

# Notes

## *Characterization of Methyl Methacrylate Grafted Jute Fibers*

Considerable work<sup>1-3</sup> on graft copolymerization of vinyl monomers onto jute has been contributed to the polymer literature. But the studies on the characterization of the grafted jute fibers are very few. In this communication we wish to report the characterization of methyl methacrylate (MMA) grafted chemically modified jute and acetylated chemically modified jute by their IR, TGA, and DTG studies. An effort has also been made to study the dyeability property of grafted jute fibers.

### EXPERIMENTAL

Methods of grafting and calculations of percentages of grafting for MMA-grafted jute<sup>3</sup> and MMA-grafted acetylated jute<sup>4</sup> have been reported earlier.

IR spectra of modified jute and different grafted jute fibers in KBr pellets or in nujol have been recorded on Perkin-Elmer Models 337 or 377 spectrophotometer. TGA and DTG curves have been recorded on DT 30 Shimadzu (Japan) thermal analyzer. The analysis has been carried out in air from room temperature up to 600°C at a heating rate of 10°C/min.

The dyeing of the fibers have been carried out with a basic dye, Rhodamine B, by a standard method of jute dyeing. The dye baths containing different jute samples (constant weight) and dye solution (0.2%) were kept on hot plate maintained at 85°C for about 30 min with occasional stirring. Then the jute samples were pressed well in filter paper and kept in oven (maintained at 70°C) overnight for drying. The dyed jute samples were subjected to light fastness to daylight by the method as mentioned by Indian Standard.<sup>5</sup>

### RESULTS AND DISCUSSION

#### IR Spectra

The chemically modified jute showed the characteristic broad absorption band of hydroxyls at about 3300 cm<sup>-1</sup>. The spectrum of MMA-grafted jute showed an additional peak of ester group at about 1715 cm<sup>-1</sup>. One would have expected the intensity of —OH peak to be reduced as a result of grafting, since it is a probable site for grafting. This, however, was not observed. Possibly, due to large concentration of —OH groups of jute, the small differences in its concentration as a result of grafting could not be detected.

In case of acetylated chemically modified jute a peak at about 1730 cm<sup>-1</sup> of ester carbonyl (due to partial acetylation) is observed. However, in the case of MMA-grafted acetylated chemically modified jute, the ester peak of grafted MMA underwent a shift to higher wave number, i.e., absorption took place at about 1740 cm<sup>-1</sup> (Fig. 1). This indicates the presence of methyl methacrylate unit in the grafted jute.

#### Thermal Decomposition Studies

TGA and DTG curves of chemically modified jute and MMA-grafted (with varying degree of grafting) chemically modified jute are shown in Figure 2. In the case of (a) original modified jute (ungrafted jute) the maximum decomposition temperature was found out to be 280°C. However, the MMA-grafted jute, (b) GY = 112.0% and (c) 154.3% showed the maximum decomposition temperature ( $T_D$ ) at 315 and 320°C, respectively. So it is observed that, with increase of graft yield (GY) from 112.0 to 154.3%, the maximum decomposition temperature enhanced by 5°C. Hence the effect of grafting of MMA onto jute is to make it more thermally stable, and this effect becomes more predominant as the percent graft-on increases.

