

STUDIES ON THE PRESERVATION OF MANILA TWINES

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INTRODUCTION

ABACA or Manila hemp is a leaf fibre extracted from the plant *Musa textilis* belonging to the family *Musaceae*. The largest portion of the world's production of this fibre is from the Philippine Islands. The main use to which these fibres are put is for the manufacture of twines and ropes. In India Manila is extensively used in the form of ropes and cables by the navy and merchant marine and to some extent as twines and ropes by the fishing industry. Manila ropes serve as head and foot ropes of fishing nets and occasionally as warps of the trawling gear; and manila twines are used for the fabric of the trawl nets particularly the large classes of nets. Like other fibres of vegetable origin, manila fibres also undergo bacterial decomposition while under prolonged immersion in water. This deterioration popularly known as 'sea rot' can, to a certain extent, be retarded by the application of suitable preservatives. The present communication deals with the scientific evaluation of the effectiveness of various indigenous and chemical fishnet preservatives on this material and the attempts made by the authors to evolve a suitable preservative for this material.

MATERIAL AND METHODS

Materials.—The material used in the study was 3 ply 2.2 mm. diameter manila twine. The preservatives, whose effectiveness was evaluated, can be broadly classified as follows: (a) Tannin preservatives; (b) Tannin fixed with Copper Sulphate and Ammonia; (c) Tannin + Coal-tar; (d) Tannin fixed with Copper Sulphate and Ammonia and subsequently treated with Coal-tar; (e) Coal-tar and other chemical preservatives.

Experimental.—The methods of treatment for the different preservatives were as follows:

In Series I (Table I) the twines were immersed in a boiling 5% aqueous solution of cutch and kept overnight before drying. For fixing the tannin Olie's (1918) is adopted by using a 1% solution of Copper Sulphate and

Ammonia. Coal-tar treatment is done both before and after fixation of the cutch by treating the twines in a solution of Coal-tar and Kerosene (3:1) and then drying.

The preservatives included in Series II are all tannin-containing barks which are commonly used by the fishermen of Kerala, Madras, Mysore and Bombay States. The methods of preparation of bark extract, fixation of tannin and subsequent treatments are essentially the same as in Series I.

Under Series III the twines were immersed in the solutions of the respective chemicals for twenty minutes and dried after draining.

In Series IV the twines were treated in a 5% solution of the respective preservatives and kept overnight. They were then dried and treated in a solution of Coal-tar and Kerosene (3:1). In the case of 'Panachikka' the twines were treated in a concentrated solution of Panachikka in water and the twines immersed overnight. The twines were then taken out and dried before the Coal-tar kerosene treatment and final drying.

The percentage impregnation of each preservative was calculated on the basis of the difference in mass of twines before and after treatment. The twines after treatment were subjected to continuous immersion in the Cochin backwaters, and were tested for their breaking strength at an interval of seven days.

RESULTS

The percentage impregnation of the different preservatives and their effectiveness are shown in Table I. Table II shows the percentage retention of breaking strength of the twines treated with different preservatives after n days of continuous immersion in the backwaters. The temperature of the backwaters during the course of experiments is represented in Table III.

DISCUSSION

1. *Impregnation.*—All the exclusive tannin preservatives impart almost an equal amount of impregnation. When tannin preservatives are subjected to fixation, it is seen that there is a slight increase in the percentage impregnation in the case of twines treated by Aiyana bark and Babul bark. Tannin + Coal-tar treatment enhances the percentage impregnation by nearly 5 times when compared with exclusive tannin treatment as well as by tannin fixation method. The nature of impregnation of these preservatives thus offers certain differences, compared to their action on cotton (Miyamoto and Shariff, 1959), Sunn-hemp (George and Radhalakshmy, 1962), and Sisal

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TABLE I
Showing the percentage impregnation, effective days and effectiveness of various preservatives

