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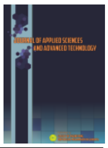

Comparative Analysis of the Amount of Fuel Use for Main Motor 1 in Theory and Reality in the Field During Operation One Trip at KMN. Cahaya Lapawawoi 01

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ABSTRACT

Ships are units used for transportation, logistics industry, fishing units and so on. In its operations, ships use fuel oil to move and reach their intended destination. The fuel oil used includes heavy fuel oil (HFO), medium fuel oil (MFO), and intermediate fuel oil (IFO). The main factors that affect the high and low use of fuel are rotation (rpm) and also the operating time of the main engine. Flowmeter is a measuring tool to determine the amount of fuel oil consumption in the engine. The function of the flowmeter is to measure the volume of liquid that passes through the device so that the total volume of liquid that enters a container / place or machine is obtained. Flowmeter and Tachometer are very helpful in calculating fuel consumption on board. Basically, with the use of high rotation, it can accelerate the speed of the ship's movement to reach its destination.

INTRODUCTION

In the world of shipping as a transportation unit, the logistics industry and the fishing industry need fuel. The fuel oil used includes heavy fuel oil (HFO), medium fuel oil (MFO), and intermediate fuel oil (IFO).(MAN B & W., 2010). One of the important components of ship propulsion is fuel oil. Fuel oil is used to drive the diesel engine so as to produce propulsion propulsion for the ship. The fuel oil needed by the diesel engine is obtained from the oil supplier by purchasing it, the fuel is sent to the ship at the port via tanker or sent to the ship when the ship is at sea using barges. The fuel purchased by the shipping company is the ship's operational cost, which is in the range of 70% of the ship's operating cost. Therefore, all shipping companies should always monitor the consumption of fuel oil on their ships closely and closely so that there is no waste of fuel consumption. (KP. Teknik, 2007).

One of the supporting factors that play an important role in achieving the objectives as mentioned above is to provide adequate facilities and infrastructure for fishing activities. The thing that must be considered is seeing the importance of using fuel during the sailing process, so the author takes the title Comparative Analysis of the Amount of Fuel Use for Main Motors 1 In Theory and Reality in the Field During Operations Per Trip in KMN. Cahaya Lapawawoi 01.

The fuel system on the ship has a role to transfer fuel from the storage tank to the main engine. It is a support for the main engine on the ship which has a very important role for the continuity of the operation of the main motor as a source of ship propulsion. (Kusuma, 2015)

Most of the fuel used by humans through a combustion process (redox reaction) in which the fuel will release heat after reacting with oxygen in the air. Diesel fuel is generally any liquid fuel used for diesel engines. The most common type is fuel oil derived from the distillation of petroleum fractions, but there are also products other than petroleum derivatives such as biodiesel, biomass diesel to liquid or gas diesel to liquid (Wikipedia, 2016).

KMN fishing vessel. Cahaya Lapawawowi 01 is a fishing vessel made of wood and coated with fiber and designed with fishing gear (Pole and Line) operating in the sea waters of Kep. Selayar. The picture of the KMN Lapawawoin 01 ship can be seen in Figure 1.

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Figure 1. KMN. Cahaya Lapawawoi 01

According to (Darma at al, 2000) the main engine is the main driving force that functions to convert mechanical power into driving force for the ship's propeller so that the ship can move. The main engine used in KMN. Cahaya Lapawawoi 01 to support fishing operations amounted to one unit which has 6 cylinders and in its operation uses diesel fuel. Image of the main engine used at KMN. The light of Lapawawoi 01 can be seen in Figure 2.

Figure 2. The Main Engine of the KMN Ship. Lapawawoi Light 01

EXPERIMENTAL METHOD

To compile the data itself, that is by combining the data obtained in the field and comparing it with the literature obtained

Data analysis method

The methods used in analyzing and processing data during practical activities are:

1. Qualitative descriptive analysis, namely by observing directly and then making systematic, factual and accurate explanations according to the activities that the author carried out while on board, then linking the data obtained in the field with a literature study.
2. Descriptive quantitative analysis, namely by analyzing data in the form of numbers or numerical theoretically and practically in the field, followed by the results of measuring the amount of fuel use every day. And the results are processed by statistical descriptive program in Microsoft Excel.

