DEVELOPMENT OF A COAL-TAR NET PRESERVATIVE[1]

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FIVE TEXT FIGURES

ABSTRACT

Undiluted coal tar net preservative does not easily dry in a warm climate, thus making the net too heavy, messy, and hard to handle. To solve this problem, a coal tar net preservative diluted with gasoline was developed with the purpose of revolutionizing net preservation in the Philippines, where tan bark extract and blood are commonly used. The diluted preservative reduces the amount of coal tar deposited in the gear to an extent that the increase in weight is quite negligible.

Diluted coal tar showed preserving qualities on cotton twines exposed to the atmospheric weather and on those immersed continuously or intermittently in brackish and marine waters. However, the imported diluted coal tar containing rosin showed better preserving qualities.

Coal tar is a mineral product obtained by the destructive distillation of bituminous coal at 1100°–1300° F. together with coal tar and other ammoniacal compounds inherently present in coal. On further fractional distillation of coal tar, antiseptic compounds such as phenols, creosote, naphthols, pyrimidine bases, etc., are produced. The protective coating which coal tar provides and its antiseptic property are responsible for its use as an efficient net preservative against the destructive effects of microorganisms and abrasion so that, although careless handling and improper care of gear are often responsible for some losses, the use of coal tar is justified and lessens such risks.

Taylor (1920, 1923) and Conn (1930), in their pioneering studies on net preservatives, recommended coal tar as a net bactericide and as a protective coating against abrasion. Because coal tar is insoluble in water, it renders the gear impervious to water, thereby enhancing quick drying even in the shade. This is highly desirable because sunlight causes rapid deterioration brought about by oxidation.

There are objections to the use of undiluted coal tar as a net preservative, most important of which are the tremendous

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increase in the weight of the gear, handling difficulties, and fire hazards. In tropical countries, the climatic condition renders the nets too messy and therefore hard to handle. But as early as 1920, Taylor recommended a mixture of coal tar and copper oleate diluted with benzene, a volatile organic solvent. Johnson (1947), Technical Adviser of the Commonwealth Training School at Cronulla, advocated a mixture of 4 parts of coal tar, 1 part diethylene and 2 parts water as an efficient net preservative. At boiling point, penetration of the resulting solution is instantaneous, resulting in a more practical and less laborious application.

Whiteleather and Brown (1945) admitted that coal tar should not be recommended as a net preservative in the tropics. However, if coal tar is diluted with a suitable volatile organic solvent, it need not be heated to promote instantaneous penetration into the twines or nettings. After removing the excess material by pressing, drying can be accomplished in a matter of a few hours only. Firth (1945, 1948) and Conn (1930) recommended gasoline as a much better solvent for coal tar because of its high volatility and availability. The use of this solvent as a thinner reduces the amount of coal tar deposited in the gear to an extent that the increase in the final weight is quite negligible.

Farrar (1950), Robertson (1930), Bright (1926), Dubos (1928), Fleming (1921), McBeth (1913), and Carrothers (1949) are among the workers who claimed that one of the causes of net deterioration is bacterial in nature. Therefore, the use of coal tar would serve efficiently against such, because it contains as main constituents antiseptic compounds such as phenols, creosote, naphthols, pyrimidine bases, etc. Robertson also proved that weathering deteriorates nets, although drying causes less bacterial action due to lack of moisture. The deterioration effect is caused by oxidation. More damage is produced in the presence of chemicals like the copper compounds. In this connection, coal tar-treated nets should be hung and dried in the shade with an abundance of circulating air.

In undertaking this study, we aimed to determine a coal-tar-gasoline solution or mixture which would be most effective against deterioration of cotton twines subjected to various conditions such as weathering, continuous and intermittent immersion in both sea and brackish waters. It is hoped that the use of such preservative may revolutionize net preservation in the Philippines from the standpoint of cost of labor, practicability, and interval of treatment.

MATERIALS AND METHODS

Materials.—The brand of coal tar used in this experiment was the master mineral black coal tar distributed by a local firm. It is soluble in organic solvents such as acetone, carbon tetrachloride, ether, chloroform and gasoline. It is partly soluble in kerosene. If used as a diluent, any of the aforementioned solvents may be used to make the solution.

Another brand of imported commercial net preservative used in this experiment was the "Texaspaltic Net Drip" manufactured by the Texaspaltic Company, New Orleans, Louisiana, U. S. A. It is claimed to protect nets from rots and abrasion. It contains rosin, coal tar, texaspaltic acid, benzene, and an alkali-proofing compound. In the label may be found the following directions: "Have nets thoroughly dry and clean. Completely saturate with undiluted net drip. Hang to dry for 24 hours. Nets will then be ready to use."

