Experiments on Preservation of Fishing Net Twines

By

G. K. KURIYAN, S. GOPALAN NAYAR AND (MISS) M. VANAJA.

It is well known that vegetable fibre twines rot on prolonged exposure in sea water due to the action of cellulose consuming bacteria and other micro-organisms present in the medium. To retard this process of deterioration and thereby lengthen the life of the fishing net, treatment with preservatives or anti-septic dyes are usually adopted by the fishermen. In a tropical country like India, where high temperature prevails, the rotting activity is relatively rapid necessitating an increased frequency in the treatment with the preservatives. That the deterioration of the vegetable fibre twines is fairly rapid in our waters has been shown by Kuriyan and Nayar (1961).

The vegetable fibre twines, which are in common use in India for the fishing nets, are (1) Cotton, (2) Hemp, (3) Sisal, (4) Manila, and (5) Coir. These materials will maintain their popularity for many more years as the use of the imported synthetic fibre twines is limited to a few centres. The need for proper preservation for a retardation of the process of bacterial action on the vegetable fibre twines, therefore, still remains an important problem from the economic standpoint.

Preservation Methods:

Rotting occurs only on prolonged exposure of the net in sea water. If a net is completely dried each day after fishing, rotting can be minimised to a considerable extent. Sun drying or "Sun light disinfection" is an easy, simple and effective method to protect nets from deterioration (Takayama and Shimozaki 1957). A thorough washing of nets in fresh water prior to drying can probably increase the effect of drying. The above authors have also advised boiling of net materials in water although effect of such a treatment is not very clear. But these methods become impractical in the case of nets which are under prolonged immersion in water while fishing *e.g.* Set nets, Trap nets, etc. Also complete drying of the nets may not be possible during the rainy season. Further, washing of nets will also be a problem as there is scarcity of fresh water in most of the Indian coastal fishing villages. Other preservation methods would therefore suggest themselves.

Both organic and chemical preservatives are in vogue for treatment of fishing nets.

Organic Preservatives:

The organic preservatives are mostly extracts of tannin from barks, twigs, leaves and seed coats. In some of the villages of Madras and Kerala, the fishermen preserve their nets with cowdung, ragi solution and rice water (Kuriyan and Nayar 1961).

Table I gives a list of the common vegetable tannin materials used for preservation.

