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ANALYSIS OF THE ABILITY TO LIFT A BALL BUOY USING COMPOSITE PARTICLES (*Ketapang Leaf*)

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ABSTRACT

The ability to lift a ball buoy is the resilience of a buoy unit to maintain itself to float above the water surface, so that it can be used as a barrier device between regions, knowing the height of surface water waves, early detection and so on. Spherical floats are hollow circular buoys with the inner chamber having air space as a buoy to avoid sinking. By giving mass of air inside the buoy, it will provide the ability of a buoy to maintain itself above the water surface. With the less air contained in the float cavity, will give less ability to defend itself above the water surface. Composite buoys are an easy, inexpensive and effective way to obtain buoys shaped with materials owned by nature around us. Making buoys using composites is an effective and efficient way, as well as providing great added value in utilizing leaf waste around us.

Keywords: abilities, ball float, composites, effective, particle.

1. INTRODUCTION

Buoy is a set/unit of material formation in a cylindrical geometric shape with an air cavity in it, so it has the ability to maintain itself to float above the water surface used for a number of specific purposes. The purpose of the buoy is as a means of personal safety on the surface of the water, as a barrier between sections, as knowing the height of the surface of the water and others [1-5]. A material will experience floating conditions, that is, objects that have a specific gravity (SG) <1. In the material to be used in floating conditions, the process of forming a part that can hold the air as the ability / self-defense to float or form a part of the material in such a way as not to sink. Materials commonly used as buoys are materials which generally have a smaller density than water, namely: plastic, Styrofoam, fiber, synthetic, rubber, and so on [6-10]. The material is more likely to float under normal conditions, even without forming in such a way or in the form of air-filled cavities. In some conditions of necessity and development of knowledge, there are many uses of buoys. The use of a common buoy is used as a tool to save yourself while in the pool, where to learn to swim at an early stage, it needs a buoy. In other conditions, buoys are used as self-protection on ships, airplanes, and transportation equipment that require as a means of personal safety in water. Some buoys are commonly used in the form of jackets, life buoys, boards and so on [11-13]. Material buoys made of plastic are very commonly used and obtained, and many produce them with these materials. The ease of obtaining plastic seed material as a buoy is one of the factors that can produce mass, with consideration of efficiency and economical aspects. In the formation of plastic as a buoy requires design, equipment, temperature and integrated air injection as a whole, so that it requires a considerable cost in production [14-16].

Styrofoam material as a buoy is only used in certain parts, where the material is more flat plate. For buoys that are commonly used are buoy jacket-shaped. Styrofoam entered in the form of a jacket that has been available as a practitioner filler. Very rarely Styrofoam material in cylindrical geometry as a float. Rubber material was chosen as a float, because it can be filled with air media in the sockets, so that it can accommodate a very large amount of air as the ability to float on the surface of the water so it does not sink. Rubber buoys are special buoys made by industry with a large enough cost. Rubber floats cannot be directly used, where the hollow part must first be filled with air. Rubber material is widely used as a buoy because it has high elasticity, is easy, can hold as much air as possible, and can be spherical, torus or cylindrical [17-18].

Plastic float material, Styrofoam, and rubber are materials that are used from natural and artificial products. the greater the development and advancement of technology are felt by all of us, where one in making cylindrical buoys that are geometrically shaped can be done manually, and the results are quite good. Some buoys that have been developed are buoys with synthetic materials, fiber, and others. Spherical, torus or cylindrical buoys can be made with appropriate technology without eliminating the purpose and benefits of the units made. Utilization of other materials can also be used as a buoy material, such as composites, where our nature very much has a composite. Composite material can be in the form of

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leaves, stems, or roots of trees that have passed their productive period. Utilization of composites that has passed its productive period is very meaningful as waste utilization, where waste which is considered detrimental and has no value can be used as useful goods. Dry leaves as waste from nature can be used as a ball-shaped float [19-20]. The purpose of this study is to make and analyze the ability of buoys made of composite material (*ketapang leaf*), in order to obtain effective and efficient results, as well as provide great added value in utilizing leaf waste around us.

2. RESEARCH METHODS

The research method used in this study can be done from beginning to end with the description of the research flow in Figure-1.