As a diluent, gasoline was used from the standpoint of price and availability. The following is a classified list of the canvassed prices of suitable organic diluents for coal tar:

1. Coal tar, 5 gallons	₱17.50
Kerosene, 1 gallon	0.67
Chloroform, 1 gallon	27.00
Total	₱45.17
2. Coal tar, 5 gallons	₱17.50
Kerosene, 1 gallon	0.67
Carbon tetrachloride, 1 gallon	7.80
Total	₱25.97
3. Coal tar, 5 gallons	₱17.50
Kerosene, 1 gallon	0.67
Acetone, 1 gallon	3.00
Total	₱21.17
4. Coal tar, 5 gallons	₱17,50
Kerosene, 1 gallon	0.67
Gasoline, 1 gallon	0.88
	₱19.05

5. *a*. Coal tar, 5 gallons	₱17.50
Gasoline, 2 gallons	1.76
Total	₱19.26
b. Coal tar, 5 gallons	₱17.50
Gasoline, 3 gallons	2.64
Total	₱20.14
c. Coal tar, 5 gallons	₱17.50
Gasoline, 4 gallons	3.62
Total	₱21.12

The cotton twine used was the No. 9, 3-ply, available in 1-lb. bundles. The brand was the international Seine Twine, manufactured and distributed by the International Company, U. S. A.

Methods.—The cotton twine was cut into equal lengths of 30 inches. A total of 30 bundles consisting of 175 pieces of the prepared twine were used. The bundles were divided into 5 parts, designated as A, B, C, D and E. In order to identify one from another, the twines were knotted as follows:

	Bundles
I. A_1 with 1 knot	2
A_2 with 2 knots	2
A_3 with 3 knots	2
II. B_1 with 1 knot	2
B_2 with 2 knots	2
B_3 with 3 knots	2
III. C_1 with 1 knot	2
C_2 with 2 knots	2
C_3 with 3 knots	2
IV. D_1 with 1 knot	2
D_2 with 2 knots	2
D_3 with 3 knots	2
V. E_1 with no knot	2
E_2 with no knot	2
E_3 with no knot	2

The prepared twines were immersed in their corresponding coal tar solutions A, B, and C and in the imported ready-made coal tar D. The twines were immersed for five minutes and the excess solution removed by evenly pressing the bundles with the hands; then they were hung and dried in the shade with free-circulating air. After four hours all the treated twines were completely dried. The increase in weight after treatment was determined.

The experiment was divided into three parts, according to the nature of exposure, as follows:

1. Weathering.
2. Continuous immersion in the sea and brackish water.
3. Intermittent immersion in sea and brackish water.

The schedule of exposure and sampling was as follows:

(*a*) *Weathering.*—One portion consisting of five bundles (A, B, C, D and E) was exposed to the atmospheric weather, and sampling was done once a week.

(*b*) *Continuous immersion.*—Same number of bundles as in (*a*). The bundles were continuously immersed in sea and in brackish water. Sampling was once a week.

(*c*) *Intermittent immersion.*—The schedule of immersion was as follows:

1. Saturday, 8:00 A.M.	Immersion.
2. Monday, 4:00 P.M.	Removal from the water and hanging to dry.
3. Tuesday, 8:00 A.M.	Immersion.
4. Thursday, 8:00 A.M.	Removal from the water and hanging to dry.
5. Friday, 8:00 A.M.	Sampling and immersion.
6. Monday, 4:00 P.M.	Repeat as of last week.

In sampling, five twines were removed from each bundle, then washed thoroughly with fresh water and dried.

RESULTS AND DISCUSSIONS

The intensity of color and the amount of coal tar deposited in the twine varied according to the density of the prepared coal tar solutions; that is, the higher the percentage of coal tar, the higher was the percentage increase in the weight of the treated twines (Table 1). Table 1 shows also that dilution B and the imported texaspaltic net drip, designated as D, yielded practically the same average increase in weight.

Intermittent submersion.—Table 2 shows the actual breaking strain of the treated twines submerged in sea and brackish water. Twines A, B and C, in brackish water, lasted 91 days; D, 98 days, and the control E, 70 days. On the other hand, in the sea, A, B and C lasted 70 days; D, 84 days and the control E, 56 days. The results of the experiment proved that coal tar shows protective quality against deterioration of twines submerged continuously or intermittently in the sea or

TABLE 1.—*Increase in weight of the twine after treatment with various dilutions of coal tar.*

Dilutions	Weight of twine		Increase in weight		
	Before treatment	After treatment	Grams	Per cent	Average
	gm	*gm*			
A-1	146.3	220.0	73.7	50.37	
A-2	144.7	218.5	73.8	51.00	
A-3	144.5	215.5	71.0	49.13	50.67
B-1	131.4	186.0	54.6	41.55	
B-2	145.5	221.0	75.5	51.88	
B-3	151.0	216.5	65.5	43.37	45.27
C-1	142.0	202.5	60.50	42.60	
C-2	144.5	207.5	63.00	43.59	
C-3	129.6	181.0	51.40	39.66	41.95
D-1	145.6	211.0	65.40	44.91	
D-2	143.3	210.0	66.70	46.54	
D-3	144.5	212.5	68.00	47.06	46.17
E-1	151.1				
E-2	162.0				
E-3	152.5				

in brackish water. It is likewise evident that the imported coal tar solution D, containing rosin in addition to the antiseptic compounds inherently present in coal tar, exhibits higher preserving quality than coal tar alone. More experiments along this line should be continued in order to get more conclusive results.

