PRESERVATION OF EGYPTIAN COTTON NETTING TWINES

By

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INTRODUCTION

Amongst the several causes of deterioration of natural netting-twines of which operational fatigue, frictional abrasion, sunlight and fish slime are examples, rotting by the action of cellulose-consuming micro-organisms is considered the most responsible. Un-preserved netting-twines after a short time reach a limit of breaking strength (50% of the initial value) below which the fishing gear becomes of no practical value. In the face of the growing competition of non-rotting synthetic fibres, it is of utmost importance to try to find new ways to immunize the natural fibres-of which cotton twines are our largest concern - against the attacks of micro-organisms.

Fishermen in various countries and even in different areas of the same country use different preservation methods, each convinced without being able to give any reasons that his method is the best.

In this work, an attempt is made to evaluate certain standard preservation methods used allover the world, with the aim of recommending the use of those that erperimentation proves to be the most suitable to our local environment.

Technique of work :

The field technique followed for this purpose was suggested by Von Brandt (1959).

Measurenment of resistance to rotting resulting from treatment with a certain preservative is carried out under field conditions. First of all our treated twines are suspended in natural waters for a certain period to determine the destructive action of the micro-biological organisms on them in other words, the efficiency of the presrvative as a rot-retarding agent. This is measured by the loss in the breaking strength suffered by the material at the end of successive periods within the duration of the experiment. As this loss will depend to a large extent on the rotting activity of the water in which the material is suspended, this value must be determined simultaneously.

Thus this test is twofold, namely it includes a test of the rotting activity of the water and another of the rotting resistance of the preserved netting material.

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A test cotton twine of Ne 20/9 was suspended at the first day of April, 1968 in water at each of the following three stations :

1— The out-door basins of the Institute of Oceanography and Fisheries, Alexandria, in the Eastern Harbour (marine water).

2.— Nouzha Hydrodrome, near Alexandria (fresh water).

3.—El-Maadia lake-sea connection of Lake Edku, about 40 kilometers east of Alexandria (brackish water).

These stations were selected in a way to represent certain of the economically important fishing areas, quite near to the laboratory, besides being of different hydrographical conditions. The attached map (fig.1) shows the locations of these stations.

Four bundles each of ten pieces, 30 cm. long of untreated twines, tied together by means of rot-resistant material, were boiled in distilled water. The free ends of each twine was knotted to prevent the bundles from being unmatted. The wet breaking strength of this twine is already measured. On the first day of the month these four bundless are stspended at each of the selected stations. After the first, second and third weeks and on the last day of the month, the decrease in the breaking strength was determined for one of the bundles at stations (1) and (2).

The rotting activity of each of these two stations during that month is determined by the percentage loss in breaking strength at the end of the four periods.

As for station (3) where the decrease in breaking strength reached more than 80% before the end of the month, the exposed bundles were replaced by new ones after they have lost $^3/_4$ of their initial strength. The percent strength losses of all successive specimens during the month were added together to represent the rotting activity of this site during this interval.

For measuring the efficiency of the different preservatives the same technique was followed using bundles each formed of 60 test pieces (30 double twine pieces), every two bundles representing twines treated with a certain preservative. The breaking strength was determined for samples taken from the bundles at the end of successive 15 days intervals on the same day of removal.

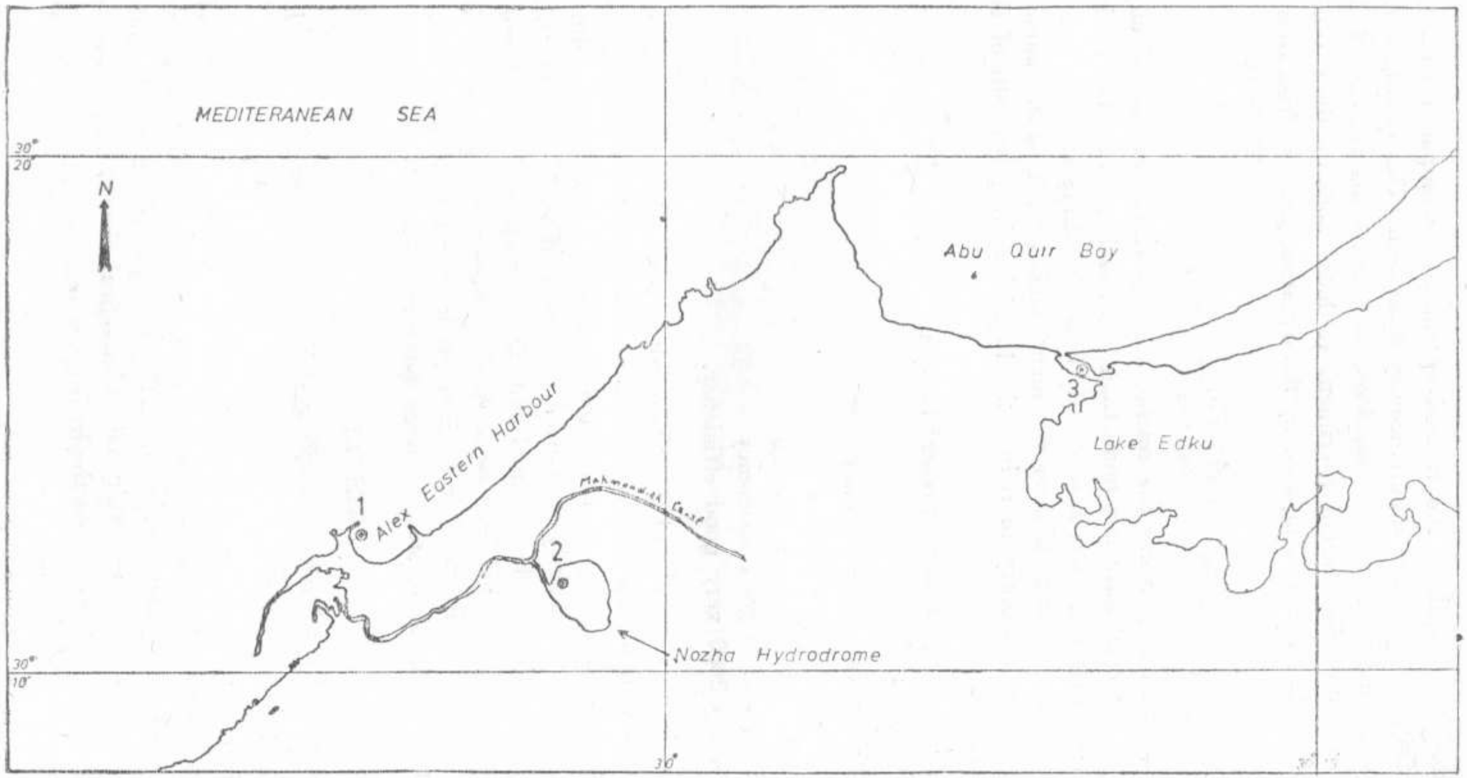


Fig. 1. Positions of Stations.

The loss in strength of the treated specimens is compared with the rotting activity of the water simultaneoulsy measured. The rotting resistance of the treated specimens is considered as that rotting activity of the water which causes the treated specimens to loose 50% of their initial breaking strength. This is computed by the equation given by Von Brandt (1959).

$$T = \frac{(t_2 - t_1) \times (R_1 - 50)}{R_1 - R_2} + t_1$$

In this fermula t_2 means the rotting activity which became effective when the test-material have lost more than 50%, and t_1 means the rotting activity before that state was reached, R_1 is the breaking strength before and R_2 the breaking strength after the mentioned state, T is the amount of rotting activity necessary to reduce the intial breaking strength of the material by 50%.

The efficiency of various preservatives are classified by von Brandt (1959) as follows :

T = 200 or less poor efficiency
= 200 - 500 low efficiency
= 500 - 1000 medium efficiency
= 1000 - 2000 good efficiency
= over - 2000 very good efficiency.

It would be very useful and demonstrative to get a preliminary picture of the rate of rotting of some of our row cotton net-twines, before attempting preseravtion. For this purpose ten twines bundles of thin and medium thicknesses are simultaneously immersed in water at station (1) within a period covering the months of April and May. Samples of the different bundles are examined for breaking strength after successive 5 days intervals. *The effective days* i.e. the number of days needed for the twines to reach 50%of their initial breaking strength were determined in each case.

RESULTS

A—Hydrographical conditions prevailing - during the duration of the experiment :

As it is obvious from the works of different authors the degree of deterioration of nets as a result of their exposure to biological factors during the fishing operations, varies with the different types of water. Various waters are characterised by certain micro-biological characteristics which in turn depend to a large extent on the hydrographical conditions prevailing in the corresponding habitats.

A general study on the hydrographical characteristics prevailing in the three selected sites is attempted by the authors. Temperature, was recorded and samples of water were analysed for chlorosity and phosphate-contents for each month all along the duration of the experiment. Tables (1), (2) and (3) give monthly observations of these parameters at the three stations investigated.

TABLE 1. - Hydrographical conditions prevailing during the duration of experiment in Station (1)

	Temperature	Chlorosity	PO_4 µ gm at/L
April (1968)	19.50	21.86	0.13
May	24.15	21.42	0.18
June	26.55	21.89	0.17
July	28.00	21.87	0.12
August	28.00	21.65	0.19
September	27.65	21.53	0.14
October	24.70	21.37	0.12
November	22.75	21.47	0.23
December	18.60	21.79	0.26
January (1969)	16.00	21.75	0.13
February	15.45	21.59	0.33
March	17.10	21.41	0.24

B — The course of rotting of certain raw net-twines in St. (1)

A pilot test with the aim of selecting the type of netting twine most convenient for our experiment was carry out.

