Paper ID: A230

Polymer-Clay Nanocomposites with Improved Thermal and Physical Properties by Free Radical Polymerization

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EXTENDED ABSTRACT

A huge interesting to use the Poly(N-vinylcaprolactam) (PNVCL) as thermoresponsive polymer in the biomedical applications, mainly in drug delivery systems. The Poly(N-vinylcaprolactam) (PNVCL) are show a lower critical solution temperature (LCST) as a temperature responsive polymers which ranging from 32 to 34ºC in aqueous solutions. In this study, free radical polymerization was used to polymerize the N-vinylcaprolactam (NVCL) with different types of the clay at 68ºC. For this purpose, Organo-modified C20, B30 and unmodified sodium montmorillonite clay (MMT) were employed to produce polymer/clay nanocomposite. Commercial grade C20, B30 and (MMT) were added in a range of 1-5 wt %, in wPP to prepare polymer-clay nanocomposites, following the free radical polymerization method. Fourier transform infrared spectroscopy (FTIR) was engaged to evaluate polymer structure before and after the polymerization [1]. Thermogravimetric analysis (TGA) was used to analyse the thermal stability and thermal properties for the polymer-clay nanocomposites. FTIR measurements as shown in Figure 1 confirmed the presence of clay (C20) in the nanocomposite produced in this study. The C-H stretch bond peaks in the range of 2852- 2936 cm^{-1} correspond to hydroxyl (C-H) group present on the surface of the composite. The band centered at ~1622 cm^{-1} represents the stretch mode of carboxylic group (C=O) [2, 3]. Presence of the above carbonyl group indicates that organoclays are chemically linked to the polymer through hydrogen bonding and thereby forming the polymer/clay nanocomposite. To find the thermal degradation of the materials TGA testing can be use. The temperature was setting from 30 to 800ºC, and the measured of the onset temperature on the degradation points 5%, 10% and 50%. The mass residue percentage can be measured on the temperature limits 500ºC and 600 ºC as shown in Table 1. The temperature at weight loss 5% can be use to select the initial thermal stability, this temperature was ranging from 34 to 71ºC. The non-volatile materials represented the last fraction of the thermal degradation measurement appeared at the temperature 600 ºC. The comparison results for the FT-IR and TGA show that the best nanocomposite was found in the case of used 1% C20 as filler.

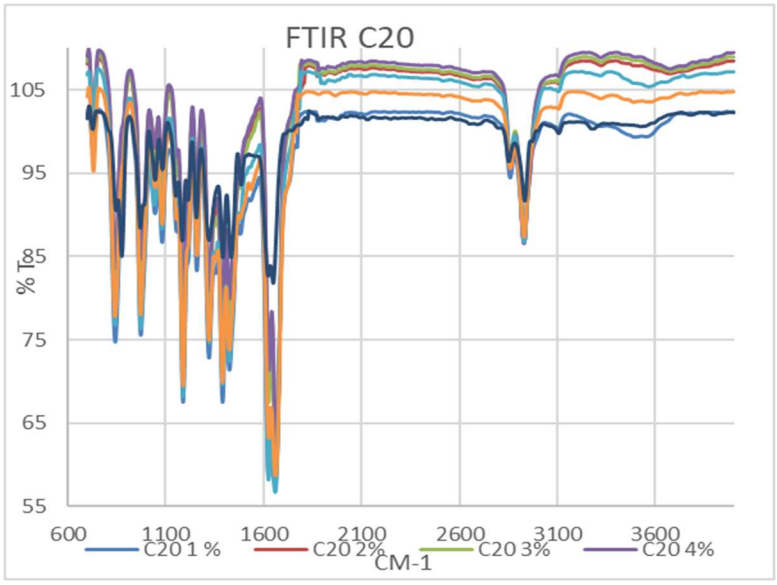

Fig. 1: FTIR spectra of the Monomer (NVCL), Polymer (PNVCL) and nanocomposite with different percentage of the organoclay C20.

Table 2 TGA data for PNVCL and nanocomposites under nitrogen flow.

Sample	Temperatur/ ºC at mass loss			Residue % at	
	5%	10%	50%	500 ºC	600 ºC
PNVCL	53.24	81.01	147.14	1.158	0.425
NVCL+1%(C20)	66.95	93.87	147.80	2.371	0.907
NVCL+2%(C20)	37.54	56.84	141.88	3.056	1.474
NVCL+3%(C20)	42.93	61.88	141.94	2.437	1.604
NVCL+4%(C20)	42.01	60.54	139.08	4.091	2.960
NVCL+5%(C20)	71.18	94.21	144.72	5.838	4.310
NVCL+1%(B30)	60.38	92.52	148.66	2.62	0.618
NVCL+2%(B30)	58.06	86.58	141.57	2.17	0.582
NVCL+3%(B30)	59.49	82.83	143.97	2.95	1.240
NVCL+4%(B30)	59.05	86.08	143.19	4.77	3.113
NVCL+5%(B30)	56.93	82.40	146.16	5.28	3.560
NVCL+1%(MMT)	34.42	46.65	155.65	4.19	0.695

Keywords: Polymer; Clay; Nanocomposite; thermal; physical.

Acknowledgment

The authors would like to thank the Universiti Malaysia Pahang for providing laboratory facilities and financial support under research grant (RDU150398)

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