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Crystallisation Behaviour of Electron Beam Irradiated Polypropylene

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The electron beam irradiation of polymers generated modification effects in macromolecular structure and material properties. In this way the modification of linear polypropylene may result in long chain branching (LCB) of the macromolecules. LCB-PP possess advantageous properties, which are important in many industrial applications, e.g. good thermoforming behaviour, high melt strength, and uniform fine cell structure of extruded foams. Furthermore, a high crystallisation temperature is particularly valuable in industrial applications for which an earlier solidification is desired because this leads to faster processing. The characterisation was carried out with high temperature size exclusion chromatography (HT-SEC), differential scanning calorimetry (DSC) and polarized light microscopy (PLM) to observe the spherulite structure.

It is well known that the irradiation conditions influence the molecular parameters of the formed branched PP. The aim of the present work is the investigation of the influence of annealing after the irradiation on the molar mass and the crystallisation behaviour.

The irradiation with 100 kGy and post annealing leads to products which are stable with respect to molar mass degradation during a long time of storage. Moreover, the crystallisation temperature decrease and the spherulite size increase compared to the initial iPP. The samples irradiated with 100 kGy without annealing show a significant molar mass degradation during storage. In contrast to the samples with post annealing an increase of crystallisation temperature takes place and the spherulite structure observed is fine-grained. The same effect occurs by addition of nucleating agent to virgin iPP causing by higher nuclei density. The resulting spherulites have minor size and the nucleated sample shows a higher crystallization temperature.

The investigation of irradiation of polypropylene with or without post annealing shows that the irradiation conditions influence strongly the final properties. The irradiation without post annealing leads to a high number of nuclei and a higher crystallisation temperature.