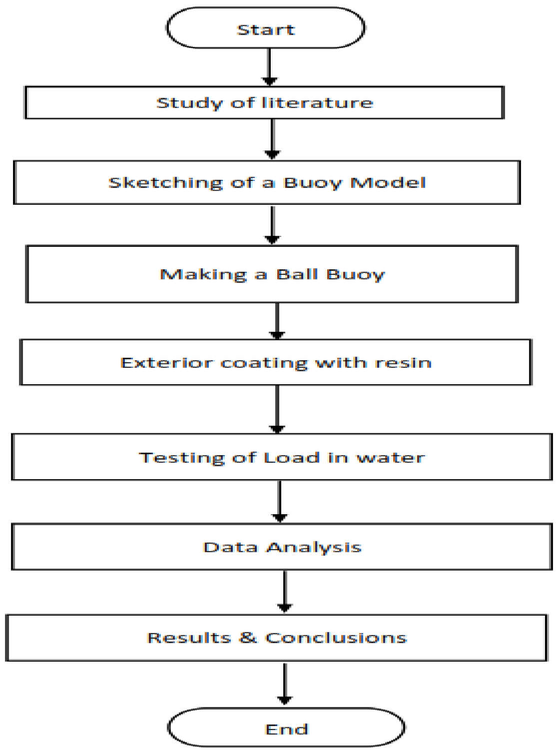

Figure-1. Schematic research methodology.

In this study, conducted a literature study to obtain information about spherical buoys and made designs. To makes a ball float with an inner diameter of 24 cm, a ball float thickness of 2 mm, and an outer diameter of 24.4 cm. Followed by making a ball float, the authors prepare a composite material (*ketapang leaf*) that has been smooth (from the refinement process) and then given a PVaC additive with a ratio of 2: 1 (additive: composite). Mix evenly from the material and form according to the ball pattern that has been prepared. After the ball is formed, it is dried until it hardens. After hardening, the ball is then coated with resin until it is evenly distributed and then dried until it is completely dry. The buoy that has dried, then is marked with a size line using a permanent marker that is used to determine the buoyant force when given a load. The author tests the ball buoy by giving a load starting from 250 - 3900 gram. After being given a load, the ball bouncer will see a floating line. The greater the buoyancy load exerted, the greater the buoyancy force exerted by the ball float. The ball buoy test can be seen in the Figure-2. The author takes the test data and continues with the calculation of the buoyancy that occurs in the ball buoy.

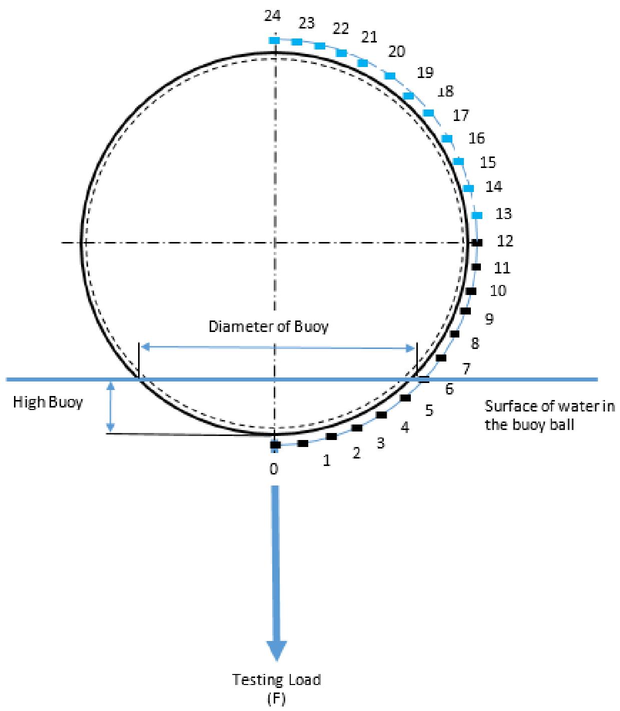

Figure-2. Ball buoy testing scheme.

3. RESULTS AND DISCUSSIONS

This ball shaped float made of composite was tested in a water bath which had dimensions of 55 cm × 37 cm × 25 cm, with full water. When not given a load (empty without load), the buoy can float freely following the waves of water contained in a water bath. This test is carried out with 5 (five) trials of each load condition to the ball buoy. The author takes the average value as the representative value of the ball float test. As for the test data from the ball float can be seen in Table-1.

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Table-1. Giving and height of ball life data.

