

INVESTIGATIONS ON WOODEN FLOATING MATERIALS- THE LOSS OF BUOYANCY UNDER CONTINUOUS IMMERSION IN WATER AND THE RATE OF ITS REDEMPTION BY DRYING

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INTRODUCTION

A wooden fishing float under immersion in water for long periods is liable to absorb water, the quantity of water absorbed possibly being dependent upon the physical factors like the specific gravity and the inherent property of the material, the time of soaking and the pressure acting on it. Consequently a wooden float is likely to become heavy and loss its original buoyancy. However, when the float is removed from water and dried, the lost buoyancy is regained on complete drying. It should be evident that, in both the amount of absorption of water and the rate of drying, the different wooden materials would exhibit different properties. These two characteristics severally and conjointly contribute to the effectiveness of the wooden float and the resultant efficiency of the gear to which it is attached. The present paper is an attempt to elucidate these two important characteristics of some of the chief wooden floating materials used on the West Cost of India.

The authors thank Shri K. Krishna Rao, Assistant Statistician for his kind help in fitting the regression lines.

MATERIAL AND METHODS

The materials included in the study

consist of five different woods. Table I presents the names of materials, their physical dimensions, the states where used and the gear to which they are commonly attached. The samples analysed represent approximately the actual size of floats in commercial use.

Experimental procedure

After recording the initial weight and buoyancy, the samples were completely suspended in water for a total period of 10 days (240 hours). The buoyancy was measured at periodic intervals as indicated below:

1st day	at an interval of	6 hours
2nd & 3rd days	„	8 hours
4th day	„	12 hours
5th to 10th day	„	24 hours

The original buoyancy is recorded in Table-I.

The method adopted for measuring the buoyancy and the equipment used are similar to those described elsewhere (Satyanarayana, 1960). Samples after exposure in water were removed and the quantity of absorbed water estimated. The wet samples were grouped into sections and one section was dried in shade and the other in sun. In both cases the amount of water evaporated was recorded at regular intervals.

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TABLE 1: SHOWING THE SPECIFICATIONS OF THE FLOATS STUDIED

Local name	Scientific Name	Original Buoyancy in gms.	States from where samples were taken	Name of fishing gear	Code No. and General shape of float	Dimensions in cms.
1	2	3	4	5	6	7
'Satwin'	<i>Alstonia scholaris</i>	106.31	Maharashtra	Drift nets (Wahur' and Surmai Jal')	5 B; Long, triangular in cross section and tapering at one end.	L=37; B=2.2; T=1.7
'Guggaladupa'	<i>Bombax malabaricum</i>	56.70	Mysore	Gill and drift nets. (Veedinabala')	3 B; Flat smooth at ends to from the sha- pe of a spindle.	L=29.5; B=4.5 to 5; T=1.0
		70.88			4 B; -do-	L=29.0; B=2.5 to 4.5; T=1.0
'Hongaru'	<i>Erythrina indica</i>	35.43	Mysore	Smallshore seines (Kairampini')	14 D; Cylindrical.	L=9.0; D=4.0
		35.43		Big shore sei- nes ('Rampni')	13 D; Flat with rou- nd and truncated edges	L=14.0; B=3.0 to 5.0; T=1.0
		177.18			12 D; -do-	L=24.0; B=5.5 to 8.5; T=2.5
		574.37			11 D; -do-	L=34.5; B=7.5 to 12.0; T=2.5
'Pangara'	-do-	517.37	Maharashtra	Shore Seines (Rampon)	15 D; Flat and rectangular	L=26.0; B= 10.3; T=3.0
		545.72			16 D; -do-	L=26.0; B=10.0; T=3.1
		205.53		Drift nets (Wahri Jal')	17 D; Long and tri- angular in cross section.	L=36.0; B=2.0 to 4.0; T=1.5 to 3.2

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RESULTS AND DISCUSSION

The results obtained are indicated in Figures 1 & 2.

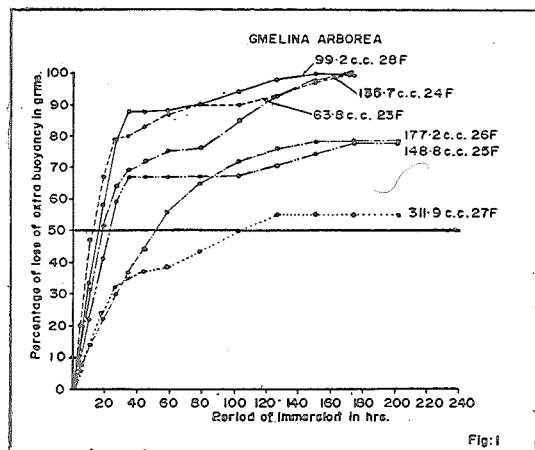


Fig. 1: Relation between the percentage loss of buoyancy of different fishing floats made of different materials and period of immersion in water.

