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Research Article

EFFECTS OF SCCO2 PROCESSING ON DIFFERENT ORGANIC MODIFIED CLAYS DISPERSION QUALITY

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ABSTRACT

Utilizing organomodified montmorillonite (MMT) (commonly called ''Nanoclay'') to reinforce polymer-based composites have raised much attention to academic and industrial sectors due to the addition of small amount of nanoclay could considerably enhance the mechanical properties of pristine polymers. In this study the scCO2 process was applied to pre-disperse three commercial Cloisite® nanoclays 10A,20A and 30B, the effects of scCO2 process and chemical and physical properties of clay particles on clay pre-dispersion were examined and the extent of clay pre-dispersion was assessed by SEM, WAXD and TGA. I found that the scCO2 processing results in pre-dispersion of organic modified clays regardless what kind of modifier on them. The degree of dispersion of different kind of clays actually is a competitive result between carbon dioxide-philicity and modifiers interaction. Likewise, TGA information affirms that the scCO2 preparing does not expel surface modifiers from clays, which maintain good solubility of clay in organic solvent and compatibility with organic phase.

INTRODUCTION

The development of new materials or enhancing the properties of existing material or to extend their materials to extend their utility so many engineers and scientists are still trying beyond the current limits. Through the perspective of present industry oriented and financial happenings, it will be efficiently supposed that the skills have opened new windows for opportunity those defines the principles for our livelihood. Those necessities produce ongoing exertions for high, new performance along less price material to attain growing necessities. Due to their elastic and viscous like properties, Polymers have been the objects of deep study. In view of the significant demands in food packaging for transparent bottles with high barrier property, and since the various processing drawbacks of previous methods to improve barrier property of polymeric packaging resources, my work aims to increase the poor barrier property of polymeric packaging materials by using polymer/clay NC technology which has been proven to be an actual solution and be comparatively cheap and simple could be adopted by present manufacturing processes .In order to astounded the widely familiar difficulties for forming polymer/clay NC, viz. poor clay dispersion and interfacial interactions. In this connection it can be utilized to improve supercritical fluid processing technique to pre-disperse nano-clays, and further compound them with polymers to form polymer/clay NC.[1-17]

MATERIAL AND METHOD

In this study, organically modified montmorillonite clays (Cloisite 10A, 20A and 30B) were used. The series of Cloisites® clays are chosen because significantly different varieties on surface chemistry of those clays possess in it, which the unique properties from hydrophilic to hydrophobic attribute them with which it can be applied to reinforce with diverse properties in a varying number of different engineering plastics. To analyze the effect of surface modification on improving chemical and physical attributes of the final NC the significant differences of clay surface chemistry can provide good control group, which could be very helpful for fundamentally study the relationships for researchers in between physical and chemical structures, processing of chemical and physical properties.[3,4,5]

scCO2 processing

The processing method for scCO2 highlighted certain amount of clay to CO2 in a vessel with high pressure which was equipped with a mechanical stirrer; then structure was then increased to the above critical point for CO2 and the clay was

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permitted for soaking with thorough mixing above a comparatively processing period which is short(~3h). Then the structure was very quickly depressurized to the pressure of atmosphere. The clay particles were collected which was processed by using a stainless steel drum which was sealed. [3-8]

RESULTS

Wide angle X-ray Diffraction (WAXD)

To determine the spacing between clay platelets changed after and before scCO2 processing were investigated BY WAXD was used. [3,4,5]

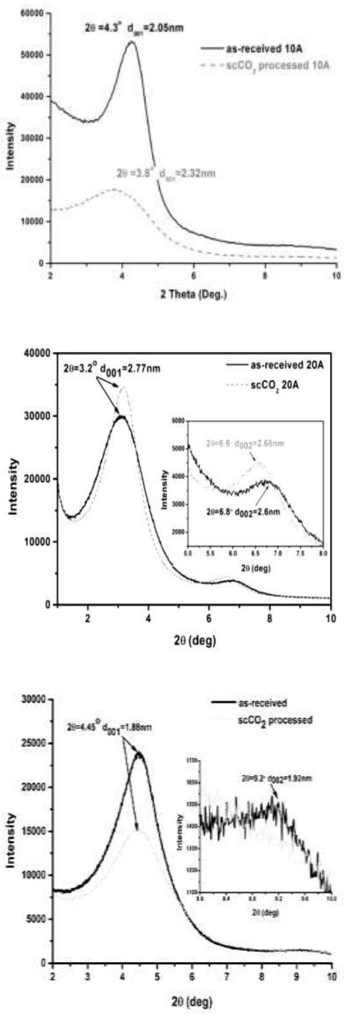

Figure 1 WAXD patterns of as-received and scCO2 processed 10A, 20A AND 30B [3]

Scanning Electron Microscopy (SEM)

In this work, the melt processing of on different types of clay nanoparticles (Cloisite 10A, 20A and 30B) after and before scCO2 processing were investigated by SEM.