Experiment series	Preservative	% Impregnation	Effective days	Effectiveness $e = b/a$
Series I	Control ..	..	12.5	1.00
	Cutch ..	10.8	14.5	1.20
	Cutch fixed ..	10.5	24.0	1.90
	Cutch + Coal-tar ..	64.0	35.0	2.80
	Cutch fixed + Coal-tar ..	69.0	More than 70 days	
Series II	Control ..	..	11.5	1.00
	Bark of Kalasam ..	9.6	13.5	1.20
	Bark of Kalasam fixed ..	8.0	37.0	3.20
	Bark of Babul ..	8.3	15.0	1.30
	Bark of Babul fixed ..	10.0	34.5	3.00
	Bark of Aiyana ..	6.6	16.0	1.40
	Bark of Aiyana fixed ..	10.4	37.5	3.30
	Coal-tar ..	28.0	34.5	3.00
Series III	Control ..	..	15.5	1.00
	Cunimine ..	3.4	37.5	2.40
	Brown Cuprinol ..	11.8	35.5	2.20
	B.C. Green Cuprinol ..	19.8	37.5	2.40
	Standard Green Cuprinol ..	15.1	40.0	2.50
	Net Life Green ..	1.2	30.5	1.90
	Marstein ..	9.5	30.5	1.90
	Cunilate 611 FNT ..	4.2	27.5	1.70
Series IV	Control ..	..	26.0	1.00
	Bark of Kalasam + Coal-tar ..	48.7	105.0	4.00
	Bark of Babul + Coal-tar ..	47.7	144.0	5.50
	Bark of Aiyana + Coal-tar ..	51.2	116.0	4.50
	Panachikka + Coal-tar ..	42.8	84.0	3.20
	Bark of Kalasam fixed + Coal-tar ..	40.2	142.0	5.50
	Bark of Babul fixed + Coal-tar ..	46.9	More than 147 days	More than 6
	Bark of Aiyana fixed + Coal-tar ..	67.3	More than 147 days	More than 6
	Panachikka fixed + Coal-tar ..	60.9	140.0	5.40

TABLE II
Percentage breaking strength of treated manila twines under continuous immersion

No.	Preservative	Original breaking strength after treatment (wet condition) in Kg.	Percentage retention of breaking strength of twines after 'n' days of immersion													
			7	14	21	28	35	42	49	56	63	70	77			
1	2	3	4	5	6	7	8	9	10	11	12	13	14			
			Series I													
1	Control (untreated)	48.4	73.9	44.7	24.8	7.6	..	..	..	..	..	..	..	..
2	Cutch	50.6	67.8	51.6	31.0	17.0	6.5	..	..	..	..	..	..	..
3	Cutch + CuSO ₄ + NH ₃	39.8	100.8	84.7	58.0	38.4	29.1	22.9	15.3	10.3	7.5	2.00	..	..
4	Cutch + Coal-tar	42.9	103.5	97.2	78.8	63.4	49.4	43.6	33.8	28.2	26.1	24.5	..	..
5	Cutch + CuSO ₄ + NH ₃ + Coal-tar	36.9	103.5	103.0	101.4	93.8	89.2	88.3	90.8	89.7	80.0	84.8	..	..
			Series II													
1	Control (untreated)	45.9	67.9	41.6	31.6	18.3	11.3	Rotten	..	..	..	..	..	..
2	Bark of 'Kalasam'	45.7	70.7	49.0	35.7	26.5	19.7	11.8	8.5	4.4	2.8	Rotten	..	..
3	Bark of 'Kalasam' + CuSO ₄ + NH ₃	48.1	86.7	77.6	72.6	64.2	54.1	39.5	28.5	18.9	14.9	7.9	3.5	..		
4	Bark of 'Babul'	46.2	73.2	52.6	41.8	33.1	25.1	17.9	11.3	7.6	3.0	Rotten	..	..
5	Bark of 'Babul' + CuSO ₄ + NH ₃	46.2	75.1	68.8	67.2	58.7	49.1	38.9	27.9	20.8	15.4	11.5	6.9	..		
6	Bark of 'Aiyana'	38.5	72.5	52.5	44.4	37.1	30.9	21.6	15.1	10.1	8.8	4.7	Rotten	..		
7	Bark of 'Aiyana' + CuSO ₄ + NH ₃	43.3	90.1	82.9	77.6	67.9	55.2	41.3	30.3	24.5	19.4	15.5	7.6	..		
8	Coal-tar	38.8	93.0	84.0	73.7	59.8	49.5	40.5	33.2	29.1	26.5	28.1	18.3	..		