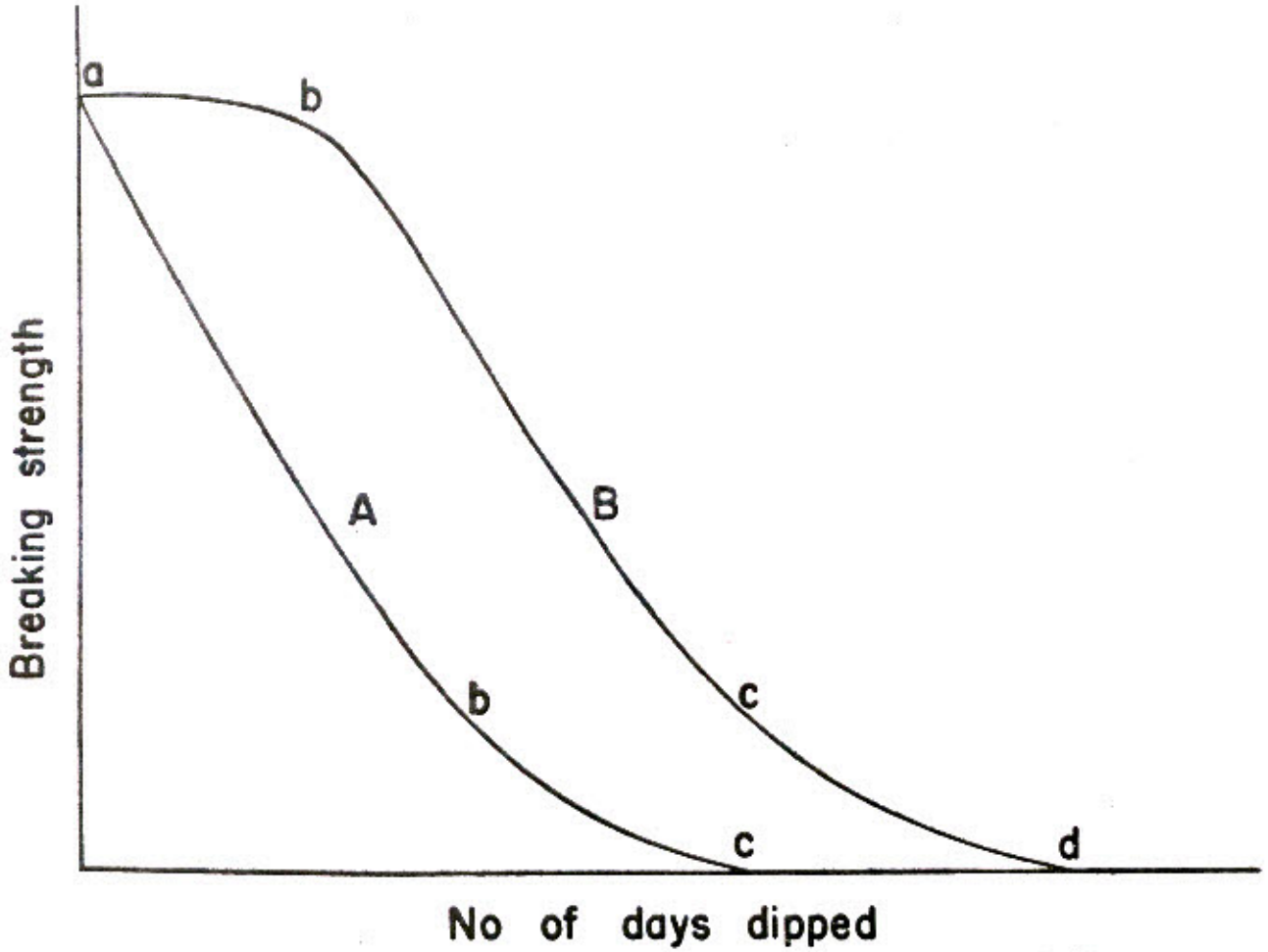
TABLE I

Popular vegetable tanning materials.

Sl. No.	Scientific name	Local name	Area where used	Source of tannin	Tannin* content %
1	2	3	4	5	6
1	*Acacia arabica* Willd.	Babul (Hindi)	Bombay	Bark	12
		Babla (Bengali)	Madhya Pradesh		
		Karivelum Pattai (Tamil)	Madras		
2	*Acacia catechu* Willd.	Cutch	Bombay	Do.	9
3	*Acacia pennata* Linn.	Chembi or Chilar	Do.	Do.	7
4	*Albizzia lebbek* Benth	Kattuvakai Pattai (Tamil)	Madras	Do.	5—11
5	*Anacardium occidentale* Linn.	..	Do.	Do.	9
6	*Avicennia* sp.	Kharod (Gujerathi)	Bombay	Do.	—
7	*Breyina pattens* Benth.	Phoola Pattai (Tamil)	Madras	Do.	—
8	*Butea monosperma* Lam.	Dhak & Palas (Hindi)	Madhya Pradesh	Do.	—
9	*Cassia fistula*	Sunari (Oriya)	Orissa	Do.	12
10	*Casuarina equistifolia* Linn.	Savuku (Tamil)	Madras	Do.	—
11	*Cereops roxburghiana* Avn.	Goran (Bengali)	West Bengal	Do.	—
12	*Diospyros embryopteris* Pers.	Panachikka (Malayalam)	Kerala	Fruits	13
		Gab. (Bengali)	West Bengal		

