Effect of Resin Finishing on Mechanical Properties of Paper Yarn

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1. INTRODUCTION

Recently, demand for eco-friendly and harmless textile material is growing as the improvement of living standard and the development of civilization. Accordingly the development of natural fibers and research for functional improvement has been actively. Paper yarn is representative natural fibers, has several functional properties of far-infrared emission, antibiosis, deodorization, easy dyeing ability, fast wet ability and dry. Also, paper yarn is produced from various processes and able to be both woven and knit[1].

Paper used as textile is manufactured mechanically in the form of roll by mass production process and has thinner, fewer defects than printing paper. Wide breadth paper is wound around a bobbin with a uniformly tension after slit into tens of thin strands. Paper yarn is made of these slitting paper strands by twist machine[2].

But, paper yarn is difficult to manufacture fabrics because the tenacity and flexibility of paper yarn are relatively lower compared to natural fibers such as cotton. In this study compared to changes of mechanical properties of paper yarn according to resin treatment conditions. So, found the optimal treatment conditions to improve the physical properties of paper yarn through the resin finishing.

2. EXPERIMENTAL

Materials

Paper yarn of 23's(Ne) purchased from Ssangyoung co., Ltd.(Korea), was used without further treatment. acrylic(Daeyoung Chemical Co., Korea), poly urethane (PU, T&L Co., Korea), 1,2,3,4- butane tetra carboxylic acid(BTCA, Aldrich chemical Co.) and dimethylol dihydroxy ethylene urea(DMDHEU, Diwa Co., Japan) were used as resins and reagents without further purification.

Method of resin finishing

Paper yarn was treated with Acrylic, PU and BTCA concentrations of 2.5, 5, 7.5, 10 wt.% respectively(pick-up 80±5%). Treated paper yarns were washed to remove the resin after dried at 100℃ for 2min and cured at 170℃ for 2min.

Table 1. Treatment conditions(concentration, drying, curing) of paper yarn according to different resin.

Resin	Concentration (wt%)				Drying (℃)	Curing (℃)
Acrylic	2.5	5.0	7.5	10	100	170
PU	2.5	5.0	7.5	10	100	170
DMDHEU	2.5	5.0	7.5	10	100	170
BTCA	2.5	5.0	7.5	10	100	170

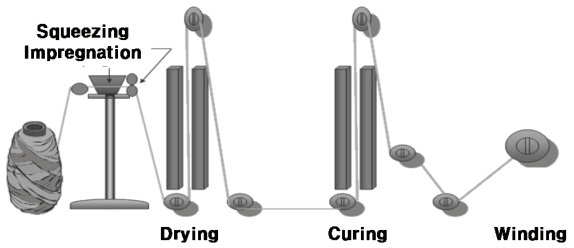

Fig. 1. Resin treatment process of paper yarn.

3. RESULT AND DISCUSSION

Table 2. Tenacity values of treated paper yarn according to different resin concentration.

Resin	Concentration (wt%)	Tenacity(g/d)	
		Dry	Wet
Untreated	-	0.761	0.594
Acrylic	2.5	0.921	0.677
	5.0	0.921	0.696
	7.5	0.963	0.765
	10	0.900	0.764
PU	2.5	0.905	0.605
	5.0	0.883	0.599
	7.5	0.900	0.618
	10	0.859	0.597
DMDHEU	**2.5**	0.751	0.592
	5.0	0.744	0.580
	7.5	0.730	0.566
	10	0.715	0.551
BTCA	**2.5**	0.747	0.593
	5.0	0.738	0.576
	7.5	0.723	0.531
	10	0.702	0.461

Table 2 shows tenacity values of paper yarns treated by each resins and it can be observed tenacity of tread paper yarns were increased comparing to untreated paper yarn. It can be known that optimum conditions(Acrylic:7.5wt%, PU:7.5wt%, DMDHEU: 2.5wt%, BTCA:2.5wt%) have a difference according to the sort of resin. Figure 3 shows dry and wet tenacity of paper yarns at optimum conditions.