TABLE 2.—*Comparative average actual breaking strain in kilos of cotton twines exposed intermittently in brackish and sea waters.*

Number of days exposed	Brackish water				
	A	B	C	D	E
7	9.30	8.18	7.86	8.96	11.44
14	7.80	8.60	8.90	11.50	10.42
21	8.08	8.50	8.30	11.30	9.38
28	8.26	8.70	7.40	13.52	9.28
35	8.06	7.96	7.26	11.70	7.00
42	6.90	6.02	5.40	11.20	4.84
49	5.90	6.19	5.02	9.98	4.00
56	6.37	5.18	4.55	8.96	2.68
63	6.10	5.68	4.85	9.60	0.61
70	4.15	4.05	5.20	6.80	0.58
77	4.10	3.70	2.20	6.70	0.31
84	3.76	3.50	2.18	4.48	
91	2.86	2.03	1.93	3.43	
98	1.52	1.02	.04	2.04	
105				1.04	

TABLE 2.—*Comparative average actual breaking strain in kilos of cotton twines exposed intermittently in brackish and sea waters.—(Cont.)*

Number of days exposed	Sea water				
	A	B	C	D	E
	9.30	8.18	7.86	8.96	11.44
	9.64	8.54	8.20	9.30	8.86
7	8.15	7.50	7.35	10.01	7.88
14	7.75	7.75	7.03	9.50	6.48
21	6.63	6.15	5.60	8.45	4.48
28	6.31	6.44	5.90	8.00	3.05
35	6.54	5.31	4.68	7.20	2.40
42	5.11	4.53	3.96	6.28	1.43
49	4.48	3.84	3.98	5.24	1.78
56	2.45	1.07	1.15	3.05	------
63	0.93	0.42	0.09	2.04	------
70	------	------	------	1.62	------
77	------	------	------	------	------
84	------	------	------	------	------
91	------	------	------	------	------
98	------	------	------	------	------
105					

Intermittent submersion of the twines proved that deterioration is faster in the sea than in brackish water (Table 2). However, Farrar (1950) claimed that during summertime, net deterioration is faster in brackish water than in sea water. His claim holds true when the treated twines are continuously submerged, as reported in Table 3, which reveals that on the

TABLE 3.—*Comparative average actual breaking strain in kilos of cotton twines exposed continuously in brackish and sea waters.*

Number of days exposed	Brackish water				
	A	B	C	D	E
0	9.30	8.18	7.86	8.96	11.44
7	9.20	8.80	8.40	9.40	10.40
14	7.52	7.46	6.18	9.36	7.58
21	5.28	4.20	6.06	10.22	5.06
28	2.46	3.54	5.50	11.04	3.52
35	0.50	1.88	2.24	10.96	0.76
42	0.41	------	0.84	7.00	------
49	0.40	------	0.36	7.00	------
56	------	------	------	2.90	------
63	------	------	------	2.44	------
70	------	------	------	1.92	------
77	------	------	------	1.54	------
84	------	------	------	0.91	------

Number of days exposed	Sea water				
	A	B	C	D	E
0	9.30	8.18	7.86	8.96	11.44
7	9.10	9.34	8.50	11.36	9.56
14	7.25	7.36	6.43	9.36	7.38
21	7.75	7.75	7.03	8.45	6.48
28	6.63	6.15	5.60	9.50	4.48
35	1.93	1.41	0.81	8.12	0.94
42	0.93	1.05	0.93	6.26	------
49	------	------	0.06	2.80	------
56	------	------	------	1.86	------
63	------	------	------	------	------
70	------	------	------	------	------

TABLE 4.—*Average actual breaking strain in kilos of cotton twines exposed to atmospheric weather.*

Number of days exposed	A	B	C	D	E
0	9.30	8.18	7.86	8.96	11.44
7	8.04	7.42	7.94	8.08	9.22
14	9.74	9.60	10.44	9.44	11.01
21	8.62	8.15	9.16	9.02	10.10
28	8.33	7.31	7.85	8.71	8.43
35	7.91	7.48	7.83	8.80	8.10
42	7.90	7.60	8.28	8.30	7.70
49	7.80	6.92	7.79	8.20	7.30
56	6.65	7.61	8.03	7.93	6.63
63	7.51	6.18	7.33	7.85	6.41
70	7.00	6.16	6.41	7.00	6.28

28th day after continuous submersion, those in the sea demonstrated higher breaking strain than those in brackish water, but the continuous striking of the waves against the twines resulted in the abrupt lowering of the breaking strain, thereby deteriorating the twines submerged in the sea in a very much shorter time.

