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Testing of fuel consumption and battery charge time on modified traditional fishing boat engines

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ABSTRACT: This study aims to test the fuel consumption and battery charging time of a modified tinting machine. Modifications are made by adding an alternator that functions to supply the power needs of the lamp and charge the battery. Tests are carried out in the laboratory to determine the effect of engine rotation speed on fuel consumption and battery charging time. The engine speed is conditioned at 1500 rpm, 2000 rpm, and 2500 rpm and the battery used is 45 Ah. The test results of fuel consumption have increased 80-90 percent in liters / hour from before modification with after modification, namely at 2500 rpm FC before modification is 0.43 liters / hour and after modification is 0.48 liters / hour. The time needed to charge the battery is influenced by engine speed, namely; At 1500 rpm the charging time is 16 hours 12 minutes, 2000 rpm rotation is 11 hours 2 minutes, and 2500 rpm rotation is 7 hours 15 minutes.Technically, this tinting machine modification can help fishermen's operations at night, but its economic feasibility requires further research.

I. INTRODUCTION

The difficult and mediocre life of traditional fishermen illustrates how poor the life of traditional fishermen is. In fact, the living conditions of fishermen, especially traditional fishermen, are very poor. Whereas on the other hand, the coastal and marine potential is so large where the Indonesian sea is among the most extensive in the world (Suartika, et al, 2020). Fishermen are people whose job is to catch fish or other biota in the waters. The waters that are the area of fishermen's activities can be fresh, brackish or marine waters. In developing countries such as in Southeast Asia or in Africa, there are still many fishermen who use simple equipment in catching fish (Listyawati, 2016; Rubiono and Martaviano, 2020). While fishermen in developed countries usually use modern equipment and large boats equipped with advanced technology (Akhayari, 2018).

Seeing the potential of Indonesia's seas and the results of research on environmentally friendly fishing gear, quality, and fish prices which state that fish prices are strongly influenced by the quality of environmentally friendly fishing gear (Aryasuta, P. C., et al, 2020; Risamasu, F. J., et al, 2019; Hadi, R., et al, 2019). Based on these things, these traditional fishermen actually have the potential to be developed and empowered because they use environmentally friendly fishing gear. Several empowerment and research programs are carried out by the government and universities to improve the economy of coastal communities.Such as the coastal community economic empowerment program (PEMP) launched by the Ministry of Marine Affairs and Fisheries (MMAF) which aims to improve the welfare of coastal communities through the development of economic activities, development of human resource quality and strengthening socio-economic institutions by utilizing fisheries and marine resources optimally and sustainably (Marine and Fisheries Service, 2017). Raleta, et al (2018), in their research replaced the boat propulsion engine which initially used a combustion motor replaced with electric power and an electric motor.The results of the tinting design applied using a wet battery brand Yuasa 100Ah. Batteries as a storage of electrical energy when solar panels stop working. The Charge Controller functions to regulate the voltage released by the battery, regulate the battery from excess charging energy (over charger), prevent excessive energy expenditure (over discharger), and as a safety in short circuit conditions.

Like fishermen in general, fishing activities of fishermen use several types of fishing fleets,

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namely boats without motors, outboard motorboats and motor boats. The difference in fishing fleets and work equipment used by fishermen means that there are differences in technology in catching fish which in this study are grouped into modern technology and traditional technology.Fishermen who use modern technology are characterized by the use of motorized boats as fishing fleets accompanied by a global positioning system (GPS) as a guide and other modern devices. While fishermen who use traditional technology, the fishing fleet used only uses tinting machines and does not use modern technology. This tinting machine is a modified multipurpose machine with a long shaft connecting between the engine and the propeller (Honda, 2021). The function of the long shaft is to keep the propeller position underwater and the engine remains on the boat as shown in figure 1.