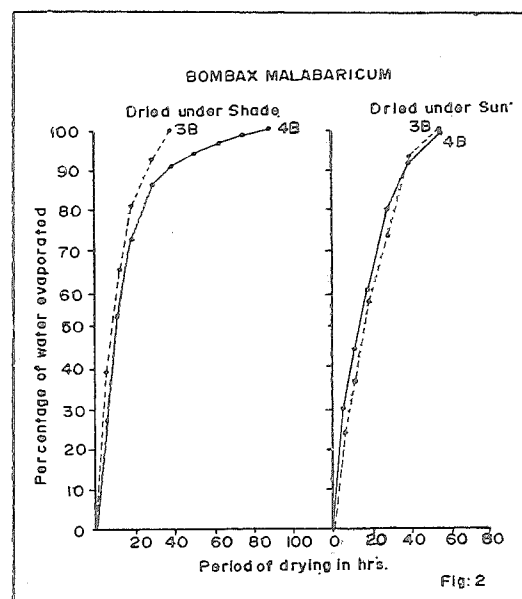
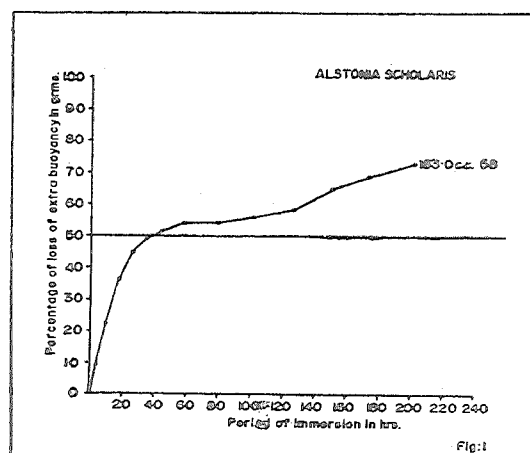
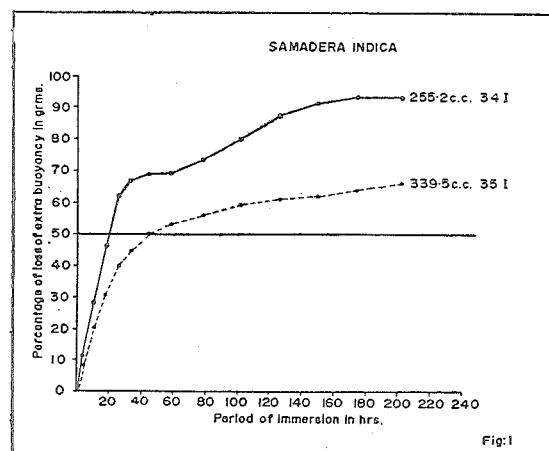
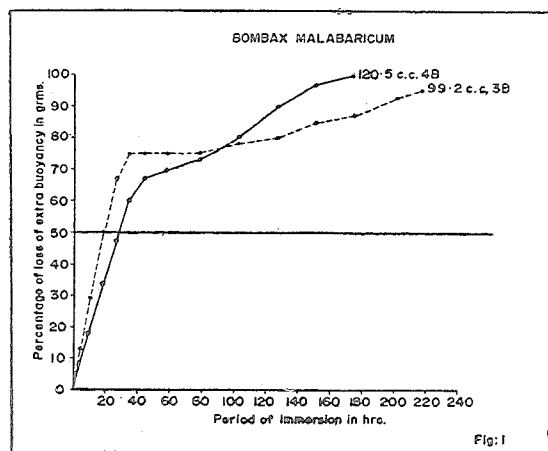
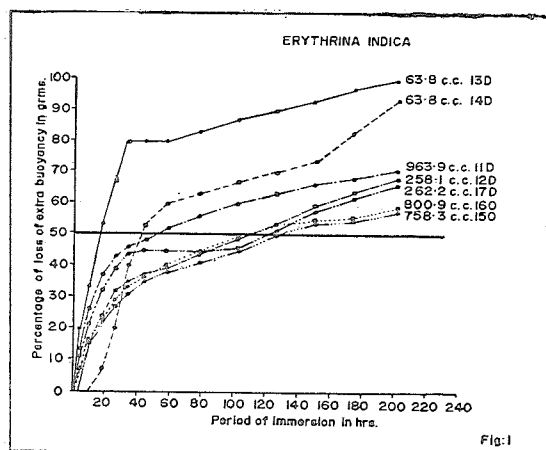


Fig. 2: % amount of water evaporated in the process of drying under shade and sun of different floats made of different material with the time of exposure.

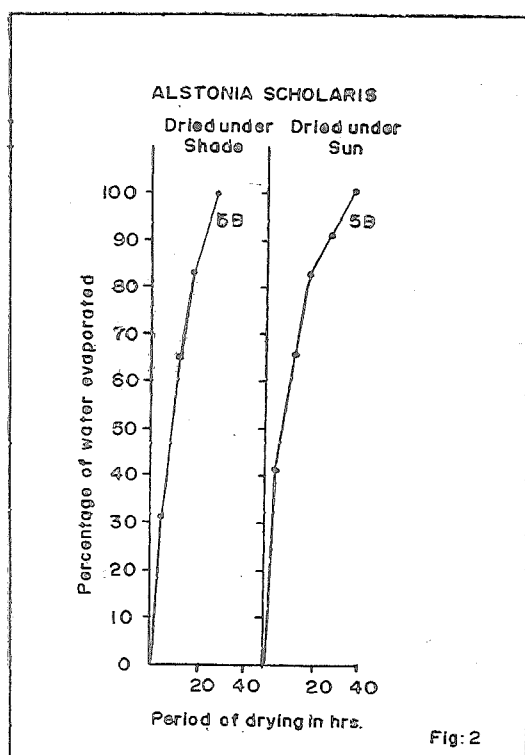


Fig: 2

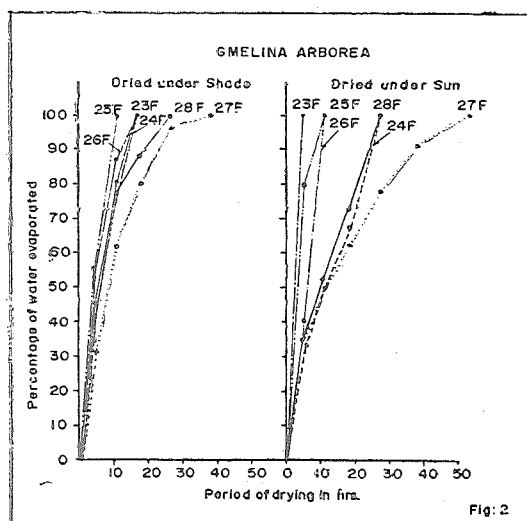


Fig: 2

The buoyancy is either completely lost or mostly lost in almost all the samples within a period of ten days. Within the same material, small sized floats lost their buoyancy in a short period, while the rate of loss was slow in their bigger counterparts. During the process of drying, the smaller floats dried completely in a day thus redeeming the lost buoyancy relatively fast.

1. loss of buoyancy in different materials and variations due to volume and shape within and different materials:-

The percentage loss of buoyancy after different periods of immersion for the samples are shown in Text. Fig. 1.

