



The influence of radiation dose in composites of HDPE-silica films onto mechanical properties

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1. Introduction

High density polyethylene (HDPE) is a well-known polymer used in manufacture industry to fabricate several products, such as packages, toys, bottles, films and container among others. These applications is due to its crystalline structure that is more dense than the others types of polyethylene, beyond the advantages like nontoxic, recyclable, chemical and mechanical resistance, support high temperature and aggressive environment [1]. HDPE is also known for the tendency to crosslinking when submitted to radiation (electron beam, UV visible and gamma radiation) [2-6]. The unmodified and modified films were evaluated by X-ray fluorescence, thermal analysis, mechanical tests and swelling degree. The objective of this work is verifying the influence of different doses in HDPE-silica composite regarding mechanical and chemical resistance.

2. Methodology

The HDPE pellets and powder silica were mixture by an extruder and pelleted in sequence. After this first process the pellets of HDPE with silica were extruder with a plain matrix in order to obtain films with 40 μ m thickness. The silica was added to the HDPE in different amounts: 5%, 10%, and 15%. In the first step, pellets were produced from the dry mixtures of HDPE and silica dioxide in powder in a double-screw extruder. The extruded strands were obtained using a pellet die (1 mm in diameter) and cut into pellets with a cutting device. In the second step in a single-screw extruder with two controlled temperature extra zone setting coupled in a plain matrix to obtain the composites films. After the processes the films were submitted to electron beam irradiation at 30kGy and 50kGy. The characterization techniques used to evaluate the unmodified and modified films were thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) to verify the changes in thermal stability and melting temperature; mechanical tests regarding deformation and tension to observe improve in mechanical resistance and swelling degree to verify the amount of silica in relation to dose irradiated when this test is carried out. The X-ray fluorescence was carried out to confirm the presence of silica in the composites materials.

3. Results and Discussion

The X-ray fluorescence confirmed the amount of silica incorporated onto HDPE matrix. Thermal analysis TGA didn't demonstrate the degradation in the polymer matrix as direct effect of radiation process. The slop for all curves with and without silica is the same and referred to the polymer matrix (Fig. 1). DSC showed a discreet change in crystallization temperature.

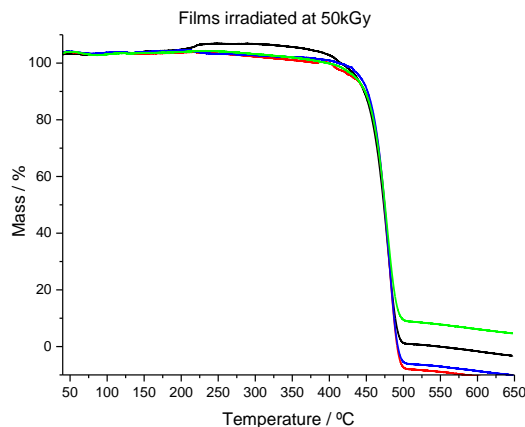


Figure 1: TGA results of pure and composites HDPE-silica.

4. Conclusions

The results indicated the effect of the radiation dose as expected, the higher dose, the higher effect on the mechanical and thermal analysis.

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