(1)	(2)	(3)	(4)	(5)	(6)
13	*Diospyros melanoxylon* Roxb.	Tandwa	Madhya Pradesh	Fruits	15
14	*Eugenia* sp.	Jaman	Do.	Bark	—
15	*Morinda tinctoria* Roxb.	Togaru Chettu (Telugu)	Andhra	Do.	—
16	*Odina wodier* Roxb.	Kalaram (Malayalam)	Kerala	Bark & Fruits	10—12
		Maritaki (Bengali)	West Bengal.		
17	*Phyllanthus emblica* Linn.	Nelli Pattai (Tamil)	Madras	Bark	—
18	*Premna* sp.	Punja or Munja (Malayalam)	Kerala	Twigs & Leaves	—
19	*Tamarindus indica* Linn.	Puliankuru (Malayalam)	Kerala	Seed coat	20
		Pulian Kottai (Tamil)	Madras		
20	*Terminalia arjuna* Bedd.	Koha	Madhya Pradesh	Bark	20—24
21	*Terminalia tomontosa* W. & A.	Ayana (Marathi)	Bombay.		
		Benapu, Mathi (Kanarese)	Mysore	Do.	15
		Sahanja (Oriya)	Orissa.		

*Tannin content is based on analysis of Badhwar *et. al.* 1949.



Text Fig. 1: Showing the course of rotting of cotton twines (Miyamoto & Shariff 1959).

Chemical Preservatives.

The most popular chemical preservative is coal tar. The other known preservatives are Copper compounds marketed under the trade names of Cuprinols, Garnol, Cunimene, Cunillate, Net Life Green, Marstein etc.

Evaluation of Effectiveness of Preservatives :

Different methods have been adopted by the various authors for evaluating the effectiveness of a fishing net preservative. Some of the methods are discussed below :

Method—1 : The effectiveness is evaluated on the basis of the number of days by which treated and untreated (control) twines lose half their original breaking strength while simultaneously under continuous immersion in water (Nayar 1960 a). Accordingly if a and b denote the number of days by which the untreated and treated twines lose their breaking strength to half their respective original values, then the effectiveness e of the preservative can be represented by the formula $e = b/a$. From the variation in e, the efficacy of the preservative can be assessed.

Method—2 : According to Miyamoto and Shariff (1959) the process of rotting of cotton twines follow two courses, which is represented in Text Fig. 1. In the case of A rotting follows a steep line from point a to b and from thence curves from b to point c. On the other hand in the case of B during the early period, rotting does not occur and hence the line takes a straight course from point a to point b but then climbs down as a steepline from b to point c.

In the case of curve A the effectiveness of the preservative can be inferred by the comparison of the steepness from a to b. The authors have suggested the formula $T_n = T_o - K_n$., where T_n is the breaking strength after twines have been immersed for n number of days, T the original breaking strength and K the co-efficient of rotting. The value of K is dependent upon the material of the twine, the environmental conditions and the effectiveness of the preservative. The values of K will therefore serve as an index for the effectiveness of the preservative.

In the case of curve B, the formula is $T_n = T_o - K$ $(n-N)$. Here N represents the number of days for which the twines did not rot. N may therefore be considered as the "number of effective days of the preservative".

Method—3 : George and Radhalakshmy (1961) in their studies on the preservation of Sun hemp twines have evaluated the effectiveness of preservatives from the trend observed in the course of rotting of twines treated with different preservatives.

Method—4 : To compare results obtained on the preservative effects at different seasons and areas, von Brandt (1957) suggests the following method :

The untreated cotton twines are subjected to rot and the loss of breaking strength recorded at regular intervals and the percentage loss added. This number gives the rotting power of that period. A treated twine is also tested in the same way till the breaking strength is decreased to half the original value. The total percentage of decrease of the breaking strength of the untreated twine during the same period will serve as an index of the preservative power.

This method not only gives a measure of the rotting value of the medium in which the experiment is conducted but also the utility of the preservation agent used.

Tannin Preservation:

The sources of tannin are barks, twigs, leaves and seed coats. The common method of preparation of the dyeing bath is to boil vegetable tanning materials in water and to use the decoction so obtained for treatment of the nets. In certain localities heating is avoided and the admixture of water and the tannin yielding materials are stored from two to three days. Occasionally the admixture is exposed to sunlight to accelerate the process of extraction.