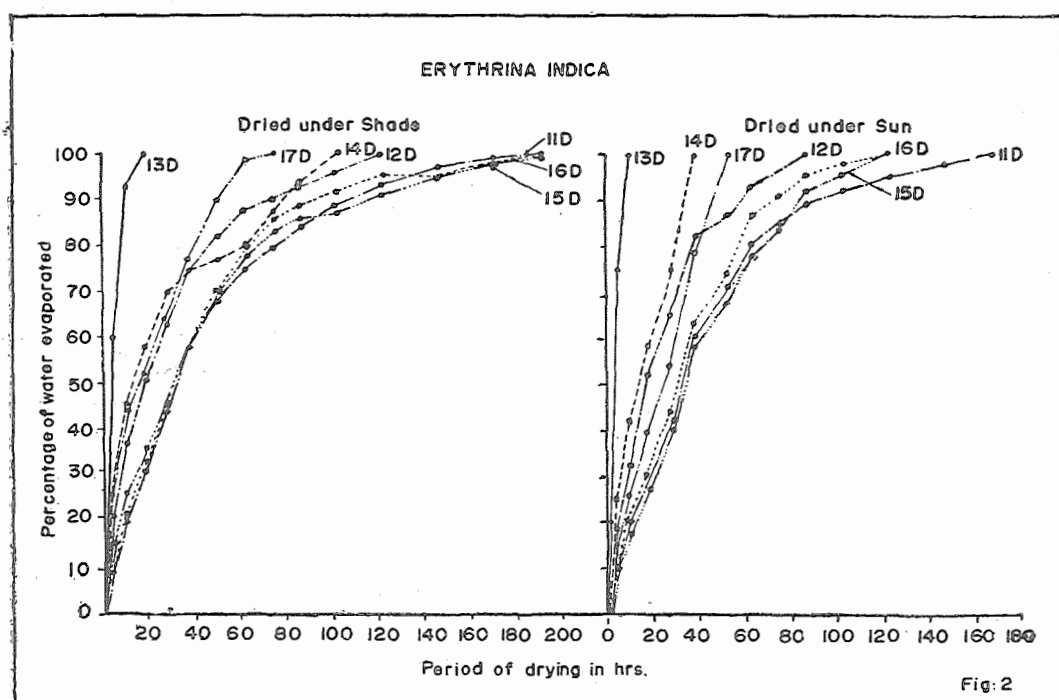
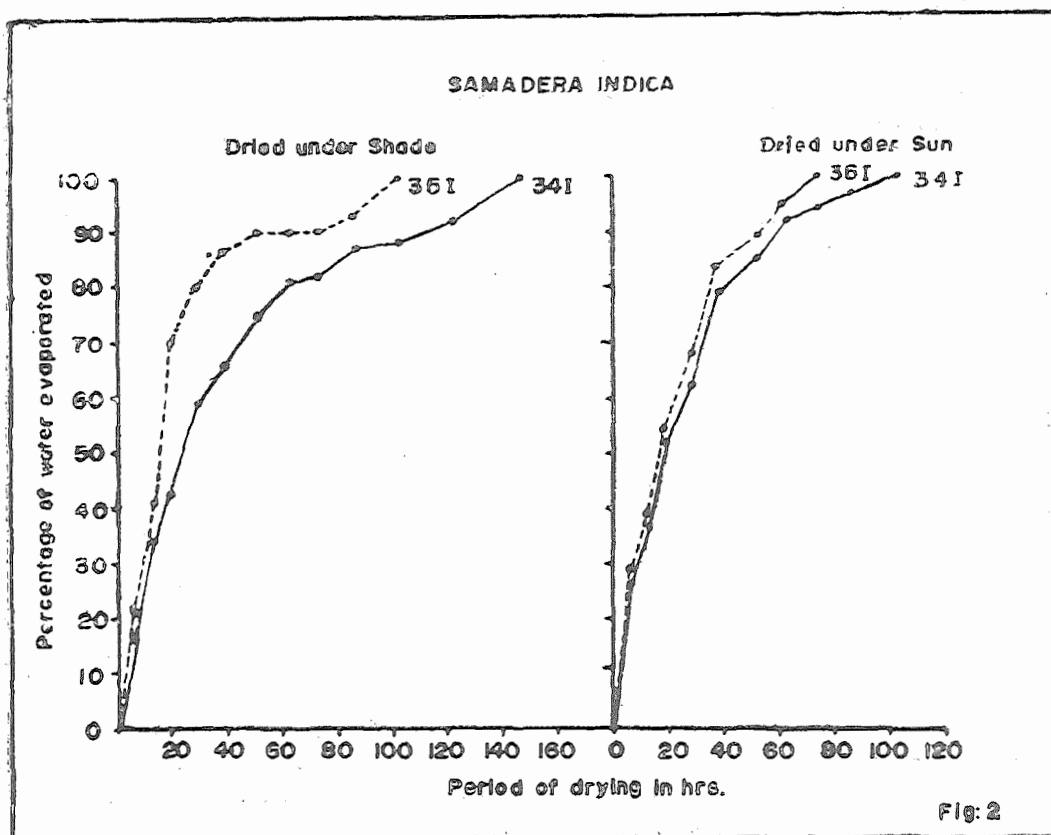
i) Loss of extra buoyancy with respect to different materials:-

Comparison of loss of buoyancy in different materials was drawn from the samples of floats having more or less same volume and shape.

If a float is considered to be of not much use, when its buoyancy has reduced by 50%; then among the smaller volumed floats (less than 100 c. c.) 50% loss is noticed in *Gmelina arborea*, *Bombax malabaricum* and *Erythrina indica* within 16, 22 and 26 hours respectively (Fig. 1). In medium sized floats (volume between 100 to 200 c.c.), *Gmelina arborea* retained 40% buoyancy upto 50 Hrs. as against 36 Hrs. in the case of *Alstonia scholaris*. In bigger sized floats (volume ranging from 200 to 300 c.c.), which are found in wide use 50% loss is recorded at 30, 102, 110 Hrs. in *Samadera indica*, *Gmelina arborea* and *Erythrina indica* thereby indicating the effectiveness of *Erythrina indica*. Considering the above, even though it can be said that as floating material, all these woods can be used with satisfaction, but floats made of *Erythrina indica* and *Gmelina arborea* retained their buoyancy for comparatively longer periods, followed closely by *Alstonia scholaris*. The remaining two floating materials (viz.) *Bombax malabaricum* and *Samadera indica* reduce their buoyancy within short periods.

ii) Influence of volume and shape:-

The reduction of buoyancy is found to be proportional to the volume of material contained in the float. Accordingly



smaller volumed group experienced less buoyancy loss than the comparatively large volumed group. Further the time taken for buoyancy loss is shorter in the

former group rather than in the latter group.

