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Ketinting Engine Alternator Cover Design Using Overval Locking Mechanism To Facilitate The Opening And Closing System With Fiberglass Reinforced Composite Material

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ABSTRACT: *Cover on an alternator has a very important role because the cover can be able to protect the components that are underneath, in the absence of a cover then the safety of these components will be threatened by objects that can damage it. Therefore, it needs a cover with a strong and durable material, composite materials can be an option to replace conventional metal materials because composite materials have advantages such as corrosion resistance, light weight and easy to form. Composite manufacturing method there are several kinds but in this study used is the method of hand lay up. There are three variations in the percentage of fiberglass given and the average value obtained from the impact toughness test at the percentage of 20% of 13.28 Joules, for the percentage of 30% of 15.03 Joules, and at the percentage of 40% of 17.25 Joules. While the impact price at the percentage of 20% obtained a value of 13.42 Joules/cm2, at the percentage of 30% of 14.71 Joules/cm2, and at the percentage of 40% obtained a value of 17.09 Joules/cm2. The value of impact toughness will continue to increase in line with the increase in the percentage of fiberglass provided. In the process of calculating the effectiveness of locking obtained calculation results showing that overval locking is more effective when compared with nuts and bolts when viewed from the time and ease of opening and closing system. However, in this study the cost of making the cover with iron plate material is cheaper when compared with fiberglass composite material, iron plate material costs Rp166, 000.00 while fiberglass composite material costs Rp 67, 000.00.*

NOMENCLATURE

Symbol	Description	Unit
A	Area	m^2
E	Absorption energy	*Joule*
HI	Impact number	*Joule*/mm^2
g	Gravitation	*m/s2*
λ	Swinger arm distance	*m*
m	Pendulum weight	*kg*

Greek letter

Subscripts

β	Pendulum end position angle
α	Pendulum starting position angle

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I. INTRODUCTION

The rapid development of science and technology (IPTEK) has brought great changes to human civilization. Humans who used to still use traditional methods switched to the use of sophisticated tools that greatly facilitate humans in completing work easily and quickly (Ratela et al, 2018). In the agricultural sector, for example, traditional communities that use simple agricultural tools and rely on the physical strength of humans or animals to plow agricultural land today have used agricultural machinery that is sophisticated and easy to operate. Likewise with the fisheries sector, fishermen who previously used oars or layers now use

machines as movers or fishing gear which greatly facilitates fishermen in fishing and catching fish.

Mentioning the word "Fisherman", especially traditional fishermen, people will always associate it with a life that is difficult and mediocre. This condition illustrates how poor the life of traditional fishermen is. In reality, the living conditions of fishermen, especially traditional fishermen, are indeed poor. Even though the coastal and marine potential is so large where the Indonesian sea is among the most extensive in the world (Suartika et al, 2020). The use of multipurpose machines or tinting machines is still the main mover for fishing boats, this is because the price is affordable and maintenance is also not difficult, and spare parts are easy to obtain making versatile machines very popular among traditional fishermen. The tinting machine is modified in such a way as to connect a long propeller shaft to continue engine power so that the propeller can be below the surface of the water and the engine remains on the boat (Sayyid et al, 2018).

Wawan (2021) in his research entitled "Modification of the Ketinting Machine by Adding an Alternator to Serve the Power Needs of Traditional Fishermen's Lights at Night" stated that the modification of the tinting machine by adding an alternator aims to help the fishing community in meeting the power needs of lights for lighting when carrying out fishing activities at night. The tinting machine is coupled with a pulley on its long shaft, and the pulley is connected to the alternator using a V-belt, so that when the tinting machine is turned on, the alternator will rotate and will charge the battery or battery.

Modifications that have been made, especially on the alternator cover, still have shortcomings, including materials. The material used is an iron plate where the iron plate has a high corrosion rate, especially for use at sea. The locking mechanism still uses bolts with a diameter of 10 mm. This makes the alternator cover require a key to open or close, so fishermen must carry several keys when going to sea to anticipate damage to the electrical system. Therefore, research on "Design and Build Alternator Cover of Tinting Machine Using Overval Locking Mechanism to Facilitate Open and Close System with Fiberglass Reinforced Composite Material" needs to be carried out to perfect previous research.

II. RESEARCH MATERIALS and METHODS

The materials used in the study were fiberglass, polyester resin, catalyst, G glue, burnt glue, overval, and iron paint, putty, paper insulation. While the tools used include: sandpaper, grinding, scissors, sororng range, brush, ruler, software inventor, and marker. Related to the research procedure will be explained as follows.

