Removable of Dye on Poly (N-tert-butylacrylamide-co-acrylamide/Maleic acid) OMMT Hydrogels

M.Venkatesan[1] and P.Pazhanisamy [2*]

[1] Centre for Research and Development , Bharathiar University, Coimbatore -641046, India.

[2]Department of Chemistry, Sir Theagaraya College, Affiliated to University of Madras, Chennai-600 021, Tamil Nadu, India.

Abstract

The present study describes the preparation of Poly (N-tert-butylacrylamide-co-acrylamide/Maleic acid) OMMT denoted as Poly(NTB-co-AM/MA)OMMT. The first step is the synthesis of Poly(NTB-co-AM/MA)OMMT. The second step is the incorporation of OMMT Nanoclay. The properties of the gel can be modified by the OMMT clay. The amount of MA and Nanoclay places essential role in the adsorption. The adsorption rate of dye stuff are slow at the initial and increases further.

Keywords: *NTB, Maleic acid(MA), Acrylamide, Organically modified montmorillonite nanoclay (OMMT nanoclay).*

INTRODUCTION

Hydrogel are prepared from monomer. It can be considered as natural polymer and polymer hydrogel and combination of two also. The are two type of gel that is physically and chemically cross linked gel. The first case the network are held together by ionic, hydrogen bonding or hydrophobic force. But the second one is covalently cross linked network. It is multicomponent system consisting of three dimensional network. By the incorporation of inorganic ordered system (clay), the properties of the gel can be modified or enhanced. The most used material is clay which shows the layer structure and it is easily available in nature. Many types of clay have exchangeable properties. when the exchangeable metal ion of the clay is replaced by cationic surfactant (alkyl ammonium ion of different of different carbon chain length). Organophilized clay is obtained. As per EU regulations 92/59/EEC, The usage of forty hazardous dye is restricted. The removal of these dye is very much essential. The adsorption study was carried out using crystal violet which is mutagenic effect reported by USFDA. The higher dosage of crystal violet is linked to bladder cancer in human. The present study aimed at the synthesis of Poly (N-tert-butylacrylamide-co-acrylamide/MA) OMMT which serves as an alternative adsorbent for the removal of dye.

EXPERIMENTAL

Synthesis of Poly (N-tert-butylacrylamide-co-acrylamide/MA)OMMT Hydrogels

Free-radical crosslinking copolymerization carried out in methanol/water mixture as the polymerization solvent, at 60^0C in the presence of APS as initiator and MBA as crosslinker. Aqueous solution containing NTB (0.5g), AM (0.5g), MBA (0.050g), APS (0.050g), MA (0.1, 0.3, 0.5g), OMMT(0.050g, 0.100g, 0.200g) prepared in methanol water mixture. Subsequent to bubbling nitrogen for 15 min, the contents were kept in thermostatic water bath at 60^0C and the polymerization was conducted for 1 day. After the reaction, the Nanocomposites were cut into pieces 3-4 mm long. The extracted Nanocomposites were dried in vacuum oven at 50^0C to constant weight for further use. Nanocomposite Hydrogels compositions are illustrated in Table 1.

Table 1. Nanocomposite Hydrogels prepared from varying amount of MA

S. No	Wt. of NTB (g)	Wt. of AM (g)	Wt. of MA (g)	Wt. of APS (g)	Wt. of MBA (g)	Methanol / Water (3:1)	Wt.of Nanoparticle (g)
1	0.500	0.500	0.1	0.050	0.050	10	0.050
2	0.500	0.500	0.3	0.050	0.050	10	0.100
3	0.500	0.500	0.5	0.050	0.050	10	0.200

RESULTS AND DISCUSSION

The schematic representation of poly(N-tert-butylacrylamide-co-acrylamide/MA) OMMT is given as Figure 1.

