FUNDAMENTAL STUDIES ON SPHERICAL GLASS FLOATS FOR FISHING NETS (3)

On the Point at which Floats are broken by External Water Pressure

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According to Saito's report[1] concerning experiments with the trawl net around the bay of Otaru, 4 pieces of 4 SUN nominal size glass floats among 50 pieces fixed to the trawl net, which corresponded to 8 %, were broken by water pressure between the surface of the sea and 820 m depth.

Assuming a glass float as an ideal true ball, external breaking pressure is simply calculated by the next equation:[2]

$$p=2ts/r \quad \cdots\cdots (1)$$

where
p: breaking water pressure in kg/cm^2
t: thickness of a glass float in cm
s: breaking compressive stress in kg/cm^2
r: radius of a glass float in cm

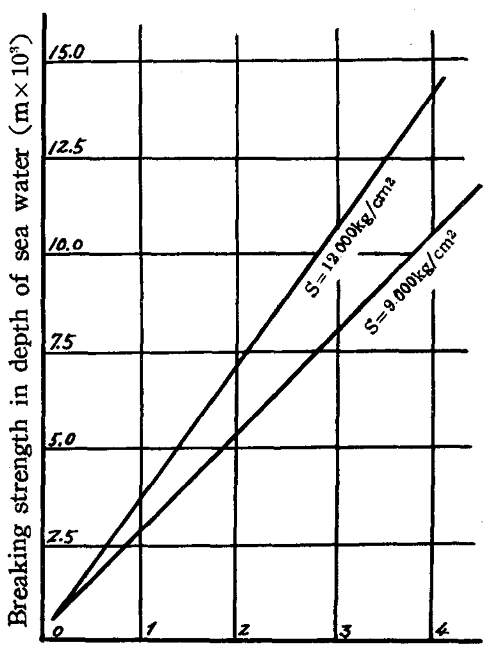

Fig.1. The relation between (p) and (t), which is calculated by equation (1)

As the actual value of breaking compressive stress of glass material lies within a range between 9000 and 12000 kg/cm^2, (p) calculated by equation (1) lies also within some range, as shown in Fig. 1. Where (r) is put in the equation as 6 cm and (t) as 1, 2 and 3 mm etc. For instance, a glass float of 1 mm thickness has a range between 300 and 400 kg/cm^2 breaking strength, which corresponds to approximately 3000 and 4000 m depth of sea water, and a float of 2 mm thickness has a range between 600 and 800 kg/cm^2, which corresponds to 6000 and 8000 m respectively.

The fact that a few glass floats fixed on the trawl net have been actually broken at such lower pressure than the calculated, suggests that some serious causes influenced these incorrectnesses. In order to make these causes plain, the authors tried to test the actual breaking pressure of as many 4 SUN nominal size glass floats in a pressure testing vessel, as shown in Fig. 2, and observed the breaking conditions of them. In the first case, measurement was made of the breaking pressures of 12 floats respectively, which were sampled at random from among 100 pieces. The results are shown in Table 1, and it was found that the breaking strength by water pressure of these glass floats was spread within a considerably wide range. It appeared that the weak points of them lay in the plugs or the areas around the plugs, as shown in the right-hand Fig. 3.

