The Preservation of Fishing Nets by Treatment with Copper Soaps and Other Substances. Part II.

By

W. R. G. Atkins, F.I.C., F.R.S.,

Head of the Department of General Physiology at the Plymouth Laboratory.

THIS paper is a continuation of Part I in a strict sense, and deals with the methods and samples considered previously. More prolonged immersion tests have enabled a more accurate estimate to be reached as to the relative values of the methods of preservation. One new preservative has been tried, an oily substance sold as "Neo-Russigen," a sample of which was supplied by the Ministry of Fisheries; in the absence of any chemical analysis of this there is no guarantee that subsequent supplies will approximate to the sample received, to which alone must the data presented be considered to apply.

The tables are completed or continued from Part I, and bear the numbers by which they were designated in Part I, to which reference as to the methods of treatment should be made. Table 14 is the only new one. In the tables more weight should be attached to the life of the net than to the percentage life, taking the untreated net as 100; this is because an untreated net placed to rot in October experiences cold weather and may last as long as five months, whereas if the immersion dates from early summer the warm weather results in more rapid decay and it may only last two months. The preserved nets will however go through both summer and winter. It might be better to take three months as a standard time for the rotting of untreated nets, but this varies also with the thickness of the twine, so the observed values have been given in each case.

A correction must be mentioned as regards the results shown in Table 7, Part I. Sample 51A, treated with the copper soaps and tar mixture, was rejected in error after eleven months. In reality it lasted for twenty months, but this is decidedly lower than usual with the mixture, cp. No. 14A, 39 months, No. 39A, over three years.

TABLE 3.

Hemp net rotting in Aquarium tank water; initial strength, average of sets of six, 13½ and 14¾ lbs. dry; after soaking for three hours, 12½ lbs. Immersed 26/9/'25.

No.	Treatment.	Till unserviceable, months.	Percentage life of net.
10	Untreated	5	100
11	Copper soaps, 12%, viz. 1 lb. per gal.	9	180
12‡	Do. with resin 1 lb. per gallon (12%)	11	220
13	Do. with anti-fouling paint, 12%	29*	580
14	Do. with tar, 12%	36†	720

‡ The soap and resin, paint or tar respectively were mixed, so that only one dip was required, 1 lb. of each being added to the gallon of copper soap solution in petrol.

* Half-strength after 26 months, still serviceable, looked as new.

† Slightly under half-strength after 26 months, still serviceable, looked as new.

TABLE 5.

Cotton net rotting in Aquarium tank water; initial strength, dry, 19½ lbs. Immersed 26/9/'25.

No.	Treatment.	Till unserviceable, months.	Percentage life of net.
10A	Untreated	5½	100
11A	Copper soaps, 12%	10¼	190
12A	Do. with resin 1 lb. per gallon (12%)	26*	470
13A	Do. with anti-fouling paint, 12%	37†	670
14A	Do. with tar, 12%	39‡	710

* Strength 10 lbs. after 25 months.

† Strength 17½ lbs. after 36 months.

‡ Strength 18 lbs. after 36 months.

TABLE 9.

Hemp net rotting in Aquarium tank water; initial strength, dry, averages of sets of six tests each, 15¼, 15¾, 18½; maximum single strand 21, minimum 12½ lbs. Immersed 17/3/'26.

No.	Treatment.	Life of net. Months.	Percentage.
28	Untreated	2½	100
29	Cutch, 2% infusion, two boilings	6	240
30	Do. followed by Olie's ammonia copper sulphate	30*	1200
31	As 29, followed when dry by 12% copper soaps	30*	1200
32	Copper soaps, 12%, but soaked for 3 hrs.	19	760
33	Copper soaps, 12% with 1 lb. resin per gallon	13½	540
34	Copper soaps, 12%, followed when dry by No. 33 treatment	29*	1160

* After 20 months strengths were 8 lbs., about half-strength.

TABLE 10.

Cotton net rotting in Aquarium tank water; initial strength, dry, 12 lbs. Immersed 17/3/'26.