Continuous submersion.—The result of the experiments of the twines continuously immersed in brackish water and in the sea corroborates the claim of Farrar (1950) that deterioration is faster in brackish water than in sea water. It proved that the imported coal tar D, containing a certain percentage of rosin, preserved the twines longer, whether such twines were submerged intermittently or continuously in brackish water or in the sea.

The twines exposed to the atmospheric weather deteriorated gradually. On the 77th day, the twines A, B, C, D, and E showed definite deterioration, although bacterial action was less due to drying. However, the treated twines A, B, C, and D seemed to have little resistance to weathering as compared to the control E which gave the lowest breaking strain.

The experiments on gear preservatives conducted by Clague and Datingaling (1950), used pure pine tar and pine tar with creosote which proved to be two of the most effective net preservatives. These preservatives, however, do not seem to be suitable for use in the Philippines, because the tropical climate renders the gear messy and consequently inconvenient to handle. But the use of coal tar properly diluted with a quick drying organic compound renders the net impervious to water, which condition enhances rapid drying even in the shade with a continuous draft. The ...

from almost 100 per cent in the case of pure tar, to only about 50 per cent when properly diluted.

The extension work conducted by Mr. Gonzalo Ferrer, Gear Technologist of the Bureau of Fisheries, revealed that the use of a diluted coal-tar net preservative proved very successful in the Visayan Islands. According to him, there were cases when the otter trawl net was used continuously for six months without retreatment. When tan bark was used, retreatment was done twice a week which made the use of this common native net preservative impractical and uneconomical. The result of this experiment proved that the use of diluted coal tar protects the twines from deterioration, whether they are immersed intermittently or continuously, or exposed to atmospheric weather.

SUMMARY

The use of coal tar as a net preservative was reviewed. The fact that pure or undiluted coal tar is not practicable to use as a net preservative under the Philippine tropical climate, three dilutions of coal tar were prepared using gasoline as a diluent.

The experiment proved that coal tar diluted with gasoline preserved cotton twines (figs. 1–5) when submerged continuously or intermittently in both brackish and sea water.

Diluted coal tar with rosin as exemplified by the imported coal-tar net preservative D, has higher preserving qualities than any of the other pure coal tar dilutions (figs. 1–5).

In the absence of the imported ready-made coal-tar net preservative D, pure coal tar diluted with gasoline would serve well as a preservative for dragging nets under Philippine climatic conditions. Because diluted coal tar impregnates the cotton fibers instantaneously without the aid of heat, it eliminates the usual fire hazard and the tremendous increase in weight. Coal tar renders the cotton fibers impervious to water, which makes drying quick, even when the net is hung in the shade with continuous air circulation.

In one of the demonstration trips in the Visayas, a fisherman, using an otter trawl net preserved in diluted coal tar, managed to fish continuously for six months under very unfavorable weather conditions without retreating his net. The use of diluted coal tar as a net preservative is now very popular in the Visayas.