Among the floats made of *Erythrina indica*, a very interesting phenomena was

observed in buoyancy reduction. The time taken to buoyancy reduction has shown increase with the corresponding increase in size and volume of the float. Between the two shaped floats of more or less same volume at 63.8 cc, the long, flat with round edged floats lost buoyancy much earlier than short and cylindrical ones. Among the two samples of the two groups having volumes about 260 cc and 775 cc, variations between the individuals was not significant, except reduction was seen in accordance with volume, since the shape of samples in each group is same. The sample of float having 963 cc volume lost its buoyancy comparatively earlier than the samples of 775 cc group, which may be due to its shape being long, wide and thin and had wider area of exposure.

In the two samples of floats made with *Gmelina arborea*, though the volume was more or less same, the loss of buoyancy was prominent in the float of triangular shape (135 cc) than in the flat and rectangular floats (148 cc), indicating the influence of shape.

Floats made in triangular blocks from the above material are specially used for bottom set and drift nets possibly due to that the shape aids it to withstand the relatively larger pressures available at these depths. Further the material is dense with specific gravity varying from 0.474 to 0.263 gm/cc., which incidentally is the highest among all the floating materials used at present in India (Kuriyan and satyanarayana, 1961).

iii) Relation between loss of Buoyancy with time of immersion:-

An attempt has been made to correlate the loss of buoyancy of the above wooden float samples with the time of continuous immersion in water. The average percentage loss of buoyancy per each hour was obtained by dividing the

percentage loss of buoyancy between two successive observations with the time interval for the same two observations and is taken corresponding to the end of the time interval. Regression lines for all the samples were fitted as shown in the text. Fig.3 and the formulas holding the relations have been calculated using the least square method and shown in Table II against the individual samples.

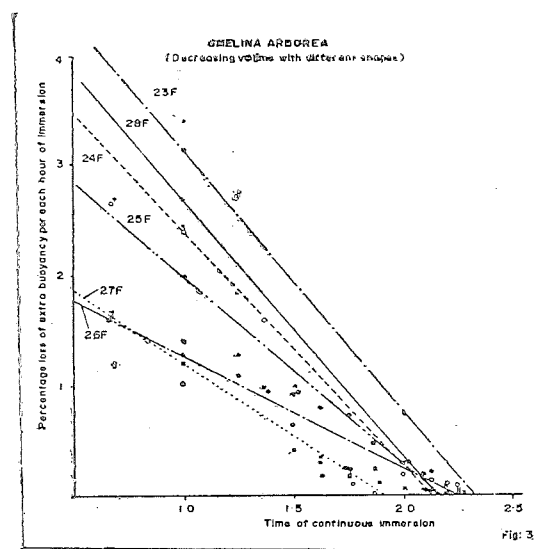
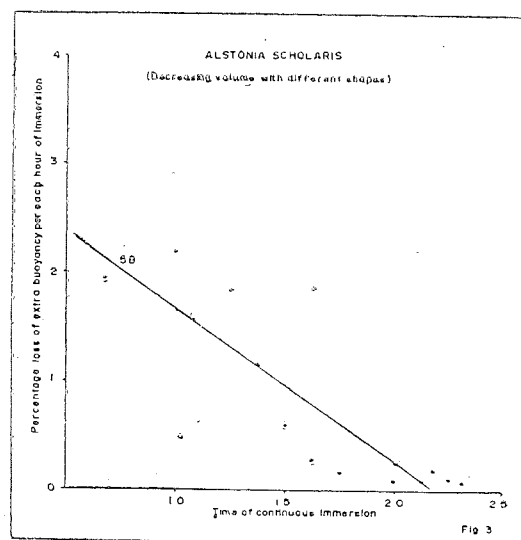
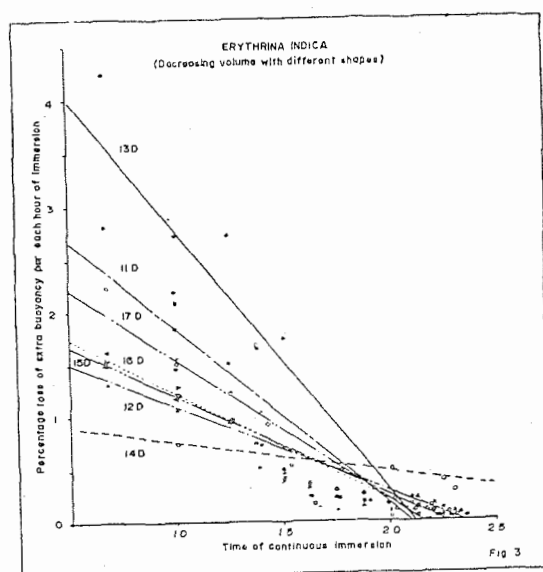
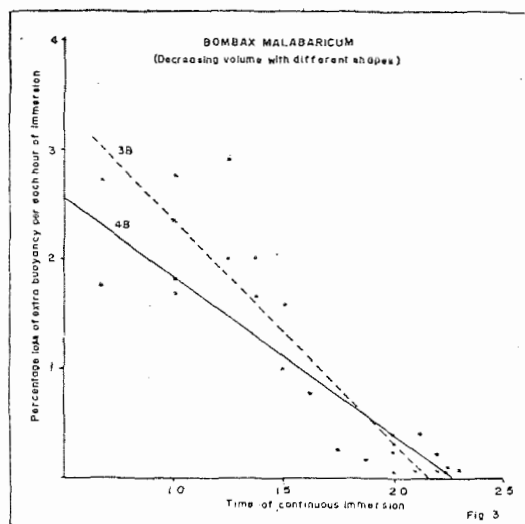
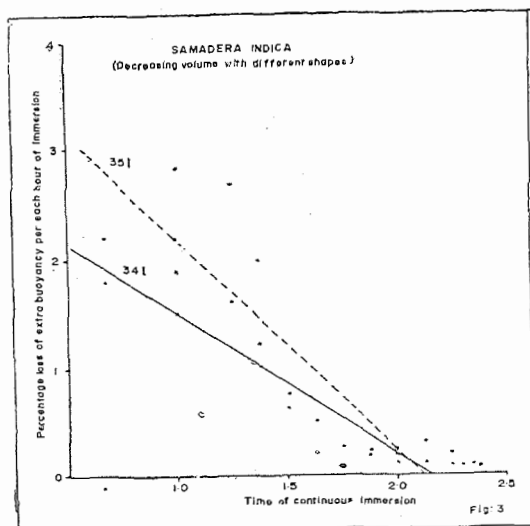