No	Load (gr)	Ball height from water surface (cm)					Average height (cm)	Information
		1	2	3	4	5		
1	0	3.0	3.0	3.5	4.0	4.0	3.50	Empty load
2	250	7.0	7.2	7.5	7.0	7.5	7.24	Object not sink
3	500	7.8	8.0	8.0	7.8	7.8	7.88	Object not sink
4	750	8.7	8.8	8.7	8.5	8.7	8.68	Object not sink
5	1000	9.1	9.2	9.1	9.0	9.2	9.12	Object not sink
6	1250	9.7	9.6	9.6	9.5	9.6	9.60	Object not sink
7	1500	10.1	10.0	10.0	10.1	10.0	10.04	Object not sink
8	1750	10.5	10.5	10.6	10.5	10.4	10.50	Object not sink
9	2000	11.0	10.9	10.9	11.0	11.0	10.96	Object not sink
10	2250	11.5	11.6	11.5	11.6	11.6	11.56	Object not sink
11	2500	12.1	12.2	12.2	12.1	12.2	12.16	Object not sink
12	2750	12.7	12.7	12.8	12.7	12.7	12.72	Object not sink
13	3400	16.3	16.0	16.0	16.5	16.0	16.16	Object sink
14	3650	19.5	19.3	19.5	19.3	19.0	19.32	Object sink
15	3900	24.0	24.0	24.0	24.0	24.0	24.00	Object sink

In Table-1, it can be seen that the ball buoy at the beginning was not given a load. In the no-load (empty) state of the ball float in the water tank, it decreases, because the gravity force possessed by the ball float with a value of 3.5 cm. Furthermore, the authors conducted the test by giving loading to the ball float of 250 gr (0.25 kg). In ball floats decreased in height by 7.24 cm. From the load given to the buoy, the load that is in the water reservoir does not sink. It floats between the surface and the bottom of the reservoir. Next, the writer adds several loading variables to the ball float. From the addition of a load of 500 gr, 750 gr, 1000 gr, the ball float also increased in height from the ball float, namely by 7.88 cm, 8.68, cm and 9.12 cm. Also from the tiered gift, the load is still between the surface of the water and the bottom of the water tank (float). The author continues to load the ball buoy, which is 1000 gr (1 kg) up to 2500 gr (2.5 kg), where the increase in ball buoy height continues to increase from 9.12 cm to 12.16 cm, where the buoy is located at midpoint of the ball (float ball sinks ½ circle ball). At a given load is still between the surface of the water and the bottom of the water bath. Furthermore, the authors conducted tests that were not added in addition to 250 gr, namely the addition of 2750 gr (2.75 kg), 3.4 kg, 3.65 kg, 3.9 kg. On this addition, there was a significant change in buoyancy height and the load was at the bottom of the water bath (a submerged object). At the loading, the height of the ball float, namely: 12, 72 cm which has passed the midpoint of the ball float, 16.16 cm where the ball float has skunked about 75%, and at a height of 24 cm, where the water surface is the same as the surface of the ball buoy.

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Table-2. Diameter and height of the float ball of Tembereng.

No	Load (kg)	Average side of a buoy(cm)	Tembereng diameter (cm)	Tembereng high (cm)	Information
1	0	3.5	6.6	0.8	Object not sink
2	0.25	7.24	12.2	3	Object not sink
3	0.5	7.88	12.8	3.4	Object not sink
4	0.75	8.68	13.5	4	Object not sink
5	1	9.12	14	4.5	Object not sink
6	1.25	9.6	14.4	5.1	Object not sink
7	1.5	10.04	14.6	5.3	Object not sink
8	1.75	10.5	14.9	5.8	Object not sink
9	2	10.96	15.1	6.2	Object not sink
10	2.25	11.56	15.3	6.9	Object not sink
11	2.5	12.16	15.5	7.7	Object not sink
12	2.75	12.72	15.3	8.3	Object not sink
13	3.4	16.16	12.7	12	Object sink
14	3.65	19.32	8.9	14.1	Object sink
15	3.9	24	0	15.3	Object sink

In Table-2, the author shows the results of tests that have been carried out loading will provide data on the diameter and height of the ball float, by making a full circle and drawing a perpendicular line to the ball float (can see in Figure-4). In table 2 shows that the heavier the burden is given will provide a high and large tin.