No.	Treatment.	Life of net. Months.	Percentage.
24A	Untreated	2	100
26A	Cutch, 2% infusion, two boilings	3	150
25A	Do. followed by Olie's ammonia copper sulphate	5	250
27A	As 26A, followed when dry by 12% copper soap	5	250
28A	Copper soap, 12%, soaked for 3 hrs.	5	250
29A	Do. with 1 lb. resin per gallon	5	250
30A	As 28A, followed when dry by 29A treatment	25*	1250

* Strength 12½ lbs. after 19 months, all colour gone and strength 7½ lbs. after 20 months.

TABLE 11.

Cotton net rotting in Aquarium tank water; initial strength, dry, 18 lbs. Immersed 20/10/'26.

No.	Treatment.	Re-treatments.	Strength, after years. 1	2	3
34A	Untreated. Life 5½ months	None	0	0	0
35A	Cutch, two boilings	Every two months	16·3	0	0
36A	Do.	Every three months	18	9·8	4·6
37A	Do. followed by Olie's ammonia copper sulphate	Every four months	22·5	20·9	18·8

TABLE 12.

Hemp net Nos. 35–39 rotting in Aquarium tank water; Nos. 40–44 in fresh water. Immersed 25/11/'26. Initial strength, dry, 16½ lbs.

No.	Treatment.	Strength, after years. 1	2	3
35	Copper soaps, 12%. Life 14 months	5·3	0	0
36	Do. with tar as No. 14	14·3	11·4	7·5
37	Cuprinol with equal volume of petrol	12·3	8·3	4·8
38	As No. 37 with 1 lb. tar per gallon of mixture	16·3	12·3	13·1
39	Copper soaps as No. 35, Cuprinol as No. 37, equal volumes of each	13·0	10·1	5·8
40	As No. 35	7·0	7·4	5·3
41	As No. 36	9·0	9·1	6·6
42	As No. 37. Life 25 months	14·0	7·9	0
43	As No. 38	13·5	11·3	13·6
44	As No. 39	12	9·6	7·7

TABLE 13.

Cotton net Nos. 38A–42A rotting in Aquarium tank water; Nos. 43A–47A in fresh water. Immersed 25/11/'26. Initial strength, 18½ lbs., done on 40A before treatment, 17½ lbs. done on 45A similarly.

No.	Treatment.	Strength, after years. 1	2	3
38A	Copper soaps, 12%. Life 21 months	22	0	0
39A	Do. with tar as in 14A	18	17	18
40A	Cuprinol with equal volume of petrol	25	26	18
41A	As No. 40A with 1 lb. tar per gallon of mixture	25	22	19
42A	Copper soaps as 38A, Cuprinol as 40A, equal volumes of each. Life 30 months	25	13½	0
43A	As 38A	22	17	16
44A	As 39A	21	20	14
45A	As 40A	16½	20	21
46A	As 41A	21	19	22
47A	As 42A	26	21	25

TABLE 14.

Cotton net rotting in Aquarium tank water. Immersed 28/4/'28.

No.	Treatment.	Life of net. Months.	Percentage.
52A	Dipped in Neo-Russigen. Initial strength 11 lbs.	14	700
54A	Cutch, two boilings. Initial strength 12 lbs.	4½	220
55A	Untreated. Initial strength 11 lbs.	2	100

Discussion of Results.

Tables 3 and 5 show how great is the advantage of adding 1 lb. tar to the copper soaps mixture, 1 lb. to the gallon of petrol. Nets, hemp and cotton lasted up to or over three years when thus treated. The results shown in Tables 12 and 13, Nos. 36 and 39A confirm this. The degree of preservation achieved is undoubtedly very good, No. 39A having its initial strength after the three years. The results with anti-fouling paint were not quite as good as with tar; it is more expensive and the proprietary paints vary greatly. It is also far more messy than tar mixed in copper soap.

