Fishery Technology
1997, Vol. 34(1) pp : 39 - 44

Properties and Performance of Fishing Hooks

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The physical and chemical properties of indigenous as well as imported hooks along with comparative fishing performance are studied. The inter relationship between different numbering systems and dimensions are worked out. It was observed that the physical parameters and breaking load were independent of hook shape. The proportion of constituent elements differed in different samples. The hooks with a coating of Nickel and Tin did not register signs of corrosion. The hooking rate of both imported and indigenous hooks was comparable but the latter was fragile and prone to deformation.

Cataloguing of the physical parameters and properties of indigenous hooks and their inter relationships will serve as a reference guide for manufacturers to offer appropriate hook sizes for the users.

Key words : Properties of hooks, Efficiency of hooks, Hooking rate.

The hook and line fishing coming under low energy harvesting technique with comparatively low investment has been gaining importance in the context of escalation of fuel cost. Hooks of different shapes and sizes, depending on the nature and behaviour of target species are used in long lines, hand lines, droplines and troll lines. Till recent times, imported hooks, with trade name, Mustad is in vogue in India, as in other parts of the world.

The main emphasis in studies with this fishing was to find out the hooking rate as a measure of performance. The efficiency of Mustad hook (4/0) has been studied by Deshpande *et al.* (1970). Kartha *et al.* (1973) evaluated the effectiveness of round bent hooks (Mustad) of different denomina-tions, and baits. But hitherto, little effort is made to study the basic properties, service life and durability. Indigenous production has begun in the small scale sector to develop substitute to imported Mustad hooks. In this context it is worthwhile to study the merits and improve the quality and performance of indigenous hooks. The present communication is an account of investigations undertaken on this line.

Materials and Methods

Indigenous round bent hooks of different sizes, 3 different sizes of CZ hooks, Swanhead hooks, tuna hooks collected from five different firms and imported (Mustad) hooks were included in the study of physical properties. The general features of a typical hook are given in Fig. 1.

The physical diamensions were noted accurately by keeping the hook against a graph paper background; the diameter was read off using screw gauge and the load required for deformation

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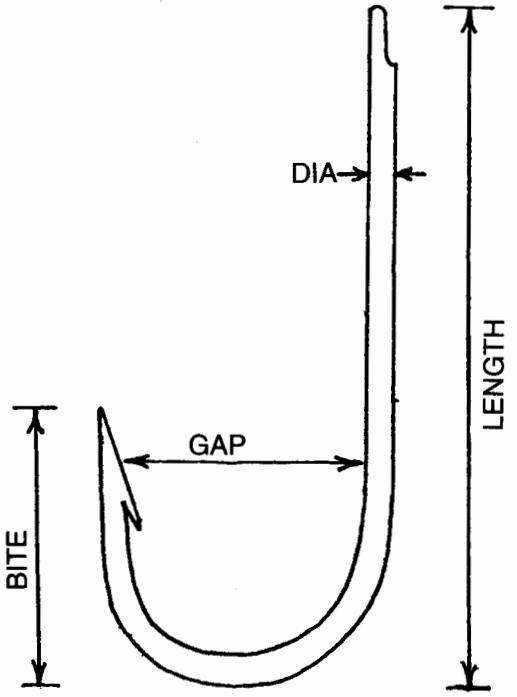

Fig. 1. Hook-general features

equal to bite length was recorded in the UTM ZWICK 1484 keeping the speed of test fixed as 25 mm/min uniformly for all samples.

Samples were prepared for chemical analysis as per ASTM method (ASTM 1981) and analysed using inductively coupled Plasma Emission Spectrophotometer (Labtam, Australia). The durability of hooks in sea water as assessed by the Salt spray analysis (ASTM 1962) by selecting representative samples from each lot.

Fishing performance was evaluated for sharks and smaller varieties of fishes in comparison with standard control (Mustad).

