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Application of Electron Beam Accelerator Technology for Treatment of Bio-threatened Cellulosic Artefacts

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As organic materials, artefacts like papyri are attacked by biological threats from different organisms specially fungi and mold. Insects have been also known to damage rolled papyri. Recently preservation of artefacts could be achieved by controlling biological damage, insect eradication and disinfection in different heritage materials using ionizing irradiation treatments. However, these technologies suffer from some limits as total dose and dose rate which can influence the efficient elimination of bio-burden, with an increase in deterioration and changes in the material during radiation treatments.

The purpose of this study is to asses influence of the irradiation dose rate on organisms cause infection to cellulose as well as on bio-threatened cellulosic material changes, i.e. degradation. The possibility of using the electron beam accelerator for treating the heritages, especially artefacts made from cellulosic materials was discussed. One of the major tasks in the electron beam radiation conservation of cellulosic cultural heritage artefacts is to reduce material deterioration caused by exposure to ionizing radiation. Electron beam is the advantage of high dose rate which in practice can reduce material deterioration processes. Papyrus paper was selected as example of natural occurring materials from which artefacts were made. The samples were exposed to electron beam irradiation using a 3 MeV linear electron accelerator. The influence of electron beam irradiation on cellulosic -based objects was evaluated in order to determine safe effective dose for cellulosic materials. To avoid over-exposure, a wide range of doses from 3 kGy up to20 kGy were studied and many analytical techniques were used to determine possible changes of mechanical, chemical and physical properties of treated cellulosic -based objects. The effect of irradiation on post-irradiation effects and appropriate irradiation procedures for wider use of the technique was evaluated. A comparative study on the effect of gamma, and e-beam, on papyri properties was also investigated. The results revealed that the Electron beam is the advantage of high dose rate which in practice can reduce material deterioration processes if compared with gamma rays. Electron beam in doses not more than 15 kGy does not cause significant deterioration in the mechanical properties of cellulosic material. The radicals trapped in EB- irradiated papyrus papers were decayed after short time.

Author: ABDELREHIM, Hassan (Atomic Energy Authority of Egypt)

Presenter: ABDELREHIM, Hassan (Atomic Energy Authority of Egypt)

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