SL 8.25

Molecular Structure and Thermal Properties of Irradiated Crosslinked Low and High-density Polyethylene

H.A. Khonakdar (a), S.H. Jafari (b), U. Wagenknecht (c)
(a) Department of Polymer Processing, Iran Polymer and Petrochemical Institute (IPPI), P. O. Box 14965-115, Tehran, Iran
(b) Department of Chemical Engineering, Faculty of Engineering, University of Tehran, P.O.BOX: 11365/4563, Tehran, Iran
(c) Leibniz-Institute of Polymer Research Dresden, Hohe Str. 6, D-01069 Dresden, Germany

Low and high-density polyethylene (PE) were crosslinked by irradiation with different doses of electron beam (EB). The gel content of the EB-exposed LDPE and HDPE was determined by the solvent-extraction method. The degree of crosslinking was also evaluated by the hot set- measuring test.
The results obtained from both sol-gel and hot set methods showed that the degree of crosslinking was dependent on the deposited energy in LDPE and HDPE samples. Increasing the absorbed dose increased the degree of network formation.
The effect of irradiation dose on the molecular weight between crosslinking (M_c), and crosslink density (ν) were calculated. The crosslinked density calculated by rubber elasticity theory and creep data, increased with increasing of irradiation doses while the M_c decreased with increasing of irradiation doses. In each irradiation dose the M_c for LDPE is smaller than HDPE while the crosslink density is higher thanthat of HDPE.
The effect of crosslinking on crystalline structure, crystallinity, crystallization and melting behaviors of PE was investigated using wide-angle X-ray diffraction and DSC techniques. It is found that the radiation crosslinking, which takes place at solid state, has no significant influence on crystalline region, while during the second heating cycle, melting temperature(T_m), the crystallization temperature (T_c), and total crystallinity (X_c) decrease with increasing of irradiation dose. On the other hand, during cooling cycle crystallization temperature shows a decrease with increasing of irradiation dose.
Wide-angle X-ray diffraction analysis also showed no significant changes in crystallite structure of the PE irradiated at solid state. As compared to HDPE, LDPE is more prone to crosslinking (more gel content) due to presence of tertiary carbon atoms as a result of branching, while HDPE with its higher crystalline content shows fewer tendencies towards crosslinking especially by way of irradiation at solid state.