Fig. 3: Regression lines for the loss of extra buoyancy with time of continuous immersion in water.





Erythrina indica:

The perusal of table as well as figure reveal that loss of buoyancy depends on volume as well as the shape of the float as the samples 13D & 14D, and 12D & 17D having same volume, exhibited different property mainly due to shape. Similarly within the same shaped floats (i. e.) 11 D, 12 D and 13 D, the difference can be attributed to the volume contained in each; but within the same shape and volume (15 D & 16 D) the equation remains almost same.

Gmelina arborea: The Table clearly indicate that as the volume increases, the slope of the curve decreases, irrespective of the shape of the floating material. Thus the loss of Buoyancy vary with the shape, hold good in this material too.

Among the sample of *Samadera indica* and *Bombax malabaricum*, the regression lines indicate that the difference is mainly due to volume as the shape of samples are identical.

2. Amount of water absorbed in different materials and its relation to shape and size of floats:-

The amount of water absorbed at saturated point in fresh water for different materials was indicated in Table III. The calculated quantity of water absorbed per 1000 cc. of material in each of the samples was also shown for comparative purposes.

The amount of water absorbed depend on the density and size of the float and the area of the absorbing surface.

From the perusal of Table III, it can be clearly seen that absorption of water is found to be significant in *Bombax malabaricum* followed by *Erythrina indica*. Though some floats of *Gmelina arborea* exhibit more or less same tendency as

TABLE II: REGRESSION EQUATIONS FOR LOSS OF BUOYANCY WITH TIMES OF IMMERSION IN WATER

Name & Code No.	Volume (c. c.)	Shape	Regression equation
<i>Erythrina indica</i>			
13 D	63.8	flat with round and truncated edges	$Y = 5.2229 - 2.4741 X$
12 D	258.1	„ „	$Y = 2.0593 - 0.8989 X$
11 D	963.8	„ „	$Y = 3.4518 - 1.6354 X$
14 D	63.8	Cylindrical	$Y = 1.0255 - 0.2275 X$
15 D	758.3	flat and rectangular	$Y = 2.1177 - 0.9593 X$
16 D	800.9	„ „	$Y = 2.1418 - 0.9644 X$
17 D	262.2	long, triangular in cross section	$Y = 2.0949 - 1.3553 X$
<i>Gmglina arborea</i>			
23 F	63.8	long and cylindrical	$Y = 6.0365 - 2.9148 X$
24 F	135.7	triangular	$Y = 4.4201 - 2.0498 X$
25 F	148.8	rectangular and flat	$Y = 3.5991 - 1.6574 X$
26 F	177.2	„ „	$Y = 2.3108 - 0.9906 X$
27 F	311.9	triangular	$Y = 2.1284 - 0.9665 X$
28 F	99.2	oblong, flat on one side & round on the other	$Y = 5.1209 - 2.3994 X$
<i>Samaeara indica</i>			
34 I	255.2	long and cylindrical	$Y = 2.8709 - 1.3189 X$
35 I	339.5	„ „	$Y = 4.0734 - 1.8815 X$
<i>Bombax malabaricum</i>			
3 B	99.2	spindle shape	$Y = 44.540 - 2.0793 X$
4 B	120.5	„ „	$Y = 3.1573 - 1.3617 X$
<i>Alstonia scholaris</i>			
5 B	163.0	long and triangular	$Y = 3.0653 - 1.4082 X$

Note: Y = Average % of loss of extra buoyancy per hour.
 X = log. of hours (Time of continuous immersion).

Erythrina indica, the small rectangular and flat floats absorbed less water, which may be due to higher density of the sample. Between samples of *Alstonia scholaris* and *Gmelina arborea*, having more or less same volumes the water absorption is high in *Alstonia scholaris* and it is nearly 10% more. Between *Samadera indica* and *Erythrina indica* having same volume, the former is better.

Considering that generally fishing gear is not kept under fishing condition for more than two days, the amount of water absorbed for nearly one and two days immersion in water respectively was worked out and the relation of water absorbed and the volume of the floats is shown in fig. 4.

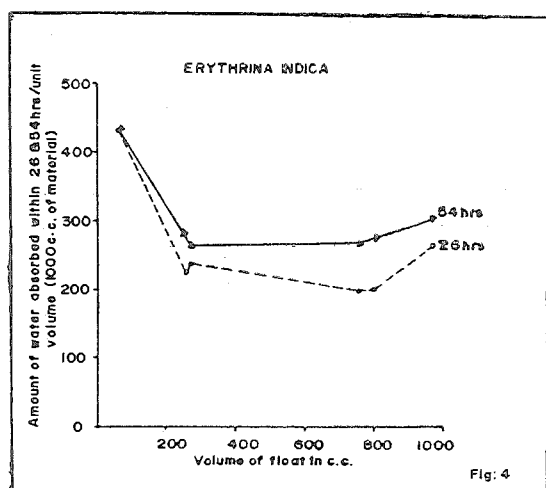


Fig. 4: Showing the calculated amount of heat absorbed per 100 c.c. of material within 26 and 54 Hrs of water immersion in different volumes of floats in different materials.

