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# MONO OR MULTIMONO - CHOICE OF THE RIGHT NETTING MATERIAL ACCORDING TO PHYSICAL PROPERTIES

by

E. Dahm

Institute for Fishing Technology,
Federal Research Centre for Fisheries
Palmaille 9, D-2000 Hamburg 50



## ABSTRACT

Today, monofilament and multimono yarns have gained a prominent position as gillnet material and have replaced multifilament ones because of many advantages. Very few data are available for a jugdement from a technical point of view whether it is better to use monofilament or multimono yarns. A number of tests carried out with fourteen different types of both monofilament and multimono for the purpose of the publication at hand prove that in the case of yarns with an equal cross section area multimono is always superior to monofilament with regard to

- breaking strength
- stiffness
- reduction of breaking strength after immersion into water

Inspite of a low degree of twist in the multimono yarns tested elasticity did not change and seems to be predominantly material dependent. Therefore, in this range of twist multimono yarns of similar technical properties like the ones tested are to be preferred to monofilament ones particularly in diameters exceeding 0,50 mm. However, technical properties of a multimono yarn in question should be controlled and compared to the data presented.

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## 1a. Summary

Seven multimono yarns and an equal number of monofilament yarns of different fineness were subjected to a number of tests in order to determine their physical properties. Whenever a comparison on the basis of equal cross section area was possible multimono yarns were shown to be clearly superior to monofilaments ones.

This is reflected in

- a higher breaking strength measured dry and wet as well as with and without knots
- a lower stiffness
- an equal elasticity
- a minor strength reduction caused by swelling after immersion.

The reference data presented may facilitate any judgement on multimono yarns of different origin.

## 1b. Résumé

Sept fils de filet du type "multimono" et la même numéro du type "monofilament" d'une differente longueur par unité de masse furent subjets a une numéro de tests avec l'intention de determiner leur qualités physicales. Oú une comparaison sur la base de la même plaine de la coupe en travers était possible les fils "multimono" toujours montraient une superiorité considerable envers les fils "monofilament".

Cela est reflêchi par

- une majeure résistance à la rupture mesurée à l'état sec ou mouillé et noué où non noué
- une flexibilité plus grande
- la même elasticité
- une mineure reduction de la résistance à la rupture causée par reception de l'eau aprés l'immersion

Les dates de réference presentés peuvent faciliter des décisions sur des fils "multimono" d'origine differente.

## 2. Introduction

Detailed investigations with regard to the efficiency of set nets in the last decennium (e.g. HYLEN and JACOBSEN 1979) have clearly shown that monofilament and multimono netting yarns have, for many reasons, distinct advantages over multifilament twisted or braided ones. Multimono has gained a particularly prominent position in this context because it incorporates the advantages of monofilament and multifilament yarns without their characteristic disadvantages. Recent publications confirming the superiority of multimono (MOHR 1983, 1984a, 1984b, MENTJES 1982) deal in detail with those properties which are most important in commercial fisheries, viz the higher efficiency, the tendency to catch less rubbish and the easier handling of nets made of this material.

Nevertheless, up to now little technological data have been published enabling a gear designer to choose the most suitable gillnet material. Certainly one reason for the lack of such comparative information is that in Europe only one or two among the monofilament producers offer multimono yarns on the market. Whereas monofilaments are used in many technical applications the demand for multimono yarns, originating solely from fisheries, is still too unimportant in Europe in order to evoke good prospects for profits from invested capital. Correspondingly low is the competition in this field. Consequently today the existing European demand is mostly covered from Far East sources.

Material of very different quality is for sale. A quality level as caused by the competion of many firms on the market of monofilament and multifilament yarns which excludes foreign competitors not attaining the same quality does apparently for the time beeing not exist with multimono. Thus little is known about the properties of this material. It is hoped that with the paper at hand this gap can be filled to some extent.

## 3. Material and methods

The monofilament and multimono yarns used in this investigation were provided by a German firm producing in Portugal. This favour is gratefully appreciated. Tests of breaking load (dry and wet) and of elongation were carried out in the Institute's laboratory according to national standards for tests of netting yarn (DIN 53834, DIN 53844 Teil 2 and DIN 53846). Weaver's knot breaking strength was, in deviation from the standard method, tested with the double weaver's knot, because this is the most common one in netting sheets of monofilament and multimono. Flexural stiffness was investigated following the "Lötzener method" described by KLUST (1982). Precise measurements of the diameters were taken according to the method developed by DAHM (1983) and those of the twist according to the national standard DIN 53832 T 1. Shrinkage in boiling water was tested in compliance with national standard DIN 53866 T 2.