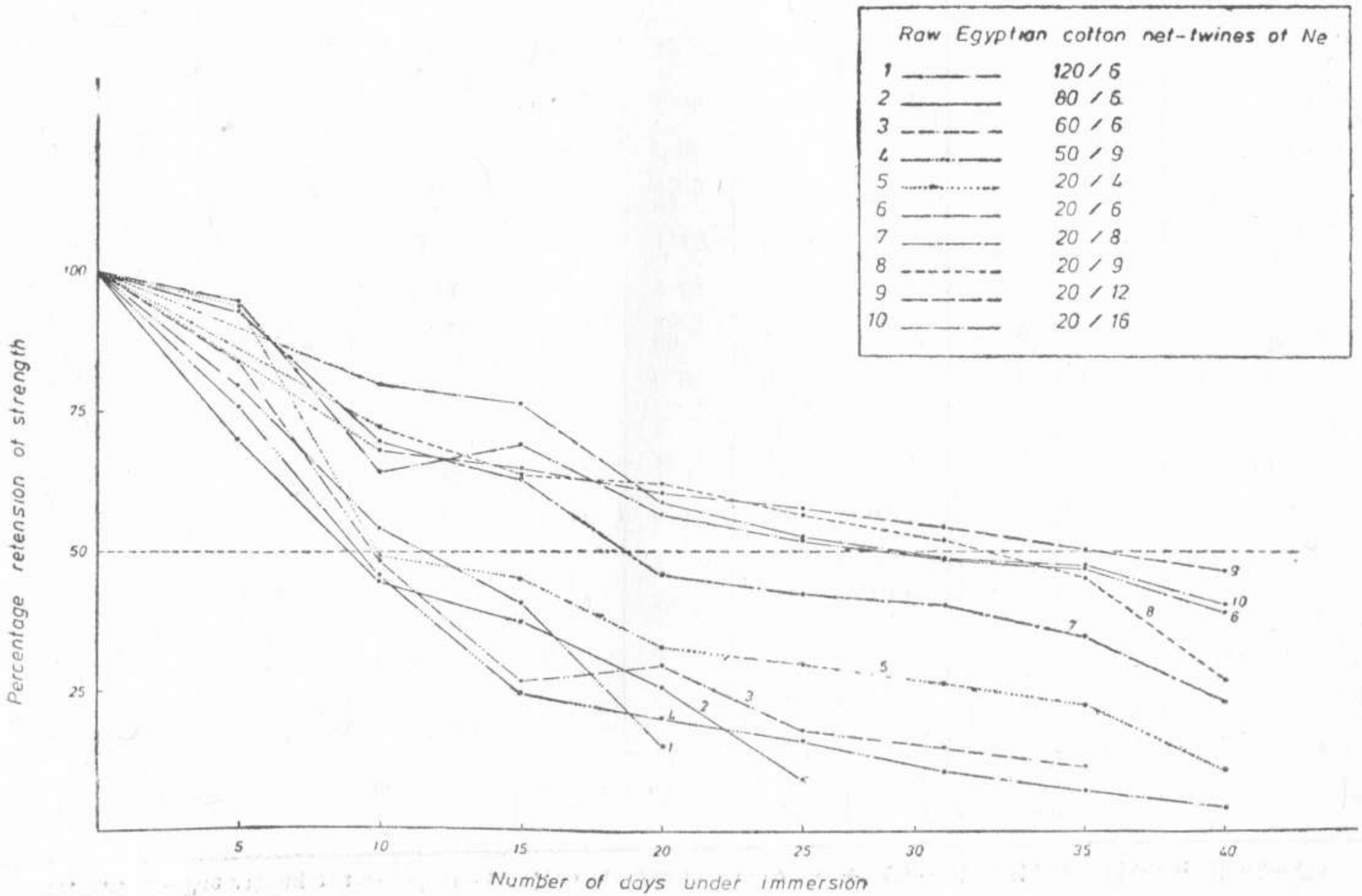
Table (4) includes the course of rotting of 10 raw Egyptian cotton net-twine types at Alexandria Eastern Harbour station, as expressed in the decrease in the breaking strength of these twines. The percentages retained breaking strengths are shown at the end of successive five days intervals.

TABLE 2.—Hydrographical conditions prevailing during the duration of experimet in Station (2).

	Temperature	Chlorosity	PO_4 µgm at/L
April (1968)	20.15	0.367	1.980
May	25.75	0.367	2.390
June	28.90	0.316	2.170
July	29.00	0.395	1.470
August	27.25	0.445	1.080
September	26.25	0.439	1.068
October	25.50	0.433	1.230
November	23.40	0.383	1.880
Decembr	19.10	0.361	2.280
January (1969)	16.75	0.241	2.458
Febrauary	15.85	0.284	2.320
March	17.45	0.312	2.440

TABLE 3.— Hydrographical conditions prevailing during the duration of experiment in Station (3)

	Temperature	Chlorosity	PO_4 µgm at/L
April (1968)	22.30	11.12	1.35
May	25.15	7.86	2.48
June	28.35	14.60	0.678
July	29.25	12.19	1.413
August	25.25	0.422	3.215
September	26.25	0.550	2.826
October	25.0	5.74	2.470
November	18.50	2.90	3.050
December	17.00	3.62	2.260
January (1969)	17.50	7.15	1.270
February	15.20	20.42	0.231
March	17.50	19.85	0.216



otting courses of ten raw Egyptian cotton net twines in Alexandrai Eastern Harbour Station

TABLE 4.—The rotting courses of 10 raw Egyptian cotton net-twines at Alexandria Eastern Harbour Station (1)

Ne			Initial value	Number of days under immersion							
				5	10	15	20	25	30	35	40
1	120/6	B.S.+	0.78	0.62	0.42	0.32	0.12	—	—	—	—
		% B.S.	100	79.4	53.8	41.0	15.0	—	—	—	—
2	80/6	B.S.	1.43	1.00	0.64	0.54	0.37	0.13	—	—	—
		% B.S.	100	69.9	44.7	37.7	25.8	9.10	—	—	—
3	60/6	B.S.	1.86	1.56	0.90	0.50	0.55	0.34	0.28	0.22	—
		% B.S.	100	83.8	48.3	26.8	29.5	18.2	15.1	11.8	—
4	50/9	B.S.	3.22	2.44	1.48	0.80	0.65	0.52	0.35	0.24	0.13
		% B.S.	100	75.7	45.9	24.8	20.1	16.1	10.8	7.4	4.1
5	20/4	B.S.	2.65	2.48	1.30	1.20	0.87	0.78	0.70	0.60	0.32
		% B.S.	100	93.5	49.0	45.2	32.8	29.4	26.4	22.6	12.0

6	20/6	B.S.	2.96	2.80	1.90	2.05	1.68	1.55	1.45	1.40	1.15
		% B.S.	100	94.5	64.1	69.2	56.7	52.3	48.9	47.2	39.2
7	20/8	B.S.	6.04	5.62	4.22	3.80	2.77	2.56	2.43	2.10	1.42
		% B.S.	100	93.0	69.8	62.9	45.8	42.3	40.2	34.7	23.5
8	20/9	B.S.	5.96	—	4.32	3.50	3.70	3.37	3.10	2.70	1.63
		% B.S.	100	—	72.4	58.7	62.0	56.5	52.0	45.3	27.3
9	20/12	B.S.	8.37	—	5.70	5.42	5.05	4.81	4.53	4.20	3.88
		% B.S.	100	—	68.1	54.7	60.3	57.4	54.1	50.1	46.5
10	20/16	B.S.	10.72	—	8.36	8.22	6.30	5.63	5.23	5.10	4.34
		% B.S.	100	—	77.9	76.6	58.7	52.5	48.7	47.5	40.5

+ B.S. = retained breaking strength,

% B.S. = percentage retension of strength.

Figure (2) demonstrates these rotting courses graphically, from which the number of effective days are demonstrated for each case. (see table 5).

TABLE 5.—Number of effective days for 10 raw Egyptian cotton-net twines, In Alexandria Eastern Harbour St. (1)

	Ne	Number of effective days
1	120/6	11.5
2	80/6	8.9
3	60/9	9.7
4	50/9	9.3
5	20/4	9.9
6	20/6	27.6
7	20/8	18.1
8	20/9	31.4
9	20/12	35.3
10	20/16	28.3

The ten types of twines can thus be classified in two groups according to the number of egective days :

First group : Includes those so-turned "thin twines" with less than 15 effective days. This group embraces twines of Ne 120/6, 80/6, 60/6 and 50/9 in addition to Ne 20/4.

Second group : Includes those so-termed "medium twines" with a number of effective days ranging between 15 and 30 days. This group embraces twines of Ne 20/6, 20/8, 20/9 and 20/16, with the exception of those twines of Ne 20/12 whose number of effective days was 35.

Cotton netting twine of Ne 20/9 was thus found to be the most convenient type for our purpose, as far as its suitable thickness and number of effective days are concerned.

C — The rotting activity of water.

Tables (6), (7) and (8) includes the values of rotting activity of the waters at the three stations under investigation. The values for each month of the year together with an average value per day for each month and the total value per year are given.