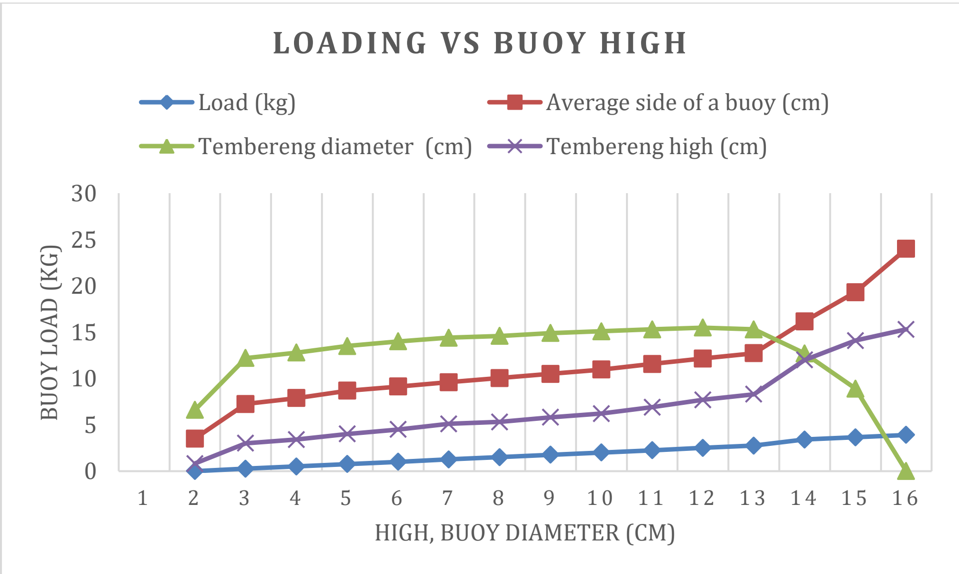

Figure-3. Loading versus buoy high.

Figure-3 presented are periodical loading gives the height of the ball buoy getting down from the surface (the higher the height value). Giving a load on the ball the greater the diameter of the ball buoy will be greater. Where is the greatest when in the middle of the diameter of the ball, which is 15.5 cm, after passing the midpoint of the ball, the diameter will decrease and is followed by the height of the ball buoy sinks that are getting biggest.

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Table-3. Ball buoy area.

No	Load (kg)	Average side of a buoy(cm)	Tembereng diameter (cm)	Tembereng high (cm)	Information
1	0	16.5792	6.6	0.8	Object not sink
2	0.25	114.924	12.2	3	Object not sink
3	0.5	136.6528	12.8	3.4	Object not sink
4	0.75	169.56	13.5	4	Object not sink
5	1	197.82	14	4.5	Object not sink
6	1.25	230.6016	14.4	5.1	Object not sink
7	1.5	242.9732	14.6	5.3	Object not sink
8	1.75	271.3588	14.9	5.8	Object not sink
9	2	293.9668	15.1	6.2	Object not sink
10	2.25	331.4898	15.3	6.9	Object not sink
11	2.5	374.759	15.5	7.7	Object not sink
12	2.75	398.7486	15.3	8.3	Object not sink
13	3.4	478.536	12.7	12	Object sink
14	3.65	394.0386	8.9	14.1	Object sink
15	3.9	0	0	15.3	Object sink

Table-3 shown diameter of the ball float starts without loading until the ball float is equal to the water surface. Addition given to the ball buoy occurs a significant increase at the midpoint of the ball buoy.

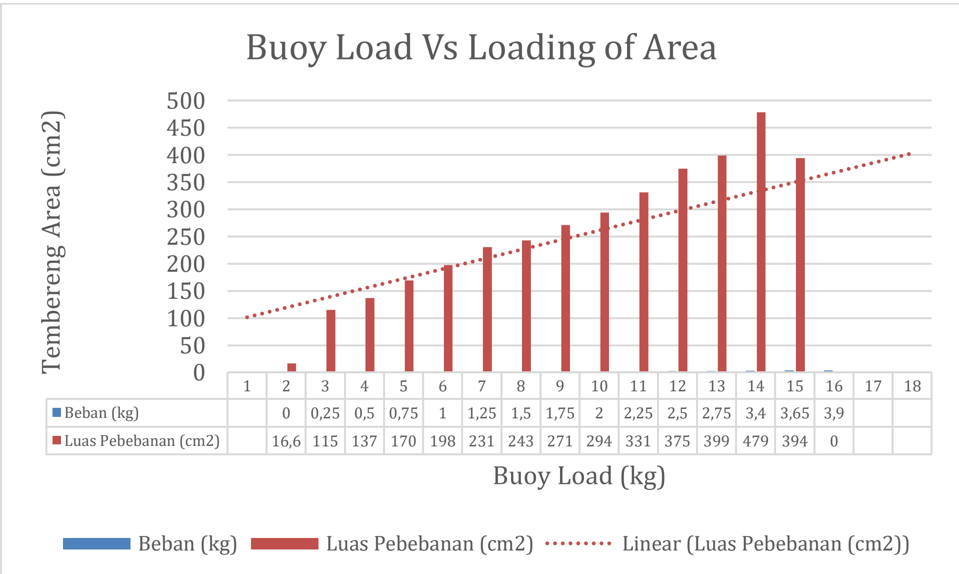

Figure-4. Buoy load versus loading of area.