## 4. Results

The results of the tests are compiled in Table 1. Attention is drawn to the following:

- With multimono the number of single elements composing the yarn and the resulting length-related weight (Rtex) show a strict linear relationship which in the yarns tested can be described by the regression:

  Rtex value = 41.65 x number of single elements - 11,313

  This equation seems not be influenced by the twist in the order of magnitude observed (about 50 turns/m).

- Breaking strength (wet and dry) and flexural stiffness of multimono yarns is also directly proportional to the number of single elements (Fig. 1).

- The low degree of twist in the tested multimono yarns creates no additional extension capability. The elongation at half knot breaking load varies in the same range as with the monofilament yarns. Therefore, to a rather high degree, this property seems to be material-dependent. This is at least true for multimono yarns of the above mentioned amount of twist.

- From comparison between multimono and monofilament yarns of equal total cross section (the pairs 4 x 0,20/0,40 and 6 x 0,20/0,50 as well as 8 x 0,20/0,60 were taken into consideration) it can be seen that the first ones reveal always a higher strength as well dry as wet. This difference can amount up to 27%. - The incongruity of the flexural stiffness between both types of netting yarns increases with increasing cross section. With a monofilament of 0,40 mm the corresponding multimono yarn has 45 % of the original stiffness, with 0,60 mm only 26 %.

- The immersion of a polyamide yarn into water leads normally to a reduction of strength due to swelling effects. As Figs.1 and 2 show, this is also the case with both monofilament and multimono yarns. Multimono yarns have a greater surface area than monofilament yarns of equal cross section. Surprisingly the strength reduction is in multimono yarns lower than in the comparable later ones. This effect is most obvious as to strength without knots (14% reduction in monofilament, 10% in multimono) followed by double weaver's knot (mono 14%, multimono 4%) and overhand knot (mono 7%, multimono 2%).

- It may surprise that the relation between diameter and strength in the investigated range of monofilaments shows also a strict linearity (see Fig.2). Since the cross section area and herewith the strained volume of material increase with the square of the yarn radius the stress at fracture (maximum strain per $mm^2$ of cross section) decreases with increasing diameter of monofilament yarns. Even in the small range of monofilaments tested here (0,3 - 0,6 mm), a reduction of stress at fracture of 25% has been observed. From Fig. 3, however, it can be seen that this is not valid for multimono yarns.

## 5. Conclusions

From the preceeding it becomes obvious that multimono yarns can be far superior to comparable monofilaments from a technical point of view. Especially in the range of diameters exceeding 0,50 mm they should be preferred due to their higher strength and reduced stiffness even if other properties essential for practical use (e.g. efficiency, handling, susceptibility to damage and "pollution") are similar with both monofilament and multimono. However, the considerable differences in the quality of multimono yarns on the market at present should be kept in mind.

The tests results presented in this paper give at least some idea of the technical properties which may be expected from multimono yarns. Before purchasing and using these yarns for the first time samples should be tested and the results compared with the data compiled in Table 1.