It is evident from the figure. 4 that the more is the volume of the float, the less is the absorption of water. In *Erythrina indica* samples the absorption is almost proportional to the volume of the float and the period of immersion. The deviations noticed may be due to the shape and density of the materials of the samples.

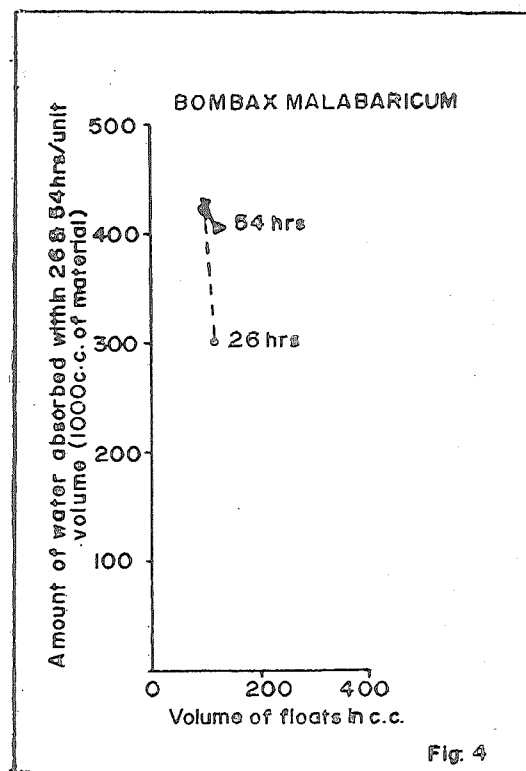


Fig. 4

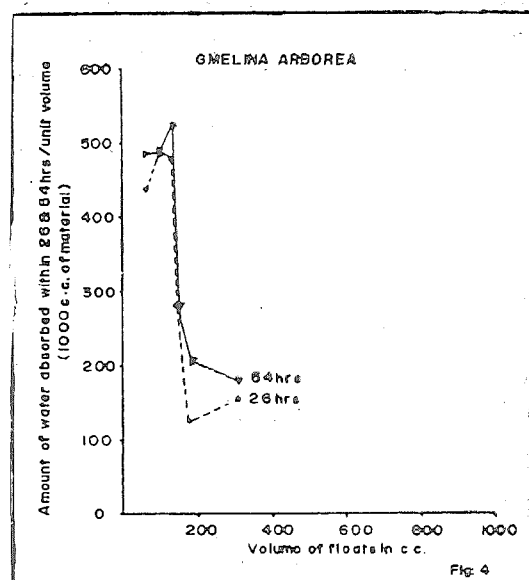
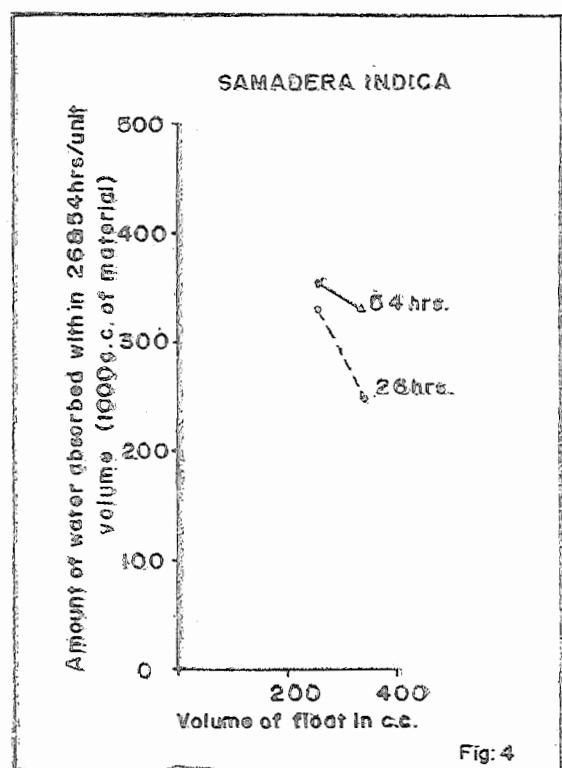


Fig. 4

3. Evaporation of absorbed water of floats on drying in sun and shade:-

The percentage amount of water evaporated in the process of drying in both sun and shade at different intervals in different samples made of different materials is represented in Text. Fig. 2. The



samples dried earlier in Sun than under shade, which is the general character of most of the woods with respect to their drying property. On comparison, it is found that samples of *Erythrina indica* dried very much earlier (by 25 to 30% time), than all others. The time of drying in Sun is nearly 10% earlier than in shade in all material except in *Gmelina arborea*, where the range is between 5 to 10%.

Considering the equal volumed floats of different materials, it is found that samples of *Gmelina arborea*, dried earlier, followed by *Alstonia scholaris*.

Within the same material, floats having same volume, but with different shapes the rate of drying is found to be different. This is clear in *Erythrina indica* in which the drying time of a sample of long and flat shape is different than the short and cylindrical one. On the whole, the size, shape and area of surface exposed, determine the rate of drying.

Here too, the regression equations were obtained between the percentage loss of water in drying under shade and sun with

times of drying and are given in Table-IV and regression lines drawn in Text Fig. 5. As previously stated, the percentage loss per hour was calculated for the successive observations and taken correspondingly to the time interval.