TABLE 6.—The rotting activity of Sea water Station (1)

	% loss in breaking strength after :				Value per day (average)
	First week	Second week	Third week	Last day of the month	
April, 1968	20.00	54.25	56.60	74.40	2.84
May	36.50	53.40	52.70	65.80	2.12
June	44.70	56.40	57.10	76.70	2.56
July	38.14	57.60	66.20	67.20	2.17
August	59.11	69.33	71.51	73.40	2.37
September	59.14	59.53	62.44	64.57	2.13
October	42.56	50.64	57.82	64.87	2.10
November	62.24	67.16	80.46	81.00	2.70
December	42.14	51.73	59.24	72.12	2.33
January, 1969	39.33	53.86	63.75	67.87	2.26
February	40.17	46.23	58.72	69.34	2.39
March	39.72	46.64	57.18	71.20	2.29

Value per year = 848.47

TABLE 7.—The rotting activity of fresh water Station (2)

	% loss in breaking strength after :				Value per day (average)
	First week	Second week	Third week	Last day of the month	
April (1968)	26.39	34.26	43.15	72.25	2.48
May	15.19	31.62	43.25	85.59	2.76
June	26.92	46.20	61.95	80.89	2.69
July	25.80	46.62	62.02	75.16	2.42
August	18.77	29.22	52.28	60.31	1.95
September	27.29	39.86	50.41	62.61	2.09
October	25.44	37.73	48.17	63.29	2.11
November	27.37	35.22	53.19	70.26	2.35
December	26.11	38.31	49.97	71.18	2.30
January (1969)	17.42	33.53	66.00	76.60	2.47
February	23.49	37.48	69.25	77.17	2.66
March	26.73	34.27	61.13	74.35	2.40

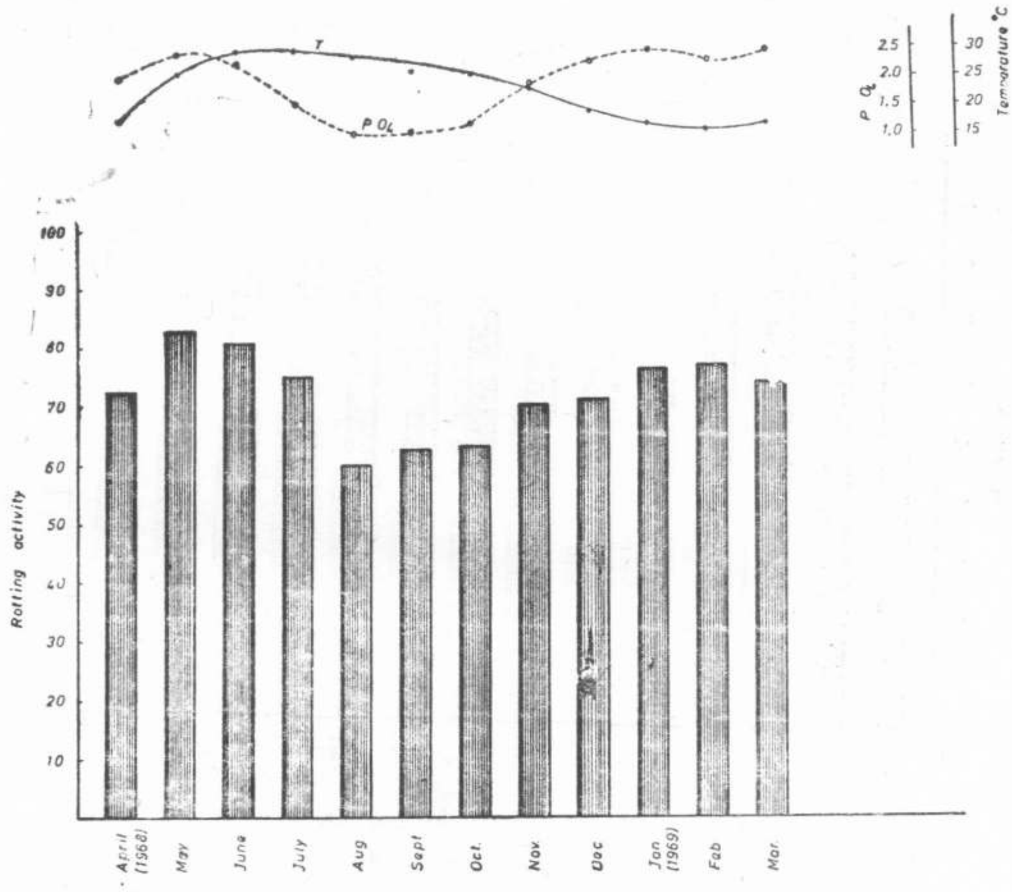
Value per year = 869.76

TABLE 8 The Rotting Activity of brackish Water station (3)

	% loss in Breaking Strength after :				Total value per month	Av. value per day
	First week	Second week	Third week	lass day of the month		
April (1968)	44.28	82.13	41.57	87.17	16[illegible].20	5.64
May	58.28	97.83	56.17	92.10	189.93	6.12
June	72.73	92.34	61.15	100.00	192.24	6.41
July	59.17	95.52	60.20	98.86	194.20	6.27
August	74.28	100.00	62.73	100.00	200.00	6.45
September	58.49	100.00	63.64	100.00	200.00	6.67
October	67.31	98.16	65.72	95.24	193.40	6.23
November	67.23	98.44	59.34	91.16	189.60	6.32
December	37.51	68.45	39.46	70.26	138.71	4.47
January (1969)	34.26	51.32	26.82	63.19	114.51	3.60
Fabruary	20.04	55.27	32.17	55.32	110.57	3.94
March	43.13	81.52	29.50	83.58	165.10	5.32

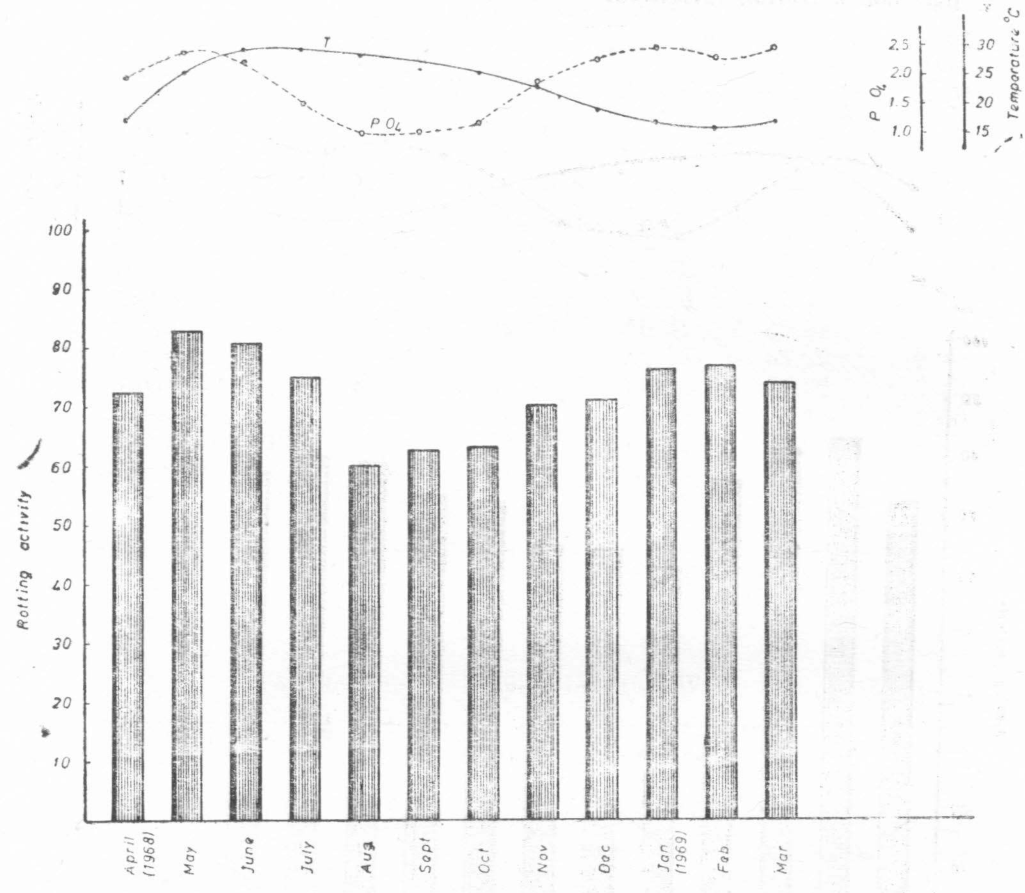
Value per year = 2057.66

In figures (3), (4) and (5) the monthly values were demonstrated as histograms compared in each case with the trends of temperature and phosphate concentration variations.



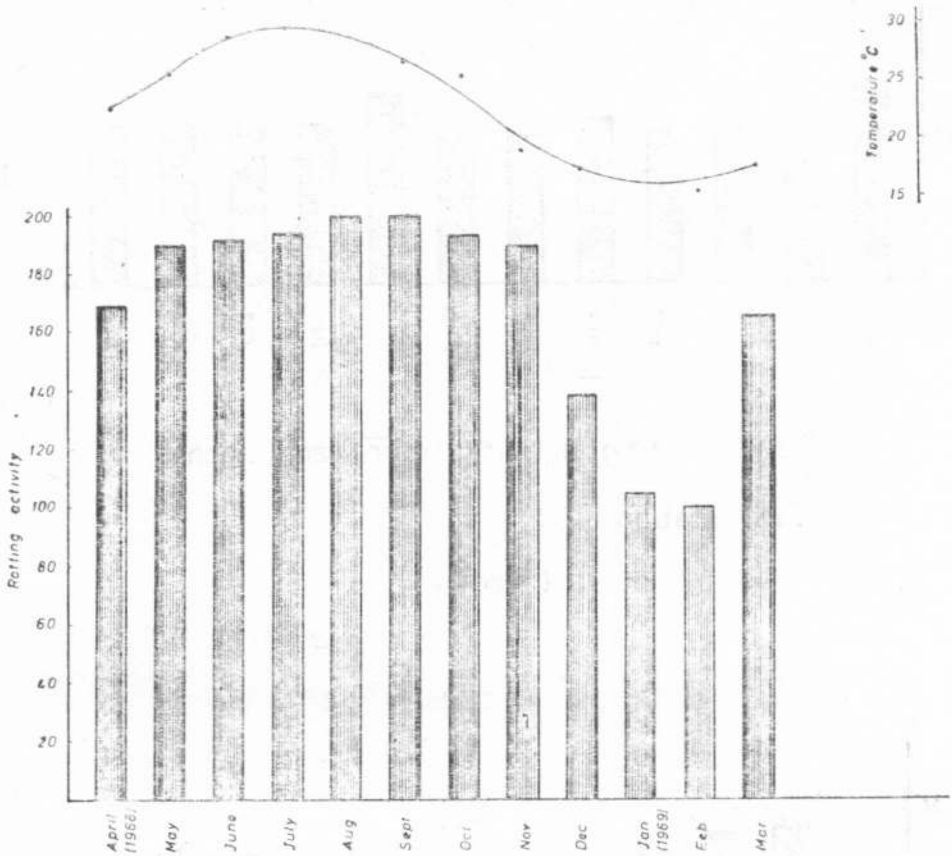
Monthly rotting activity in station (2).

