the advantage of being environmentally friendly, and in the case of gamma and X ray irradiation, of being very penetrating.

History Applications

Research in this field started in the 1960s with the first large-scale application taking place in France (Nucleart project). The disinfection, using irradiation, of the mummy of pharaoh Ramses II occurred in Grenoble in 1977 receiving considerable media attention at the time. A more recent example is the disinfection of Kroma in 2010, a baby mammoth found in permafrost soil in Siberia.

Historic wooden artefacts are often infested with woodworm or wood-boring beetles. These species are easily killed by irradiation at doses around of one kilogray whatever their development stage (egg, larva or adult). Doses of a few kilograys are needed in order to inactivate fungi. Doses up to ten kilograys have no or minimum effect on wood (protective effect of the lignin-cellulose complex) and most paints, pigments or varnishes.

Technical Considerations

Manuscripts and paper documents can be damaged by fungi and by bacteria, especially in humid environments. With increasing doses of radiation, the cellulose fibres, with no or little lignin that constitute paper, undergo depolymerisation. This may cause unacceptable changes in mechanical properties, colour, pH or water sorption. The tolerance of any paper to irradiation must therefore be assessed before the treatment of archives or book collections is undertaken to eliminate fungi or woodworms. Similarly, there are examples of parchment, textiles and leather items that were successfully treated by irradiation but the selection of the irradiation dose must be made on a case-by-case basis taking into account the severity of the attack and the resistance of the material.

Irradiation is also used to consolidate or stabilize wooden artefact. The treatment is based on the impregnation of the degraded wood with a liquid monomer (most often polyester resins) that will harden through the polymerising effect of irradiation. Air or water must be removed from the pores before the liquid matrix is introduced. Dose, dose rate and concentration of reagents must be carefully determined to control a reaction that is generally exothermic. As a result the weight of the object is generally increased by 50 to 100 %.

