

Mechanical and Microstructural Study of Photo-Aged Low Density Polyethylene (LDPE) Films

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Abstract : This study deals with the ageing of Blown extruded films of low-density polyethylene (LDPE), used for greenhouse covering. The LDPE have been subjected to climatic ageing in a sub-Saharan facility at Laghouat (Algeria) with direct exposure to sun. The microstructural changes in the films were analyzed by IRFT for different states of ageing. The mechanical characterization was performed on a uniaxial tensile apparatus. The mechanical properties such as Young's modulus, strain at break, and stress at break have been followed for different states of exposure time (0 to 6 months). The Climatic ageing of LDPE films shows the effect of ageing on the microstructural Plan which leads to: i) To an oxidation of the molecular chains. ii) To the formation of cross-linkings and breaking chains, which both of them are responsible for the mechanical behavior's modifications of the material. Cross-links are in favor of strengthening of the mechanical properties at break (the increase of σ_r and ϵ_r). In other side, the chains breaking leads to a decrease of these properties. The increase in the Young's modulus also seems to be related to those structural changes since the cross-links increase the average molecular weight. Branchings and tangles are favorable pairs for the ductile nature of the material. And in other side, the chains breaking reduces the average molecular weight and therefore promotes the stiffening (following to morphological changes) so the material becomes fragile. The post-mortem analysis of the samples shows that the mechanical stress has an effect on the molecular structure of the material. Although if quantitatively the concentrations of different chemical species exchanges, from a quantitative point of view only the unsaturations raises the polemics of a possible microstructural modification induced by mechanical stress applied during the tensile test. Also, we recommend a more rigorous analysis with other means of investigation.

Keywords : low-density polyethylene, ageing, mechanical properties, IRTF

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