(Fig. 3)



Monthly rotting activity in station (2)

(Fig. 4)

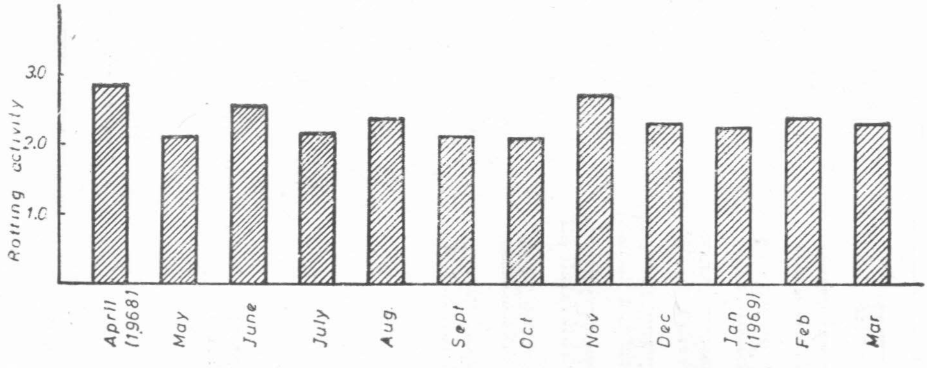


Monthly rotting activity in station (3)

(Fig.5)

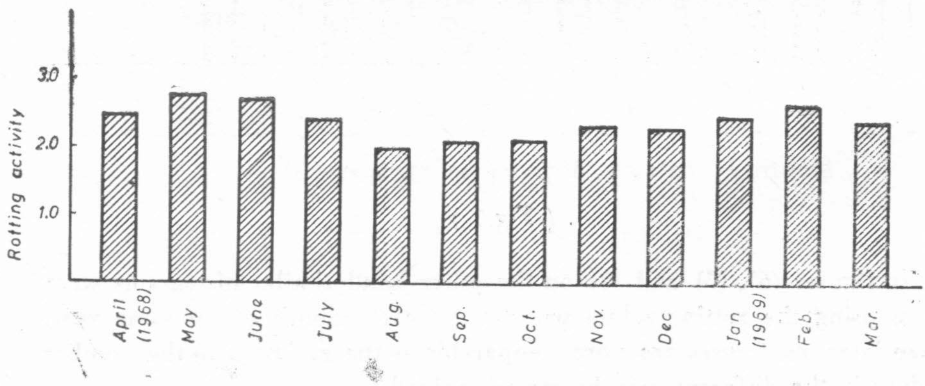
In figures (6), (7) and (8) on the other hand similar histograms were drawn using the rotting values per day for each month of the same year. These later test figures are more comparable as the variation in the number of days in the different months are so avoided.

Generally speaking, as it is evident from the tables and figures, the rotting activity per day in the different months in stations (1) and (2) are more or less similar ranging between 2.12 and 2.70 for stations (1) and between 1.95 and 2.76 for station (2) respectively. Whereas in station (3) the rotting activity values were considerably higher varying between 3.60 and 6.45 per day.



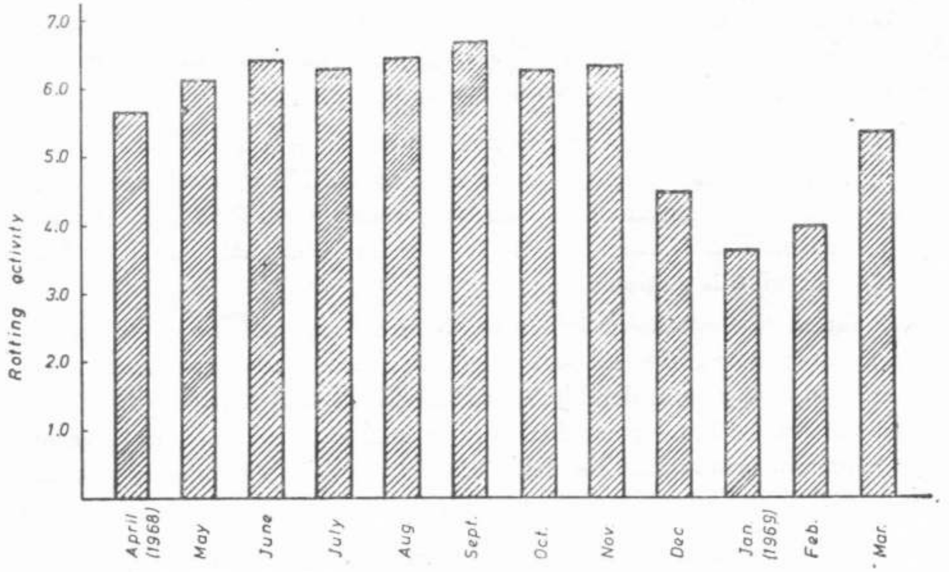
Daily rotting activity per each month in station (1)

(Fig. 6)



Daily rotting activity per each month in station (2).

(Fig. 7)



Daily rotting activity per each month in station (3).

(Fig. 8)

To look for an an explnantion firstly for the close similarity in the rotting activity of the waters of stations (1) and (2) and secondly for the superiority of station (3) in this respect, the temperature and phosphate factors will be taken into consideration. As far as the temperature is concerned this factor cannot be of any significance as the values and trends of water temperature variation along the year are almost similar in the three stations.

Considering the phosphate concentration factor it is evident from tables(1), (2) and (3) that its values in station (1) are considerably low compared with these values in the other two stations. It would be expected on the basis of phosphate concentration which is an important decaying agent (Klust and Mann, 1955), to get higher values of rotting activity for station (2) than station (1). However, a comparison of the values of rotting activity per year in these two stations, shows that they are almost similar, being 848.47 in station (1) and 869.76 in station (2). The considerably high rotting activity value per year (2057.66) in station (3) inspite of the fact that phosphate concentration is not very far from that of station (2) must have another explanation.

As a matter of fact the movement of water where the experiments were conducted must have played a very prominent role in controlling the rotting activity in these environments.

In station (1), the experiment was conducted in a semi-closed basin, with open connections with the eastern harbour outside ; water passes free in and out of these connections sometimes vigorously when the wind is strong. This movement must have made up for the low phosphate concentration in the water of this station.

As far as the conditions in station (3) are concerned the water moves in and out through the lake-sea connection where the experiment was conducted - with a considerable speed all along the year. In fact, the author has always found great difficulty in anchoring his small boat while suspending and collecting his materials there. This vigorous movement must explain the high values of rotting activity of water at this station.

It is suggested that the effect of water movement in accelerating rotting activity is attributed to One or both of the following causes :

1 — The rinsing effect of water and the probable mechanical destruction of the membranous structure of the protecting layer of each fibre followed by its slow chemical effect on the cellulose of the fabric (Zaucha, 1959).

2 — This mechanical and chemical destruction leaves the cotton fibres of the twines used, vulnerable to the attack of micro-organisms.

3 — The process of rotting of raw cotton twines is much accelerated by the current which renews the decaying agents (calcium and phosphate salts) and micro-organisms in the water (Koura, 1963).

Considering the trend of variation in rotting activity in every station, the following generalizations can be drawn :

1— The range of temperature variation in the three stations is in all cases favourable to microbiological activity (see Klust and Mann, 1954). A slight correlation between the trend of variation in rotting activity and the trend of temperature variation along the successive months of the year of investigation can be noticed in figure (5) for station (3).

2 — The correlation between the trend of variation in the rotting activity and the phosphate concentration is hardly noticed in station (1). As far as the conditions in station (2) are concerned, this correlation is slightly more prominent. As for station (3) correlation does not exist whatsoever.

3 — The autumn months in stations (1) and (2) were characterised by a flourishment of algal growth which was noticed to cover the twines with a distinctly thick coat. This period of the year is always characterised by a comparatively low values of rotting activity. This phenomenon was also recorded by koura (1970) in station (1). This can be explained by the fact that the flourishment of algal growth especially planktonic Diatoms, happens always on the expense of the nutrients in water specially phosphate (El Magharby and Halim, 1965) which is considered as an important decaying agent (Klust and Mann, 1955). As a matter of fact the low coucentration of phoshate in autumn month evident in stations (1) and (2) may support this view.

The coat of algae may also play the role of a separating wall between the twines and the activity of the micro-organisms, hence retarding more or less their rotting action.

This phenomenon was not noticed in station (3) which may be explained by the fact that the active currents do not give a chance for such algal accumulation.

D—Rotting Resisttance of Egyptian Cotton Netting Twines

Certain preservation methods have a sterilizing action, destroying putrivactive bacteria either by sunlight drying after boiling or copper compunds bathing. Others make it physically impossible for bacteria to attack the fibres by coating them with a film of either tannin (Cutch treatment), Coal-tar or seed oil.

Treatment may be carried out with cutch alone, or fixation of cutch by oxidation is affected with reagents like Ammoniacal copper sulphate (Dutch method, oile 1918) or potassium dichromate (von Brandt, 1955).

Coal-tar substance with high phenolic content offer fair protection againest rotting and mechanical wear caused by dragging of trawl nets along the sea bottom. Being an oil, it also acts as a water repellent. In combination with other treatments it enhances the effectiveness of the concerned method.

