

E-beam simulation for Cultural Heritage cellulosic materials preservation at IRASM

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Romania has an experience of over 20 years of Cultural Heritage preservation by gamma irradiation treatment at IRASM Radiation Processing Centre, Department of IFIN-HH. The cultural heritage artefacts include archives, books, documents, wood artefacts (furniture from the Theodor Aman Museum in Bucharest, orthodox churches), wood icons, and other artefacts made from natural biopolymeric materials. IRASM IFIN-HH has Conservation Treatment and Investigation Laboratory Licenses issued by Romanian Ministry of Culture since 2014.

The field of radiation preservation of cultural heritage artefacts is well established within the European Region, important contributions being made by France (ARC-NUCLEART, Grenoble), Romania (IRASM IFIN-HH), Poland (ICHTJ), Croatia (Ruđer Bošković Institute), Hungary (Institute of Isotopes), Italy, Portugal, Serbia and others.

The use of accelerators for Cultural Heritage preservation and disinfestation was done successfully in Poland by ICHTJ for wood and fabric. In Romania there are two old research LINAC facilities at INFLPR. In 2015 was made a Feasibility study for an "Electron Accelerator for Radiation Technology Applications" at IRASM IFIN-HH. This work aims to simulate the best irradiation conditions for treatment of Cultural Heritage cellulosic materials, using a compact e-beam.

Monte Carlo Simulations were made with RAYXPERT, ver 1.8.5 (TRAD Tests & Radiations).

Starting from an e-beam irradiation room model, made after a feasibility study of an "Inhouse-inline" irradiator (MEVEX, Canada, 2015), the matrix dose mappings resulted from different irradiation geometries simulating conveyor movement were merged. The simulation was made for a stack of books $L \times l \times h$ 42 cm x 45 cm x 9 cm and a maximum target absorbed dose of 10 kGy, obtained with 5 MeV electrons and 1 mA beam current. Usual conveyor speeds (cm/s) and 2 passes (one irradiation on top and one on the bottom) were used for studying the dose distribution for the selected artefact model. The simulation results showed the total irradiation time at around minutes per stack of books, resulting in a productivity of a few cubic meters per day, which is comparable with the productivity of existing SVST Co60 existing industrial irradiator. The maximum dose rate on the surface of the experimental model was found to be on the order of magnitude of MGy/h.

The findings are encouraging for the large volume treatment of book collections, archives and paper cultural heritage items.

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