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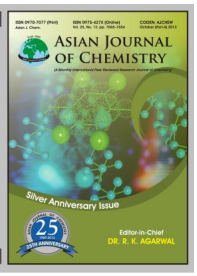

Performance of Membrane with Poly(vinyl acetate) Modified by Starch

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The use of starch on poly(vinyl acetate) emulsion blend modified in order to achieve improved film toughness, which aims to improve water resistance and film-forming emulsion adhesive performance. Dynamic mechanical properties (DMA), scanning electron microscopy (SEM) method was used to analyze the dynamics of film emulsion blend composite mechanics, the distribution of latex particles and glass transition temperature. The results show that with pure poly(vinyl acetate) (PVAc) compared to starch-modified film-forming emulsion film distribution, glass transition temperature of the homopolymers emulsion up to 50 ºC.

Key Words: Poly(vinyl acetate), Starch, Dynamic mechanical properties, Performance XPS.

INTRODUCTION

Poly(vinyl acetate) is a thermoplastic polymer, as industrial raw materials and adhesives are widely used in recent years[1]. Because of its pollution-free water-based adhesive characteristics, but also for wood and wood products can produce high strength and durability of the bonding, it has become a widely used general-purpose adhesive. However, poly(vinyl acetate) emulsion as a thermoplastic adhesive, low softening point and the manufacture of poly(vinyl alcohol) used as the hydrophilic emulsifier and protective colloid and thus it produces the greatest weaknesses *i.e.*, poor heat resistance and water resistance[2]. This limits the scope of its use and reducing its value. In recent years, the poly(vinyl acetate) emulsion adhesive is modified by the additive modification, copolymerization, blending modification, protective colloid, the modified initiator and emulsifier[3]. As it is known, a new polymer blend must present an improvement of mechanical properties of this new product[4]. In this paper, the shortcomings of its poor heat resistance, adding starch to the polymerization of vinyl acetate was modified to improve its various properties[5]. There are several techniques that could be used to investigate polymer blends membranes.

EXPERIMENTAL

Scanning electron microscopy (SEM was used for observation the surface structure of films with instrument Quanta 200 scanning electron microscope (supplied by FEI Co., Ltd). Dynamic mechanical analysis (DMA) was performed with a D204 dynamic mechanical properties by NETZSCH Instruments (Germany). Tests were run at 3.33 Hz with a strain of 0.1 % and the temperature was ramped from -50 to 150 ºC at 5 ºC /min.

Vinyl acetate used for the preparation of poly(vinyl acetate) was purchased from Tianchen Chemical Company and used as received. Poly(vinyl alcohol) vinol (PVA. 1799) was purchased from TianTai chemical company and used under nitrogen, (N-butyl-1-butanamine), ammonium persulphate, ethanol were purchased from Shenyang XinSi reagent manufactory.

Preparation method of high solid content emulsion-based composite: The experimental setup was equipped with stirrer, reflux condenser, dropping funnel and thermometer. In all four bottles, added a certain amount of monomer, emulsifier solution, 10 % aqueous solution of poly(vinyl alcohol) and the amount of water at 60 ºC under mixing emulsion, stirring speed 400, heated to 70 ºC, added mixed emulsifier, buffer and some mixed monomer until system back end. After warming to 80 ºC start dropping the remaining monomer and initiator added in batches, dropping in 3-time access control 4 h. After the temperature dropping to 90 insulation 50 min, cooling to 30 ºC, discharge.

RESULTS AND DISCUSSION

Dynamic mechanical analysis of starch modified poly(vinyl acetate) composite film emulsion: Experiments in the preparation of high solid content reached 50 % of the poly(vinyl acetate) emulsion has good water resistance, but

the emulsion adhesive joints more fragile, vulnerable to external influences, the film and toughness is poor. The starch is a good film toughness and performance advantages for both, the latex compound modified, resulting in high-performance emulsion system. All the laboratory pure poly(vinyl acetate) emulsion with D01 said 5,15,25,35 share of poly(vinyl acetate) emulsion, respectively, the ratio of starch. In the polymerization process by adding modified starch to the emulsion system performance have a greater impact toughness of starch solution is a good emulsion, high solid content D01 is the glass transition temperature of 30 ºC. The test of the dynamic mechanical properties curve shown in Fig. 1.