The nets are treated in the hot, cold or precooled extract. The hot tannin solution is avoided in certain cases possibly under the belief that heat might affect the resultant strength of treated twines. Kuriyan and Cecily (1961) have shown that boiling water does not affect the strength of cotton twines upto 120 minutes.

The percentage concentration of the dyeing solution is dependent upon the raw material and the quantity and the amount of water used. Since the methods of preparation of the extract rest on personal predilections and local variations, there must naturally be a great degree of variance in the strength of the different tannin extracts in common use. This would either lead to insufficient treatment due to low concentration of the extract or to a waste of material due to excessive concentration of the solution. The optimum concentration of cutch in solution for treatment of cotton was determined to be 4 to 5% (Nayar 1961 b).

The experiments on the tannin dyeing baths on the different materials namely, Miyamoto and Shariff (1959) on Cotton; George and Radhalakshmy (1961) on Sun hemp, Nayar *et. al.* (1960 a) on Sisal and Nayar and Naidu (1961 a) on Manila have revealed (Table II) that exclusive tannin treatment although widely used in the country, is not really effective.

TABLE—II

Showing the effectiveness of various tannin preservatives on different fishing gear materials

Name of preservatives	Effectiveness on			
	Cotton	Sun hemp	Sisal	Manila
Control (Untreated)	1·00	1·00	1·00	1·00
Terminalia sp. (Myrobalan fruits)	0·53	—	—	—
Diospyros embryopteris (Panachikka) . . .	1·51	1·29	1·32	—
Odina wodier (Kalasam bark)	1·22	1·16	0·81	1·20
Temarindus indica (Tamarind seed coat) . . .	1·37	—	—	—
Acacia catechu (English cutch)	1·45	1·26	1·35	1·20
Acacia arabica (Babul bark)	—	—	1·18	1·30
Terminalia tomentosa (Ayana bark)	—	—	—	1·40

—The effectiveness of these preservatives has not been studied.

Tannin Fixation:

The easily soluble nature of tannin in water is the chief handicap in exclusive tannin treatment. If, however, tannin can be fixed on to the treated twines the longevity of the preservative can be greatly enhanced. The action of the fixatives is oxidation of the tannin. The common fixatives used are Copper sulphate and Ammonia as in the Dutch method (Olie 1918), Potassium dichromate as in the Spezialgerbung process (von Brandt 1955) and Sodium dichromate (Miyamoto 1958). Migita (1943) used a 1% $K_2Cr_2O_7$ solution to effect superior tanning while von Brandt (1955) suggests a 3% solution of the same oxidising agent for tannin fixation.

The tannin fixation experiments conducted at Cochin had been an adaptation of the Dutch method. The twines were dyed in a 5% solution of tannin and dried completely. 1% solution of $CuSO_4$ was prepared to which liquor ammonia was added till the precipitate first formed redissolved the tanned twines were treated in this solution, till the colour of the solution turned brownish black, which served to indicate the end of the oxidation.

Table III gives the result of the fixation treatment on different materials. The fixative used in all the series was $CuSO_4$ admixed with liquor ammonia.

In the fixation method, from the Table it would be evident that the effectiveness of the preservative in most cases increased almost two times when compared with their unfixed counterparts. It may be added that the impregnation of the preservative in the fixation method is more uniform and the increase in weight of the treated material is also not appreciably much.

Chemical Preservatives

Coal tar is possibly the commonest fish net preservative used in almost all countries. Conflicting opinions have been expressed by different workers about the suitability of coal tar for cotton twines. Firth and Carlson (1944) ecommend coal tar as an effective preservative and also maintain that the tar should be heated up to a temperature of 65 – 80°C (150°F – 180°F). According to these authors this temperature range gives good penetration and does not char the webbing. Miyamoto (1958) recommends the dilution of coal tar with Kerosene (10 – 30%). He is of the opinion that heating should be avoided due to the hazards in boiling coal tar. Whiteleather and Brown (1945) consider that coal tar should be avoided particularly in tropics. Carrothers (1949) also recommends the preservation of cotton web with coal tar. Sulit and Panganiban (1954) based on their investigations in the Philippines are of opinion that coal tar treatment is effective particularly when resin is admixed in small quantity. Takayama and Shimozaki (1957) are of the view that this treatment shows greater preservability of the fibres. These authors recommend a subsequent tarring of Cutch dyed twines. von Brandt (1955) suggests the additional treatment of nets soaked in tannin containing extracts with tar oils, carbolineum being particularly preferred.