Seed-oil has the advantage of water proofing the twine; it reduces the penetration of bacteria into the twine.

The most recent development in the field of net preservation is rendering the fibre resistant to attacks by converting it into cellulose derivatives by esterification or etherification, or the deposition of a synthetic resin "Arigal" in the fibre. This will rendre the twines rot-proof without adversly changing the properties of the fibres (Ruperti, 1959).

For the sake of evaluation a good preservative shall :

1 —Secure and effective rot-resistance;

2 —maintain this quality for a long time;

3 —protect the gear even outside the water againest all weather influences;

4 —allow the preserved nets to be stored without damage;

5 —increase the catching ability of nets;

6 —make the nets very fit to fishing operations without changing efficiency and srength;

7 —enable the fishermen to carry out the preservation by themselves without difficulty.

(von Brandt, 1953)

Evaluation of the efficiency of the different preservatives :

The following is a demonstration of the results of the tests conducted on Egyptian cotton net-twines Ne 20/9, treated by different preservatives, in the three sites chosen :

Tables (9), (10) and (11) show the decrease in the breaking strength of the treated twines at successive 15-days intervals, for the three stations of investigation. For each interaval the percent retained values of breaking strength are given. These data are plotted in figures (9) (10) and (11).

For the sake of comparison, table (12) includes the results of similar work on the Egyptian cotton net-twines Ne 20/9, treated with the same group of preservatives carried out in 1963-1964 by R.Koura in station (3) (unpublished data).

Applying the method suggested by von Brandt (1959) the rotting resistance of the treated speciments as a measure of the efficiency of the preservative used, was determined. The "T" values for the various preservatives in which the rotting activity of the medium was taken into consideration are given in table (13) for the three stations under investigation.

TABLE 9. — **The course of rotting of treated cotton net-twines of Ne 20/9 at Alexandria Eastern Harbour Marine Water (Station No. 1)**

	Preservative		15.5.68	1/6	15/6	1/7	15/7	1/8	15/8	1/9	15/9	1/10	15/10	1/11	15/1/69	15/2	15/3	15/5
1	Cutch	B.S.	5.04	3.94	3.11	1.73	0.39	0.07										
		%B.S.	100	78.2	61.7	34.3	7.7	1.4										
2	Cutch + Cu SO_4	B.S.	5.06	4.62	4.16	2.42	2.06	1.41	0.91	0.43								
		%B.S.	100	91.3	82.2	47.8	40.7	27.9	18	8.5								
3	Cutch + K_2 or$_2$07	B.S.	4.65	4.63	4.71	5.30	4.91	4.17	1.09	0.89								
		%B.S.	100	100	101.3	114	105.6	89 7	23.7	17								
4	Coal tar	B.S.	5.26	4.52	4.09	3.63	3.106	0.98										
		%B.S.	100	86	77.8	69.1	58.8	18.6										
5	Cutch + coal tar .	B.S.	4.58	4.64	4.73	4.53	4.08	4.30	1.92	1.53								
		%B.S.	100	101.3	103.3	98.9	89.1	93.9	41.9	33.4								
6	Cutch + Cu SO_4 + Coal tar	B.S.	5.00	4.79	4.56	4.42	4.50	4.00	3.52	3.39	2.14	0.50						
		%B.S.	100	95.8	91.2	88.4	90	80	70.4	67.8	42.8	10						
7	Cutch + Cu $K_2cr_2$07 + Coal tar	B.S.	4.89	4.59	4.39	4.63	4.45	4.40	4.40	3.52	2.84	2.14	1.30	0.95				
		%B.S.	100	93.7	89.8	94.7	91	90	90	72	58.1	43.8	26.6	19.4				
8	Seed Oil (cotton seed oil)	B.S.	4.81	4.71	4.70	3.88	3.85	2.12	0.81	0.81								
		%B.S.	100	97.9	97.7	80.8	80	44.1	16.8	16.8								
9	Cutch + Seed oil .	B.S.	4.79	4.12	3.94	3.74	4.05	2.81	0.68	0.03								
		%B.S.	100	86	82.3	78.1	84.6	58.7	14.2	1								
10	Cu SO_4	B.S.	5.23	4.21	3.06	3.10	1.73	0.59										
		%B.S.	100	80.5	58.5	59.3	33.1	11.3										
	Arigal	B.S.	4.71	4.74	4.63	4.55	5.18	5 07	—	5.0	4.98	5.04	—	4.98	—	4.90	4.94	4.60
		%B.S.	100	100.6	98.3	96.6	109.9	107.6	—	106.2	105.7	107	—	105.7	—	104	104.2	97.0

TABLE 10. — **The course of the rotting of treated cotton net-twines Ne 20/9 at "Nozha Hydrodrome" Freshwater station No. (2).**

	Preservative		15.5.68	1/6	15/6	1/7	15/7	1/8	15/8	1/9	15/9	1/10	15/10	1/12	15/12	15/2 1969	15/3	15/5
1	Cutch	B.S.	5.04	4.53	1.15	0.69	0.32											
		%B.S.	100	89.9	22.8	13.7	6.4											
2	Cutch + $CuSO_4$	B.S.	5.06	4.86	4.74	3.59	2.04	0.98	0.52	0.30								
		%B.S.	100	96	93.7	70.9	40.3	19.4	10.3	6								
3	Cutch+$K_2cr_2 07$	B.S.	4.65	4.33	4.15	2.85	1.31	0.45	0.10									
		%B.S.	100	93.1	89.3	61.3	28.2	10	2									
4	Coal tar . . .	B.S.	5.26	2.67	0.32	0.12												
		%B.S.	100	50.1	6.8	2.3												
5	Cutch +Coal tar	B.S.	4.58	4.15	3.6	3.9	0.65	0.17										
		%B.S.	100	90.6	78.6	80.8	14.2	3.7										
6	Cutch+$CuSO_4$+ Coal tar	B.S.	5.	4.71	4.78	5.06	5.0	4.60	3.27	2.99	2.43	1.63	1.40	0.843	0.375			
		%B.S.	100	94.2	95.6	101.2	100	92	65.4	59.8	48.6	32.6	28	16.9	7.5			
7	Cutch + $K_2 cr_2$ 07 + Coal tar	B.S.	4.89	4.85	4.65	3.08	1.9	1.65	0.83	1.46	0.725	1.31	0.68	0.43	0.15			
		%B.S.	100	99.2	95.1	63	38.8	33.7	16.9	29.8	14.9	26.8	13.9	8.8	3.1			
8	Seed Oil . . .	B.S.	4.81	3.73	1.04	0.10												
		%B.S.	100	77.5	21.6	2												
9	Cutch+Seed Oil	B.S.	4.79	3.62	3.06	1.29	0.63	0.25										
		%B.S.	100	75.6	63.9	26.9	13.2	5.4										
10	Cu SO_4	B.S.	5.23	3.42	0.84	1.43	0.0											
		%B.S.	100	65.4	16.2	27.4	0.0											
11	Arigal	B.S.	4.71	4.73	4.69	4.52	4.91	4.36	—	4.91	—	—	4.55	—	4.32	4.20	4.27	4.30
		%B.S.	100	100	100	96.0	104	92.5	—	100	—	—	96.6	—	91.8	89.2	90.7	91.2

TABLE 11. — **Course of rotting of treated cotton nettwines at Maabia Brackish Water Sta. No (3)**

	Preservative		15/5/68	22/5	1/6	15/6	1/7	15/7	1/8	15/8	15/11/69	15/2/69	15/5/69
1	Cutch	B.S.	5.04	2.743	0.828								
		%B.S.	100	54.4	16.0								
2	Cutch + Cu SO_4	S.	5.06	—	3.36	1.00							
		% S.	100	—	66.4	18.							
3	Cutch + K_2 cr_2 07	B.S.	4.65	—	3.82	2.78	1.10	0.40					
		%B.S.	100	—	82.1	59.8	23.6	8.6					
4	Coal Tar	B.S.	5.26	4.79	1.234								
		%B.S.	100	91.5	23.4								
5	Cutch + Coal Tar	B.S.	4.57	—	4.27	1.73	0.38						
		%B.S.	100	—	93.5	37.9	8.3						
6	Cutch + Cu SO_4 + Coal Tar	B.S.	5.00	—	3.89	3.42	1.43	0.25					
		%B.S.	100	—	77.8	63.4	28.6	5.0					
7	Cutch + K_2 cr_2 07 + Coal Tar	B.S.	4.89	—	4.40	3.90	3.30	2.22	0.751	0.540			
		%B.S.	100	—	90	79.7	69.5	45.4	15.4	11			
8	Seed Oil (seed cotton oil	B.S.	4.81	—	3.73	1.94	0.28						
		%B.S.	100	—	77.5	40.3	6.0						
9	Cutch + Seed Oil	B.S.	4.79	—	3.62	2.65	0.55						
		%B.S.	100	—	75.2	55.3	11.5						
10	Cu SO_4	B.S.	5.23	1.40	0.873								
		%B.S.	100	26.8	16.7								
11	Arigal	B.S.	4.71	—	5.17	4.92	4.83	4.72	4.75	4.45	4.35	4.40	4.10
		%B.S.	100	—	112	104	102	100	100	94.5	92.3	93.5	87

TABLE 12.—The course of rotting of treated cotton net-twines Ne 20/9 at Maadia brackish water station No. (3) by Koura 1963-1964.

