

A sustainable approach to archaeometrical and conservation studies using nuclear techniques

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3D modeling and printing technology was sustainably used in the design of the portable X-ray based multi-technique equipment and for the sample holder used for the archaeometric studies performed with such a system, as well as in the design of the multi-level sample holder for irradiation, where other recyclable materials were also used.

Irradiation treatments in a gamma irradiation plant combined with previous exposition to essential oil atmosphere was evaluated as a sustainable treatment due to their economic and environmental advantages over traditional chemical biocide treatments. Viability methods, independent or dependent on culture medium, are experimented in the search for a quantitative, sensitive and sustainable method to evaluate the efficiency of massive antifungal treatments on documentary material. A limited dilution method, applied in a multiple inoculum with a reduced amount of culture medium, is evaluated for the estimation of spore viability. A probabilistic model, developed for this purpose, was programmed in a computer software. This viability method, sensible to the individual spore level, shown to be a reproducible. A general methodology is conceived and applied, which includes sampling procedures and efficient extraction of spores by means of mini-probes containing radiosensitive silica glass pearls, designed for reproducible growth of inoculated material, allowing the determination of incubation conditions and the optimal treatment dose. The miniprobes were inoculated with fungal spores, isolated from documentary material, in culture medium and on paper, leather and synthetic binding materials, which made it possible to determine the doses of irradiation that produced inhibition/mitigation, decontamination or sterilization. Gamma irradiation was also used as a sustainable procedure for sterilization of plastic materials (24- or 96-well plates) used in the proposed viability methods. It is necessary to record the doses and dose rates received by the materials in the irradiation treatment of documents and books, for which sensitive dosimeters in the application range are required. A miniprobe with 0.5 mm silica glass beads (recyclable) is proposed as a routine on-site dosimeter. Finally, the proposed dosimeter was found to be sensitive in the useful dose range for document and book irradiation treatments.

Key words: biodeterioration, fungi, viability, preservation, irradiation.

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