The experiments conducted at Cochin were on three distinct lines namely,

1. Exclusive coal tar treatment on various materials,
2. Coal tar on tannin treated twines; and
3. Coal tar on tannin fixed twines.

The results are indicated in Tables IV, V & VI.

TABLE—III

The effectiveness of tannin fixation method on different gear materials

Names of basic preservative used	Effectiveness on		
	Sun hemp	Sisal	Manila
Control (Untreated)	1·00	1·00	1·00
English cutch	2·10	3·20	1·90
Odina wodier	2·10	3·99	3·20
Diospyros embryopteris	1·75	2·52	—
Acacia arabica	—	1·93	3·00
Terminalia tomentosa	—	—	3·30

—The effectiveness has not been studied.

TABLE—IV

The effectiveness of exclusive coal tar treatment on different gear materials

Preservatives	Effectiveness on				
	Cotton	Sun hemp	Sisal	Manila	Coir
Control	1·0	1·0	1·0	1·0	1·0
Coal tar	2·9	2·5	3·1	3·0	2·3

TABLE—V

The effectiveness of coal tar on tannin treated twines

Preservatives	Effectiveness on				
	Cotton	Sun hemp	Sisal	Manila	Coir
Control	1·00	1·00	1·00	1·00	1·00
Cutch + Coal tar	6·3+	3·89	7·47	2·80	2·40
Kalasam + Coal tar	9·2+	4·46	7·63	4·00	2·48
Myrobalan nuts + Coal tar	10·6	—	—	—	—
Panachikka + Coal tar	14·25+	2·45	3·28	3·20	2·96
Babul + Coal tar	—	—	5·72	5·50	—
Aiyana + Coal tar	—	—	—	4·50	—

—The effectiveness has not been studied.

TABLE—VI

The effectiveness of coal tar on tannin treated twines by the fixation method.

Preservatives	Effectiveness on			
	Sun hemp	Sisal	Manila	Coir
Control	1·00	1·00	1·00	1·00
Cutch 'fixed'+Coal tar	3·56	10·13	5·00+	3·19
Kalasam 'fixed'+Coal tar	5·13+	12·74	5·50	2·93
Panachikka 'fixed'+Coal tar	4·34	4·60	5·40	3·09
Babul 'fixed'+Coal tar	—	9·5+	6·0+	—
Aiyana 'fixed'+Coal tar	—	—	6·0+	—

—Effectiveness has not been studied.

Although coal tar by itself is an effective preservative, subsequent treatment of coal tar on tannin treated twines and tannin fixed twines, shows greater preservability of the treated materials under continuous immersion tests. The main draw backs of coal tar treatment are :

It renders the treated material sticky; The weight of the material is considerably increased;

The material becomes stiff and rigid and hence there is greater possibility of breakages at the knots;

Coal tar can cause deterioration of the fibres to a critical extent if not properly applied.

Because of these draw backs, coal tar treatment can be resorted to only for a few kinds of nets; such as trawls where mechanical wear and tear are the chief cause of deterioration, the stake or bag nets which are almost under continuous immersion. Most authors consider that coal tar forms a "A strong tough skin on the outside of the netting material which not only protects the fabric from external abrasion but also prevents water from coming into contact with it—in other words tar helps to keep the net dry even when immersed in water".

The other chemical preservatives commonly used elsewhere are Garnol, Cuprinols, Cunimine, Cunnillate, Net life Green, Marstein etc. Cuprinols, Cunimine and Cunillate are British products; Net life green is American; Marstein-Norwegian, and Garnol—Dutch. The main component of all these chemical preservatives seem to be Copper compounds like Copper oleate or Copper naphthenate. Burdon (1955) indicates that in the tropics the chemical preservatives comprising of copper compounds rapidly decompose in strong sunlight rendering them ineffective. Clague and Dattigaling (1950) maintain that they were highly effective in Philippine waters.