Tables 12 and 13 compare the British product, mixed copper soaps (stearate, palmitate, and oleate), with the Danish "Cuprinol," the copper soap of a naphthenic acid (or acids) derived from petroleum, probably Galician. Comparisons were made with and without tar, in both fresh and salt water. Both types of copper soap are more effective on cotton than on hemp. In sea-water Cuprinol is far more durable than is the

fatty acids soap. The two are about equal on cotton in fresh water, but on hemp the advantage lies with the fatty acids soap. The fresh water was the Plymouth tap supply, a very soft water with scarcely a trace of lime in it. When both are mixed with tar, Cuprinol and the fatty acids copper soap appear to be about equal, and the latter is very much the cheaper. Both give excellent preservation to cotton nets for three years under soakage conditions. With hemp Cuprinol shows up better than the fatty acid soap ; the latter is the product developed by Lever Bros. and later supplied as Pilot Protective Copper Soap by Messrs. Ogston and Tennant, of Renfrew. The results may probably be taken as applicable without serious error to the copper oleate, manufactured according to the American formula by Messrs. Wm. Bailey & Son, of Wolverhampton. It was, however, found (Atkins, 1926) that a 5% solution of the mixed soaps was just as effective as 10% of the pure oleate and it is possible that the former is more effective because of a lesser solubility. With tar such differences should be reduced, and the oleate is rather more readily soluble in petrol.

Table 14 shows that Neo-Russigen is much better than cutch alone, though not as good on cotton as fatty acid copper soaps, cp. No. 38A, but better according to No. 11A. It falls far behind copper soap and tar, however.

Tables 9 and 10 make a comparison of cutch and Olie's ammonia copper sulphate with copper soap. All the results are poor on the cotton of Table 10, except copper soap followed by copper soap with resin. On the hemp of Table 9, however, the preservation was good, Olie's method and copper soap after cutch coming out equal. Undoubtedly a preliminary treatment with cutch greatly enhances the preservative effect of both Olie's method and the copper-soap method.

It seemed advisable to test whether good preservation could be obtained by repeated treatments with cutch at two or three month intervals and of Olie's method at four-month intervals. Table 11 shows that three-monthly re-treatments with cutch are better than two-monthly, also that, under the test conditions, four-monthly re-treatments with Olie's method result in the original strength having been maintained for three years, which is equivalent to one treatment with copper soap and tar or Cuprinol and tar. The nets boiled in cutch and treated with ammonia copper sulphate feel rather harsh to the hand and give a clean break in the tensile test. The nets have not the softness and pliability of those treated with copper soap with or without tar. Fillon (1925) speaks highly of Olie's method and prefers it.

SUMMARY.

1. The most efficient preservation for a single treatment is given by a mixture of copper soaps and tar, either :

(*a*) One pound of a copper soap of mixed fatty acids (Pilot Protective Copper Soap) dissolved in one gallon of petrol or gas-works benzol. This gives a 12% solution approximately, to which 1 lb. of tar to the gallon is afterwards added. (*b*) "Cuprinol" may be used instead of the fatty acid copper soap as in (*a*). Cuprinol may be used alone and is more effective than fatty acid copper soap in sea-water; it is also more expensive. It is, however, improved, especially for hemp nets, by the addition of tar, 1 lb. to the gallon of mixed Cuprinol; the latter is sold as a solution, to be mixed with an equal volume of petrol before use. Hemp and cotton nets treated according to methods (*a*) and (*b*) have lasted three years when allowed to soak in Aquarium sea-water, in jars, the water being changed three times a week.

2. Efficient preservation, with maintenance of the original strength for three years, has also been given to cotton nets treated according to Dr. Olie's method and re-treated every four months. This treatment consists of boilings in cutch on two occasions, the net being dried in between. It is then soaked for 15 minutes in a 1% solution of copper sulphate* to which ammonia has been added in an amount just sufficient to re-dissolve the precipitate first formed.

I am indebted to my laboratory assistant, Mr. F. J. Warren, for performing the tensile tests during the last year.

REFERENCES.

ATKINS, W. R. G. 1926. Notes on the preservation of fishing nets by means of copper soaps. Journ. Mar. Biol. Assoc., N.S., **14**, 63–69.

—— 1928. The preservation of fishing nets by treatment with copper soaps and other substances. *Loc. cit.*, **15**, 219–235.

FILLON, R. 1925. Les traitements préservateurs des filets de pêche en coton. Office sci. et tech. des pêches maritimes. Notes et mém., No. 45. Paris.

* One pound dissolved in ten gallons of fresh water, with about six ounces by weight of strong ammonia.