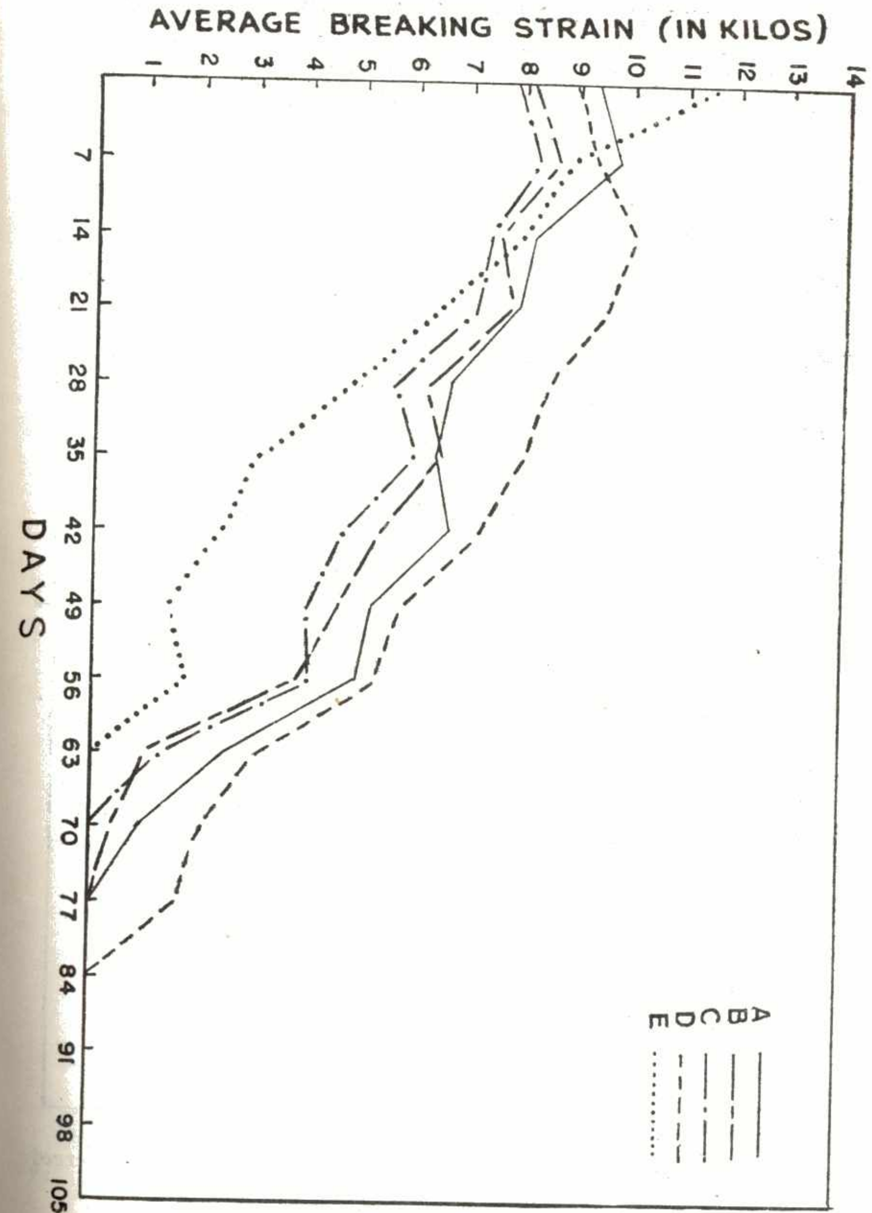

FIG. 1. Average actual breaking strain in kilos of cotton twines submerged intermittently in sea water.