Experiments conducted at Cochin to test the effectiveness of the above chemical preservatives show that they are not really effective in Indian waters.

REFERENCES

Badhwar R.L. *et. al.*	1949	"Vegetable tanning materials of India". Part—I Survey. *Indian Forest Leaflet* 72.
Burdon T.W.	1955	"Net preservation in the tropics". *World Fishing Vol.* 4, *No.* 4.
Clague, J.A. & Dattigaling, B	1950	"Fishing Gear Preservatives for Philippine waters *Res. Rept. No.* 22 *U. S. Fish. & Wild Life Service.*
Carrothers, P.J. G	1949	"Notes on cotton web and its preservation with coal tar". Second Rept. Vancouver. *Edward Lipsett Ltd.* 13.
Firth, F.B. & Carlson, C.B.	1944	"Preservation and care of fishing nets". *Fisheries Leaflet No.* 66 *U. S. Dept. of Int. Fish & Wild Life Service.*
George, N.A. & (Miss) Radhalakshmy, K.	1961	"Preliminary studies on the preservation of sun hemp fishing net twines". (Under publication).
Gopalan Nayar, S.	1961(*b*)	"Studies on the optimum concentration of tanning solution for preservation of fishing gear". (Under publication)
I bid., George, N.A. & Narayanan, K. P.	1960(*a*)	"Studies on the preservation of Sisal twines". (Under publication).

Ibid. & Mangayya Naidu, R.	1961(*a*)	"Studies on the preservation of Manila twines". (Under publication).
Ibid	1960(*b*)	"A note on the preservative qualities of certain indigenous preservatives on coir twines". *Sci. & Cult. Vol.* 26, *No.* 6.
Ibid & (Miss) Vanaja, M. .	1961(*c*)	"Studies on the efficacy of chemical preservatives on coir twines". (Unpublished).
Kuriyan, G.K. & Cecily, P.J.	1961	"A note on the effect of boiling on fishing net twines" *Curr. Sci. Vol.* 30, *No.* 8.
Kuriyan, G.K. & Gopalan Nayar, S.	1959	"Common Indian Fishing Gear Preservatives—A General Account". (Under publication).
Migita, M. . . .	1943	"Fixing of Tanned nets" *Journal Fish. Exp. Stt., No.* 13 (1943).
Miyamoto, H. . .	1958	"Suggestions for preservation of fishing nets". Paper presented at the Gear Symposium, Cochin.
Miyamoto, H. & Shariff, A.T.	1959	"Experiments on fish net preservatives". *Ind. Jour. Fish. Vol. VI, No.* 1.
*Olie, J. Jr. . . .	1913	"Voovechriften Voor de behandeling Van netten net koper sulfat en Ammonia". *Verslag van der direstur Vanhet Nederlandsch. Visscherij—Procdstetion war het Jaar.* 1917.
Sulit, J. I. & Panganiban, P.	1954	"The efficacy of some net preservatives on cotton twines". *Proc. Indo-Pacific Fish Council Sect. II.*
Takayama, S. & Shimozaki, Y.	1957	"Development of fishing net and rope preservation in Japan". Paper No. 59. *International Fishing Gear Congress, Hamburg, Germany.*
*von Brandt, A. . .	1955	"Anleitung zum konservieren Von fisch netzen". *Heft zur rationalisieruug der Fischerei* 4 (1955).
Ibid	1957	"Method of testing resistance of net materials to micro-organisms". Paper No. 1 *International Fishing Gear Congress, Hamburg, Germany.*
*Whiteleather, R. T. & Brown, H. H.	1945	"An experimental Fishery survey of Trinidad, Tombago and British Guiana with recommended improvements in method and gear". *Rept. of Anglo American Carribean Comm.*

*Not consulted in original.

GMGIPND—DME NS—97 F. & Agri.—1-2-63—500.