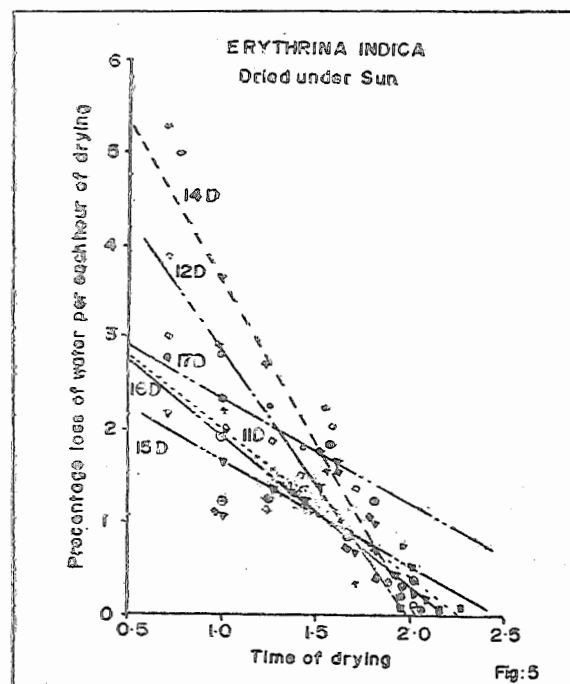


Fig. 5: Regression lines for the loss of water in drying under sun with time of drying.

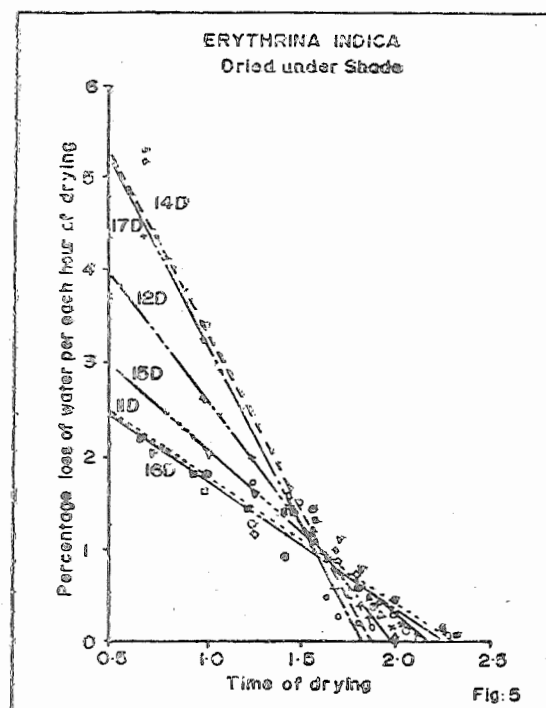


TABLE IV: REGRESSION EQUATIONS FOR LOSS OF WATER IN DRYING UNDER SHADE AND SUN

Name of floating material with code No.	Volume in c. c.	Regression Equations		Remarks
		Under shade	Under Sun	
<i>Erythrina indica</i>				
13 D	63.8			dried within 15 & 10 hrs. exposure under shade and sun respectively.
12 D	258.1	$Y = 5.8880 - 2.9615 X;$	$Y = 5.6327 - 2.7813 X$	
11 D	963.8	$Y = 3.2279 - 1.4185 X;$	$Y = 3.5567 - 1.5993 X$	
14 D	63.8	$Y = 7.0735 - 3.6623 X;$	$Y = 7.0292 - 3.4549 X$	
15 D	758.3	$Y = 3.2877 - 1.7629 X;$	$Y = 2.8591 - 1.1698 X$	
16 D	800.9	$Y = 3.2877 - 1.4479 X;$	$Y = 3.5484 - 1.5731 X$	
17 D	262.2	$Y = 7.1094 - 3.7857 X;$	$Y = 3.5196 - 1.1625 X$	
<i>Gmelina arborea</i>				
23 F	63.8	..... ;	.....	Sample dried within 15 & 5 hrs. under shade and Sun.
24 F	135.7	..... ;	.....	Sample dried within 15 & 10 hrs. under shade and Sun
25 F	147.8	..... ;	.....	Sample dried within 10 hrs. under shade as well as sun.
26 F	177.2	..... ;	.....	Sample dried within 15 & 10 hrs. under shade & Sun.
27 F	311.9	$Y = 11.8308 - 7.1629 X;$	$Y = 9.6898 - 5.6009 X$	.....
28 F	99.2	..... ;	.....	Sample dried within 24 hrs. under both side and sun.
<i>Samadara indica</i>				
34 I	255.2	$Y = 4.2121 - 1.9498 X;$	$Y = 6.5287 - 3.3621 X$	.....
35 I	339.2	$Y = 7.1851 - 3.7593 X;$	$Y = 7.2326 - 3.8473 X$	.....
<i>Bombax malabaricum</i>				
3 B	99.2	$Y = 13.4338 - 8.4378 X;$	$Y = 6.8919 - 3.5497 X$	.....
4 B	120.5	$Y = 8.8708 - 4.8529 X;$	$Y = 8.6996 - 4.8705 X$	.....
<i>Alstonia sholaris</i>				
5 B	163.0	 ;	$Y = 14.3141 - 9.1386 X$	*Sample dried within 24 hrs. under shade.