Results and Discussion

Hooks are usually designated by numbers, the value either decreasing with increase in the size of hooks or vice versa. Baranov (1970) states that most of the hooks come under the two categories of numbering namely sea and river numbering system and the size is characterised by the weight of 1000 hooks. Andreev (1963) mentions three different types of numbering represented as Marine numbering and River numbering and a third one based on gap size. These systems are interrelated and also with the weight of the hooks by definite mathematical relationship (Table 1).

Table 1. Interrelation between the numbering system and the different parameters of hooks

X	Y	
Marine numbering	Weight in g of hook	$Y = ab^X = 16.42 \times 0.698^X$
River numbering	Weight in g	$Y = ab^X = 0.313 \times 1.433^X$
Gap	Marine numbering	$Y = a + bX = 13.189 - 0.368X$
Gap	River numbering	$Y = a + bX = -2.90 + 37.67X$
Gap	Weight in g	$Y = a + bX\ cX^2 = -0.57 - 0.03X + 0.01X^2$

The details of hooks analysed are given in Table 2. The Mustad round bent hooks follow the River numbering system given by Andreev (1963). The gap length and number are related linearly and the number and weight show an exponential curve here also (Fig. 2 & 3). The higher sizes of Mustad round bent hooks are represented by numbers 0/1, 0/2 and so on. The relevance of this figure is checked extrapolating the relation between number and gap size (Fig. 2). For a particular value of gap size, the number coincided with 0; this is referred as 0/1 and subsequent number 0/1+1, 0/1+2 etc.

Gap size being one of the parameters for designating hooks its relation with

Table 2. Data on hooks analysed

Serial No.	Hook No.	Type of hook	Length mm	Gap mm	Bite mm	Diameter mm	Weight g	Load for deformation N
A: Mustad hooks:								
1	0/3	RB	130	45	53	4.87	27.987	1377.28
2	0/2	RB	112	38	47	4.45	19.996	1241.28
3	0/1	RB	100	32	48	4.07	15.098	1178.24
4	1	RB	90	30	40	3.67	11.008	844.80
5	2	RB	72	23	29	2.95	5.633	742.40
6	3	RB	72	23	29	2.95	5.633	645.12
7	4	RB	62	21	24	2.62	4.154	504.40
8	5	RB	54	18	21	2.35	2.896	395.60
9	6	RB	50	15	17	2.03	1.948	292.00
10	7	RB	46	14	16	1.82	1.440	232.00
B: Indigenous hooks - Firm I								
11		RB	116	38	48	5.02	25.913	1258.56
12		RB	135	40	50	5.40	33.629	1466.24
Firm II								
13		RB	118	38	48	4.85	23.941	1231.68
14		Tuna	75	25	46	5.40	23.460	4085.76
15		Tuna	65	20	33	5.02	16.276	1603.84
16		Tuna	60	26	37	5.30	18.738	1500.80
17		Tuna	60	20	38	5.00	14.712	1541.76
Firm III								
18		RB	75	25	30	2.90	5.650	390.08
19		RB	65	20	25	2.60	3.970	558.24
20		RB	60	17	23	2.25	2.810	383.36
Firm IV								
21	6/0	CZ	45	17	18	1.50	1.487	313.44
22	8/0	CZ	55	20	21	2.50	3.817	592.16
23	2/0	CZ	100	40	40	4.50	20.321	1345.92
Firm V								
24		SH	46	14	18	0.92	0.824	96.30
25		SHB	48	12	15	0.92	0.815	206.20
26		SHBR	80	18	26	1.85	3.960	390.44
27		SHB	88	20	27	1.86	3.93	579.44

RB - Round bent; SH - Swan head silvery; SHB - Swan head black; SHBR - Swan head brown

other dimensions were drawn (Fig. 4, 5 & 6). The empirical relation connecting gap size with different parameters is presented in Table 3 where 'a', 'b' and 'c' represent the constants in the respective relationships.