		Initial 1.12.63	15.12.63	31.12.63	15.1.64	31.1.64	19.2.64
Cutch + Cu SO_4	B.S.	4.60	4.60	3.70	1.40	0.0	
	%	100	100	80	30.4	0.0	
Cutch + K_2 Cr_2 C7	B.S.	4.60	3.90	3.10	2.50	2.10	1.4
	%	100	84.7	67	54.3	45.6	30.4
Cutch + Cu SO_4 + Coal tar	B.S.	4.60	3.50	2.90	2.10	1.20	0.6
	%	100	76	63	45.6	26	13
Cutch + K_2cr_207 + Coal tar	B.S.	4.60	3.50	3.70	3.20	3.30	2.10
	%	100	76	80	69.5	71.7	45.6

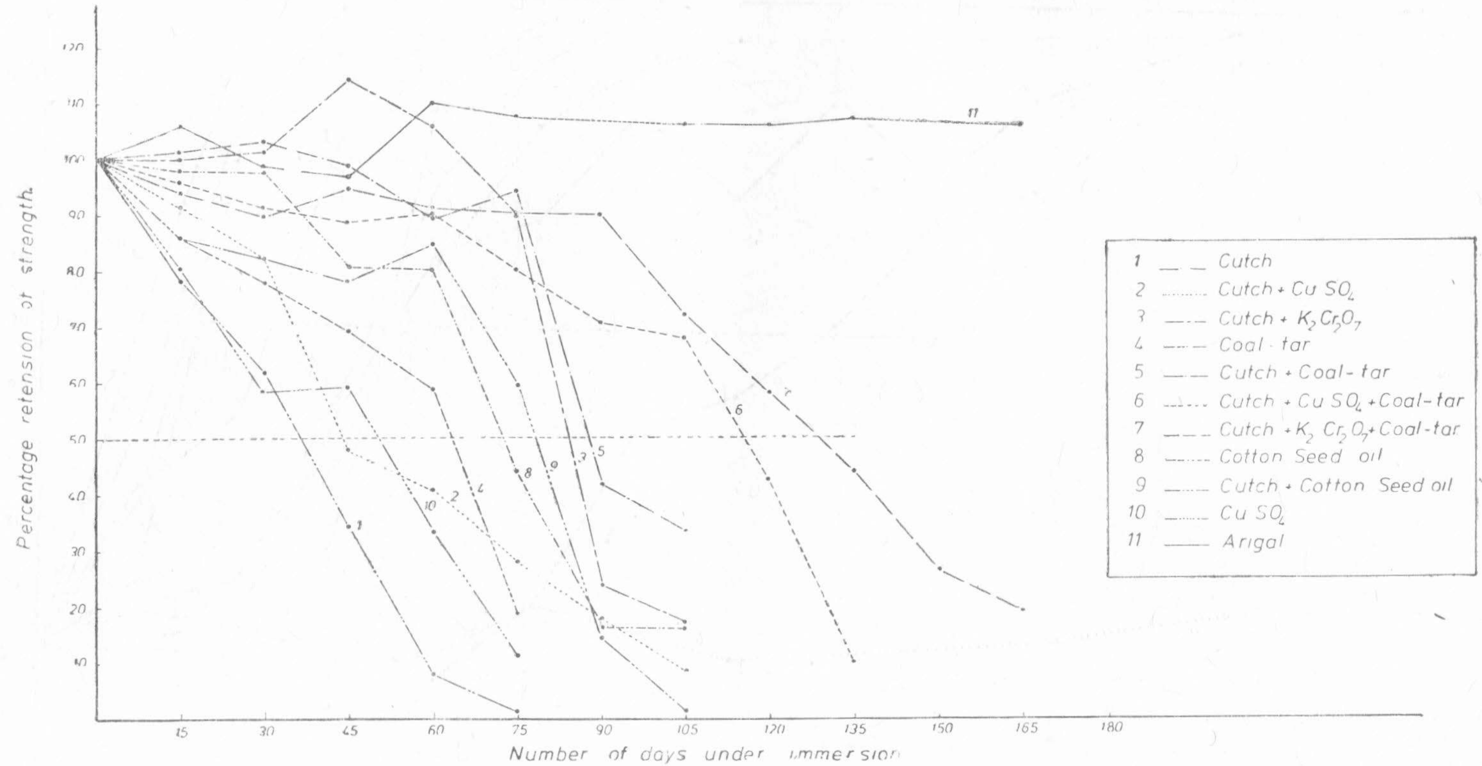


FIG. 9. Course of rotting of tréated cotton net-twines Ne 20/9 in Alexandria Eastern Harbour station No (1)

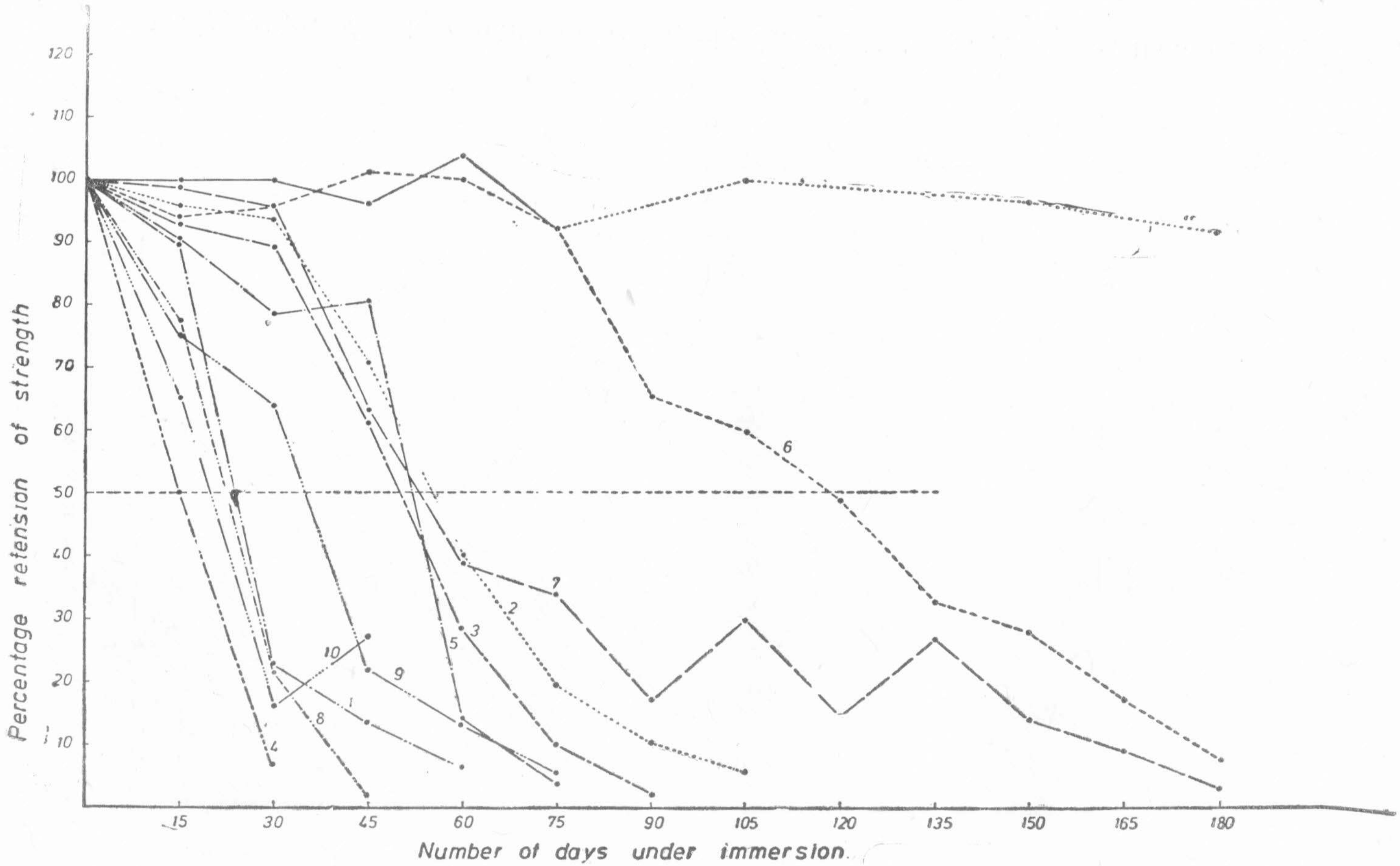


FIG. 10 Course of rotting of treated cotton net-twines Ne. 20/9 in Nozha hydrdrome st, No (2)