The research procedure starts from making impact test specimens, impact testing, and making alternator covers.

Impact Testing Specimen Making

Impact testing specimen bolting starts from making molds in accordance with the provisions in impact testing. The first step is to form wood with a standard size of ASTM D 265 with a length of 55 mm, a width of 10 mm, and a height of 10 mm. Then make a container with infraboard as a place to pour silicone rubbre which is the basic material in making the mold. Next is to put the formed wood into the infraboard container, then mix silicone rubber with a catalyst and stir until smooth. After that, silicone rubber is poured into a container and waited for it to dry. After the mold is dry, the next process is to cut and measure the fibers that will be used to make specimens, namely with percentages of 20%, 30%, and 40%. Next, the resin and catalyst are mixed according to the dosage, then the resin and fiber are put into the mold until the mold is fully filled. And the last process is to dry the specimen by drying it in the sun. An image of an impact toughness test specimen can be seen in figure 1.

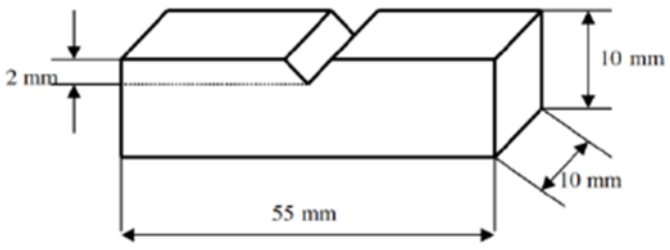

Figure. 1 Impact testing specimens

Impact Testing

After the specimen is completed, the next process is the impact testing process. The first step is to measure the specimen according to the standard size of the test. Measurements are made using a caliper, after which it is continued by making notches on the specimen using a miser. Next, the pendulum is raised according to a predetermined angle (α) and recorded on the pointing needle. The test specimen is placed on the anvil

straight, then the pendulum is released and the angle (β) on the pointing needle is observed and recorded on the impact test results table.

Equations in Impact testing;

1. Absorption energy

$$E = m.R.(\cos ß - \cos α) \quad (1)$$

2. Impact number

$$HI = \frac{E}{A} \quad (2)$$

After the data retrieval process is complete, the data that has been recorded will be calculated so that the impact resilience value is obtained. The best impact toughness value will be used as a sample in making the alternator cover.

Alternator Cover Manufacturing

Before making an alternator cover, first prepare a work plan starting from the design process, manufacturing process, finshing process to testing. The work steps in making alternator covers with fiberglass reinforced composite materials are as follows:

1) Preparation

The first step in a work plan is the preparation process. The preparations made in this study are as follows: Alternator cover design The design of this alternator cover is carried out using the Inventor 2021 application to make a design design and dimensions of the cover to be made. Preparation of tools and materials At this stage, the preparation of tools and materials to be used in the manufacture of alternator covers is carried out.

2) Mold Making

After the tools and materials are collected, the next stage is mold making. The steps in making this mold are as follows: Printing design drawings that have been made, printing these images is done as a basic guideline in the pattern making process. Make a pattern on used cardboard using a marker according to the size in the design drawing. Then cut the pattern that has been made using scissors or other tools. Next, the cut parts are assembled into one whole piece using paper insulation and burnt glue.

3) Alternator Cover Manufacturing

After the mold is finished and ready for use, the next step is the process of making the alternator cover. The steps in making the alternator cover are as follows: Measuring and cutting fiberglass according to the shape of the mold that has been made. Next, the resin is poured on the prepared container. Then the resin and catalyst are mixed to taste and mix thoroughly. Apply a small amount of resin to the mold to glue the fiberglass. Attach fiberglass to molds that have been applied resin. Slowly pour the resin on the fiberglass then flatten it with a brush. The finished cover is dried in the sun.

4) Finishing Process

After the alternator cover is completely dry, it will proceed to the next process, namely the finishing process. The steps in the finshing process are as follows: Cutting and smoothing uneven parts with burrs. Slowly remove the mold on the alternator cover. Clean mold marks by washing them. Re-wash before caulking and drying. Apply putty on uneven surfaces. Uneven surfaces are sanded until smooth. The cover is washed again to clean the residual sanding dirt. Paint and thinner are mixed and then applied to the entire surface with a brush until smooth. The painted cover is then dried in the sun.