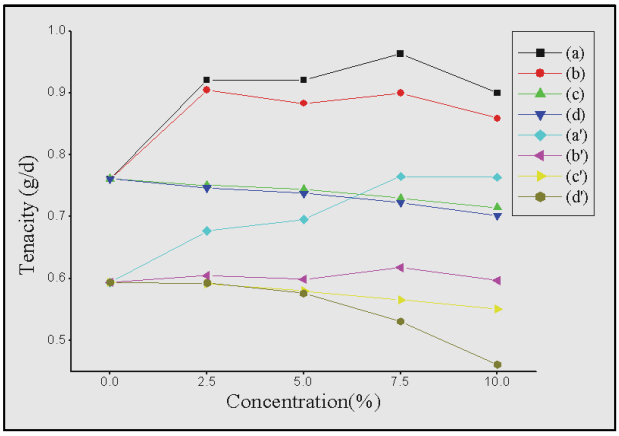

Fig. 3. Tenacity values of paper yarn at optimum conditions of resin concentration; (a):Acrylic 7.5wt%, (b):PU 7.5wt%, (c):BTCA 2.5wt%, (d):DMDHEU 2.5wt% and (ˈ):wet.

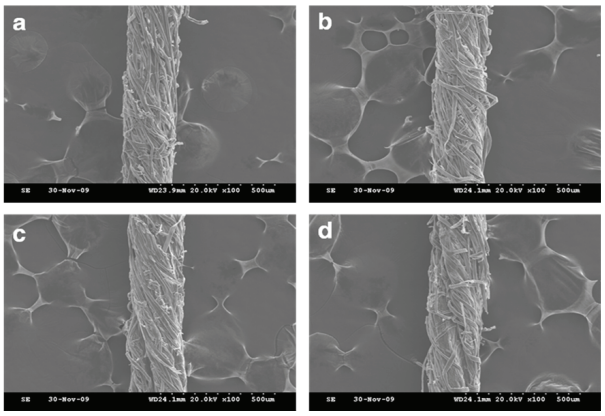

Fig. 4. SEM photographs of paper yarn treated with (a):Acrylic 7.5wt%, (b):PU 7.5wt%, (c):BTCA 2.5wt%, (d):DMDHEU 2.5wt%.

Fig. 5 is the result of FT-IR of paper yarn pre-dry for 2 min at 100℃ after treating by Acrylic, PU, BTCA, DMDHEU resin and heat-treated for 2min at 170℃. -OH group peak of PU was showed around 3400cm^{-1}, -NH- group peak was showed around 3200cm^{-1}. As It can be known that paper yarn were treated by PU[4]. and C=O group peak of BTCA and DMDHEU resin was showed around 1720cm^{-1}, Ester group have cross-linked reaction from BTCA and paper yarn, ester combination (C=O)[5,6].

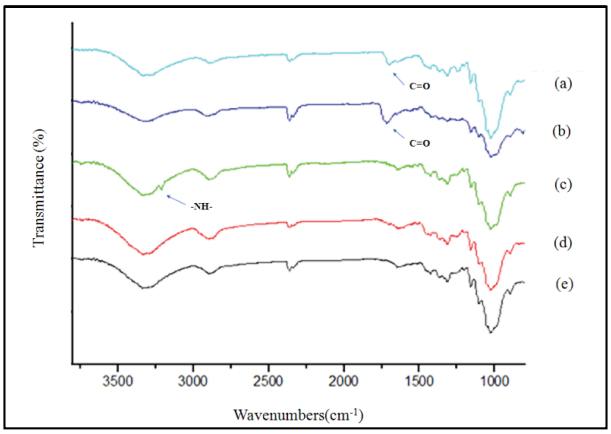

Fig. 5. FT-IR spectrum of paper yarn treated with different resins; (a):DMDHEU, (b):BTCA, (c):PU, (d):acrylic and (e) untreated.

4. CONCLUSION

Paper yarn has low tenacity and flexibility comparing to natural fiber like cotton, is difficult to manufacture knit fabric and have a property to be decreased tenacity under wet condition. Therefore, through this study, it can be considered physical properties changes according to the sort of resin. Paper yarns have a little difference as treated resin but increased tenacity values. Acrylic resin has the highest dry and wet tenacity values at 7.5wt% concentration.

5. REFERENCES

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