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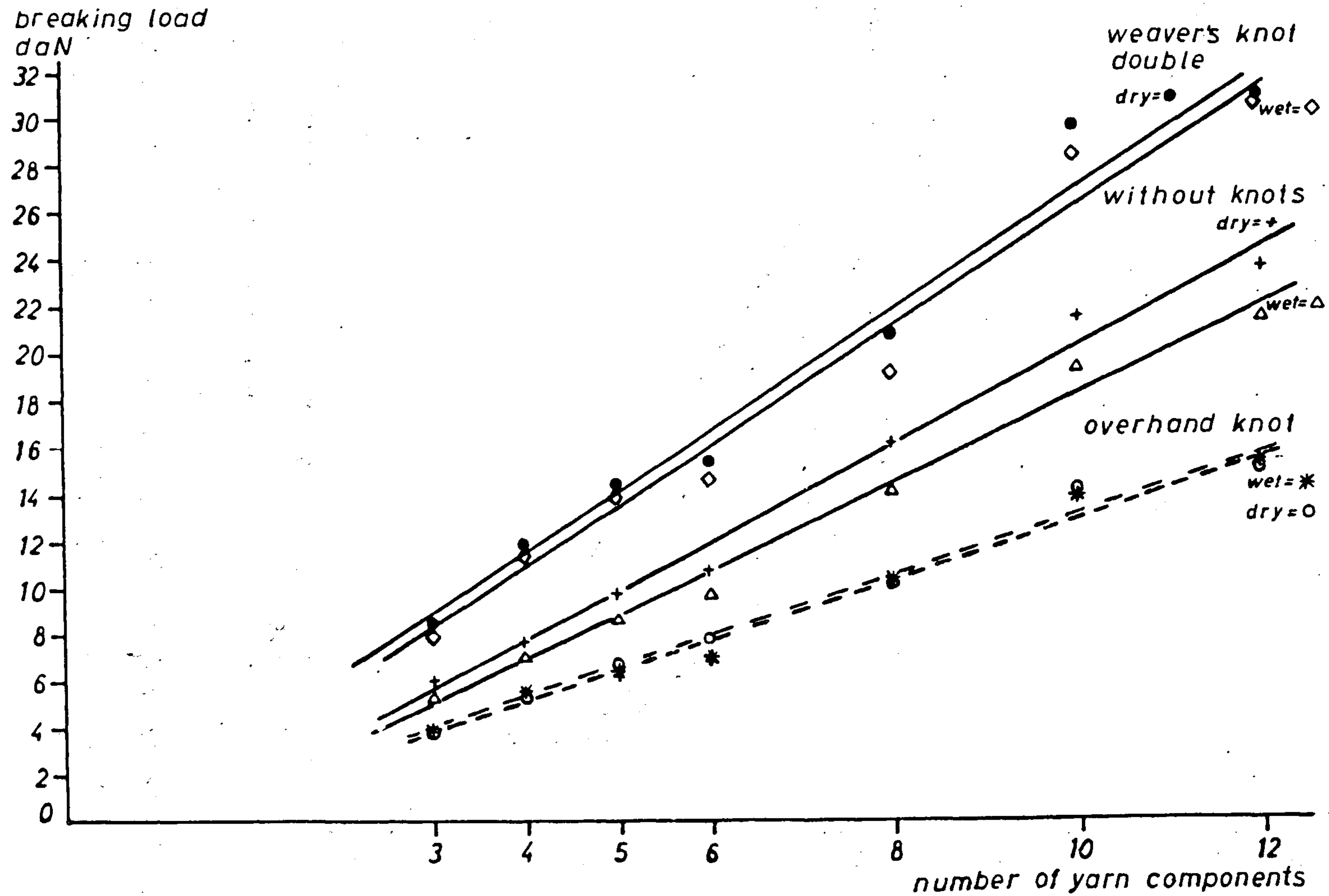


Fig. 1 Relationsship between breaking load and number of the multimono yarn components