Figure-4, illustrated that load starts from 0 (no load) to a load of 3.9 kg. In Figure-4, the area of a ball float given a loading is not too significant, i.e. the area of 0 kg to 1 kg. In this area the linear line in the area of the ball float is still under burden. However, after loading 1 kg to 3.9 kg, the ball buoy area is getting bigger and above the linear line of the ball buoy loading area. This shows the surface area of the ball buoy can withstand higher loads than it should. The largest surface area of the ball float is at 3.4 kg and here the load given to the buoy is not between the surface of the water and the water tank (sink).

Table-4. Buoy force.

No	Load (gr)	Loading of Area (cm2)	Buoy Force (gr/cm2)	Information
1	0	16.58	0.00	Object not sink
2	250	114.92	2.18	Object not sink
3	500	136.65	3.66	Object not sink
4	750	169.56	4.42	Object not sink
5	1000	197.82	5.06	Object not sink
6	1250	230.60	5.42	Object not sink
7	1500	242.97	6.17	Object not sink
8	1750	271.36	6.45	Object not sink
9	2000	293.97	6.80	Object not sink
10	2250	331.49	6.79	Object not sink
11	2500	374.76	6.67	Object not sink
12	2750	398.75	6.90	Object not sink
13	3400	478.54	7.11	Object sink
14	3650	394.04	9.26	Object sink
15	3900	0.00	0.00	Object sink

In Table-4, seen by giving a periodic load, then the buoy ball will also do the buoyancy force from the given load. A float ball without a load gives the buoyancy force (float) the ball at 0 gr/cm^2. By giving loading to the ball buoys from 250 gr (0.25 kg) to 3900 gr (3.9 kg) gives a great buoyancy buoy force as well.

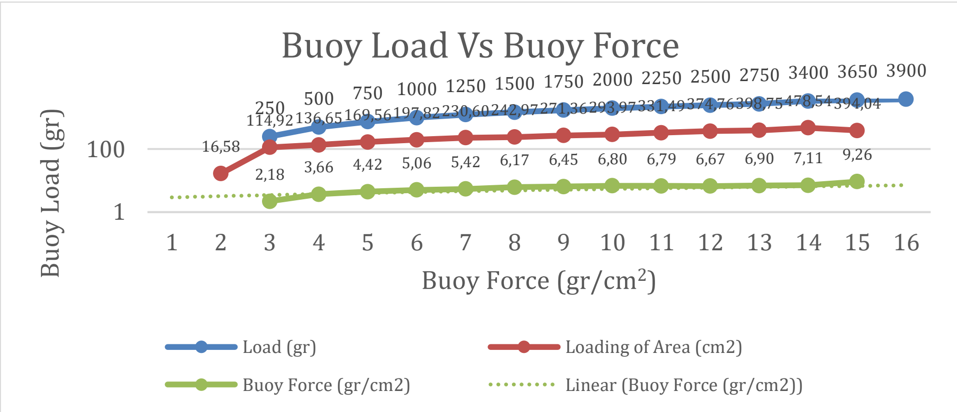

Figure-5. Ball buoy force.

In Figure-5, you can see a graph of loading starting from 250 gr - 3900 gr, which produces a buoy force to be able to maintain itself so it does not sink. The buoy force is the weight given to the ball float in direct proportion to the ball float cross-sectional area. From these results it is seen that the ball buoy experiences a greater force with the addition of its loading. The line trend of the ball buoy force is getting bigger and increasing, starting from 2.18 gr/cm^2 (0.25 kg) to the greatest of the load testing of 3.9 kg is 9.26 gr/cm^2.

4. CONCLUSIONS

From the testing and analysis, conducted on ball buoys with composite materials, it can be concluded that: making ball buoys from composite materials can be made effectively, efficiently, easily and cheaply. The ability of the ball buoy force to defend itself so that it does not sink in the water is quite large, namely by giving a load of 3.9 kg on a float ball diameter of 15.5 cm produces a buoyancy force of 9.26 gr/cm^2.

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