

ELECTRON BEAM PROCESSING TO IMPROVE BIODEGRADABLE POLYMERS AND FOR INDUSTRIAL WASTEWATER TREATMENT AND RECYCLING

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Radiation technology has been used to control environmental pollution. The aim of these studies was to apply the electron beam radiation technology for controlling plastic pollution and environmental protection.

(1) Mobile irradiation unit:

The treatment of wastewater and industrial effluents by electron beam irradiation is a promising technique. The design and construction of a mobile unit by the Nuclear and Energy Research Institute (IPEN-CNEN), containing an electron beam accelerator of 0.7 MeV and 20 kW is innovative to demonstrate the effects and positive results of this technology, as shown in Fig. 1. The mobile unit has as one of its main advantages the possibility of treating effluents in the place where the source is located, eliminating costs and bureaucratic problems associated with the transportation of waste, besides publicizing the technology in several places in the country. To implement the project, IPEN-CNEN has been consolidating partnerships with national and international companies. The resources for the development of the unit have been supplied by the Brazilian Innovation Agency (FINEP) and International Atomic Energy Agency, financing the “IAEA TCProject BRA1035 - Mobile electron beam accelerator to treat and recycle industrial effluents”. The Institute has associated with a specialized company (Truckvan Industry) in an innovation project for the unit design and development. A 3D model study of the control room and laboratory space was done to facilitate understanding the internal distribution of the laboratory analysis equipment (Gas Chromatography Mass Spectrometry, Total Organic Carbon and UV-Visible Spectroscopy). The irradiation system with electron accelerators allows treating different types of effluents. Depending on the effluent, the amount of ionizing radiation energy required for treatment may vary, as well as the amount of treated effluent per day. For the construction of the mobile unit, the estimated cost is about US\$ 1.5 Million. The type of treated effluent, the treatment cost per m³/day and other information regarding the cost of maintenance and operation of the mobile unit are obtained from the Business Plan of the Mobile Unit.



FIG. 1: Mobile electron beam irradiation unit for the treatment of industrial effluents in Brazil.

(2) PBAT/PLA polymeric blend Ecovio®

The mechanical properties of the PBAT/PLA polymeric blend Ecovio® irradiated by electron beam were evaluated, as shown in Fig. 2. A reduction of 78.6% was observed in relation to tensile strength at the highest radiation dose of 80 kGy. There was also a reduction of 80% in Yong's modulus at this absorbed dose. A significant change in hardness was not observed at a dose of 65 kGy in relation to the non-irradiated material. The absorbed dose of 65 kGy was noteworthy, because at this dose, there was an increase of 43% in impact strength resistance and an increase of 17.4% in thermal stability of the polymeric blend.

Therefore, products made with the biodegradable polymeric blend need to be resistant to cross-sectional demands, impact and thermal stability and should have an average lifetime of 1 to 5 years. Then, for products, such as injected packaging, films for tube production, plastic bags, packaging for cosmetics and food packaging, among others, it is recommended to use the PBAT/PLA polymeric blend Ecovio® irradiated by electron beam with adsorbed dose of 65 kGy.

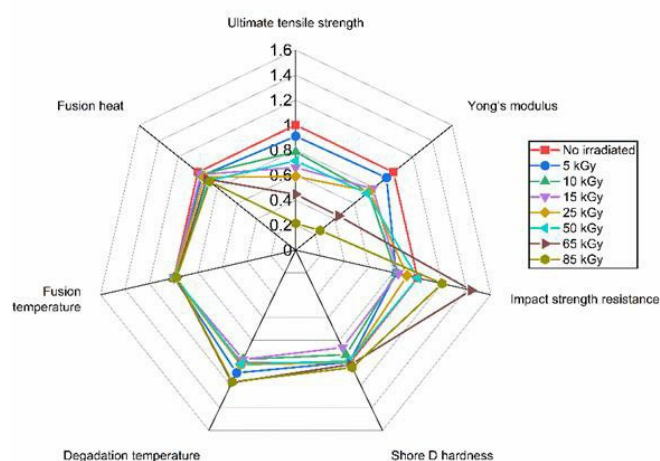


FIG. 2: Results of mechanical and thermal analyzes of the PBAT/PLA polymeric blend as a function of the absorption dose.

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