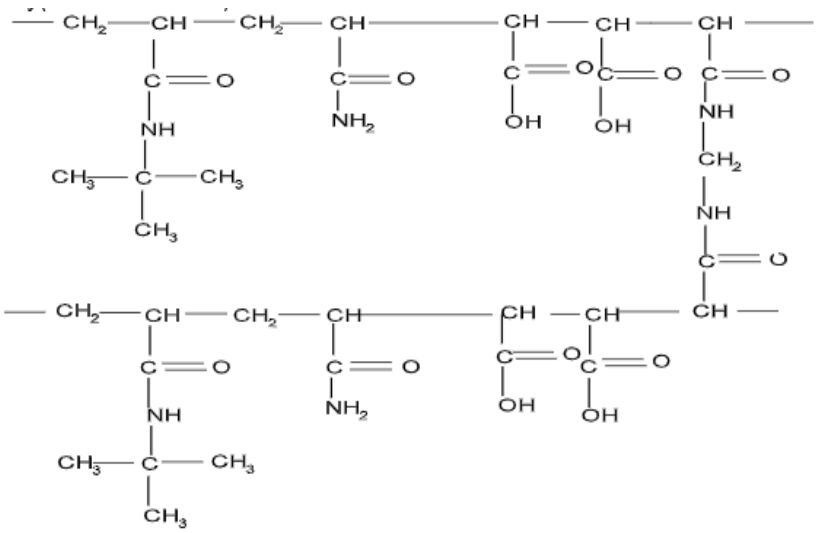

Figure 1. Schematic representation of poly (NTB-co-AM/MA) OMMT Hydrogel

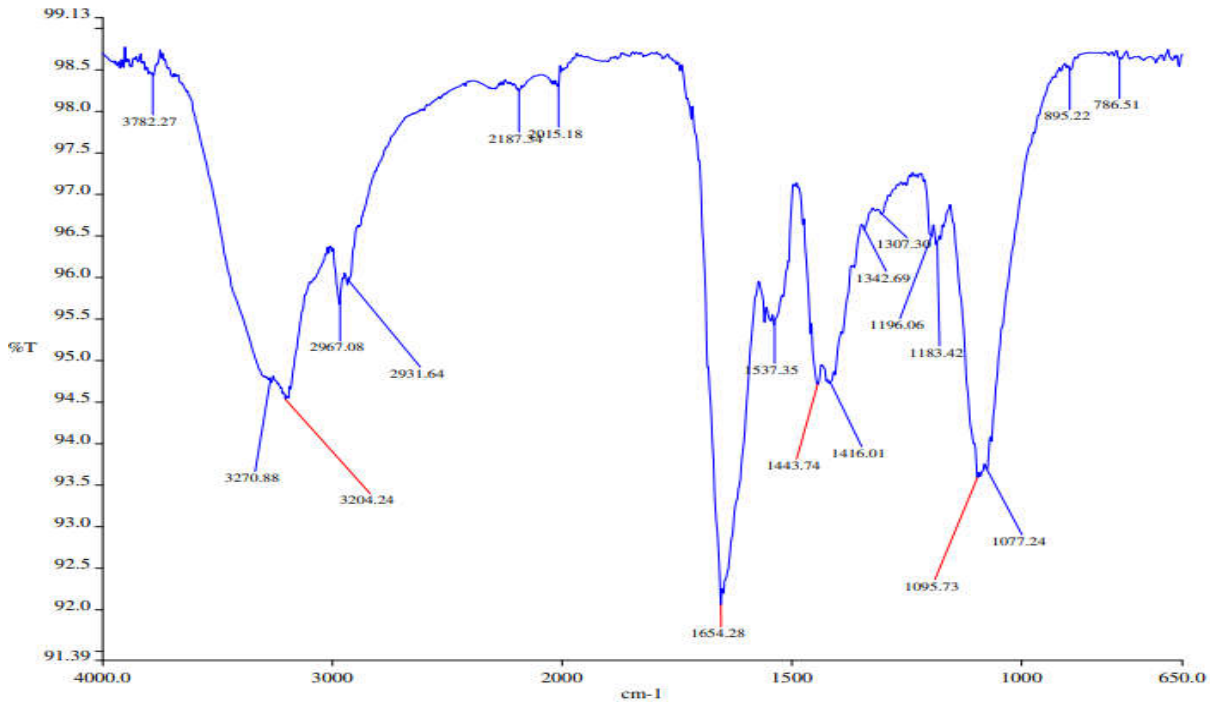

Figure 2. FT-IR spectrum of poly (NTB-co-AM/MA) OMMT Hydrogel

FT-IR Spectroscopy

FT-IR spectra of poly (NTB-co-Am/MA) OMMT Hydrogel is shown in Figure 2. The IR testing of the hydrogels showed that the existence of peaks corresponding to the functional groups of monomeric units present in the copolymeric hydrogel chain. A broad peak corresponding to NH stretching of NTB was observed around 3270.8cm^{-1}. Furthermore, the peaks were also observed at 1654cm^{-1} corresponding to C=O of NTB and carboxyl unit and 1537cm^{-1} corresponding to C=ONH$_2$ of AM unit. The band at 2931cm^{-1} is due to C-H stretching of polymer backbone, and peaks at 2967.08 cm^{-1} indicates coupled OH in-plane bending and C-O stretching. Peak at 3782.27 cm^{-1} is due to –OH group between the two planes of the clay. Si-O-Si symmetric stretching mode was observed at 1182.42 cm^{-1}. Peak at 786.51 cm^{-1} indicates Si-O-Si and R-O-Si (R=Al, Mg or Li) respectively. It confirms the incorporation of the clay into the polymer matrix.

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SEM Analysis

The SEM images of poly (NTB-co-AM/MA) NCH are shown in Figure 3. The SEM micrograph of the composite have the morphology cauliflower like structure and the diameter is in the nm scale. It confirms the sample of our synthesized hydrogel composite as real composite, and are uniformly distributed throughout the polymer matrix.

