

STUDIES ON THE MODIFICATION OF POLY (VINYL CHLORIDE)

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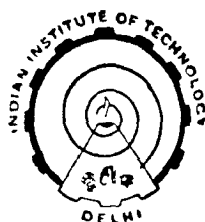
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CENTRE FOR MATERIALS SCIENCE & TECHNOLOGY

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to the

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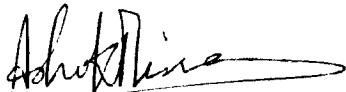
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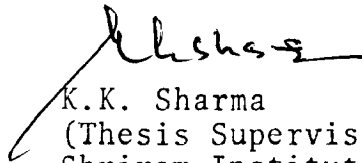
C E R T I F I C A T E

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.

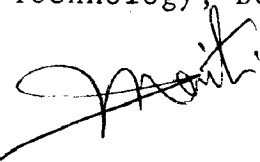
The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.



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U.K. SAROOP

A B S T R A C T

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 (T_g).

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

Page No.

Abstract	i
<u>CHAPTER - 1</u> INTRODUCTION & LITERATURE REVIEW	1
1.1 INTRODUCTION	1
1.2 Modification by Blending	4
1.2.1 Importance of Blending	4
1.2.2 Techniques of Blending	8
1.2.3 PVC/Poly(acrylate ester) blends	11
1.2.4 PVC blended with Rubbery Polymers	14
1.2.5 PVC/ABS blends	17
1.3 Modification by Grafting	22
1.3.1 PVC Grafted Copolymers	22
1.4 Objective of the work	28
<u>CHAPTER - 2</u> STUDIES ON POLYBLENDS OF POLY(VINYL CHLORIDE) (PVC) WITH VARIOUS ACRYLATE COPOLYMERS - PHYSICAL AND MECHANICAL PROPERTIES	30
2.1 Introduction	30
2.2 Experimental	34
2.2.1 Materials	34
2.2.2 Synthesis of acrylate copolymers	35
2.2.3 Preparation of Polyblends	35

2.2.4	Characterisation and Testing	36
2.3	Results & Discussion	37
2.3.1	Nuclear Magnetic Resonance (NMR) Studies	37
2.3.2	Thermal Analysis	41
2.3.3	Mechanical Properties	44
2.3.3 (a)	Tensile Properties	45
2.3.3 (b)	Impact Strength	47
2.4	Scanning Electron Microscopic Studies	51
 <u>CHAPTER - 3</u> BLENDS OF POLYVINYL CHLORIDE (PVC) AND ACRYLATE COPOLYMERS - RHEOLOGICAL STUDIES		54
3.1	Introduction	54
3.2	Experimental	56
3.2.1	Materials	56
3.2.2	Preparation of Polyblends	57
3.2.3	Characterisation Methods	57
3.3	Results	59
3.3.1	Plasticity Curves	59
3.3.2	Shear Stress-Shear Rate curves	60
3.3.3	Melt Viscosity	65
3.3.4	Die Swell & Melt Elasticity	66
3.3.5	Melt Fracture	71
3.4	Discussion	72

✓ CHAPTER - 4

STUDIES ON THE POLYBLEND OF
POLYVINYL CHLORIDE (PVC)
AND ACRYLONITRILE BUTADIENE
STYRENE COPOLYMER (ABS) -
EFFECT OF RUBBER CONTENT

		75
4.1	Introduction	75
4.2	Experimental	77
4.2.1	Materials	77
4.2.2	Characterisation Methods	79
4.2.3	Preparation of Polyblends of PVC & ABS	80
4.3	Results & Discussion	81
4.3.1	Infra Red Spectroscopic Studies	81
4.3.2	Thermal Properties	83
4.3.2 (a)	Glass Transition Behaviour	83
4.3.2 (b)	Thermogravimetric Analysis	85
4.3.3	Mechanical Properties	88
4.3.3 (a)	Impact Strength	88
4.3.3 (b)	Tensile Properties	92
4.4	Scanning Electron Microscopy	96

CHAPTER - 5

GRAFTING OF POLYVINYL CHLORIDE
(PVC) WITH METHYL METHACRYLATE
SYNTHESIS AND CHARACTERISATION

		98
5.1	Introduction	98
5.2	Experimental	99
5.2.1	Materials	99
5.2.2	Preparation of dehydrochlorinated PVC	100

5.2.3	Graft Polymerization	100
5.2.4	Estimation of Extent of Grafting	102
5.3	Results & Discussion	102
5.3.1	Effect of Ratio of MMA to DPVC	102
5.3.2	Effect of Reaction time	104
5.3.3	Effect of Initiator concentration	107
5.3.4	Effect of PVC Dehydrochlorinated at varying Temperatures	110
5.3.5	Effect of solvent concentration	110
<u>CHAPTER - 6</u>	GRAFTING OF POLYVINYL CHLORIDE (PVC) WITH METHYL METHACRYLATE - THERMAL AND MECHANICAL BEHAVIOUR	112
6.1	Introduction	112
6.2	Experimental	113
6.2.1	Materials	113
6.2.2	Characterisation techniques	114
6.3	Results & Discussion	115
6.3.1	Infra Red Spectroscopy	115
6.3.2	Thermal Studies	116
6.3.2 (a)	Thermomechanical Analysis	116
6.3.2 (b)	Thermogravimetric Analysis	117
6.3.2 (c)	Differential Thermal Analysis	119
6.3.3	Intrinsic Viscosity	122
6.3.4	Mechanical Properties	124

<u>CHAPTER - 7</u>	GENERAL SUMMARY AND CONCLUSIONS	128
7.1	SUMMARY	128
7.2	CONCLUSIONS	134
<u>CHAPTER - 8</u>	SUGGESTION FOR FUTURE WORK	137
REFERENCES		141