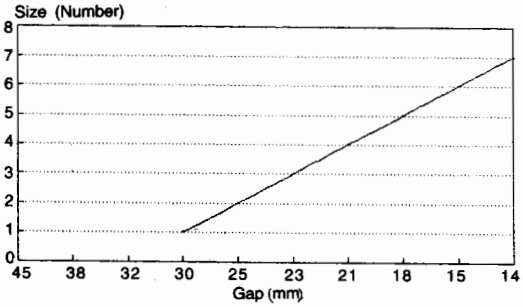

Fig. 2. Showing relation between gap and size

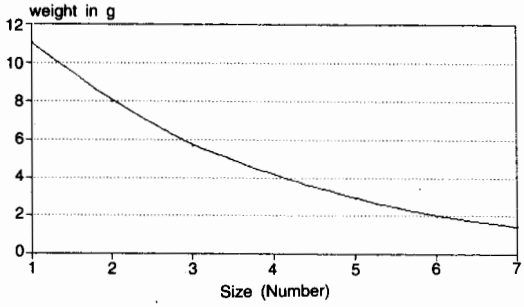

Fig. 3. Showing relation between size (No.) & weight (g)

Comparing the data with indigenous samples, the sample no. 11 supplied by Firm I coincides with 0/2; and the three samples supplied by Firm III were made equal to Mustad hook nos. 3, 4 & 5 but only No. 4 had comparable load withstanding capacity as Mustad of equivalent size. The sample 2/0 of Firm IV was comparable to Mustad 0/2, the other two deviated from the corresponding nos. of Mustad.

According to Andreev (1963) the physical parameters and the breaking load of the hook were independent of the shape and nature of hook. The Swan head hooks were therefore compared to Mustad round bent hooks. Samples 26 & 27 of Firm V could be equated to Mustad Hook No. 5 and 4 respectively, provided gap size is taken for numbering, so also load withstanding capacity.

Table 3. Interrelation between dimensions of the hooks (Mustad Round bent hooks)

X	Y	
Gap size mm	Number	$Y = a + bX = 11.814 - 0.374X$
Number	Weight in g	$Y = ab^X = 15.77 \times 0.710^X$
Gap size mm	Weight in g	$Y = ab^X = 0.294 \times 1.133^X$
Gap size mm	Dia. in mm	$Y = a + bX + cX^2 = 0.329 + 0.109X + 0.0002X^2$
Gap size mm	Bite length in mm	$Y = ab^X = 7.053 \times 1.061^X$

Chemical analysis data of hooks is given in Table 4. Essentially the composition of the hooks remained approximately the same, with same type of elements in different samples. But the

Table 4. Chemical analysis of hooks

Element	Mustad hook	Indigenous hooks				
		Firm III	Firm IV-6/0	Firm IV-2/0	Firm V brown	Firm V black
		% composition				
Mo	0.0497	-	0.602	0.512	0.015	0.06
Cu	0.0834	0.122	0.2947	0.2249	0.098	0.106
Ni	0.0506	2.980	1.0817	6.7696	0.370	0.380
Sn	0.0895	0.146	0.2373	0.1848	0.430	0.470
Mn	0.6289	0.637	2.5756	2.1266	0.424	0.420
Cr	0.0840	0.106	0.0288	0.1053	0.465	0.490
Zn	0.03	0.007	1.2215	0.6564	0.0098	0.0088
Sb	0.4917	0.000	0.000	0.000	0.092	0.099
Sn	6.67	2.503	43.37	35.33	8.71	9.05
Pb	1.93	0.838	0.000	0.000	0.000	0.000
Ti	0.0037	0.000	0.000	0.000	0.000	0.000
Fe	89.888	92.659	50.588	54.90	87.921	87.635

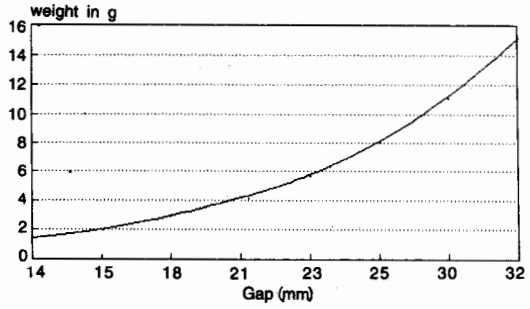

Fig. 4. Showing relation between gap (mm) and weight (g)