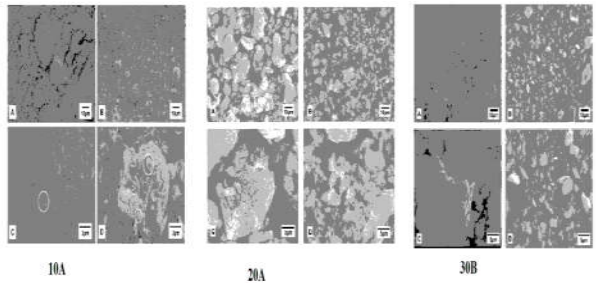

Figure 2 SEM images of as-received and scCO2 processed 10A, 20A and 30B [3]

Thermal Gravimetric Analysis (TGA)

To observe the difference of clay's surficial modification of chemical after and before scCO2 processing were investigated by TGA thermograms.

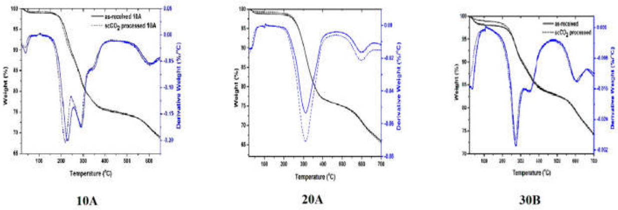

Figure 3 TGA curves of as-received and scCO2 processed [3]

The same results also reported by Manitiu *et al*. [3] Fengyuan Yang [3] and published for 93A using quiescent scCO2 processing [4].

Well dispersion or intercalation/exfoliation of nanoscale fillers (nano-clay) in polymer matrix is currently not easy to be achieved. Supercritical carbon dioxide (ScCO2) has been reported to have great potential for facilitating the dispersion or intercalation/exfoliation of the nanoscale fillers in polymer matrix. On the basis of WAXD and SEM research, the fresh processing method of scCO2 was stared as a efficient method to pre-disperse organic changed clays. Normally, the scCO2 processing effect in pre-dispersion of organic changed clays nevertheless what kind of transformer on them. The distribution degree of various kinds of clays essentially is a competitive result between carbon dioxide-philicity and modifiers interaction, which means stronger carbon dioxide-philicity and interaction of weaker modifier end in good pre-distribution. Apart from it, TGA data show that the processing of scCO2 didn't eliminate modifiers of surface from nanoclays [15] which kept the good solubility of clay in organic solvent and the compatibility to organic phase. Furthermore, the pre-distributed clay keep unaffected even after 6 [16] month's storing at normal temperature, which shows that the subsequent pre-dispersed clays well-maintained as-received clay's organic modifier and the expanded structure is thermodynamic stable under room temperature. We trust the prolonged flexible and puffy structure of the scCO2 processed clays reduced the average particle size, weakened compact of clay particles and visible excess of the existing area of surface and would be easy to distribute into a matrix of polymer than the clay of as-received, however the thermodynamic stable structure will make them be easily compatible to many traditional compounding techniques like melting mixing, solution and polymerization of in-situ and to overwhelmed kinetic limitation caused by little processing time. Compared to the as-received nanoclays prepared without the aid of $ScCO_2$ processing, the nanocomposites with $ScCO_2$ processing addition appear to have higher degree of nano-filler dispersion or intercalation/exfoliation.[3,15-17]

CONCLUSION

$scCO_2$ processing allows pre-dispersion of organic modified clays regardless what form of modifier on them. $scCO_2$ processing did now not eliminate surface modifiers from nano-clays which saved the best solubility of clay in organic solvent and the compatibility to organic phase (based on TGA consequences). The expanded flexible and puffy structure of the $scCO_2$ processed clays exposed greater of the to be had surface area and ought to be easier to disperse right into a polymer matrix than the as-obtained clay. The degree of dispersion of different kind of clays without a doubt is an aggressive result among CO_2-philicity and modifiers interaction which means that stronger CO_2-philicity and weaker modifier interaction result in better pre-dispersion.[3,16,17]

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