

Multipurpose γ -Irradiator and Mobile Unit with an Electron Beam Accelerator Developed in Brazil

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Radiation processing technology for industrial and environmental applications has been developed and used worldwide in the fields of water treatment, advanced materials, nanotechnology, medicine, tissue engineering, disinfestations and disinfection of books and documents, processes and industrial production and natural resources, among others. The Radiation Technology Centre (RTC) of the Nuclear Energy Research Institute (IPEN), of CNEN, Brazil, developed a small size continuous run and multipurpose industrial γ -irradiator with a revolutionary design and national technology to be used as a demonstration facility for manufacturers and contract service companies that need economical and logistical in-house irradiation system alternatives. It will be useful for supporting the local scientific community for product and process development using γ -radiation, assisting the traditional and potential users on process validation, and for training and qualification of operators and radioprotection officers. The technology developed for this facility consists of a continuous tote box transport system comprising a single concrete vault, where the automated transport system of products in and out of the irradiator utilizes a revolving door integrated with the shielding, avoiding the traditional maze configuration. Covering 76 m² of floor area, the irradiator design is product overlap sources with a maximum ⁶⁰Co capacity of 37 PBq (tote boxes, Category IV, wet storage). The performed qualification programme of this multipurpose irradiator was based on AAMI/ISO 11137 standard. The irradiator currently holds 7.4 PBq (200 kCi) of ⁶⁰Co. For irradiator dose optimization, the source distribution was done using the Cadgamma software. The poly-methylmetacrylate (PMMA) dosimeter system was used for irradiator dose mapping. The economic analysis and performance, concerning to the dose uniformity and ⁶⁰Co utilization efficiency were calculated and compared with other commercial γ irradiators available in the market.

The RTC is involved in establishing a mobile electron beam accelerator unit to treat industrial effluents for reuse purposes. The mobile unit will be equipped with an electron beam accelerator (0.7 MeV, 20 kW) with safety requirements (BSS, IAEA and CNEN Safety Standards), and can be used for effluent treatment from petroleum production, for petroleum desulfurization, and, in addition, for degradation of toxic organic compounds in wastewater for reuse. This project is supported by the IAEA (TC Project BRA1035, 2016–2018) and by the Brazilian Financial of Studies and Project (FINEP). To enlarge the national capacity to treat industrial effluents using electron beam accelerators, the mobile unit treating effluents on site from 1 m³/h up to 1000 m³/day, will provide an effective facility between a laboratory-scale plant to a large-scale plant, with the objective to demonstrate its efficacy and to transfer the technology. Studies have taken place in various productive sectors in the country and in other foreign laboratories to prove that radiation treatment offers technological and economic benefits over conventional techniques for treating recalcitrant pollutants.