DSC CHARACTERIZATION OF POLYMERIC BLENDED FILMS SYNTHESIZED BY SOLUTION CASTING TECHNIQUE

M.sreedevi[1], R. Jeevan kumar[1*]and N.V.S.Gupta
[1]Department of physics, Sri Krishnadevaraya University, Anantapur 515003, A.P, India.
[2]Department of physics, G.Pullareddy,Engineering College,Kurnool A.P, India.

ABSTRACT:

Homopolymer films NaCMC (Sodium Carboxy Methyl Cellulose) and PVA (Poly Vinyl Alcohol) and blended films prepared by a solution casting method with the composition ratios,10:40,20:30,25:25,30:20 and 40:10 of NaCMC and PVA respectively, were prepared. the influence of blend compositions of PVA and NaCMC has been investigated by Differential Scanning Calorimeter (DSC), ThermogravimetricAnalysis (TGA) of all compositions have beeninvestigated .The results obtained from above studies are critically discussed, it revealed that with the increased composition of NaCMC the stability of Blended film increases and estimated the activation energy of the all blended films synthesized in the present investigation.

KEYWORDS:NaCMC, PVA, Blended Films, Solution casting method, DSC and TGA.

INTRODUCTION:

Polymer Blends represent class of materials with better mechanical properties and bio –compatibility than those of single components. An important and determined aspect of the blend is the miscibility of the component.when two polymers undergo miscibility, well order micro structure of theresult, which give blend unique certain physical properties according to the formation of micro phase configuration. The resulting micro phase configuration can induce pronounced changes in various properties in different from homopolymer. Miscibility polymer blends is assigned to specific interaction between polymer component, which usually give rise to a negative free energy mixing in spite of the high molecular weight of polymers. PVA is received great deal of attention due to its considerable applications. Either pure or composite with other materials. the optical uses of PVA or concerned with the retardation polarization and filtration of light and with photography. NaCMC is used different field ranges from technological industries to the biological, pharmaceutical, petroleum and medical field. Blending NaCMC with another flexible synthetic polymer such as PVA seems to be an attractive where for improving properties of the film. The survey of literature on compatibility of blended polymeric materials[1-3] but there are no work available on NaCMC and PVA blend films which has variety of technological application. The aim of the present investigation was to prepare the films with blends of NaCMCand PVA by solution casting method and study of their thermal properties by using Differential scanning calorimetry(DSC), Thermogravimetric Analysis (TGA) of all compositions synthesized in the present work.

MATERIALS AND METHODS:

MATERIALS:

Sodium carboxymethylcellulose (Mw 90000) was purchased from E. Merck (India) Limited, Mumbai, India. PVA (Poly Vinyl Alcohol) (Mw57,600) was supplied by Molychem India ltd,Mumbai. All the laboratory reagents were procured from S&D fine chemicals, Boisar and were used without further purification. Bi distilled and deionized water with almost zero conductivity was used as a solvent.The Characteristics of NaCMC and PVA were listed in Table-1.

Table-1. Characteristics of polymer samples used in the present work.

Name of the Polymer	M_w	T_g (^{0}C)	Tm (^{0}C)	T_c (^{0}C)
NaCMC	9.00x 10^4	31.94	404.54	301.48
PVA	5.76x 10^4	41.92	221.98	187.43

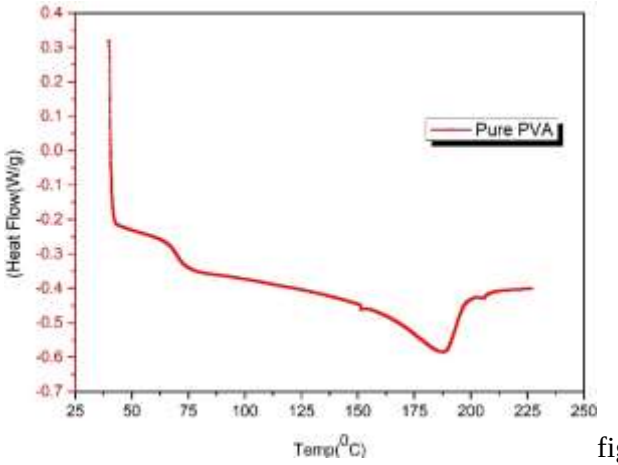
Preparation of Blended Films:

A series of good quality NaCMC/PVA films were prepared by solution casting technique varying the NaCMC content from 20 to100% using deionized water as solvent[4].Thin films of the selected polymers and their blends were prepared by the present method as follows separate aqueous solutions of NaCMC and PVA were prepared. A solution of NaCMC was added with the various composition ratios to the PVA with constant stirring. The mixtureswere stirred for 45 minutes at room temperature to ensure proper mixing.After stirring the mixture continuously for 10- 12 hours it was kept for 24 hours to eliminated bubbles. The total polymer concentration was kept at 1%(w/v). Stock solutions of NaCMC and PVA and their different blend compositions were then casted onto a Teflon coated clean glass plate and dried using ovenat 50^{0}C and kept in dust free atmospherefor 4 days to ensure removal of the solvent traces. The dried thin films were peeled off from the glass plate and were found to be transparent. The prepared films of purepolymers and blends werekept in vacuum desiccators until use. These peeled films were cut in pieces suitable for measurements[5].the thickness of the films ranging from .10 to 015 was obtained by using micro meter[6],and these filmswere characterized by using DSC – TGA studies listed in Table-2..

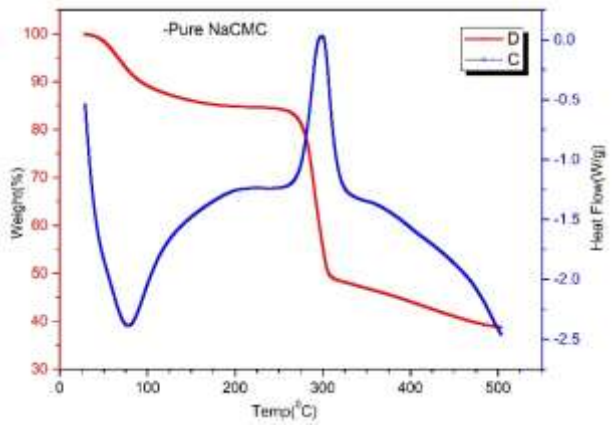
DSC Analysis:

To find out the thermal stability of fabricated samples using DSC techniques. DSC curves for pure PVA and pure NaCMC, N10/P40, N20/P30, N25/P25blends. The DSC curves of pure PVA (Fig.1) shows endothermic peak at 187.43^{0}C. Which indicates melting temperature. The DSC curves of pure NaCMC(Fig.2) shows exothermic peaks at 301.48^{0}C and endothermic peak at 80.42^{0}C. which indicating the melting temperatureThe DSC curves N10/P40 (Fig.3) shows endothermic peak at 274.26℃.Whereas the DSC curves of N20/P30 (Fig.4) endothermic peak shows at 311.82^{0}C which indicating the melting temperatureThe DSC curves of N25/P25(Fig.5) shows endothermic peak at 304.4^{0}C. The results suggested that with increased amount of PVA in the blends increased the melting temperature. the shift end melting temperature values in the DSC curves of polymer blends indicates interaction between PVA and NaCMC.PVA chains more rigid and increases the glass-transition temperature of the membranes. Xiao and Gao[7]were also reported similar observations in case of NaCMC/PVA hydrogels.

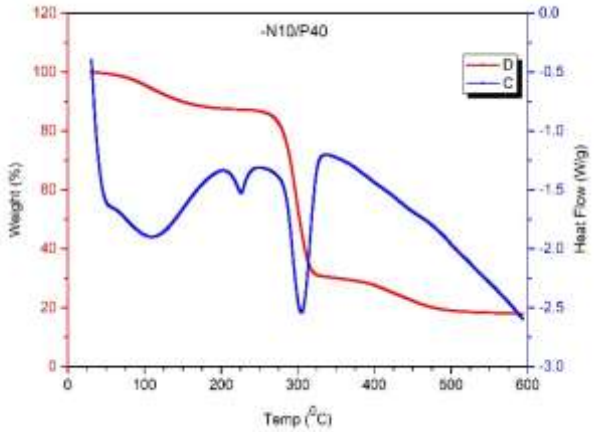
DSC- TGA graphs

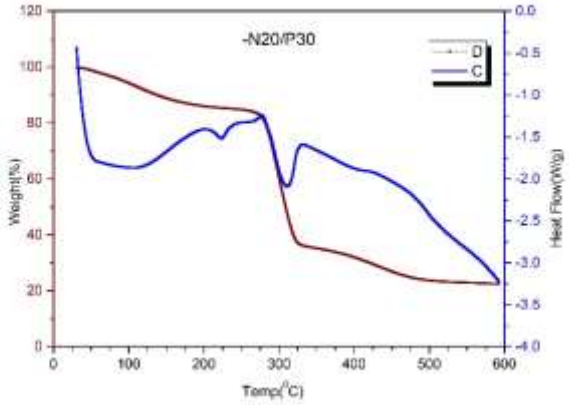


figure(1)