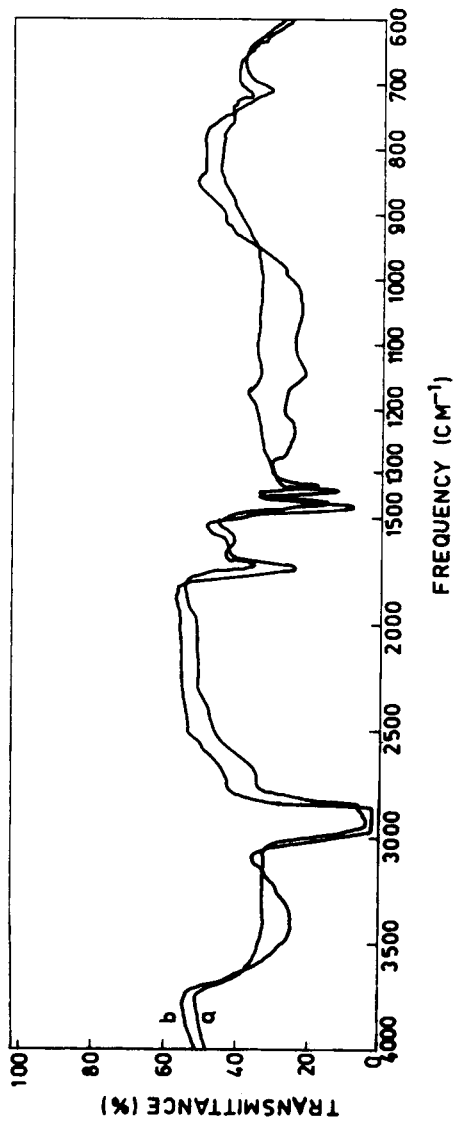


Fig. 1. IR spectra (in nujol) of (a) acetylated chemically modified jute and (b) MMA-grafted acetylated chemically modified jute.

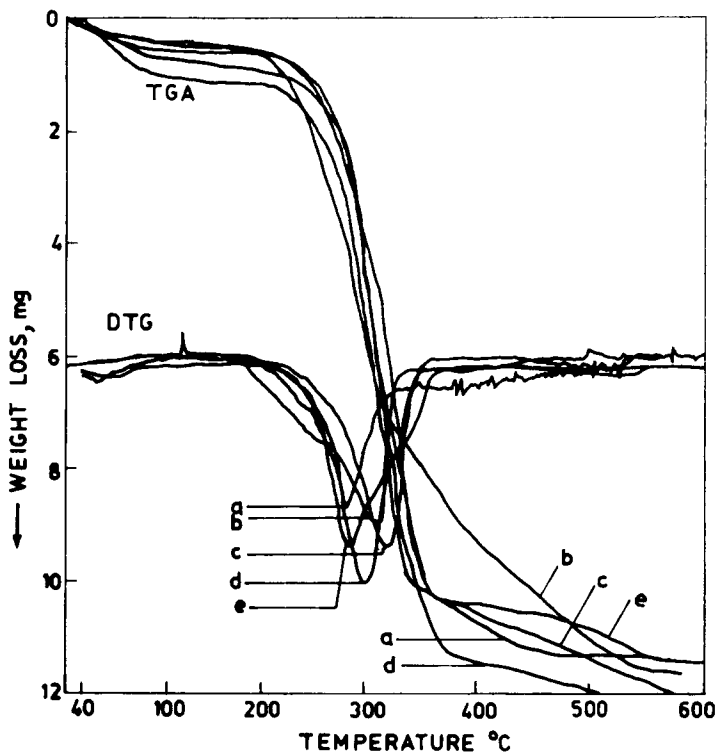


Fig. 2. TGA and DTG curves of: (a) chemically modified jute, MMA grafted jute fibers; (b) GY = 112.0%; (c) GY = 154.3%; (d) GY = 88.6%; (e) GY = 69.0%.

We have already mentioned while discussing the effect of reaction medium on grafting of MMA onto jute<sup>3</sup> that the increase in concentration of acid is not only unfavorable to grafting but also destroys some of the important properties of the fibers. The proof of this fact in terms of thermal stability are discussed below. There we have reported<sup>3</sup> that by increasing the concentration of  $H_2SO_4$  beyond  $0.15 \text{ mol L}^{-1}$  the percentage of graft yield decreases. TGA and DTG curves of MMA-grafted jute [(i) GY = 88.6%, acid concentration used,  $[H_2SO_4] = 0.25 \text{ mol L}^{-1}$  and (ii) GY = 69.0%, acid concentration used,  $[H_2SO_4] = 0.60 \text{ mol L}^{-1}$ ] are shown in Figures 2(d) and 2(e) and from DTG curves the maximum decomposition temperatures ( $T_D$ ) were found out to be 290 and 280°C, respectively. From experimental observation it is proved that increase in acid concentration beyond the optimum value is not only unfavorable to grafting but also depresses the thermal stability of the fiber.