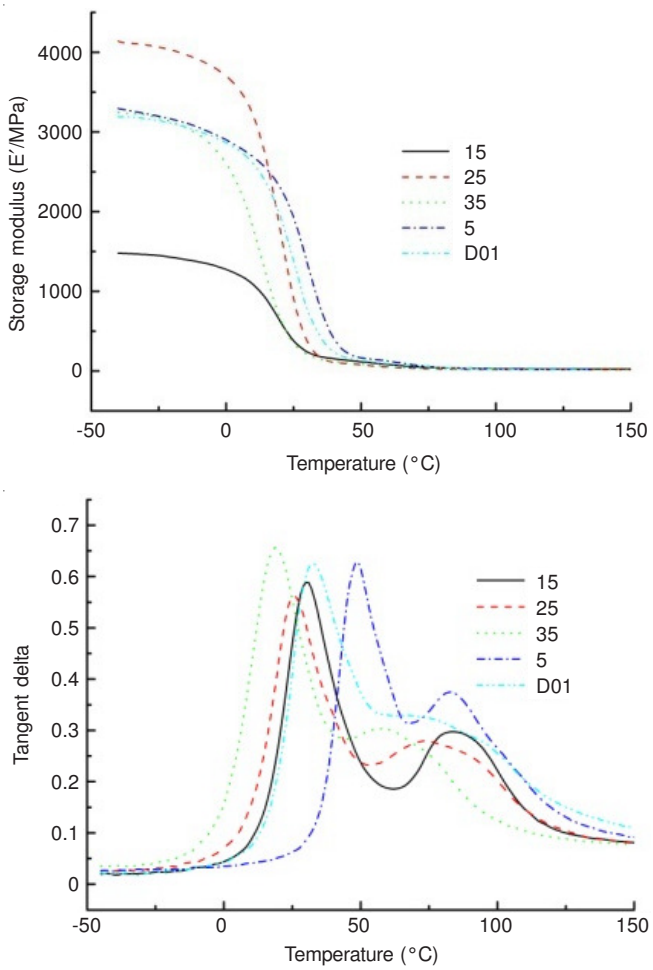
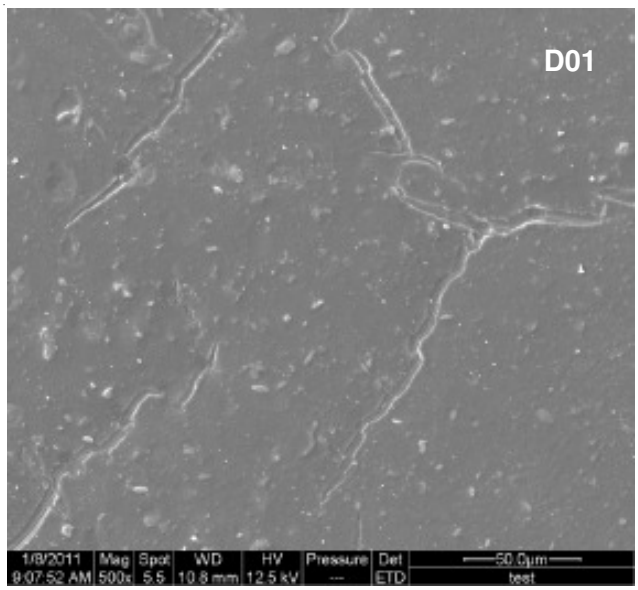
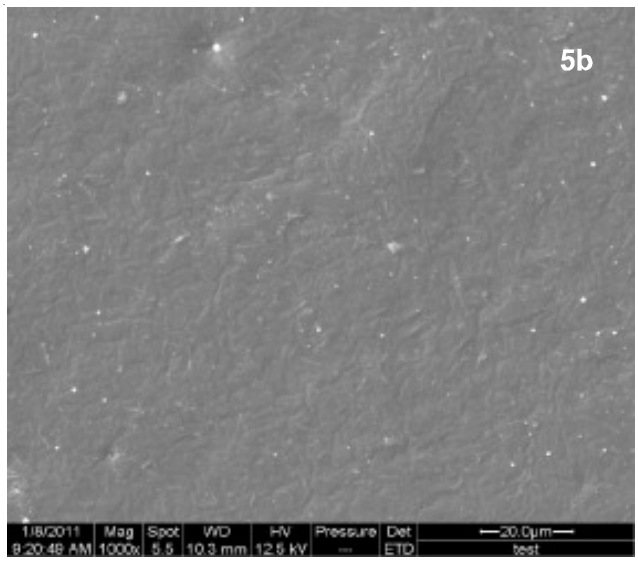