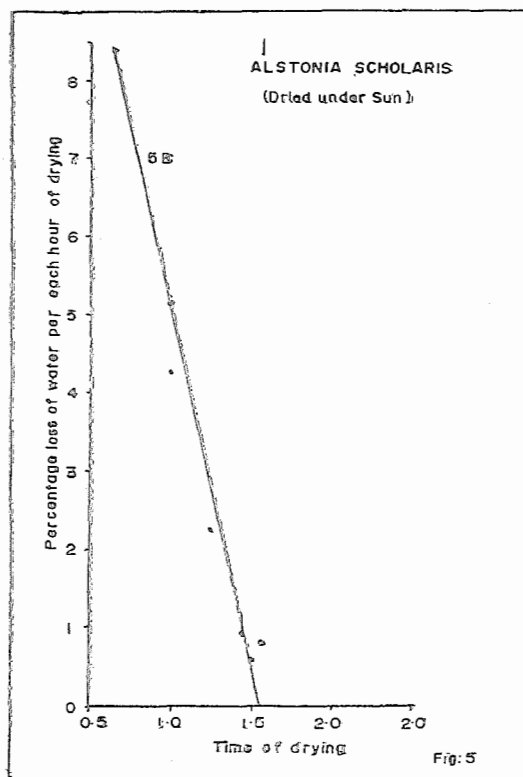
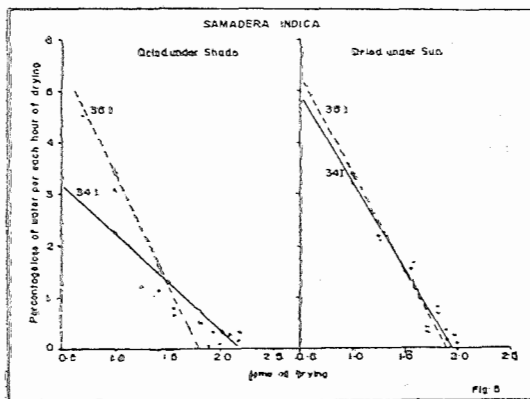
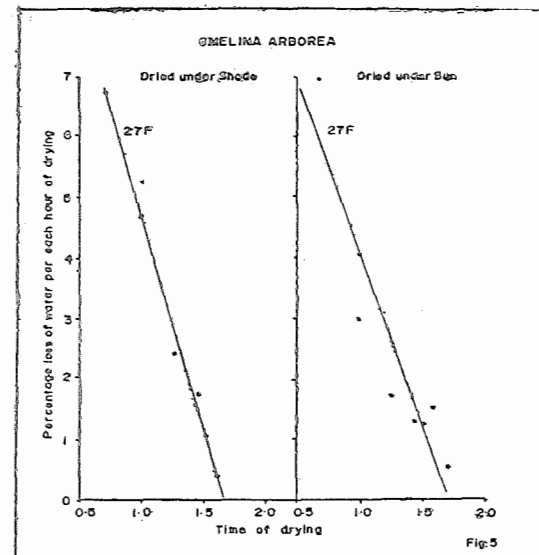
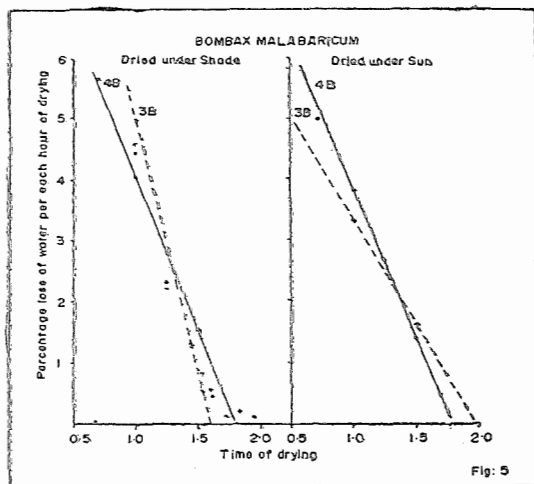
Note: Y = Average percentage of loss of water for each hour.
X = log. of hours. (drying time)

TABLE III: AMOUNT OF WATER ABSORBED AFTER 235 HRS. OF CONTINUOUS IMMERSION

Name of material of the float	Code No., Volume & shape of the float	Quantity of water absorbed within 235 hrs. in gms.	Calculated amount of water absorbed for 1000 cc of material in gms. at saturated point.
<i>Alstonia scholaris</i>	5 B: 163.0 cc. Long triangular in cross section	56.7	348.0
<i>Bombax malabaricum</i>	3 B: 99.2 cc. Flat spindle shaped	70.9	715.5
	4 B: 120.5 cc. „ „	70.9	588.4
<i>Erythrina indica</i>	14 D: 63.8 cc. Round small cylinders	57.3	898.4
	13 D: 63.8 cc. Thin flat with round edges	35.4	555.5
	12 D: 258.1 cc. Long and flat with round edges	134.6	521.6
	11 D: 963.9 cc. Long and flat with round edges	431.3	447.5
	17 D: 262.2 cc. Long triangular in cross section	134.7	513.5
	15 D: 758.3 cc. Flat rectangular	361.4	476.6
	16 D: 800.9 cc. Flat rectangular.	311.9	389.3
<i>Gmelina arborea</i>	23 F: 63.8 cc. Long cylindrical	35.4	555.6
	24 F: 135.7 cc. Triangular block	56.9	419.2
	28 F: 99.2 cc. Oblong flat on one side and round on other	42.5	428.5
	27 F: 311.9 cc. Semitriangular block	60.2	193.1
	25 F: 148.8 cc. Semirectangular block (Flat)	42.5	285.7
	26 F: 177.2 cc. Semirectangular block (Flat)	35.4	200.0
<i>Samadara indica</i>	34 I: 255.2 cc. Long cylindrical	106.3	416.6
	35 I: 339.5 cc. Long cylindrical.	155.9	459.2

1	2	3	4	5	6	7
VOL. IX No. 2 1972	'Shiveni'	<i>Gmelina arborea</i>	35.43	Mysore	Drift nets	23 F: Long and cylindrical L=30.0; D=2.5 to 3.0
			93.12			24 F: Triangular piece L=9.0; B=4.0; T=8.0
	'Shivani'	-do-	56.70	Maharashtra	Gill and drift net ('Hoga' and 'budi jal')	28 F: Oblong flat on one side and round on the other side. L=16.5; B=5.5; T=12.0
			141.75		Bottom set gill nets ('Khandali jali')	27 F: semi triangular piece L=11.0; B=8.0; T=2.0
	'Shevan'	-do-	63.78	Gujarat	Bottom Set and drift nets ('Dhakal & valli Jala')	25 F: Small-rectangular and flat. L=10.3; B=8.3; T=3.0
			63.78			26 F: -do- L=11.0; B=8.0; T=2.0
	'Karingotta'	<i>Samadara indica</i>	205.55	Kerala	Gill and drift nets ('Aila and Mathichala vala')	34 I: Long and cylindrical L=30.0; D=3.5
			134.66			35 I: -do- L=30.0; D=3.8

L = Length; B = Breadth and T = Thickness; D = Diameter.



Erythrina indica: The table IV as well as Fig. 5 reveal that within the floats having identical volume (13 D & 14 D) the flat one is found different in drying quality than cylindrical one. The shape and area of exposure mainly controls the property when exposed for drying in both shade and sun.

Gmelina arborea: The samples of this material have got the same property in drying earlier except one, (i.e) 27° F, which takes long time mainly due to its shape and volume.

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