TABLE II (Contd.)

Series III

No.	Preservative	Original breaking strength after treatment (wet condition) in Kg.	Percentage retention of breaking strength of twines after 'n' days of immersion															
			7	14	21	28	35	42	49	56	63	70	77	84	91	98		
1	Control (untreated)	35.9	76.3	54.6	31.7	22.3	12.8	8.1	Rotten	..	..	..	..	..	..	..	..
2	Cunimine	33.2	106.9	101.5	92.4	72.0	55.4	36.1	20.8	9.6	Rotten	..	..	..	..	..	..
3	Brown Cuprinol	27.9	111.1	114.7	104.7	78.1	51.6	28.7	23.6	13.3	Rotten	..	..	..	..	..	..
4	B. C. Green Cuprinol	34.5	96.5	96.0	86.7	70.1	53.3	43.8	35.3	21.2	16.2	12.2	16.5	11.9	7.8	Rotten	Rotten	
5	Std. Green Cuprinol	36.0	96.7	85.8	79.4	65.5	59.4	46.7	36.5	21.1	18.3	16.1	20.8	15.0	8.3	Rotten	Rotten	
6	Net Life Green	36.6	92.9	84.7	73.5	57.1	38.5	23.8	15.0	7.6	Rotten	..	..	..	..	..	..
7	Marstein	33.7	100.9	90.8	76.0	55.2	41.5	32.3	22.2	13.6	4.0	Rotten	..	..	..	..	..
8	Cunillate 611 FNT	30.8	93.2	81.2	67.8	49.3	36.0	21.4	13.0	4.9	Rotten	..	..	..	..	..	..

TABLE II (Contd.)

Series IV

No.	Preservative	Original breaking strength after treatment (wet condition) in Kgs.	Percentage retention of breaking strength of twines after 'n' days of immersion									
			7	14	21	28	35	42	49	56	63	70
1	Control (untreated) ..	29.1	89.3	75.0	60.0	47.1	34.0	23.0	12.7	6.5	Rotten	
2	Kalasang + Coal-tar ..	21.3	100.4	101.4	99.5	101.8	98.5	95.3	88.0	88.0	78.8	72.3
3	Bark of Babul + Coal-tar	20.2	98.0	104.0	111.8	116.3	113.8	111.8	105.4	98.5	96.0	92.1
4	Bark of Ayna + Coal-tar	19.4	108.7	112.8	116.0	116.0	114.4	105.6	97.0	90.2	90.0	80.9
5	Panichikka + Coal-tar..	21.6	93.0	97.6	103.2	112.5	110.6	102.8	84.2	73.6	64.0	58.3
6	Bark of Kalasang + CuSO ₄ + NH ₃ + Coal-tar	25.5	85.1	92.7	85.5	91.0	93.3	100.1	100.0	100.3	95.2	92.1
7	Bark of Babul + CuSO ₄ + NH ₃ + Coal-tar	21.0	89.5	87.6	92.8	98.1	97.1	96.6	102.8	110.4	116.1	116.1
8	Bark of Ayna + CuSO ₄ + NH ₃ + Coal-tar	21.2	110.3	118.4	120.7	123.5	123.5	123.5	124.5	126.4	129.2	130.0
9	Panichikka + CuSO ₄ + NH ₃ + Coal-tar	22.0	103.1	110.4	115.0	111.3	106.8	107.7	110.0	108.6	112.7	110.9