Fig. 1. Starch modified poly(vinyl acetate) emulsion film spectrum of different proportions of dynamic mechanical properties

Fig. 1 showed that the D01 numbered poly(vinyl acetate) storage modulus 3250 MPa, the corresponding loss factor is 30 ºC, respectively, when the proportion of EVA added to 5 %, the storage modulus did not increase with pure D01, but the loss factor maximum temperature of up to 50 ºC. Added for 15 %, the modulus 4500 MPa, loss factor increased the maximum temperature at 30 ºC, but the ratio of 25 %, the largest increase in storage modulus, 4200 MPa, an increase of 33 %, the glass transition temperature is not very large increase. Therefore, starch is added to improve the ratio of 25 %, the best, it reached 4000MPa. Improve the poly(vinyl acetate) film glass transition temperature; it will help the use of film-forming materials and anti-aging properties, integrated storage modulus and loss angle factor, the opt-in ratio of 5 %, the best individual performance.

SEM analysis of poly(vinyl acetate) composite film modified starch: Fig. 2 shows the different proportions of starch with different poly(vinyl acetate) film microstructure. As can be seen from Fig. 2, the microstructure of the diaphragm are different, poly(vinyl acetate) film is very uniform, no big reunion between the particles, indicating that the dispersion of latex is very good, but the film cracks, due to emulsion viscosity is too, leading to the film during film formation, moisture evaporation uneven, brittle film. In Fig. 2(b), add 5 % starch ratio of the film, it is clearly seen that the poly(vinyl acetate) molecules form a continuous network structure, bonding together the starch granules, the viscosity changes caused by changes in the form of a good film. With the gradual increase in the proportion of starch, formation of the film getting better and better, indicating that starch can increase the toughness of film emulsion, the role played by plastic.





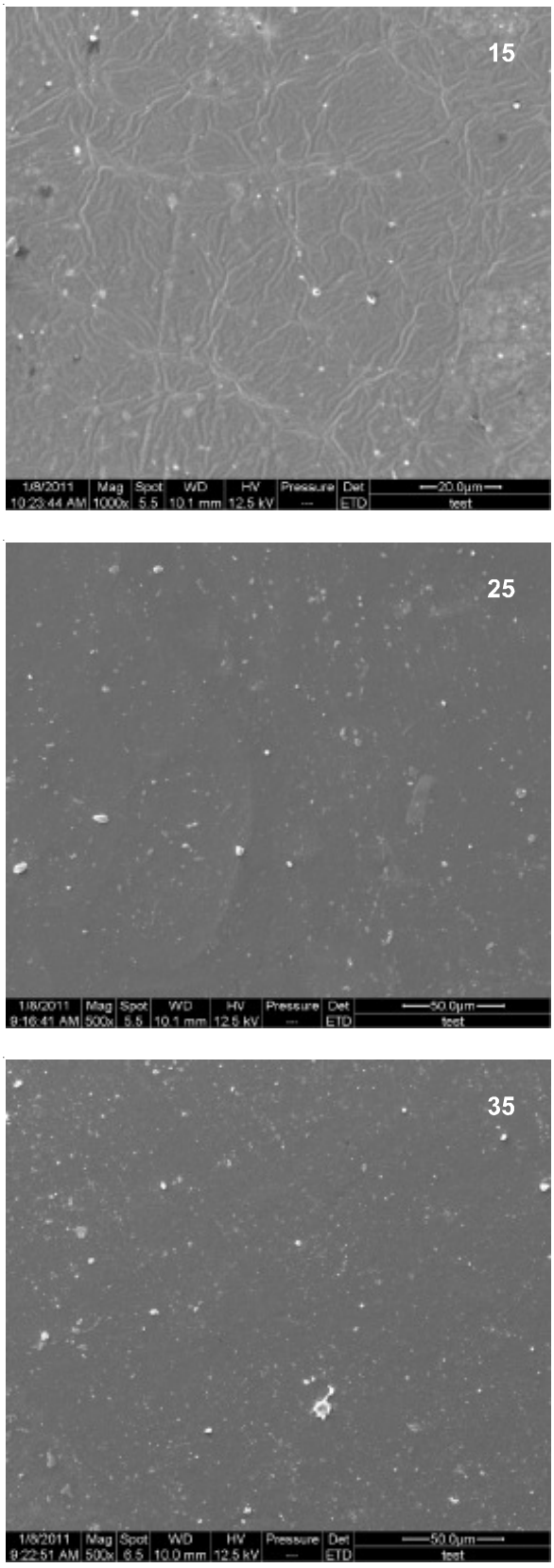


Fig. 2. SEM pictures of film with different poly(vinyl acetate)/EVA

X-ray photoelectron spectroscopy analysis of poly(vinyl acetate)/EVA film: X-ray photoelectron spectroscopy analysis was used to characterize the chemical changes of the film glue. In the high resolution atomic percent of C1s, O1s were shown in Table-1 and Fig. 3.

