NOTES

Infrared Spectra of Acrylonitrile Grafted Jute Fibers

For proper characterization of vinyl-monomer-grafted cellulose material, the infrared spectroscopic method has widely been used. Arthur and Demit[1] studied graft copolymerization of cotton cellulose and acrylonitrile, initiated by γ-ray irradiation by the infrared method. Lin et al.[2] grafted methyl methacrylate onto bamboo and they observed that the grafting of methyl methacrylate on bamboo can be ascertained by the presence of characteristic absorptions of polymer branches in the infrared spectrum. Kulkarni et al.[3] studied infrared spectra of acrylonitrile grafted cotton fabrics. But it is found that no detailed infrared spectral analysis of acrylonitrile-grafted jute fibers has yet been undertaken. This note is a report on infrared spectra of acrylonitrile-grafted jute, grafted in raw and bleached condition.

EXPERIMENTAL

The two species of jute, i.e., Corchorus Capsularis and Corchorus Olitorius, were taken. They were first dewaxed by soxhleting with a mixture of alcohol and benzene. A part of the dewaxed jute was then bleached by 0.5% (volume) aqueous hydrogen per oxide solution at 80°C, for 2 h. The lignin content of raw dewaxed jute was found to be 12% while that in bleached jute was only 8%. The estimation of lignin was done by TAPPI standard[4] according to which 15 mL cold (12–15°C) 72% sulfuric acid was added to 1 g of an oven dry sample. This dissolves the carbohydrates, leaving an insoluble residue that is lignin. The mass of this insoluble residue (lignin) was determined and the percentage was worked out. The bleached and raw dewaxed jute fibers were taken for grafting with acrylonitrile monomer in redox system, with ceric ammonium

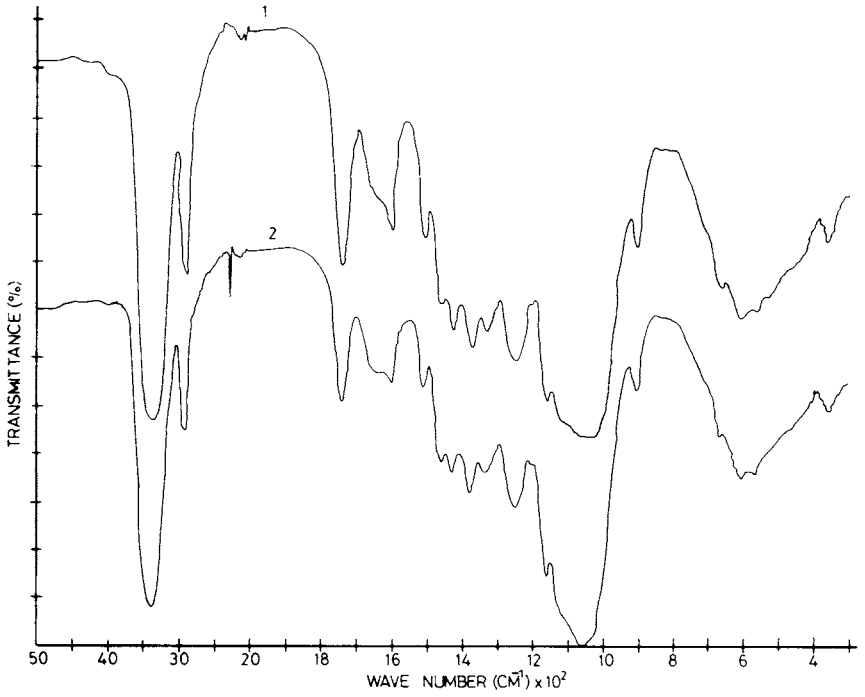

Fig. 1. IR spectra of: (1) raw dewaxed white jute; (2) 22% acrylonitrile-grafted white jute.

