Study of miscibility and interaction in poly Acrylic Acid-polyvinyl acetate blend using Density and Viscosity Technique

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Abstract : The density and the viscosity measurements of polymer blend solutions form an important tool for the evaluation of parameters which give an insight into the nature of miscibility and molecular interactions in polymer blend. Inthe present investigation, densities and viscosities have been measured in 4% solution of polyAcrylic Acid and Poly vinyl Acetate in DMSO using calculated and reduced viscosity parameters varations with composition of blend shows nonlinear increase or decrease with molar concentration which suggest immiscibility or semicompatibility among the component polymers. Two immiscible polymers are need to be compatibilized in order to be used in commercial applications. The nature of solvent-polymer polymer –polymer interaction and the effect of Temperature on the molecular interaction of PAA-PVAc inDMSO have been studied.

Key words : Miscibility**;** Poly acrylic acid, Reduced viscosity, Dimethyl sulphoxide; polyvinyl acetate

1 INTRODUCTION

There are various techniques for studying the compatibity of polymer blends,viscosity measurments reveal compatibility or miscibility of blends.Many workers [1,2] have carried out pioneering work on polymer-polymer compatibility using .Mechanical and viscometric studies on blends of polystyrene {PS} anPVAchadbeenreportedearlier(MamzFolaranmi, (1996)[3,]revealing compatibility domains along composition ranges. Three techniques are widely used to measure densities of polymer sample, these include density gradient column, dilatometryand pycnometry (Tager, 1978). [4] Viscometric study of interactions and miscibility have been successfully applied to the water soluble polymers [5]grafted copolymers[6] electrolytes[7]and even to the mixtures of polymer solutions and micro emulsions[8]The measure of interaction in apolymer solution is the interaction parameter X_i given by

$$X_i i = \mathbf{vi/}\ RT\ (\delta 2 - \delta 1)^2$$

EXPERIMENTAL METHOD

The blends PAA-PVAc of different compositions have been prepared by mixing solutions of the polymersin DMSO at 303.15,308.15K,313.15KPAA (Aldrich Chemicals co.,Inc.,USA M_v =2000) and PVAc (M/S Wilson laboratories, Mumbai,India,M_v=25000) have been employed in the present study. The total weight of the two components in the solution is always maintained at 2 and 4 g/dl.The temperature was maintained constant by circulating water from a thermostat with a thermal stability of +/-0.05^{0}C through a double walled jacket of Thermostat.Density and absolute viscosity measurements of blend are measured by pycnometer with an accuracy of +/- 0.01% and Ubbelohde viscometer.

RESULTS AND DISCUSSION

The measured values of density and viscosity values are used to calculate various solubility parameters of polymer and solvent were used to calculate the interaction parameters between the polymers and polymer blends.The blend solvent interaction parameters for the blend solvent systems can be calculated by using the solubity parametrs of the blend as given by δ = x1δ1 +x2δ2.Based on the values of interaction parameters compatibility of polymer blend is discussed.

The variations of absolute viscosity with increasing percentage of PAA (component1) in the blend has been plotted at different temperatures is shown in Fig.1. It is seen from that for 4 % concentration the absolute viscosity decreses as temperature increses and the sharpness of the maxima is nseen at 40-60 of PAA-PVAc blend composition.Similar behaviour was found by Bailey[9] for aueous solution blends of PAA-PEO. The plots show the variations non-linear with the composition . This behaviour indicates that PAA and PVAc blend exhibits immiscibility and incompatibility in DMSOand also confirms the moderate positive interaction between two blends at weight % 40-60 at lower temparatures.It also indicates that polymer-polymer interactions are weaker than the polymer-solvent and polymerblend-solvent interaction.

Fig:1

Viscosity data for 4% blend of PAA-PVAc in DMSO at differ ent Temperatures

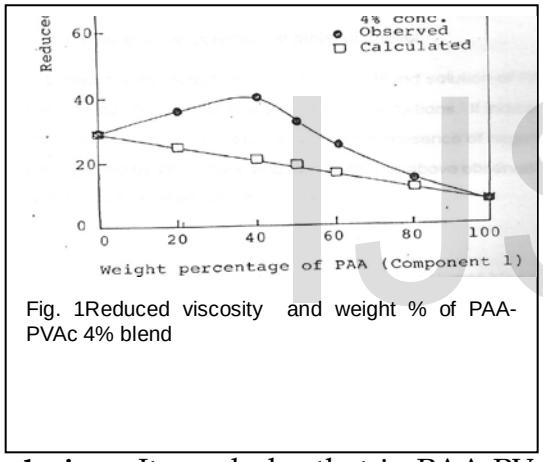

Fig. 1Reduced viscosity and weight % of PAA-PVAc 4% blend

Conclusions: It concludes that in PAA-PVAc blend polymer-polymer interactions are weaker than the polymer-solvent and polymerblend-solvent interaction.

TABLE 1

Density ρ (g/cm^3)	Absolute viscosity η (cP)	Reduced viscosity η_{sp}/C(dl/g) Observed	Calculate
	30° C η_o = 2.139		
1.0966	4.619	28.981	28.981
1.0974	5.250	57.776	24.689
1.0983	5.654	41.072	20.398
1.0992	4.895	32.207	18.253
1.0987	4.370	26.065	16.108
1.1006	3.414	14.904	11.817
1.1023	2.783	7.526	7.526
	35° C η_o = 1.956		
1.0921	4.196	28.623	28.623
1.0926	4.750	35.710	24.392
1.0935	5.097	40.138	20.162
1.0931	4.480	32.252	18.046
1.0942	3.924	25.148	15.931
1.0951	3.070	14.228	11.700
1.0974	2.541	7.470	7.470
	40° C η_o = 1.822		
1.0864	3.802	27.159	27.159
1.0861	4.502	36.772	22.900
1.0876	4.529	37.133	18.640
1.0880	3.997	83.832	16.510
1.0879	3.529	23.413	14.380
1.0898	2.714	12.238	10.120
1.0920	2.249	5.861	5.861
	45° C η_o = 1.608		
1.0812	3.495	29.318	29.318
1.0820	4.012	37.375	24.755
1.0829	4.097	38.679	20.193
1.0830	3.625	31.341	17.911
1.0833	3.188	24.554	15.630
1.0845	2.468	13.368	11.067
1.0873	2.027	6.505	6.505

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