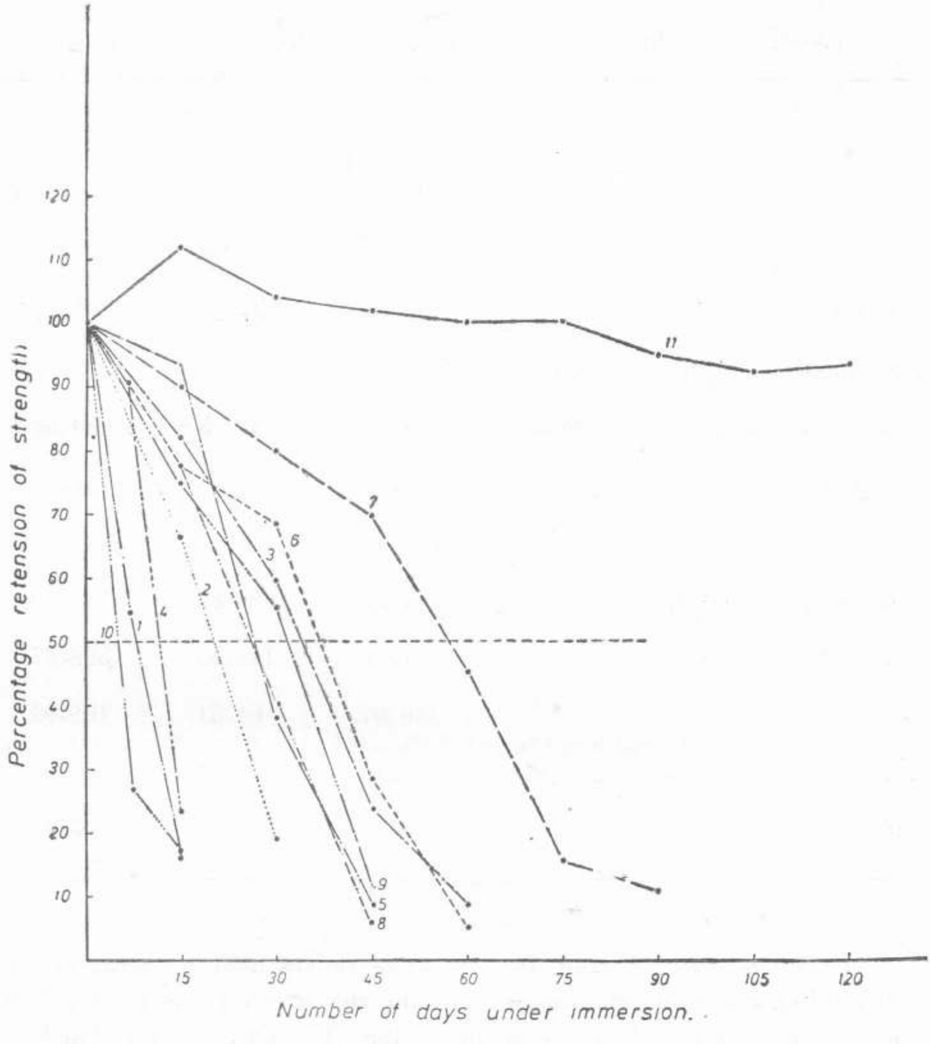


FIG. 11. Course of rotting of treated cotton net-twines No. 20/9 in Maadia station. No (3)

TABLE 13.—The rotting resistance (T) of the treated twines.

	Treatment	T		
		Station (1)	Station (2)	Station (3)
1	Cutch	82.60	68.21	49.14
2	Cutch + Copper sulphate	108.17	149.75	131.02
3	Cutch + potassium dischromate	199.18	137.65	220.09
4	Coal tar	150.75	44.26	84.44
5	Cutch + coal tar	207.82	141.75	173.12
6	Cutch + $CuSO_4$ + coal tar	274.22	287.82	238.49
7	Cutch + $K_2Cr_2O_7$ + coal tar	301.71	144.55	368.67
8	Seed oil	146.07	64.31	168.92
9	Cutch + seed oil	184.72	99.79	205.69
10	$Cu\ SO_4$	122.17	57.11	45.72

In tables (14), (15) and (16), the preservatives used are arranged in a descending order in an attempt to show the preservatives most suitable to each water type. In the same tables the "T" values are translated into the efficiency terminology suggested by von Brandt (1959). In station (1) (marine water), the most suitable of the ten preservatives used are :

Cutch + potassium dichromate + Coal-tar.

Cutch + copper sulphate + Coal-tar.

Cutch + Coal-tar.

Cutch + potassium dichromate

all giving "T" values higehr than 200.

The remaining five preservatives are of poor efficiency.

TABLE 14.—Evaluation of the efficiency of the different preservatives in station (1)

	Treatment	Efficiency
1	Cutch + K_2cr_207 + coal tar	low
2	Cutch + $CuSO_4$ + coal tar	"
3	Cutch + coal tar	"
4	Cutch + K_2 cr_2 07	"
5	Cutch + seed oil	poor
6	Coal tar	"
7	Seed oil	"
8	Cu CO-	"
9	Cutch + Cu SO·	"
10	Cuch	

TABLE 15.—Evaluation of the efficiency of the different preservatives in station (2)

	Treatment	Efficiency
1	Cuch + Cu SO_4 + coal tar	low
2	Cutch + Cu SO_4	poor
3	Cutch + K_2 cr_2 07 + coal tar	"
4	Cutch + coal tar	"
5	Cutch + K_2 cr_2 07	"
6	Cutch + seed oil	"
7	Cutch	"
8	Seed oil	
9	Cu SO_4	"
10	Coal tar	"

TABLE 16.—Evaluation of the efficiency of the different preservatievs in Station (3)

	Treatment	Efficeincy
1	Cutch + K_2 cr_2 07 + coal tar	low
2	Cutch + Cu SO_4 + coal tar	„
3	Cutch + K_2 or_2 07	„
4	Cutch + seed oil	„
5	Cutch + coal tar	poor
6	Seed oil	„
7	Cutch + Cu SO_4	„
8	Coal tar	„
9	Cutch	„
10	Cu SO_4	„

In station (2) (fresh water) the most suitable preservative is :

Cutch + copper sulphate + Coal-tar.

Whereas the remaining preservatives gave efficiency values below 200.

As for station (3), the best preservatives of the group are :

Cutch + potassium dichromate + Coal-tar.

Cutch + copper sulphate + Coal-tar.

Cutch + potassium dichormate.

Cutch + seed oil.

while the rest are of poor efficiency.

On the basis of table (13), figure (12) was drawn to compare in a histogram from the efficiency of each of the preservatives used in the three media. The following observations can be deduced :

1. The best preservatives of the group in all cases are :

Cutch + copper sulphate + Coal-tar.

Cutch + potassium dichromate + Coal-tar.

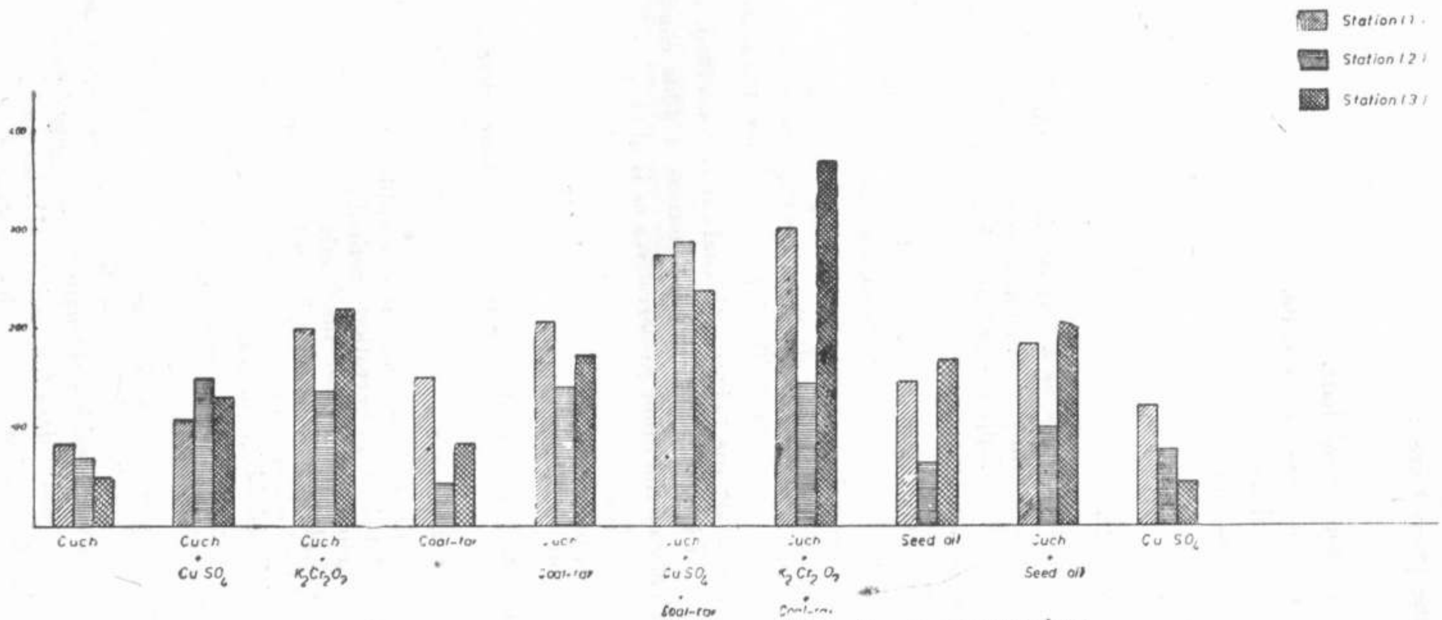


FIG. 12. Efficiency of preservatives of cotton net-twines.

while the poorest are :

Cutch

Cutch + copper sulphate.

Cutch + potassium dichromate.

Cutch + Coal-tar,

Cutch + seed oil,

Coal-tar

Seed oil.

Copper sulphate.

2. Potassium dichromate as a fixative for tannin is more effective in waters of high salinity ; whereas copper sulphate is more effective in fresh water, Copper sulphate when used alone as a sterilize is of a very poor efficiency.

3. In all preservation methods in which chromium took part, the highest efficiency was observed in station (3).

4. With the exception of Cutch + copper sulphate + Coal tar the efficiencies of almost all the preservatives in the fresh water of station (2) are comparatively poor ("T" less than 200).

5. As far as coating the twines with coal tar is concerned, it is evident that alone, it is of poor efficiency where-as it adds considerably to the efficiency of the other preservatives as is obvious in case of .

Cutch + coal tar
Cutch + copper sulphate + coal tar
Cutch + potassium dichromate + coal tar

6. The efficiency of seed oil is as poor as coal-tar when used alone.

Discussion and Conclusions :

Cutch, a tannin product, although it is considered as a basis for most of the vegetable net-twines preservation methods, yet its aplication alone proved in all present cases almost uneffective, the value of "T" being 82.60, 68.21 and 49.14 in stations (1), (2) and (3) respectively. The thin film of tannic acid which it builds up on the fibres does not last for long because of its high solubility in water. The solible nature of tannin restricts the use of exclusive cutch treatment for preservation of net-twines. To keep up its bactericidal action, frequent re-dieng is needed to maintain strength of the net, which would otherwise deteriorate. The effective days, i.e., the number of days in which the cutch treated cotton twines loose 50% of their initial breaking strength when exposed to deterioration in the field were 37,24 and 8 days for stations (1), (2) and (3) respectively. The very low value in station (3) can be attributed to the continuous washing action to which the twines are subjected in this station.

