THE INFLUENCE OF ELECTRON-BEAM IRRADIATION ON THERMO-MECHANICAL PROPERTIES OF HDPE/SUGARCANE BAGASSE FIBER COMPOSITE

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Abstract

In the present work, the influence of electron-beam irradiation on thermo-mechanical properties of HDPE and HDPE/Sugarcane bagasse fiber composite was investigated. The materials were irradiated using a Dynamitron electron beam accelerator, at room temperature in presence of air, at radiation dose 100 kGy, at dose rate of 28.02 kGy/s. Irradiated and non-irradiated samples were submitted to thermo-mechanical tests and the correlation between their properties was discussed. The results showed significant ($p < 0.05$) changes in thermo-mechanical properties of HDPE, due to sugarcane bagasse fiber incorporation, except to tensile strength at break and Vicat tests. In addition, for both, HDPE and HDPE/Sugarcane bagasse fiber composite, the electron-beam irradiation promoted a significant gain up to 200 % in tensile strength at break, flexural strength and flexural modulus and promoted a significant decrease only at elongation at break of the irradiated HDPE/Sugarcane bagasse fiber composite.

Experiment/Methods

Materials - The materials used in this study were HDPE resin - HDPE JV060U – commercial grade by Braskem S/A (MFI = 7.0 g/10 min at 190 ^{0}C/2.16 Kg, specific density = 0. 957 g/cm^3) and sugarcane bagasse fiber from agro-industrial residues.
Methods - Preparation of HDPE/ Sugarcane bagasse fiber composites; Electron-beam Irradiation; Thermo-mechanical tests

Results

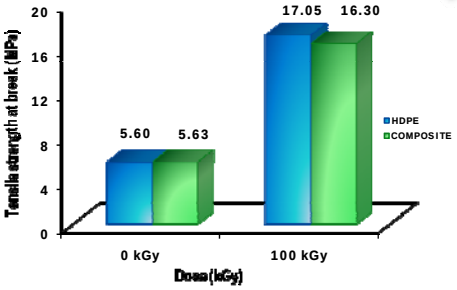

Figure 1. Tensile strength at break, as a function of the electron-beam radiation dose, for the HDPE and HDPE/Sugarcane bagasse fiber composite

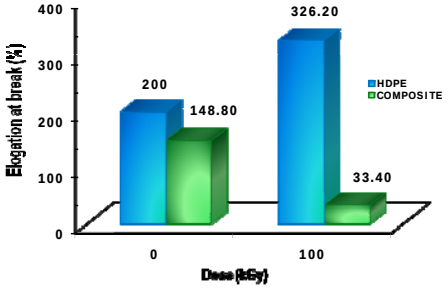

Figure 2. Elongation at break (%), as a function of electron-beam radiation dose, for the HDPE and HDPE/Sugarcane bagasse fiber composite.

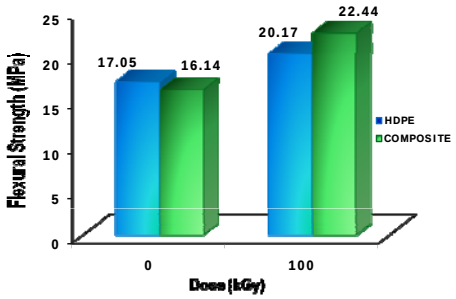

Figure 3. Flexural strength, as a function of electron-beam radiation dose, for the HDPE and HDPE/Sugarcane bagasse fiber composite.

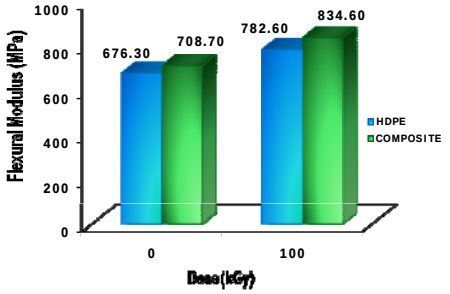

Figure 4. Flexural modulus, as a function of electron-beam radiation dose, for the HDPE and HDPE/Sugarcane bagasse fiber composite.

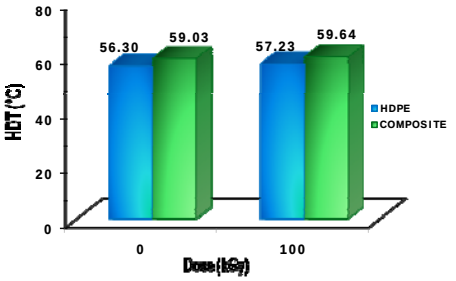

Figure 5. HDT as a function of electron-beam radiation dose for the HDPE and HDPE/Sugarcane bagasse fiber composite.

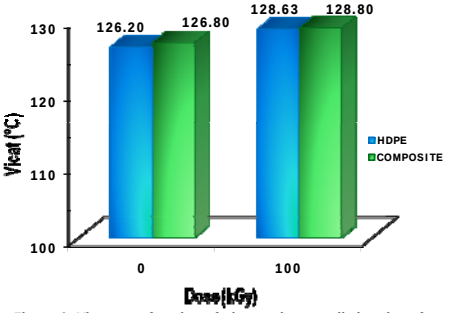

Figure 6. Vicat as a function of electron-beam radiation dose for the HDPE and HDPE/ Sugarcane bagasse fiber composite.

Conclusion

The test results showed that the values of tensile strength of HDPE after 100 kGy of electron beam irradiation were 200% higher than the non-irradiated HDPE and about. 190% for the irradiated samples of the composite when compared with non-irradiated samples of the same composites ($p < 0.05$). These results strongly suggest that the irradiation of electron beam leads to a significantly higher molecular chain of HDPE cross-linking. The significant gain in thermo-mechanical properties of HDPE due to sugarcane bagasse fiber incorporation and electron-beam irradiation showed that incorporation of sugarcane bagasse fiber followed by electron-beam irradiation could lead to the obtaining of HDPE/Fiber composite materials with better thermo-mechanical properties than resin ones.