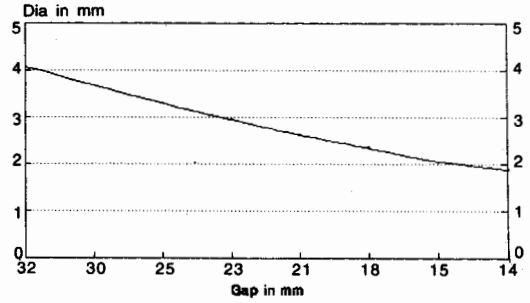

Fig. 5. Showing relation between gap (mm) and diameter (mm)

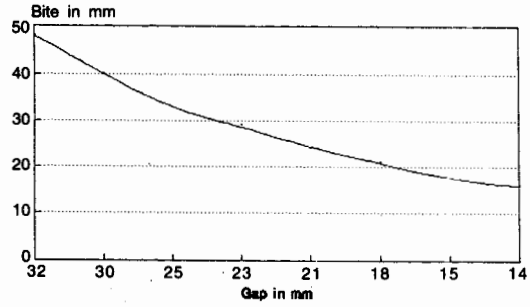

Fig. 6. Showing relation between gap (mm and bite (mm)

proportion of these elements differed in different samples. The hooks from Firm III which had a coating of Ni and Sn (55.50 & 35.50%) performed well in salt spray tests along with Mustad samples. After 98 h of salt spray exposure (equivalent to 365 days in sea water) these two sets of samples did not register any pitting or signs of corrosion.

Only few attempts were made to compare the efficiency of indigenous and imported hooks. George *et al.* (1991) experimented 0/4 Round bent indigenous hooks along with imported Mustad hooks. These observations were made from M.V. Saraswathy of CIFE, Bombay, in and around Angrea Bank and off S.W. Bombay. The data collected on the sharks landed by each type of hooks during the course of the cruise revealed that the hooking rate of sharks in both types of hooks were comparable (Table 5). The same was the case with respect to the weight of shark landed per hook. However compared to imported ones, the Indian hooks were fragile and liable to deformation under load. Similar

Table 5. Catch details

Mustad hook			Indian hook		
No. of hooks used	No. of sharks	Weight of sharks (kg)	No. of hooks used	No. of sharks	Weight of sharks (kg)
60	1	5.00	50	0	0.00
70	4	355.00	70	3	375.00
48	5	300.00	100	1	7.00
48	0	0.00	48	6	400.00
48	5	325.00	48	1	55.00
50	8	950.00	50	1	120.00
50	4	270.00	60	12	1330.00
18	0	0.00	60	6	400.00
25	3	280.00	26	1	15.00
			25	2	190.00
477		2625.00	585	40	3312.00
Hooking rate %		6.63		6.83	

observations were made with Indian hooks of other denominations through field trials. The findings are in agreement with laboratory studies that certain samples of Indian hooks registered corrosion in salt spray test and unrecoverable deformation under load.

The studies were undertaken as recorded data on the physical properties of indigenous hooks are not available. A comparison is made with Mustad hooks to impress that indigenous production of standard quality hooks is possible. For all fishing hooks there is a relationship between number, gap size and weight. The indigenous hooks tested also conformed to this, eventhough some samples showed minior variations. Chemically too both indigenous and imported hooks had same elemental make up with minor changes except for the content of antimony, lead and titanium, which were absent in some indigenous samples. Salt tolerance of indigenous hooks compared very well with the foreign hooks. The only limitation of indigenous hooks was deformation under load. However the hooking rate of both types of hooks remained the same.

The authors are grateful to Dr. K. Gopakumar, Director, Central Institute of Fisheries Technology for according permission to publish this paper. Thanks are also due to Dr. K. Ravindran, Head of Fishing Technology Division for critically appraising the text.

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