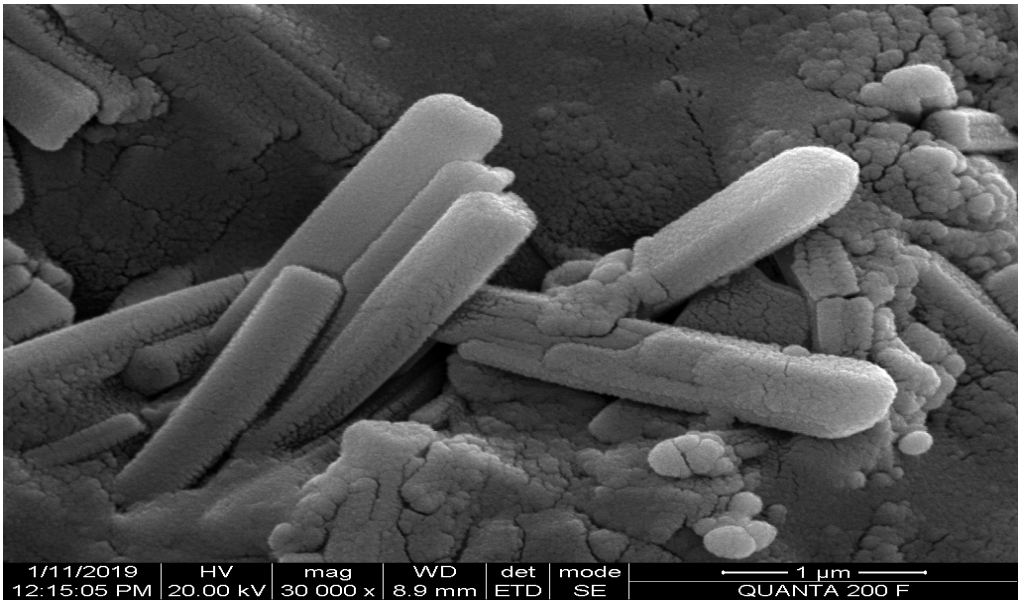

Figure 3. SEM images of poly (NTB-co-AM/MA) OMMT Hydrogels

Adsorption of crystal violet

The adsorption curves of nanocomposite Hydrogels are shown in Figure 5. The maximum adsorption capacity is nearly about 75% for 0.1g of MA and clay (0,0) and it is decreasing if clay content is at 50mg and 100mg. After one day all nanocomposite showed dark color compared with the original composites. Also, the color of crystal violet solution became colorless compared with the original solution in case 75%. The cationic dyes like CV have electronegative atoms such as nitrogen and sulfur behave like hydrophilic groups and form hydrogen bonds with water. Addition of clay content is more leads to cross linking density result the reducing of adsorption.

Calculation of Removal efficiency

The Removal efficiency (RE%) of Nanocomposites was calculated by using the following expression

$$\mathbf{RE\% = (C_0\text{-}C/C_0) \times 100}$$

Where C_0 and C are the initial and equilibrium concentration of the crystal violet dye solution.

Table 2. Concentration of dye varying in Time (OD) on adsorption of poly(NTB-co-AM/MA) OMMT Nanocomposite hydrogels

	OMMT	SAMPLE NO.	INTIAL	2HRS	4HRS	6HRS	8HRS	24HRS	26 HRS
NTB-co-AM-MA (0.1g)	0	19	0.3393	0.3	0.19	0.1765	0.0925	0.0926	0.0845
	50	20	0.3393	NA	0.3076	0.2777	0.1829	0.1742	0.1664
	100	21	0.3393	NA	NA	NA	NA	0.3048	0.2844

The concentration varying (OD) of poly(NTB-co-AM/MA) Nanocomposites Hydrogels at different time intervals.