No.	Preservative	Percentage retention of breaking strength of twines after 'n' days of immersion										
		77	84	91	98	105	112	119	126	133	140	147
1	Control (untreated) ..	..	..	..	..	..	..	..	..	..	..	..
2	Kalasang + Coal-tar ..	61.0	61.0	61.0	56.8	50.0	45.0	44.6	42.7	41.7	38.5	15.4
3	Bark of Babul + Coal-tar	90.5	83.1	84.1	85.1	82.6	76.2	71.7	68.3	66.3	62.3	41.5
4	Bark of Ayna + Coal-tar	73.2	63.9	62.3	60.3	54.6	51.0	49.8	49.8	46.3	41.2	25.2
5	Panichikka + Coal-tar	51.3	50.0	43.5	41.2	38.8	37.0	36.5	37.0	35.6	31.9	17.6
6	Bark of Kalasang + CuSO ₄ + NH ₃ + Coal-tar	88.6	91.3	89.4	83.5	86.0	66.2	63.5	70.5	64.7	55.6	32.9
7	Bark of Babul + CuSO ₄ + NH ₃ + Coal-tar	113.8	107.1	104.2	109.0	102.3	98.5	94.7	102.3	102.8	100.0	64.7
8	Bark of Ayna + CuSO ₄ + NH ₃ + Coal-tar	133.0	130.0	129.2	127.3	115.0	115.5	115.0	127.3	118.5	116.5	76.8
9	Panichikka + CuSO ₄ + NH ₃ + Coal-tar	114.1	108.4	105.4	96.3	77.8	66.3	63.1	67.2	61.8	51.0	30.0

TABLE III

The temperature of the backwaters where the treated twines were submerged

Months	Temperature in Centigrade		Average
	Maximum	Minimum	
1959			
June	.. 32.0	27.5	29.7
July	.. 32.5	27.5	29.3
August	.. 31.5	29.0	30.5
September	.. 32.0	29.0	30.4
October	.. 31.5	30.0	30.7
November	.. 31.5	29.0	30.5
December	.. 32.5	29.0	31.2
1960			
January	.. 32.5	29.0	31.1
February	.. 32.0	29.0	30.9
March	.. 32.5	30.5	31.5
April	.. 34.0	31.5	32.9
May	.. 32.5	29.0	31.0
June	.. 32.0	29.0	30.5
July	.. 31.5	28.0	30.0
August	.. 32.0	27.0	29.3

(Nayar, George and Narayanan, 1962). Among chemical preservatives coal-tar imparts the highest percentage impregnation as in cotton (Miyamoto and Shariff, *op. cit.*), Sunnhemp (George and Radhalakshmy, *op. cit.*) and Sisal (Nayar, George and Narayanan, *op. cit.*).

2. *Breaking strength.*—Table II (Series I) shows the course of rotting of twines treated with cutch (tannin preservative) following different methods of treatment. It will be evident from the table that the rate of deterioration of twines, treated by tannin fixation method and subsequently treated with

coal-tar, is slow compared to other methods of treatment as is evidenced by the fact that the twines retain nearly 80% of their original breaking strength even after 70 days of continuous immersion.

Table II (Series II) represents the course of rotting of twines treated with indigenous tannin preservatives by the fixation and non-fixation methods and also of twines treated exclusively with coal-tar. It is seen that the course of rotting of coal-tar-treated twines is slower compared to twines treated by tannin preservatives following different methods of treatment.

Table II (Series III) incorporates the rate of rotting of twines treated with chemical preservatives. It will be evident from the table that the course of rotting of twines treated with Marstein, Cunilate, Net Life Green, Brown Cuprinol and Cunimine is rapid compared to Standard Green Cuprinol and B.C. Green Cuprinol. A similar pattern of rotting has been observed for Sisal twines treated with these preservatives (Nayar, George and Narayanan, 1962).