TABLE-1
ATOMIC PER CENT OF ELEMENTS
POLY(VINYL ACETATE) FILM MODIFIED BY STARCH

Name	Peak BE (eV)	D05 (At %)	5 (At %)	15 (At %)	25 (At %)	35 (At %)
C1s	285.00	79.36	77.05	74.96	73.87	72.02
O1s	531.95	20.64	22.95	25.04	26.13	27.98

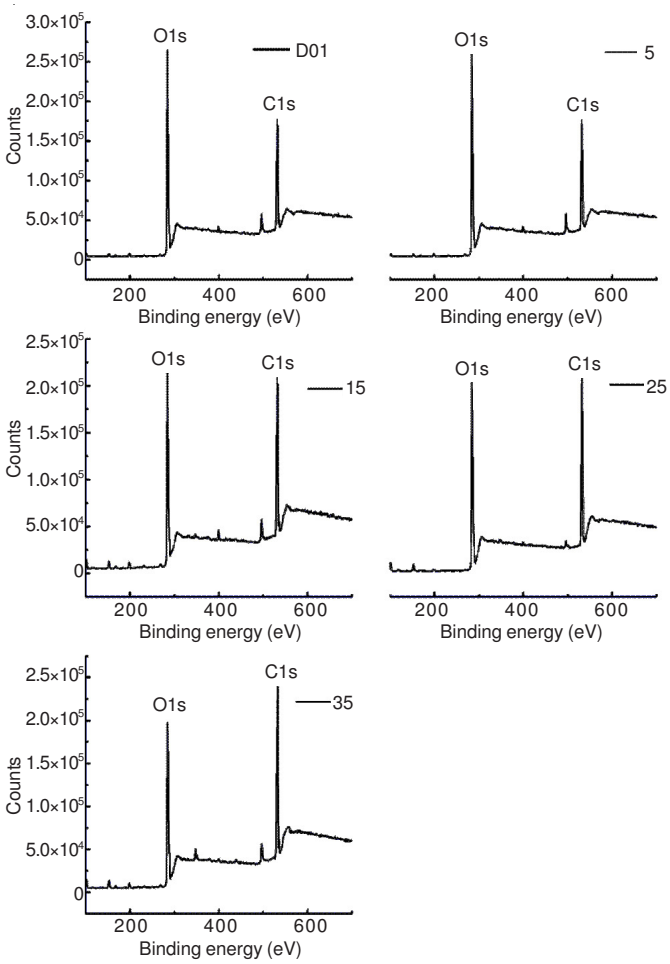


Fig. 3. XPS spectra of film with different poly(vinyl acetate)/starch

With the increase in the proportion of starch, the poly(vinyl acetate) film in the atomic percentage of carbon content decreased to 72 %, while the oxygen atom content increases first and finally to stable. In the mix processed, although there is no formation of new bonds, but the proportion of composite films increase in starch formation. As the oxygen atoms increases, the increase in the proportion of hydroxyl introduced.

Conclusion

Effect of the use of the starch to improve the toughness of the emulsion. Dynamic mechanical properties and SEM were applied to characterize the proportion of starch in different effects on the emulsion film. Dynamic mechanical properties results show that, D01 initial storage modulus are 3250 MPa, the corresponding loss factor were 30 ºC, when the starch is added to improve emulsion film storage modulus, starch is added to increase the maximum ratio of 25 %, reached a 4200 MPa D01 respectively, compared with net up 33 % from the

dissipation factor to consider, adding 5 % of the emulsion. Film temperature to 50 ºC, overall performance is better. SEM results show that the starch-modified emulsion film is uniform, no big reunion between the particles, indicating that the emulsion dispersion is good. From the results of XPS analysis, it was clear that the oxygen content increased in the proportion of starch.

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