SURFACE FUNCTIONALISATION AND GRAFTING OF POLYETHYLENES BY 2-STAGE METHOD USING POTASSIUM PERSULFATE AND CERIC ION TECHNIQUE

NIPAPUN LIEWCHAROEN

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Functionalisation and grafting of polyethylene (PEs) was performed using a 2-stage method. The polymer surface was first hydroxylated by normal or accelerated decomposition of potassium persulfate (K$_2$S$_2$O$_8$). Ethanol (EtOH) and ethyl acetate (EtOAc) were used as accelerators for accelerated decomposition of K$_2$S$_2$O$_8$. Afterwards, grafting was carried out by ceric ion technique. Gravimetric and ATR-IR results confirmed successful grafting of both systems. For normal system, the percentage of grafting, to a good approximation, was directly proportional to the decomposition of K$_2$S$_2$O$_8$ while the percentage of grafting of the accelerated system was relatively low despite the very high decomposition of K$_2$S$_2$O$_8$. The wettability and adhesion strength of the treated samples were studied according to contact angle and peel test, respectively. Hydroxylation with both normal and accelerated systems, without grafting, was found to increase both the wettability and adhesion properties of the film. These properties could be improved further by grafting reaction with acrylamide monomer (AAM). However, the high percentage of grafting resulted in poor contact angle and peel strength. It was proposed that the cross-linking effect reduced the adhesion and wettability of the grafted samples. The hydroxylated and grafted samples of the accelerated system displayed higher effectiveness on wettability and adhesion properties. SEM was also used to elucidate the surface morphology of unmodified, hydroxylated and grafted PE samples. In all conditions, no change in surface morphology was observed after hydroxylation reaction. The surface morphology of grafted samples was relatively featureless at low percentage of grafting and became grainy at high percentage of grafting.

The applicability of the two-stage technique was investigated by grafting PE film. PE film was grafted with water soluble and water insoluble monomers. These were acrylic acid (AA) and methyl methacrylate (MMA), respectively. Results showed that both water soluble and water insoluble monomers could be grafted onto PE surface by this method. Contact angle and peel strength were used to study surface properties of the grafted samples. Peel strength of the grafted PE with AA increased by a factor of 30 while the peel strength of PE grafted with MMA increased by about 50 times. In addition, PE fibres with various draw ratios were grafted with AAm and AA using the same technique. The effectiveness of grafting and adhesion property was investigated by gravimetric and pull out strength. The percentage of grafting decreased when PE fibre was drawn to higher ratios. The pull out strength tended to increase after grafting reaction. The increase in pull out strength was about 5 to 8 times that of the original fibre.
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คณะวิทยาศาสตร์และเทคโนโลยีพืชศาสตร์ มหาวิทยาลัยมหิดล นนทบุรี

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