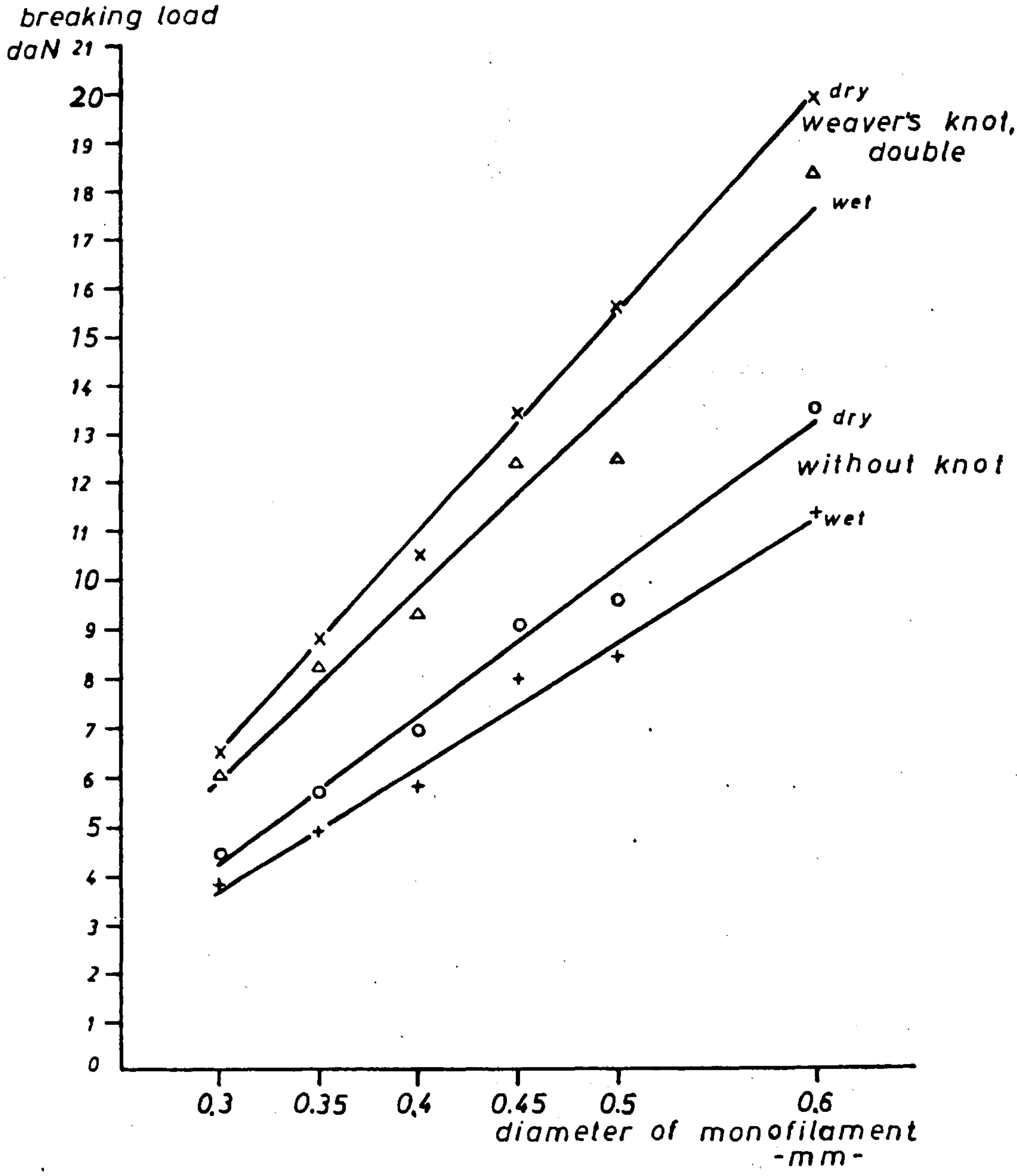


Fig. 2 Relatiansship between diameter and breaking load of monofilament yarn

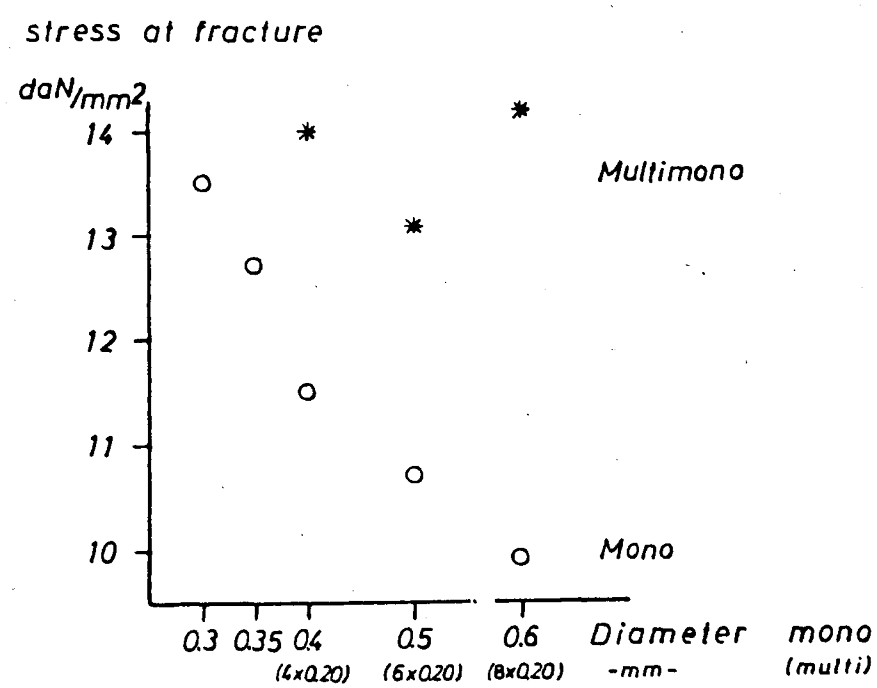


Fig. 3 Influence of netting yarn diameter on highest strain borne

Table 1: Results of different tests on multimono and monofilament netting yarns

| Tests | Multimono | | | | | | | Mono | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,20 x 3 | 0,20 x 4 | 0,20 x 5 | 0,20 x 6 | 0,20 x 8 | 0,20 x 10 | 0,20 x 12 | 0,30 | 0,35 | 0,40 | 0,50 | 0,60 | 0,45 | 0,50* | 0,60* |
| Rtex (g/km) | 115 | 164 | 196 | 229 | 313 | 414 | 489 | 89 | 119 | 151 | 231 | 346 | 184 | 244 | 332 |
| Diameter (planimeter-method)(mm) | 0,2 + | 0,202 + | 0,2 + | 0,193 + | 0,2 + | 0,2 + | 0,204 + | 0,28 | 0,35 | 0,38 | 0,47 | 0,58 | 0,43 | 0,49 | 0,59 |
| BL, dry (da N) | 5,892 | 7,733 | 9,835 | 10,905 | 16,31 | 21,575 | 23,705 | 4,461 | 5,682 | 6,969 | 9,547 | 13,465 | 9,075 | 11,338 | 15,078 |
| BL, wet (da N) | 5,462 | 7,049 | 8,82 | 9,875 | 14,335 | 19,525 | 21,655 | 3,803 | 4,888 | 5,803 | 8,405 | 11,255 | 7,985 | 9,765 | 12,915 |
| BL, dry with overhand knot (da N) | 3,991 | 5,415 | 6,859 | 7,847 | 10,33 | 14,158 | 15,18 | 3,288 | 4,322 | 4,928 | 8,23 | 8,491 | 6,115 | 6,663 | 8,73 |