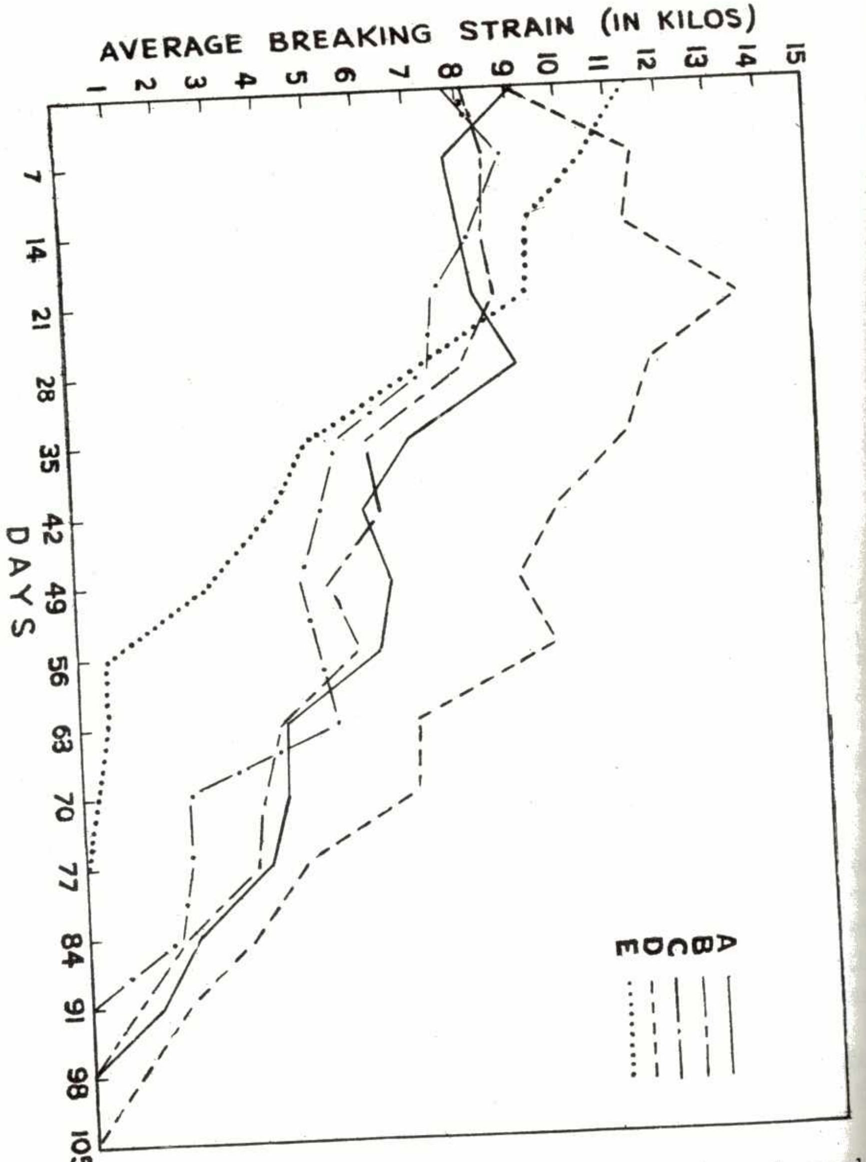

FIG. 2. Average actual breaking strain in kilos of cotton twines submerged intermittently in brackish water.

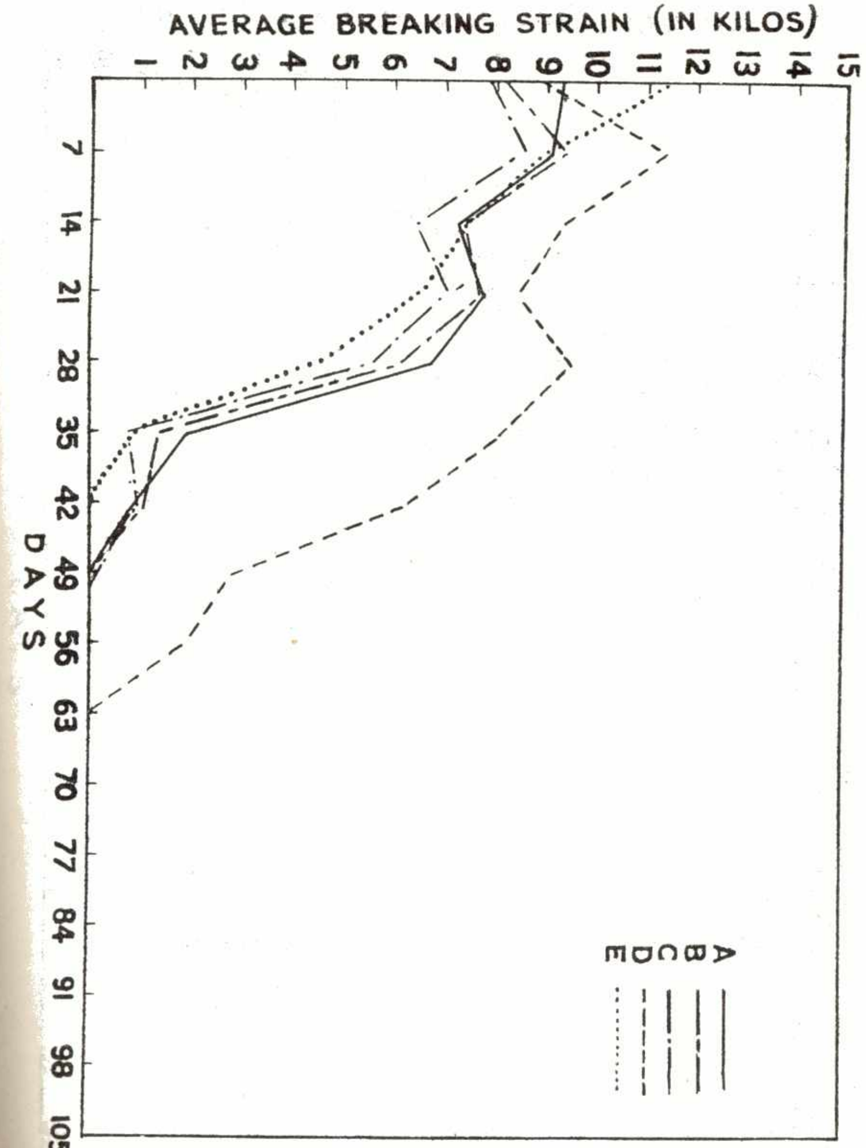

FIG. 3. Average actual breaking strain in kilos of cotton twines submerged continuously in sea water.