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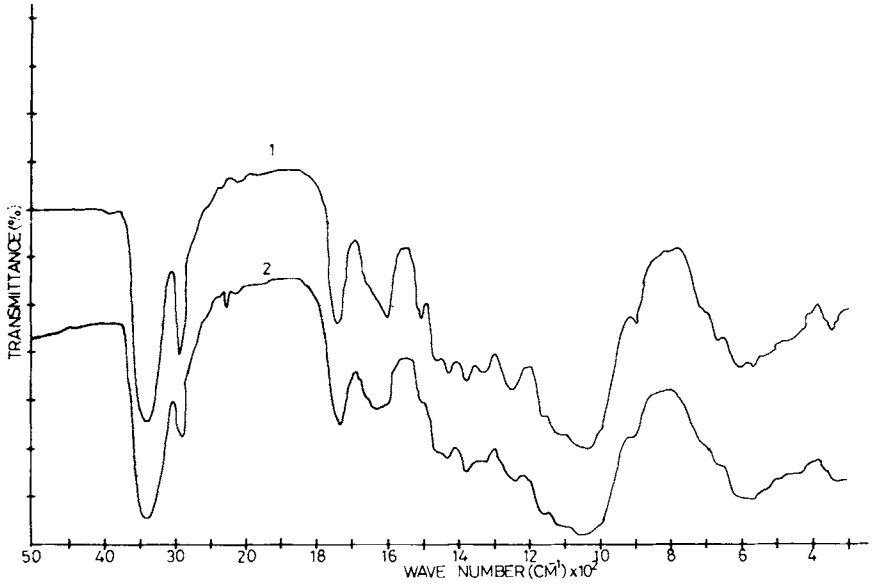

Fig. 2. IR spectra of: (1) raw dewaxed tossa jute; (2) 20% acrylonitrile-grafted tossa jute.

sulfate in 1% sulfuric acid acting as initiator. The grafting reaction was carried out in an inert (nitrogen) atmosphere. The parameter which was varied in the grafting reaction was the time of reaction, with increase of which graft add-ons were found to increase.

The infrared spectra of raw and grafted jute fibers were taken in a Shimadzu double beam IR 440 spectrophotometer employing KBr wafer technique. This consists in cutting the fiber samples into small pieces by scissors and then sieving through a 100 mesh screen. KBr pellets were made by mixing about 3 mg of samples with 200 mg of KBr. A KBr pellet without sample was used in reference beam.

RESULTS AND DISCUSSION

The infrared spectra of both Capsularis and Olitorius jute fibers grafted in raw and bleached conditions are given in Figures 1–4. It has been observed that the formation of graft copolymer with acrylonitrile could easily be detected by the presence of the distinctive and characteristic

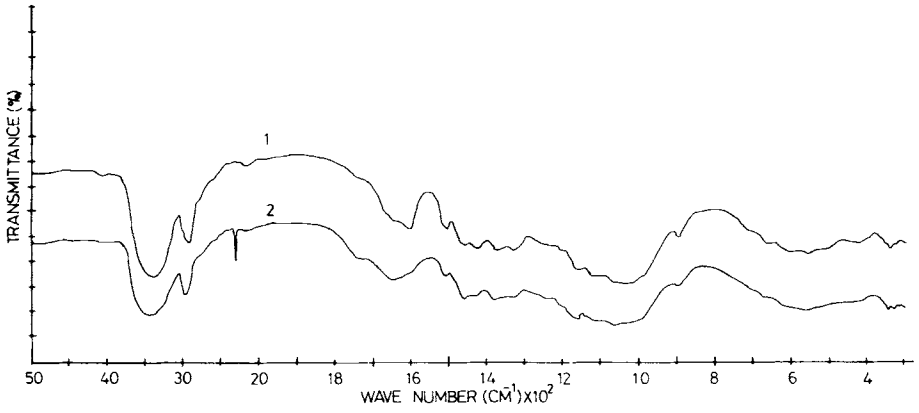

Fig. 3. IR spectra of: (1) bleached tossa jute; (2) 30% acrylonitrile-grafted bleached tossa jute.