| BL,wet, with overhand knot (da N) | 4,028 | 5,672 | 6,676 | 7,218 | 10,37 | 14,033 | 15,235 | 3,095 | 3,887 | 4,389 | 7,492 | 9,028 | 6,053 | 6,172 | 8.26 |
| BL, dry, with weaver's knot double (da N) | 8,6 | 11,92 | 14,64 | 15,57 | 20,89 | 29,77 | 31,ol | 6,515 | 8,835 | 10,51 | 15,575 | 19,825 | 13,425 | 15,225 | 20,07 |
| BL, wet, with weaver's knot double (da N) | 8,153 | 11,747 | 14,05 | 14,72 | 19,465 | 28,485 | 30,905 | 6,02 | 8,255 | 9,33 | 12,415 | 18,31 | 12,39 | 13,925 | 18,485 |
| Elongation at half BL weaver's knot % | 13,8 | 15,4 | 14,4 | 15,1 | 13,3 | 15,8 | 14,2 | 15,5 | 16 | 15,9 | 16,5 | 18,1 | 15,8 | 15,5 | 14,8 |
| Stiffness (Lötzener Method) g | 8,32 | 11,75 | 14,0 | 14,5 | 18,7 | 25,1 | 29,5 | 11,4 | 18,9 | 25,9 | 48,1 | 71,8 | 32,9 | 48,6 | 83,4 |
| Twist T/m | 50 | 51,6 | 44,2 | 58 | 58 | 54 | 52 | | | | | | | | |
| Twist coeffizient | 17 | 21 | 20 | 28 | 32 | 35 | 36 | | | | | | | | |
| Shrinkage at 100° C % | 3,3 | 2,6 | 2,5 | 4,0 | 1,9 | 3,9 | 2,6 | 4,4 | 4,4 | 4,6 | 3,0 | 4,5 | 3,5 | 4,3 | 4,6 |

*color dark green instead of pale green

BL = breaking load

+ = single element