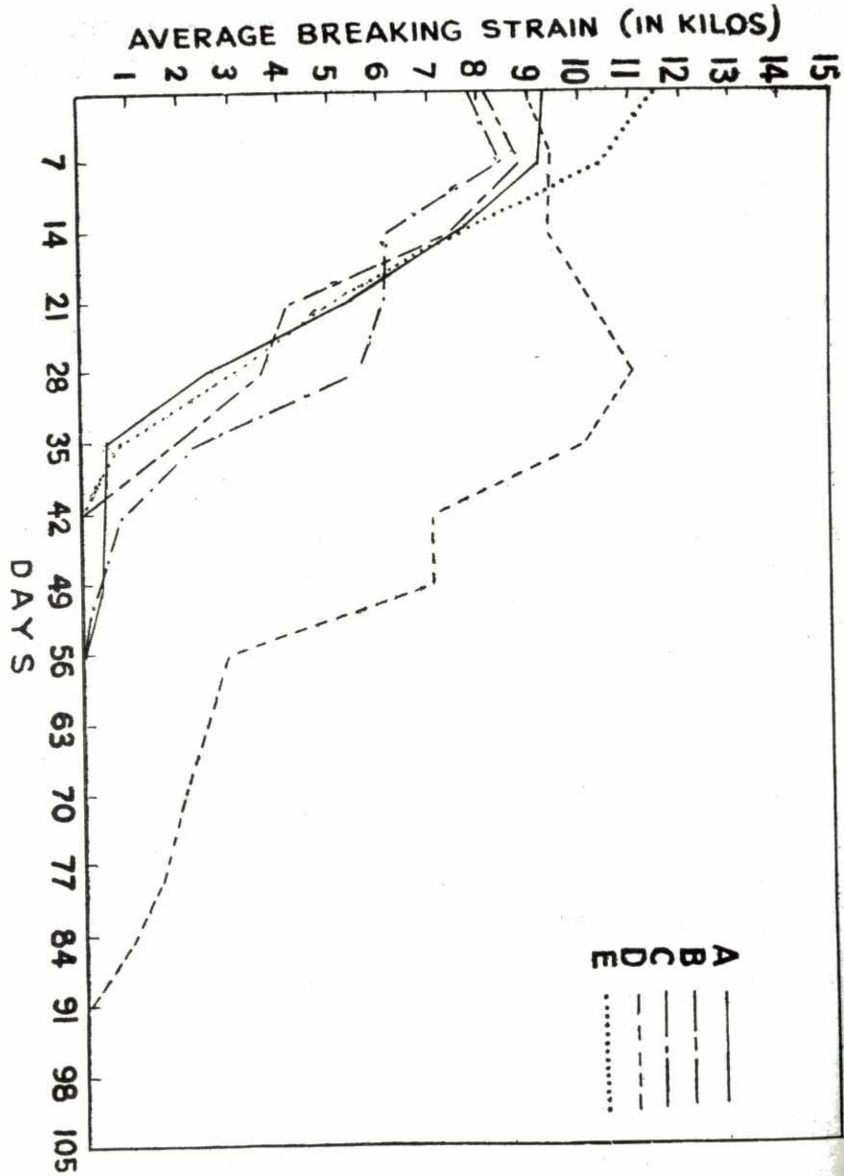

FIG. 4. Average actual breaking strain in kilos of cotton twines submerged continuously in brackish water.