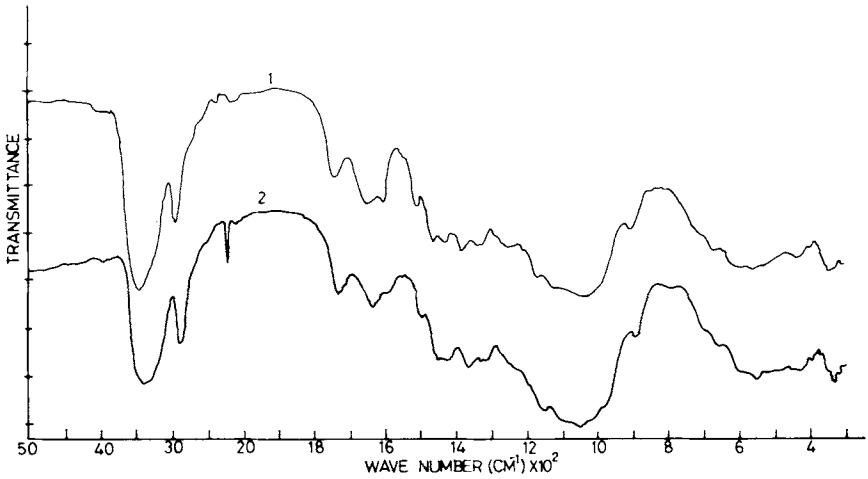

Fig. 4. IR spectra of: (1) bleached white jute; (2) 27.8% acrylonitrile-grafted bleached white jute.

nitrile absorption band at around 2260 cm^{-1}.[5] In Table I the absorbance values of nitrile absorption peak at 2260 cm^{-1} are given for raw and differently grafted jute fibers. It is observed that, as expected, with the increase in graft add-ons, the absorbance values showed an increasing trend.

Lin et al.[2] observed that the absorption peaks at 1604, 1510, 1460, and 1340 cm^{-1} are dependent on lignin content in a lignocellulosic material. In Table II, the absorbance values of these peaks corresponding to differently grafted jute are given. It is noted that, with the increase of graft add-ons, the absorbance values showed a decreasing trend. This shows that the acrylonitrile monomer grafts itself on lignin along with cellulose substrate. It is also observed in Table II that the absorbance values corresponding to different peaks due to lignin decreases with the bleaching of jute. This is evident because, due to hydrogen peroxide bleaching, lignin is oxidized and also a little amount of lignin (3%) is removed.

CONCLUSION

The above discussion conclusively shows that when jute fiber is grafted with acrylonitrile monomer, the monomer is grafted on lignin as well as cellulose substrate.

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TABLE I
Absorbance Values at 2260 cm^{-1} Due to C≡N Group

Sample	Absorbance (%) values
Raw dewaxed white jute	0
22% AN-grafted white jute	0.034
Bleached white jute	0
27.8% AN-grafted bleached white jute	0.0494
Raw tossa jute	0
20.0% AN-grafted tossa jute	0.0199
Bleached tossa jute	0
20.2% AN-grafted bleached tossa jute	0.118

TABLE II
Absorbance Values of Peaks at 1604, 1510, 1460, and 1340 cm^{-1}

Sample	1604 cm^{-1}	1510 cm^{-1}	1460 cm^{-1}	1340 cm^{-1}
Raw dewaxed white jute	0.1741	0.0872	0.1671	0.0862
22% AN-grafted white jute	0.0799	0.0482	0.0902	0.0702
Raw dewaxed tossa jute	0.1441	0.0659	0.0913	0.1039
20.0% AN-grafted tossa jute	0.0300	0.0135	0.0400	0.0304
Bleached white jute	0.0792	0.0374	0.0530	0.0334
27.8% AN-grafted bleached white jute	0.0261	0.0237	0.0340	0.0251
Bleached tossa jute	0.1221	0.0429	0.0726	0.0458
20.2% AN-grafted bleached tossa jute	0.0310	0.0135	0.0445	0.0160

AN = Acrylonitrile

References

1. J. C. Arthur, Jr., and R. J. Demit, *Text. Res. J.*, **31**, 988 (1961).
2. K. C. Lin, Y. S. Wu, T. H. Tan, and T. L. Tai, in *Graft Copolymerization of Cellulosic Fibers*, David N. S. Hon, Ed., Am. Chem. Soc., Washington, DC, 1982, Chap. 15, p. 233.
3. A. Y. Kulkarni, A. G. Chitale, B. K. Vaidya, and P. C. Mehta, *J. Appl. Polym. Sci.*, **7**, 1581 (1963).
4. *TAPPI Standards and Suggested Methods*, Technical Association of the Pulp and Paper Industry, New York, 1971.
5. C. Y. Liang and S. Krim, *J. Polym. Sci.*, **31**, 513 (1958).

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