III. RESULTS AND DISCUSSION

Impact testing is carried out to determine the amount of energy absorbed by fiberglass composites with percentages of 20%, 30%, and 40%. Impact toughness test results as shown in figure. 2 below.

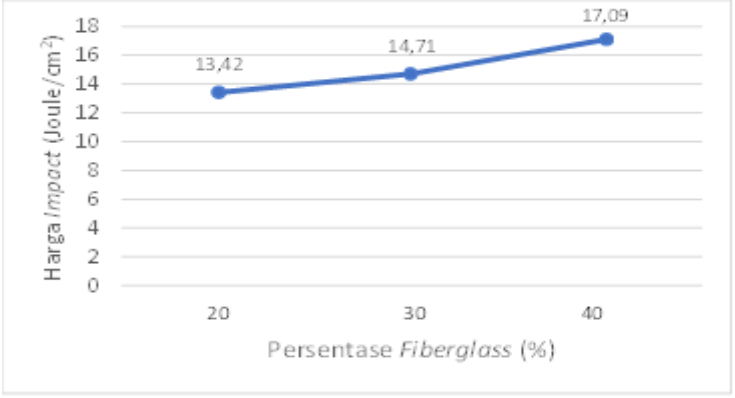

Figure. 2 Impact Resilience Average Value Graph

From figure. 2 above, it can be seen that the value of impact toughness will increase in line with the increase in the amount of fiberglass given. The impact toughness value at a percentage of 20% is 13.42 Joules/mm2, at a percentage of 30% is 14.71 Joules/mm2, the increase in impact price value at a percentage of 20% and 30% is not significant, but at a percentage of 40% the impact price value increases significantly at 17.09 Joules/mm2. From the results of the impact toughness test, it can be seen that the variation in the percentage of fiberglass is very influential on the toughness of the impact produced.

Based on the results of impact testing as shown in table 4.3 above, the bolting of this fiberglass-based alternator cover uses a percentage of 40% fiberglass and 60% polyester resin. This is done because at a percentage of 40% the impact toughness value is stable and has the highest value of other specimens, The steps in making the alternator cover are as follows: Design design. Pattern making. Pattern cutting. Mold assembly process. Fiberglass cutting. Measurement of the amount of resin. Application of resin and fiberglass by hand lay up method. Drying process. Finishing process. Painting.

After all the processes are completed, the results of making the alternator cover with fiberglass reinforced composite material will be obtained as seen in figure. 3 below.

Figure. 3 The result of making the alternator cover

The calculation of locking effectiveness based on the opening or closing time is carried out to measure the time used to open and close the alternator cover. This calculation is done by calculating the opening and closing times using a stopwatch on a mobile phone. Three repetitions were carried out in each experiment to produce a value that could be averaged so that with that value one value could be taken as a reference or level of effectiveness of each experiment. From the calculations, it can be seen that overval locking consumes less time when compared to bolt locking. This can be a reference that overval locking can facilitate the system to open and close without using the help of any tools to open it.

This alternator cover cost comparison is done to compare the cost of making covers from two different materials with different dimensions. The old alternator cover uses iron plate material with a cross-sectional area of 2508.78 cm2 while the new cover or cover made in this study has a cross-sectional area of 3549.64 cm2. Dimensional changes were made to perfect the previous cover because it still could not close perfectly. However, even though the size of the new cover is larger than the old cover, the cost of making a new cover is cheaper than the old cover.

IV. CONCLUSION

Based on the results and discussion above, the following conclusions were obtained:

1. The highest impact toughness value is found at a percentage of 40% with an absorption energy value of 17.25 Joules and an impact price of 17.09 Joules/cm2. While the lowest impact toughness value is found at a percentage of 20% with an absorption energy value of 13.28 Joules and an impact price value of 13.42 Joules / cm2.
2. When viewed from the speed of locking opening and closing times and the ease of opening and closing, overval locking is more effective. Overval locking takes 51.72 seconds to open and close, while bolt locking takes 290.20 seconds. With overval locking, the system opens and closes faster and easier because it does not require assistance from any tools.
3. In addition to the high cost, the process of making covers with iron plate material is more difficult.
4. The cost of making an alternator cover with iron plate material is more expensive when compared to fiberglass reinforced composite materials. Making a cover with iron plate material costs Rp145,183.92 while fiberglass reinforced composite material costs Rp132,900.73.

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