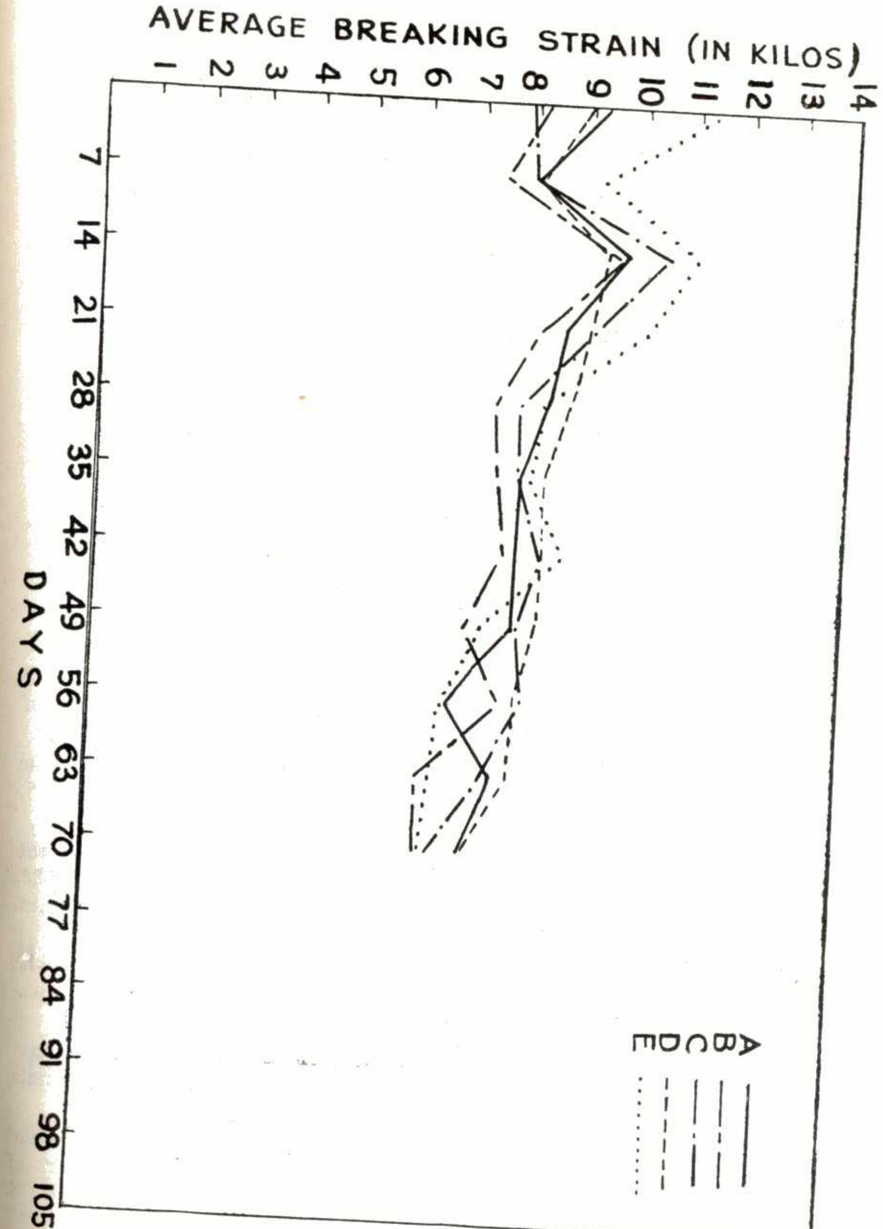

FIG. 5. Average actual breaking strain in kilos of cotton twines exposed in the atmospheric weather.

REFERENCES

BRIGHT, T. B. (1926). The microscopic examination of damaged cotton hairs by Congo Red Test and the swelling test of Fleming and Thaysen. Manchester, England. Text. Inst., Journ. Trans. 17: T396–T404.

CARROTHERS, P. J. G. (1949). Notes on cotton-web and its preservation with coal tar. Vancouver, British Columbia, Canada. Edward Lipsett, Ltd., 13.

CLAGUE, J. A. and B. DATINGALING. (1950). Fishing gear preservatives for Philippine waters. Washington 25, D. C. Research Report No. 22, Fish and Wildlife Service, U. S. Department of the Interior, 23.

CONN, W. T. (1930). Net preservative treatments. U. S. Bur. of Fish., Doc. No. 1075, Appendix III, Report of the U. S. Commissioner of Fisheries for 1930, 5.

DUBOS, R. J. (1928). The decomposition of cellulose by aerobic bacteria. Baltimore, Md., Journ. of Bacteriology 15: 223–234.

FARRAR, B. (1950). Studies on the preservation of fish nets. Brit. Col. Research Council (Tech. Bull. No. 11), Dept. of Comm. and Agric., 9.

FIRTH, F. E. (1944). Preservation and care of fish nets. Chicago 54, Ill. Fish. Leaf. 66, U. S. Dept. of Int., U. S. Fish and Wildlife Service.

FIRTH, F. E. (1948). The development of fish net preservatives. Cuprinol Div., Darworth Inc., Fishing Gazette, 64.

FLEMING, M. and A. C THAYSEN. (1921). On the deterioration of cotton on wet storage. Biochemical Journ. 15: 407–414. Chicago, Ill.

JOHNSTON, E. (1947). Preserving nets. Fish. Newsletter, Dept. of Comm. and Agric. 6: 18.

MCBETH, J. G. and F. M. SCALES. (1913). The destruction of cellulose by bacteria and filamentous fungi. Washington, Bull. 226, U. S. Dept. of Agric., Bureau of Plant Industry, 50.

ROBERTSON, A. C. and W. H. WRIGHT. (1930). Investigations upon the deterioration of nets in Lake Erie. U. S. Bur. of Fish., Doc. 1083, Appendix VIII, Report of the U. S. Commissioner of Fisheries, 149–176.

TAYLOR, H. F. (1920). Preservation of fish nets. U. S. Bur. of Fish., Doc. 898, Appendix IV, Report of the U. S. Commissioner of Fisheries, 35.

TAYLOR, H. F. and A. W. WELLS. (1923). Properties and value of certain fish net preservatives. U. S. Bur. of Fish., Doc. 947, Appendix I, Report of the U. S. Commissioner of Fisheries, 409–437.

WHITELEATHER, R. T. and H. H. BROWN. (1945). An experimental fishery survey in Trinidad, Tobogo, and British Guiana. Report of the Anglo-American Carribean Commission, Dept. of the Int., U. S. Fish and Wildlife Service, Washington 25, D. C.

ILLUSTRATIONS

TEXT FIGURES