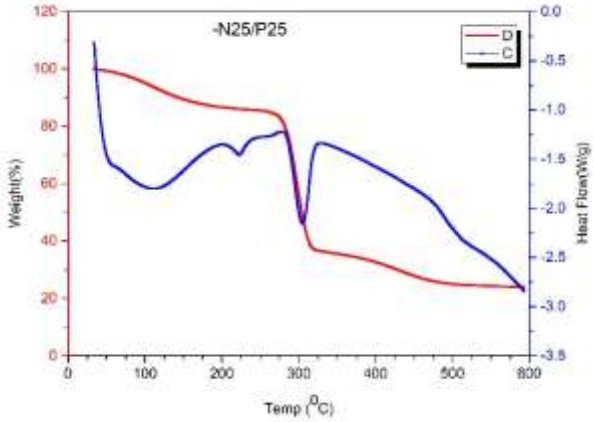


figure(2)





fig(3)



figure(4)

figure (5)

DSC -TGA thermograms of Figure (1) PVA and Figure (2)NaCMC blend films, Figure (3)N10/P40, Figure (4)N20/P30, Figure (5)N25/P25.

Sample	T_g (^{0}C)	T_0(^{0}C)	T_m (^{0}C)	T_c (^{0}C)	Range (T_c-T_0)
PureNaCMC	31.49	238.17	404.54	301.48	63.31
Pure PVA	41.92	156.98	221.98	187.43	30.45
N10/P40	42.85	181.21	540.02	274.26	93.05
N20/P30	42.64	193.12	520.24	311.82	118.7
N25/P25	35.09	173.55	473.55	273.20	99.65

Table-2. Characteristics of polymer samples used in the present work were obtained from DSC – TGA studies.

Thermo Gravimetric Analysis (TGA):

TGA plays an important role in determining thermal stability of the material. TGA is a process in which materials is decomposed by heat, which causes bonds within the material to be broken. TGA curves their derivations of PVA NaCMC, N10/P40, N20/P30, N25/P25 indicated figure (2). The assessment of transition behaviour in PVA/NaCMC blends samples had to be made carefully.TGA curves shows that the thermal stability of the blend samples lies in between those of the two individual homopolymer and the degradation is completed. The TGA graphs indicated weight loss, NaCMC and N10/P40, N20/P30, N25/P25 weight loss is 100.01. According these observations indicate the compatibility between NaCMC and PVA because of the presence of -OH &CH_2CH_2COONa in NaCMC and -OH groups in PVA capable of hydrogen bonding. As seen, T_g shift to higher temperature with increasing heating rate, T_m is only slightly affected. Moreover, the exothermic peak of (NaCMC) shift towards higher temperature.

Conclusion:

In the present study TGA and DSC, thermal curves shown that the thermal properties of NaCMC /PVA blend sample are enhanced by increasing content of NaCMC. The thermal stability of different samples where confirmed by the corresponding determined activation energies.DSC analysis show that the melting point of NaCMC and PVA decrease on blending NaCMC with PVA, and melting peak is widen. The T_g increases with increase on blending of NaCMC with PVA.Blending of NaCMC with PVA will enhance the interaction between NaCMC and PVA,and this renders PVA chains more rigid and increases. Single glass transition was observed for the PVA and NaCMC blends and the melt isotherms was found to shift towards higher temperature with increasing amount of PVA increasing. Differntial Scanning Calorimetry(DSC) studies gives support thermal stability for prepared polymeric films by solution casting technique. The DSC curves of PVA shows endothermic peak at 310.3^{0}C and the DSC curves of NaCMC shows exothermic peak at 297.6^{0}C. This result suggested that increase amount of PVA in the blendsincrease of melting temperature and it shifts to the end melting temperature values. DSC curves the

miscibility data obtained from above simple method and analytical technique results support the miscibility window obtained by simple solution techniques.

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