The rate of rotting of twines treated with tannin preservatives with coal-tar and tannin preservatives fixed with coal-tar is represented in Table II (Series IV). It will be apparent from the table that the rate of rotting of twines treated by 'Babul' bark fixed + coal-tar and 'Aiyana' bark fixed + coal-tar is significantly slower than the twines treated with other preservatives as borne out by the fact that they have retained more than 50% of their original breaking strength even after 147 days of continuous immersion in water.

3. *Effectiveness of preservatives.*—The method adopted in evaluating the effectiveness of each preservative is on the basis of the number of days by which the control (untreated) and treated twines lost half their original breaking strength. If a and b denote the number of days taken by the control (untreated) and treated twines to reach 50% of their original breaking strength then the effectiveness e of the preservative can be denoted by the formula $e = b/a$. The values of b and a are calculated by the intermittent supplement method based on the data in Table II and the value of e for the different preservatives are shown in Table I.

Table I will indicate that among twines treated by various tannin preservatives alone, the different preservatives show almost equal effectiveness on this material. It is interesting to observe that on Sisal also the effectiveness of tannin preservatives alone is more or less similar to that observed in the present material (Nayar, George and Narayanan, 1962). When the effectiveness of twines treated with different tannin preservatives following

Olie's (1918) method of fixation is compared it is seen that the bark of 'Kalasam', the bark of 'Babul' and the bark of 'Aiyana' seem to be more effective on this material than cutch and the former method of preservation is equally effective as coal-tar treatment. In the case of Tannin + Coal-tar-treated twines the bark of 'Babul' is the most effective followed by the barks of 'Aiyana' and 'Kalasam' and it is also seen that in tannin-treated twines fixed and subsequently treated with coal-tar 'Babul' bark and 'Aiyana' bark show excellent qualities of preservation. Hence it is advisable that gears which require coal-tar treatment may be given 'Babul' or 'Aiyana' bark fixed treatment followed by coal-tar instead of other tannin preservatives. Among the chemical preservatives, the Cunimine and Cuprinol groups of preservatives show more effectiveness than the other preservatives studied under this series. The effectiveness of these preservatives on Sisal (Nayar, George and Narayanan, 1962) follows more or less a similar pattern. Miyamoto and Shariff (1959) maintain that these preservatives are little effective on cotton, although Clague and Dattigaling (1950) report that they were highly effective on cotton in Philippine waters.

Percentage impregnation and effectiveness.—An examination of Table I would reveal that the percentage impregnation by itself does not affect significantly the effectiveness of preservatives. It is very probable that the effectiveness is affected by the difference in the types of barks from which the tannin extracts were prepared for the treatment of twines.

SUMMARY

The effectiveness of four tannin preservatives and eight varieties of chemical preservatives on manila twines are studied. The comparative merits of different methods of tannin treatments are also discussed.

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REFERENCES

- Clague, J. A. and Dattigaling, B. 1950 Fishing gear preservatives for Philippine waters. *U.S. Fish. and Wild Life Service Res. Rep.* 22.
- George, N. A. and Radhakrishna, K. 1962 Preliminary studies on the preservation of sunn-hemp fishing net twines (In press).
- Miyamoto, H. and Shariff, A. T. 1959 Experiments on fishing net preservation. *Indian J. Fish.*, 6 (1), 145-85.
- Nayar, S. Gopalan, George, N. A. and Narayanan, K. P. 1962 Studies on the preservation of Sisal twines (In press).
- * Olie, J. Jr. 1918 .. *Voorschriften voor debehandeling von netten met kopersulfaat en Ammonia. Verslag van der directur van het Nederlandsch. Visscherij Proedstation over het jaar, 1917.*

* Not consulted in original.