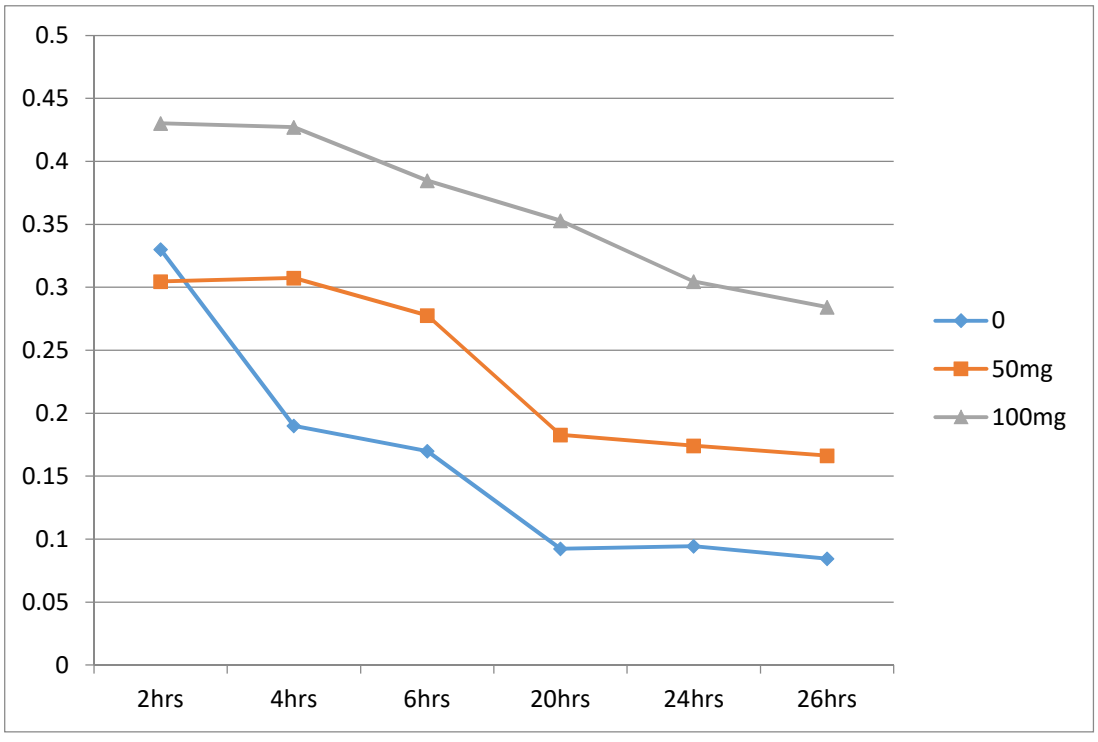

Figure 4. Concentration varying(OD) of poly(NTB-co-AM/MA) Nanocomposites

Table 3. Removable efficiency in % on adsorption of poly(NTB-co-AM/MA) OMMT Nanocomposites Hydrogels

NTB-AM-MA	OMMT	SAMPLE NO.	2HRS	4HRS	6HRS	8HRS	24HRS	26 HRS
NTB-co-AM-MA(0.1)	0	19	11.67	43.88	47.98	72.73	72.73	74.98
	50	20	NA	9.34	18.15	46.06	48.65	50.95
	100	21	NA	NA	NA	NA	10.16	16.18

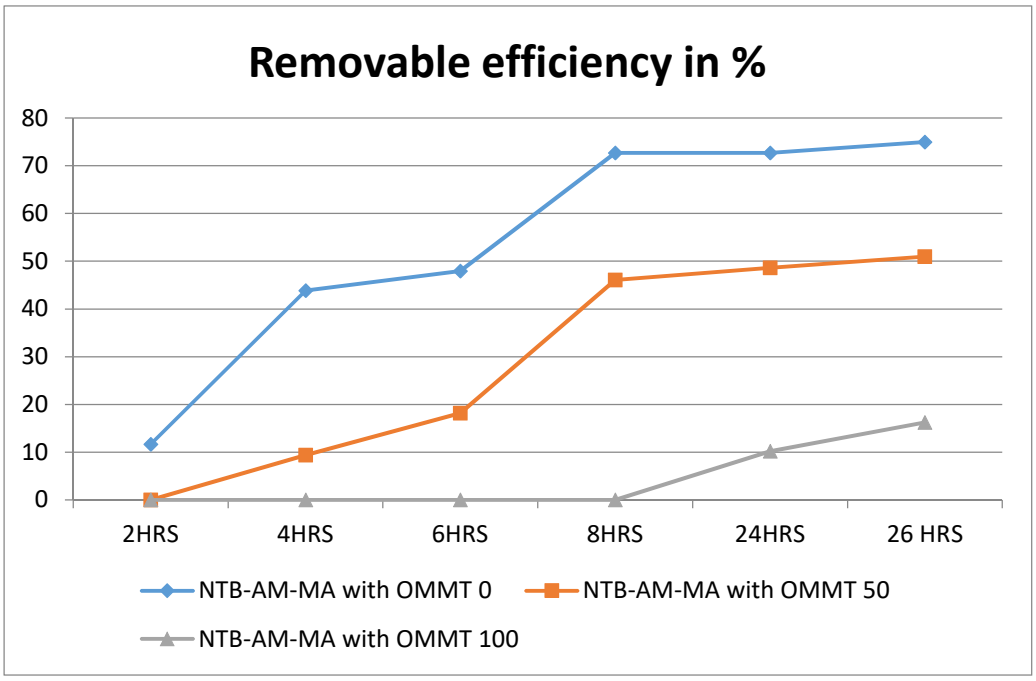

Figure 5. Removable efficiency in % of poly(NTB-co-AM/MA) Nanocomposites

CONCLUSION

The Poly(NTB-co-AM/MA) OMMT hydrogel showed the maximum of 75 % removable efficiency of dye when containing 100mg of OMMT nano clay compared to other hydrogels. In the wake of serious environmental concerns and health hazards, World has made legislations more stringent on the control of ecological factors to preserve and sustain the pollution free environment. From this study, it may be concluded that the removal efficiency of dyes from various textile industries effluent by adsorption of hydrogel has been found to be very useful for controlling water pollution due to hazardous dyes.

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