APPLICATION OF ELECTRON BEAM ACCELERATOR FOR PRESERVATION BIODETERIORATED CULTURAL HERITAGE PAPER-BASED OBJECTS: MULTIPARAMETRIC ANALYSIS

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The cellulose, which is the main component of the paper additionally with proteins present in book bindings is the environment very prone to attack of the harmful microorganisms. The investigation of the atmospheric air in libraries revealed the presence of broad spectrum of fungi and bacteria [1-3]. Records show that large volumes of books and archival collections may be affected by bioburden because of improper storage conditions or accidents such as floods [4, 5]. The harmful influence of microorganisms on paper-based historical objects leads to their degradation and real loss for the culture. Moreover, microorganisms present in books or archives may influence the human health negatively.

Thus, effective disinfection methods of paper-based objects are still being developed in order to propose effective, fast and low-cost method that can be applied on the mass scale in emergency situations as well as for the preventive treatment.

Currently the most common method used for decontamination of library and archival collections is ethylene oxide treatment, which is toxic to humans and the natural environment. The promising alternative for this technique can be ionizing radiation. Electron beam (EB) irradiation can be effectively applied for decontamination of biodeteriorated archives as well as for preventive conservation of large volumes of books in short time [6]. Moreover, due to the high dose rate of EB irradiation, appropriate dose is delivered to the treated objects in several seconds therefore post-oxidation related effects of paper degradation are significantly limited.

Samples of different papers were exposed to electron beam irradiation using a 10 MeV-10 kW linear electron accelerator “Elektronika” and delivered doses were confirmed using Gammachrome Harwell dosimeters for lower doses, and the calorimetric method involving graphite and polystyrene calorimeters was applied to measure absorbed radiation doses in a range from 1.5 to 25 kGy.

A wide range of doses from 0.4 kGy up to 25 kGy were studied in order to determine safe and simultaneously effective dose for different papers decontamination with electron beam.

Changes in all samples properties were determined according to the relevant ISO and TAPPI standards. Microbiological investigation confirmed that dose of 5 kGy effectively eliminate bacteria and fungi in Whatman CHR 1 paper and office paper and did not influence the studied optical, thermal (Fig.1), physicochemical and mechanical parameters of these papers.

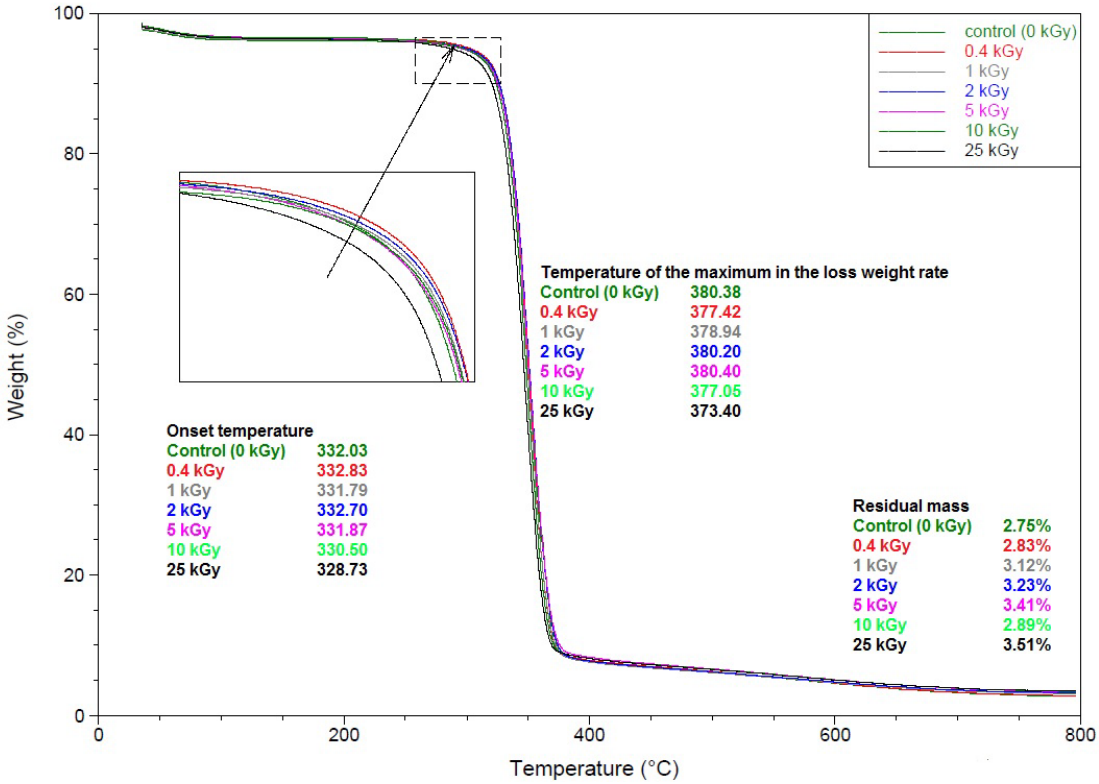

FIG. 1. TGA curve for thermal decomposition of Whatman CHR1 paper.

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