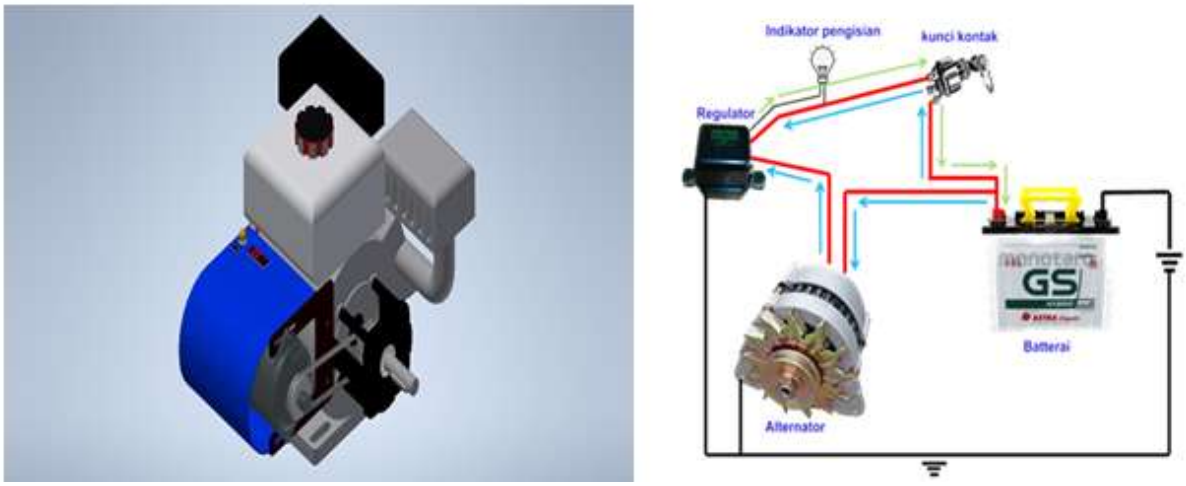

Figure 1. Desain modifikasimesinketinting

To optimize traditional fishermen's operations in the fish season, fishermen go to sea day and night. For night operations require lights and power supplied from the battery on the boat. The problem is when the condition is tired, far away, and also time sometimes makes fishermen forget to charge their batteries when finished using. So that when going to sea at night there is no battery to supply lamp power. To overcome these conditions, what if the tinting machine is made like other motorized vehicles that can charge their own batteries.

Therefore, modify the tinting machine by adding an alternator to help fishermen meet the power needs of lighting at night (Suartika, et al, 2021). In this study, testing the effect of engine modification on fuel consumption and battery charging time will be carried out on a laboratory scale.

II. EXPERIMENTAL SETUP

This study modified the tinting machine designed and then tested fuel consumption and battery charging time. Tests were conducted on engine speed variations of 1500 rpm, 2000 rpm, and 2500 rpm. Fuel consumption data was collected using 50 ml of fuel each experiment and recorded the length of time it took the engine to spend the fuel. FC data retrieval is done before the tinting machine is modified and after it is modified. Data collection of the length of battery charging time is carried out by recording voltage (V) and current (I) every 60 minutes.

Tools and materials used in research are; meter, digital caliper, ammeter, tacho meter, drill machine, stopwatch, Autodesk Inventor software, excell software, alternator, pully, V-belt, and iron plates of 2 and 5 mm thickness. The modified engine specifications are shown in table 1 and the specifications of the battery used have a capacity of 45 Ah, 12 volts, and a lamp load of 45 watts.

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Table 1. Modified tinting machine specifications

Description	Spesifications
Merk	HONDA
Start	Recoil
Power (Hp)	6,9 HP/4500 rpm
Rpm max (rpm)	4500
Torsi (Nm)	26,4 Nm/1500 rpm
Spindle (mm)	20
Dimension (mm)	353 x 374 x 346

Figure 2. Data collection of fuel consumption and battery charging

To determine the charging time of the battery, the equation is used (Nasrah, 2013):

$$tpi = (\frac{Kapasitas\ \ aki}{Arus\ \ pengisian}) + (30\% \times (\frac{Kapasitas\ \ aki}{Arus\ \ pengisian})) \quad (1)$$

Where,tpi is the battery charging time (hours).

Analysis of battery capability can be calculated using the equation:

$$I = P/V \quad (2)$$

Where, I is the current flowing (amperes), P is the load (watts), V is the voltage (volts).

To determine fuel consumption (FC) the equation is used:

$$FC = \frac{Vbb}{t} \quad (3)$$

where FC is the fuel consumption before or after modification, Vbb is the volume of fuel, t is the time it takes to spend 50 ml of fuel.

III. RESULTS AND DISCUSSION

Fuel comsumption

Fuel consumption tests were conducted on three rotation variations with three repetitions. The data taken is the length of time the machine spends 50 ml or 0.05 liters of fuel (Vbb). Then it is analyzed by doing calculations using equation 3.The calculation results of the average time before and after modification are known fuel consumption (FC) at 1500 rpm before modification is 0.29 liters / hour and after modification is 0.33 liters / hour. At 2000 rpm FC before modification was 0.33 liters / hour and after modification was 0.37 liters / hour.At 2500 rpm FC before modification is 0.43 liters/hour and after modification is 0.48 liters/hour as shown in figure 3. The results of the analysis of fuel consumption before and after modification of the three variations of engine speed there is an increase in fuel consumption in the range of 80-90 percent (89%, 89%, 0.90%) which is influenced by high and low engine speeds. The greater the engine speed, the greater the fuel consumption.