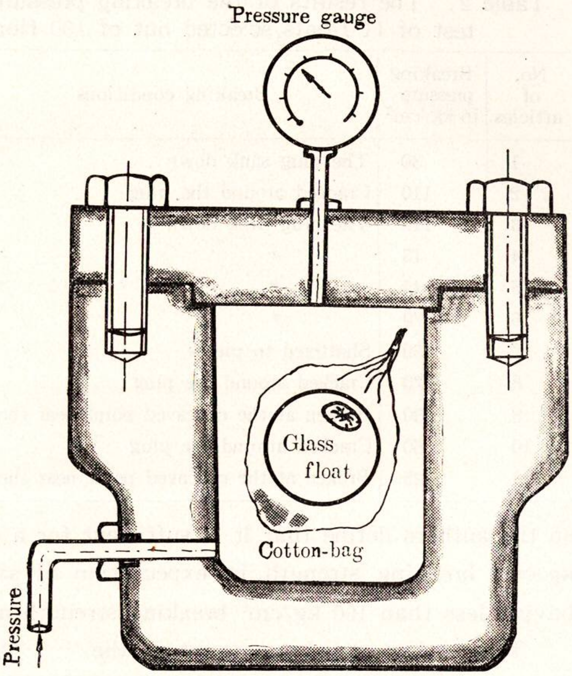

Fig. 2. Sketch of the pressure testing vessel

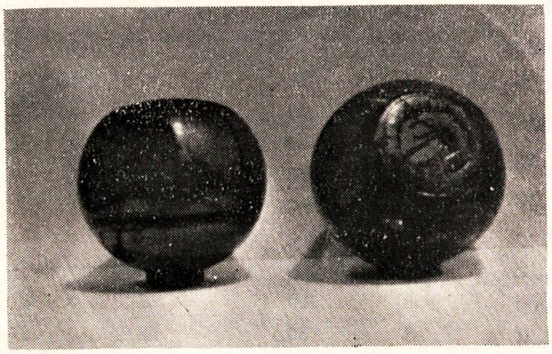

Fig. 3. An example of the breaking conditions around the plugs (right) and of the glass floats having flat or concaved surfaces around the plugs (left)

Table 1. The results of the breaking pressure test of 12 floats sampled at random among 100 floats

No. of articles	Breaking pressure in kg/cm²	Breaking conditions
1	460	Unbroken
2	180	Shattered to pieces
3	390	Shattered to pieces
4	430	Unbroken
5	210	Shattered to pieces
6	150	The plug sank down
7	40	Cracked around the plug
8	440	Broken at the blowhole
9	220	The plug sank down
10	75	Cracked around the plug
11	700	Unbroken
12	300	Cracked around the plug

Where a plug is used to fill up the hole of a glass float which is made when a blast tube[3] is pulled out. In the case of filling up the hole by the plug, slight push makes a flat or concave surface close around the hole. Then tests were made of the breaking pressures of 11 glass floats which were selected out of 100 and had considerable flats or concaved surfaces around the plugs, as shown in the left-hand Fig. 3. The results are shown in Table 2. These glass floats

Table 2. The results of the breaking pressure test of 11 floats selected out of 100 floats

No. of articles	Breaking pressure in kg/cm²	Breaking conditions
1	30	The plug sank down
2	110	Cracked around the plug
3	110	The plug sank down
4	15	〃
5	45	〃
6	170	〃
7	150	Shattered to pieces
8	70	Cracked around the plug
9	30	Broken at the concaved point near the plug
10	60	Cracked around the plug
11	125	Broken at the concaved point near the plug

were broken at lower pressure in comparison with the other approximately spherical glass floats.

As the trawl net is commonly towed at depths within 200 m in sea water, a glass float having more than 20 kg/cm² breaking strength would seem reasonably certain not to be broken. But the trawl net is operated repeatedly and sometimes towed at more than 200 m depth, so the authors define that it is sufficient for a glass float to have more than 100 kg/cm² breaking strength in expectation of safety factor. In other words, floats having less than 100 kg/cm² breaking strength are unsatisfactory.

The authors tried to ascertain the percentages of bad ones in the 4 SUN float stock manufactured at a certain glass works in Hakodate. Eighteen bad ones were found among 140 floats sampled, and the number in the stock was estimated at about 300 pieces. They were alltested in the pressure testing vessel, and the results were shown in Table 3, where 11 pieces among them had less than 100 kg/cm² breaking strength of pressure. Accordingly it is concluded that the estimate of the percentages of the bad glass floats among the stock is between 3.9 % and 14.7 %, with confidence limit 98 %.[4)]

Table 3. The results of the breaking pressure test of 18 bad floats selected out of 140 floats

No. of articles	Breaking pressure in kg/cm²	Diameter of the flat surface in cm	Breaking conditions
1	35	47	Sank down
2	50	56	Cracked
3	65	53	〃
4	60	50	〃
5	260	Blowhole	〃
6	200	Crooked float	〃
7	150	44	〃
8	100	56	〃
9	30	52	〃
10	125	50	〃
11	150	51	〃
12	30	54	〃
13	120	50	〃
14	100	Concaved	Sank down
15	150	49	Cracked
16	90	54	〃
17	50	51	〃
18	75	54	〃

Literature cited

1) Saito, I. & Mishima, S. (1950). [On the fish ground, fishing gear of the trawl net and its fishery] *Hokubu Nihonkai Shinkai Gyoden Chosa Hokoku* **2**, 56–57. (in Japanese).

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