MECHANICAL EVALUATION OF PVC FILMS MODIFIED BY ELECTRON BEAM IRRADIATION

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The polyvinyl chloride (PVC) is a technological and low cost polymer. Although this polymer is weather resistant, it presents high sensitivity to high energy irradiation because of the weakness of carbon-chloride bond face to carbon-carbon and carbon-hydrogen bonds [1]. Upon exposure to high energy irradiation, some carbon-chloride bonds are broken to give rise radicals like chlorine and organic chloride that are initiators of two concurrent processes: degradation and crosslinking. The degradation process on PVC is macroscopically observed by discoloration effects, where the material tends to darken or to turn yellow, mainly at a typical sterilization dose of 25 kGy [2]; this process yields hydrogen chloride as a byproduct, it is autocatalytic and it continues after irradiation exposure. By other way, the crosslinking leads to an improvement in thermal resistance and mechanical properties.

The aim of this work is to evaluate the mechanical properties of PVC irradiated by electron beam to verify the degradation process. Also, mechanical properties are investigated on styrene grafted PVC by electron beam irradiation using mutual and pre-irradiation methods to verify the mechanical resistance changes of obtained product if grafting process is applied from non-irradiated and from pre-irradiated substrates.

The PVC commercial film samples with 210 μm thickness were cut into a dumbbell-shape (gauge length: 25 mm, width: 4.10 mm, area: 0.86 mm^2). The grafting media was styrene /butanol-1 mixture in several monomer concentrations (from 10% to 100%). The samples were irradiated on a Job 188 Dynamitron® Electron Beam Accelerator with 1.5 MeV energy. All irradiation procedures were performed in atmosphere air and the irradiation conditions comprised doses from 10 kGy to 100 kGy and dose rates of 2.2 kGy/s and 22.4 kGy/s. The styrene grafted samples were analyzed by gravimetry to determinate the grafting yield; the final values have been averaged from a series of three measurements. The Mid-ATR-FTIR was the spectrophotometer technique used for qualitative/semi-quantitative analysis of grafted samples. The Young's module and tensile strength of pre-irradiated and grafted PVC samples at both methods were measured at a Lloyd LXR tensile tester at a crosshead speed of 10.00 mm/min.

We observed the decrease of Young's module and tensile strength with the increase of absorbed dose at pre-irradiated PVC samples, that it indicates degradation process. These mechanical parameters results are discussed to styrene grafted PVC samples.

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