Fixation of cutch to reduce its solubility as affected with oxidizing agents like potassium dichromate and ammoniacal copper sulphate gave generally more or less better results. "T" increased to 199,18, 137.65 and 220.09 for cutch fixed with potassium dichromate in stations (1), (2) and (3) respectively, whereas it increased to 108.17, 149.75 and 131.02 for cutch fixed with copper sulphate in stations (1), (2) and (3) respectively.

Takayama and Shimozaki (1959) stated that application of fixtures such as potassium dichromate can double the life of cutch-trated material. In Chrzan's (1955) opinion, the highest preservative effect may be ascribed to tanned nets, fixed with potassium dichromate.

On the other hand, Farrar, (1949) stated that cutch followed by bluestone "copper sulphate" either neutral or ammoniacal is a useful preservative for cotton gear, provided the colour is no objection.

The superiority of potassium dichromate as a fixative for cutch in marine waters was also observed by Koura (1963) who stated that this may be due to the effect of higher salinity, where the ions of copper in copper sulphate are easily exchanged with the different ions found in the sea water.

The relative high efficiency of preservation mothods containing chromium, observed in station (3) characterized by strong water currents can be due, according to Klust's opinion (Klust 1952) to that the surface of each fibre becomes completely covered with the preserving agent that have a quality, besides destroying germs, of strong adhesion so that it cannot be easily removed in water.

Exclusive treatments of the twines with diluted coal-tar gave poor results especially in fresh water. "T" was 150.57, 44.26 and 84.44 for stations (1), (2) and (3) respectively.

Sulit, (1953), found out that coal-tar shows protective quality against deterioraion of twines submerged continuously or intermittently in sea or brackish waters.

Pure coal-tar used as a net preservative does not easily dry and makes the net-twines in most cases uncomfortably heavy, messy and hard to handle (Sulit, 1953). This treatment in addition would often result in deteriorating the structure of the fibre to a critical extent (Takayama and Shimozaki (1959).

The poor results of coal-tar treatment can be referred to the low degree of cohesion between the preserved medium and the fibres. Tar according to Klust (1952), although deposited in a thick layer on the surface of the yarn, fails to cling to each individual fibre without leaving gaps, and are therefore considerably less effective than special tanning.

Dilution of coal-tar as a solution to lessen their disadvantages was tried in many places, yet it was agreed that the more coal-tar is diluted the lower its value as a preservative.

Retreatment of cutch-dyed net-twines by diluted coal-tar gave a noticeable provement in the efficiency of the former preservatives. "T" increased to 207.82, 141.75 and 173.12 for stations (1), (2) and (3) respectively, Here also the least value of "T" was in fresh water.

The best results obtained in this respect was got by coating tanned net-twines, fixed with either bluestone (copper sulphate) or red-stone (potassium dichromate), with diluted coal-tar. For the former case, "T" 274.22, 287.82 and 238.49, for the latter case, "T" was 301.71, 144.55 and 368.76 for stations (1), (2) and (3) respectively in both cases. Farrar (1949) stated that this treatment is very effective in protection of the gear against bacterial action, abrasion and weathering.

Seed oil, supposed to protect the twines against abrasion to lay the fuzz and to reduce the fouling (Farrar, 1949) did not work in our case especially in fresh water.

When used alone the values of "T" were : 146.07, 64.31 and 168.92 for stations (1), (2) and (3) respectively. When used to coat tanned twines the situation did not change much. "T" just increased to 184.72, 99.79 and 205.69 for stations (1), (2) and (3) respectively. Farrar (1949) stated that treatment with linseed oil proved to be deleterious to the twines ; this suggested the application of this oil by means of volatile solvents to reduce the deleterious effect.

Exclusive treatment with copper sulphate as a sterilizer gave unsatisfactory results : "T" was 122.17, 57.11 and 45.72 for stations (1), (2) and (3) respectively.

Now, all these conventional preservatives gave efficiency values within the range of either "poor" or "low". As a matter of fact they are according to the more recent terminology of von Brandt (1964), either "of no practical effect" or at the best "of minor effect".

In his work, on the Egyptian cotton net-twines, carried out in Germany, Koura (1963) got better results especially in the case of both cutch fixed with potassium dichromate and the same coated with coal-tar. To explian this difference the following factors have to be taken into consideration :

1. Koura, 1963, treated his material with cutch of the purest quality (of 65% tannin concentration).

2. The concentration of tannin in a sample of the cutch just imported to Egypt from Tanzania (before distribution among the dealers) analysed by koura (unpublished results), was 40.68 %.

3. The poor results got in the present work and that by koura in 1963-1964 (unpulbished work) on the same Egyptian cotton net-twines (table 12), using in both cases the cutch available on the local market, show that the concentration of tannin in the cutch used, is most probably very much below 40.68 %.

4. The authers noticed, when preparing cutch solution that a considerable amount of brown impurities remained undissolved inspite of boiling and continuous stirring. This denotes that certain foreign materials may have been added to the imported cutch before putting it on the market.

This explanation is supported by the very low values of the percenage impregnation of cotton net-twines with different concentrations of the cutch locally available on our markets as shown in table (17). The modesty of these values will be more evident from the following comparison between the percentage impregnation (after one bath in a 2% cutch solution) of the Egyptain cotton net-twines with the cutch locally used in Egypt and with that used in India. *

TABLE 17.—The percentage increase in weight of Egyptian cotton net-twines due to its impregnation with Cutch solutions of different concentrations

	First bath (30 minutes)			Second bath (30 minutes)		
	W_1	W_2	% impreg—nation	W_1	W_2	% impregnation
2% + 2%	5.494	5.695	3.66	5.494	5.654	2.91
4% + 4%	5.172	5.518	6.69	5.172	5.513	6.59
6% + 6%	4.943	5.394	9.12	4.943	5.375	8.74
8% + 8%	5.542	6.200	11.87	5.542	6.145	11.11
10% + 10%	5.383	6.093	13.05	5.471	6.253	16.16
2% + 4%	5.020	5.173	3.52	5.020	5.282	5.22

W_1 = weight of raw twines in grams.

W_2 = weight after the first 2% cutch solution bath.

$W_{2'}$ = weight after the second 2% cutoh solution.

* This experiment was carried out by the second auther during his stay in India in 1970 in the Central Institute of Fisheries Technology, COSHIN.

	Percentage impregnation
Cutch used in Egypt (Mangroove)	3.52%
Cutch used in India (Kalasam)	25.80%

It is thus logic to assume that the expanation of the poor performance of the preservatives containing cutch must lie firstly in the modest quality of cutch imported, in addition to the instability of this quality due to the different amount of foreign matter added.

As far as the application of "Arigal" as a protective preservative for the net-twines, the technique followed was conducted in co-operation of the regional office of the producing company.

Experimentation on "Arigal" treated samples of cotton twines carried out simultaneously and at the same stations gave the following results (see tables (9), (10) and (11) :

Along a whole year period (15-5-1968 to 15-51969) the retained breaking strength has not fallen in the three cases below around 90% of the initial values. The course of variation in the breaking strength in this period is shown in figures (9), (10) and (11).

Similar results were arrived at by koura (1963) and Radhalekshmi and Kuriyan (1969).

Recommendations :

The authors are now in a better situation to draw certain conclusions and to present recommendations regrading the methods of preservation most suited for use in different types of Egyptian waters :

1. Using cutch alone as a preservative, although it is cheap material and easy to be applied by local fishermen, yet its effectiveness is of a very shortlife ; which necessitates the repeti tion of its application at short intervals. Thus in the long run, it will prove to be both a burden on the fisherman's purse and effort.

2. To get a better preformance from cutch, it has to be fixed with either copper sulphate or potassium dichromate ; the former is more effective in fresh water, whereas the latter is more so in marine water. Certain precautions however, have to be followed in this respect. With potassium dichromate, all excess traces of it must be got rid of, by very careful washing, or else it would crystallize among the fibres damaging them. As for fixation with copper sulphate, chemical destruction of the net may result from the release of sulphuric acid if it is not neutralized carefully by ammonia. However, the relatively high cost of these two materials and the much labour and time consumed in their application is compensated for by the efficiency added to the net.

3. Exclusive treatment with coal-tar must be discontinued especially in fresh water. Coating the fixed tanned twines and nets with diluted coal-tor should be restricted to dragged nets more subjected to abrasion. Using this double treatment for tangle-nets, besides affecting their performance, renders them difficult to handle.

4. The use of seed oil in preservation of nets seems to be of no value.

5. Treatment by copper sulphate alone, besides giving unsatisfacory results is accompanied withcertain difficulties : The first is the necessity of very frequent repeated treatment for sufficient preservation ; the second is that in sea water copper sulphate turns to basic copper chloride ; which if left exposed to sunlight and air would deteriorate the net. However, it may be recommended for use in preserving tangle-nets on condition that precaution should be taken againest the later danger.

It is however obvious that the quality of the cutch available on the Egyptian markets is both low and unstable. If satisfactory results are to be got using the conventional preservation methods, cutch should firstly be imported of good quality, and secondly it should reach the hans of the fihermen free from any foreign matter added.

Cotton net-twines treated with the "Arigal" process gave on the other hand astonishing results. All along the year of experiment the protected twines almost retained their initial breaking strength. This result supported by other experiments elsewhere makes it clear that treatment with "Arigal" represent a very successful and convenient solution for our problem with net-twines. The availability of cotton in our country, the comparatively low-initial cost of "Arigal" together with the fact that there would be no need for repeating the treatment, are all strong points supporting its use.

As this process although simple enough, cannot be conducted by individual fishermen, specialized sections of dyeing plants, well equipped with the needed experience should carry out the matter, in order to reach the necesssary standard of efficiency. This operation has to be done under the supervision and co-operation of qualified fishery technologists.

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