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The Effect of the Reactants Concentration and Processing Parameters on the Trends of Maleation and Side Reactions Occurring During Melt Functionalization of HDPE

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The grafting degree with regard to the side reactions occurring in maleation of molten polyethylene (polyethylene (PE) crosslinking, homopolymerization of maleic anhydride (MAH) and poly(MAH) grafting onto PE) has not been studied considerably. In this article, we have studied the effects of processing parameters (temperature and rotor speed) and reactant variables (MAH concentration, peroxide type and concentration) on the degree of maleation and the side reactions occurring in the maleation of molten PE in a Brabender Plasticoder. On the basis of the position of anhydride carbonyl absorbtion band appeared in FTIR spectra of maleated products and the ratio of the grafting degree in the sol to gel fractions for each sample, it was proved that over 3phr of MAH, the monomer takes part in homopolymerization reaction and poly(MAH) grafts onto the PE which results in coloured products. In general, by increasing the amount of peroxide, gel formation is increased but the grafting degree of MAH passes a maximum and drops at high peroxide level. By increasing the MAH concentration, grafting degree and gel formation increase, pass a maximum and finally fall down. The MFI of products passes through a minimum with increasing MAH concentration but it always decreases by increasing grafted MAH. According to the similar trends of gel formation, maximum torque and grafting degree in terms of the MAH concentration, an equation was obtained showing a relation between the concentration of soluble portion of maleated PE, peroxide concentration and the degree of grafting onto PE. The reduction in temperature and rotor speed were found to cause poly(MAH) to graft onto the PE for [MAH] ≤ 3phr. The same result was obtained when the processing temperature reached to the boiling point of MAH. Therefore, it was concluded that the maleation of PE must be conducted under high control condition.