In case of acetylated chemically modified jute the maximum decomposition temperature ( $T_D$ ) was found to be 170°C [Fig. 3(a)]. However, in the case of MMA-grafted acetylated jute (GY = 183.9%), the  $T_D$  was found to be 300°C [Fig. 3(b)]. So it is observed that the  $T_D$  value of acetylated jute after grafting with MMA is enhanced considerably. However, the chemically modified jute having  $T_D = 280^\circ\text{C}$  after acetylation loses its thermal stability from 280 to 170°C.

### Dyeability Property

The results of light fastness rating of different jute samples are represented in Table I.

It is observed from the table that the light fastness rating of MMA-grafted jute is higher by about 3 units than that of chemically modified, i.e., ungrafted jute. Defatted natural jute after chemical modification does not show any effect on the fastness of dyeing. However, chemically

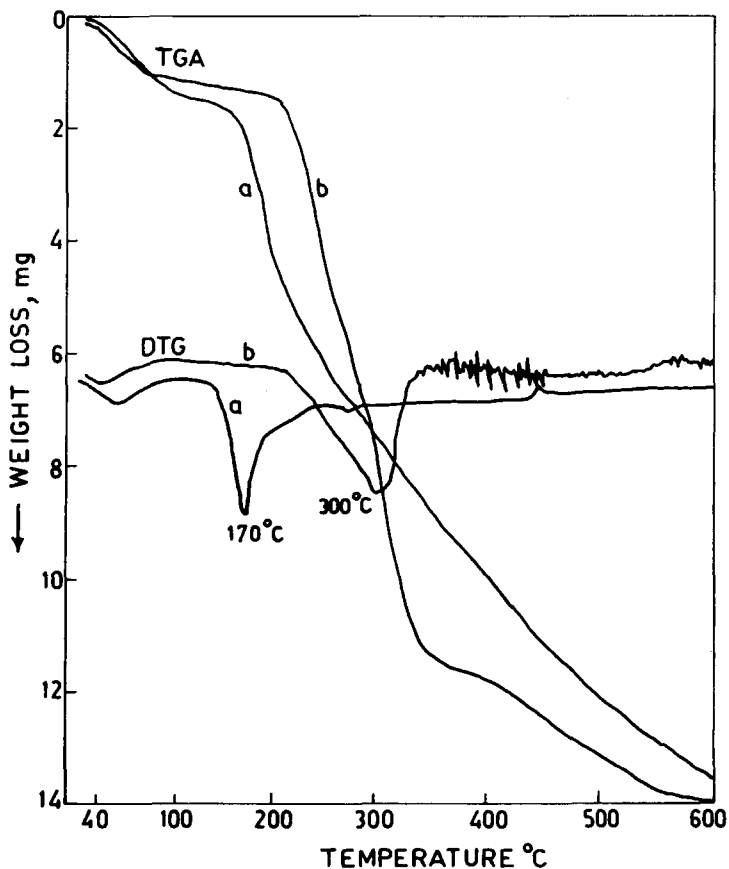


Fig. 3. TGA and DTG curves of: (a) acetylated chemically modified jute; (b) MMA-grafted acetylated chemically modified jute (GY = 183.9%).

TABLE I

Sample particulars	Fastness to light (rating)
Defatted natural jute	3
Natural jute (chemically modified)	3
Acetylated chemically modified jute	2
MMA-grafted chemically modified jute fibers	5-6
MMA-grafted acetylated chemically modified jute	5

modified jute after acetylation loses its light fastness rating by 1 unit. But the light fastness rating of MMA-grafted acetylated jute is higher by about 3 units than that of ungrafted acetylated chemically modified jute.

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**References**

1. I. M. Trivedi and P. C. Mehta, *Cell. Chem. Technol.*, **7**, 401 (1973).
2. A. K. Mohanty, B. C. Singh, and M. Misra, *J. Appl. Polym. Sci.*, **31**, 1763 (1986).
3. A. K. Mohanty, B. C. Singh, and M. Misra, *Angew. Makromol. Chem.*, **147**, 185 (1987).
4. A. K. Mohanty, S. Patnaik, B. C. Singh, and M. Misra, *J. Appl. Polym. Sci.*, in press.
5. Method for Determining of Colour Fastness of Textile Materials to Daylight : 15 : 686-1957;  
Method for Evaluating Change in Colour : 15 : 786-1956.

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