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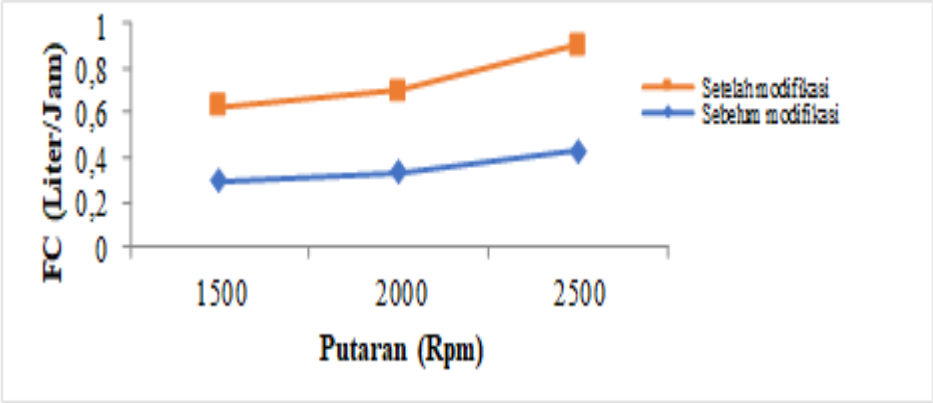

Figure 3. Comparison of fuel consumption (FC) before and after modification

Battery charging

The results of battery charging test data collection with three variations of 1500 rpm (1505, 1498, 1518, 1508 and 1510 rpm), 2000 rpm (2075, 2015, 2023, 2011 and 2001 rpm), and 2500 rpm (2508, 2511, 2501, 2512 and 2506 rpm) carried out every 60 minutes found that the length of battery charging time at each revolution**.**The time required to charge the battery is determined mathematically using equation 1. The calculation of battery charging time (tpi) at each revolution (1500 rpm, 2000 rpm, 2500 rpm) sequentially is 17 hours 57 minutes, 11 hours 46 minutes, 8 hours 52 minutes.While from the results of the experiment, it was found that the battery charging time (tpi) at 1500 rpm is 16 hours 12 minutes, 2000 rpm is 11 hours 2 minutes, and 2500 rpm is 7 hours 15 minutes. There is a difference in battery charging time (tpi) from the results of mathematical calculations with the results obtained from experiments shown in figure 4.

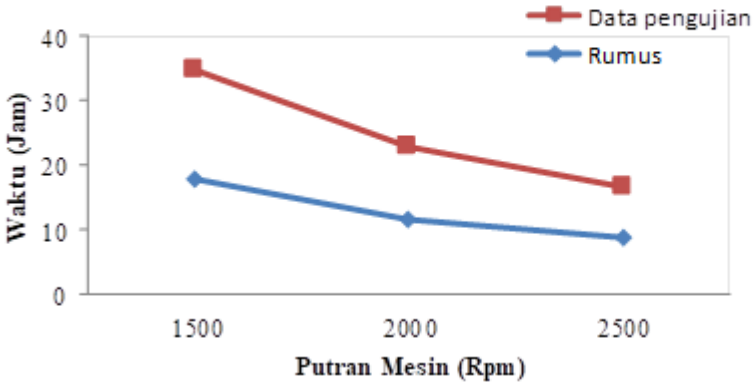

Figure 4. Comparison of battery charging time from mathematical formula calculations with test data on rotation variations of 1500 rpm, 200 rpm, 2500 rpm

Comparison of battery charging time using a mathematical formula with experimental results there are differences. The difference of 1500 rpm is 1.23 hours, the 2000 rpm rotation is 0.57 hours, and the 2500 rpm rotation is 0.99 hours. Based on data analysis and observation, the phenomenon in the field of battery charging time differences is caused by engine speed that cannot be kept constant at the specified rotation and its tendency is above the expected rotation. This condition affects the voltage and current flowing into the battery. Where the greater the engine speed, the smaller the time needed to charge the battery or the faster the battery is fully charged according to the capacity or ability of the battery. For the ability of the battery used in the study if

calculated using equations 1 with 45 Ah, the lamp load is 45 watts, the battery can be used for 8 hours 24 minutes.

IV. CONCLUSION

The test results of fuel consumption have increased 80-90 percent in liters / hour from before modification to after modification. The time needed to charge the battery is influenced by engine speed, namely; At 1500 rpm the charging time is 16 hours 12 minutes, 2000 rpm rotation is 11 hours 2 minutes, and 2500 rpm rotation is 7 hours 15 minutes. Technically, this tinting machine modification can help fishermen's operations at night, but its economic feasibility requires further research.

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