STUDIES ON THE MODIFICATION OF POLY (VINYL CHLORIDE)

by

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m y P a r e n t s

C E R T I F I C A T E

This is to certify that the thesis entitled "STUDIES ON THE MODIFICATION OF POLY(VINYL CHLORIDE)" being submitted by Mr. Upender Krishen Saroop to the Indian Institute of Technology, Delhi, for the award of Doctor of Philosophy in the centre for Materials Science and Technology, is a record of bonafide research work carried out by him. Mr. Upender Krishen Saroop worked under our guidance and supervision and has fulfilled the requirements for the submission of the thesis.

The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Poly(Vinyl Chloride) (PVC) is a general purpose polymer which possesses many excellent properties but it suffers from poor impact strength and low thermal stability. These problems can be overcome to a great extent by blending PVC with various polymeric materials or grafting with suitable monomers. The main objective of the present work has been to carry out the studies on such modifications in PVC.

Keeping in view the primary objectives for modifications of PVC, a literature review has been presented on polyblends of PVC with various polymers especially polyacrylates and Acrylonitrile butadiene styrene (ABS) copolymer. A review of grafting of various monomers onto PVC has also been presented.

Various acrylate polymers and copolymers which improve the mechanical properties of PVC can also act as processing aids. The effect of blending acrylate copolymers on the physical and mechanical properties of PVC has been investigated. The selection of polymers has been made on

the basis of their compatibility considerations and those with Solubility parameter values close to PVC were chosen for blending. Copolymers of Methylmethacrylate with methyl acrylate, ethyl acrylate, butyl acrylate and 2-ethyl hexyl acrylate were synthesised and the respective acrylate copolymers were then blended with PVC by melt blending technique. These acrylate copolymers are compatible with PVC showing a single glass transition temperature (Tg). Mechanical properties of polyblends revealed an increase in impact strength while a decrease in yield stress and initial modulus as the number of carbon atoms in the side chain of the acrylate copolymer increased. The incorporation of these acrylate copolymers introduce ductility into otherwise rigid and glassy material like PVC, which has also been supported by scanning electron microscopy observations.

Rheological properties of PVC/Polyacrylate blends are reported which include parameters like shear stress - shear rate relationship, apparent melt viscosity and melt elasticity. These materials show a pseudoplastic non-Newtonian behaviour and melt viscosity showed a downward trend with

increasing side chain length of the copolymer. Some polyblends were prone to melt fracture beyond a certain limit of shear stress and temperature.

Polyblends of PVC and ABS were prepared and evaluated with a view to study the effect of Polybutadiene (rubber) content of ABS on the mechanical properties of these polyblends. Impact strength of PVC increases significantly on incorporation of ABS, however level of increase is strongly related to the rubber content in ABS. Polyblends with highest rubber content in a particular blend ratio have impact strength better than both PVC and ABS. The role of ABS has been shown to enhance the thermal stability of PVC which was demonstrated by Thermogravimetric analysis (TGA). Differential scanning calorimetry (DSC) studies reveal that these polyblends may not be completely miscible as they show two Tg values.

PVC has been grafted with methylmethacrylate to improve some properties. PVC was dehydrochlorinated to increase the sites for grafting in an alkaline medium. Grafting has been carried out by using benzoyl peroxide as a free radical initiator and conditions for synthesis were standardised to achieve optimum grafting. The grafted

product was characterised for thermal and mechanical properties which reveal a single Tg value, enhanced thermal stability and increase in tensile strength as well as tensile modulus.

Lastly, summary and conclusions highlighting the salient features of the aforesaid methods have been reported. A few suggestions for future scope of the work are also reported.

C O N T E N T S