In calculating this fuel consumption, the authors classify into five operating conditions of the main motor based on the rotation of the motor as summarized in the machine's daily journal and the motor load is assumed to be constant/fixed. The five operating conditions for the main motor are as follows:

1. The ship departs for the fishing area
2. The ship carries out a fishing operation
3. Total Stationer during sailing
4. The ship has moved to the fishing ground
5. Ship back to base

According to Rais (1996) specific fuel consumption is the ratio between the fuel consumed in a certain time and the power produced by the motor. The theory of fuel consumption can use the following formula:

$$B = \frac{be \times Ne}{\rho} \quad \text{........ 1}$$

Description :
be : Specific fuel consumption (gr/HP.hour)
B : liter fuel consumption (liter/hour)
Ne: Effective Power (HP)
P : Density of diesel fuel (gr/liter)

To determine the effective pressure of the motor (Pe), by taking the power and full rotation of the motor. Using the following formula:

$$Pe = \frac{Te \times 60 \times 75 \times z}{\pi/4 \times D^2 \times S \times n \times i} \quad \text{.......... 2}$$

Description :
Pe = Average effective pressure (kg/cm2)
Te = Motor power (HP)
D = Diameter of cylinder (cm)
S = piston stroke (mm)
n = Motor speed (Rpm)
i = Number of cylinders

After the effective pressure of the motor is known using equation 2 then the results are distributed by equation 3. Thus the effective power of the motor can be known, by knowing the results of the effective power of the motor means that the specific effective fuel usage can be known by distributing Ne in equation 1.

In the use of fuel B can be known from the measuring instrument, so in the specific fuel effectively need to know the effective power Ne. If the effective pressure of the motor is not known, to calculate the effective power of the motor using the following formula:

$$Ne = \frac{\pi/4 \times D^2 \times Pe \times s \times n \times i}{60 \times 75 \times z}$$

Description :
Ne = Effective power (HP)
Pe = Average effective pressure (kg/cm2)
D = Diameter of the cylinder (cm)
s = piston stroke (m)
n = Motor speed(Rpm)
i = Number of cylinders
z = 1 for 2 stroke motors and 2 for 4 strokes

RESULTS AND DISCUSSION

Ship Departs Towards Catching Area

When the ship departs for the fishing area, the rotation of the main motor is around 1000 rpm. Based on the rotation range of the main motor, the fuel consumption of the main motor from the overall calculation results when the ship is heading to the fishing area is 218.8 liters. The calculation method is as follows:

$$Ne = \frac{\pi/4 \times D^2 \times Pe \times s \times n \times i}{60 \times 75 \times z}$$
$$= \frac{0{,}785 \times (13cm)^2 \times 8{,}81\,kg/cm^2 \times 0{,}14m \times 1000 \times 6}{60 \times 75 \times 2}$$
$$= \frac{981.774{,}06}{9.000}$$
$$= 109{,}08\,HP$$
$$B = \frac{be \times Ne}{\rho}$$
$$= \frac{168 \times 109{,}08}{837{,}3}$$
$$= 21{,}88\,liter/jam$$

(Average pressure (Pe) = 8.8 1 kg / cm², rotation of the induction motor (n) is 1000 rpm) So, the main motor fuel consumption at 1000 rpm is 21.88 liters / hour.

Ship Conducting Capture Operation

To carry out fishing activities, the rotation of the main motor tends to be lower than when the ship departs for the fishing area. The rotation of the main motor at the time of the capture operation is around 800 rpm. From the rotational range of the main motor, the fuel consumption of the main motor from the overall calculation when the ship is carrying out fishing operations is 140 liters. The calculation method is as follows:
Average pressure (Pe) = 8.81 kg / cm², main motor rotation (n) is 800 rpm

$$Ne = \frac{\pi/4 \times D^2 \times Pe \times s \times n \times i}{60 \times 75 \times z}$$
$$= \frac{0{,}785 \times (13cm)^2 \times 8{,}81\,kg/cm^2 \times 0{,}14\,m \times 800 \times 6}{60s \times 75\,kg\,m/s \times 2}$$
$$= \frac{785.419{,}29}{9.000}$$
$$= 87{,}26\,HP$$
$$B = \frac{be \times Ne}{\rho}$$
$$= \frac{168 \times 87{,}26}{837{,}3}$$
$$= 17{,}50\,liter/jam$$

So, the main motor fuel consumption at 800 rpm is 17.50 liters/hour.

Total Stationary during sailing

Total stationary while at sea, the rotation of the main motor is around 590 rpm. From the range of rotation of the main motor, the fuel consumption of the main motor from the overall calculation results when the ship is stationary is 51.65 liters. The calculation method is as follows: (Average pressure (Pe) = 8.81 kg / cm², the main motor rotation (n) is 590 rpm).

$$Ne = \frac{\pi/4 \times D^2 \times Pe \times s \times n \times i}{60 \times 75 \times z}$$
$$= \frac{0{,}785 \times (13)^2 \times 8{,}81\,kg/cm^2 \times 0{,}14\,m \times 590 \times 6}{60s \times 75\,kg\,m/s \times 2}$$
$$= \frac{579.246{,}69}{9.000}$$
$$= 64{,}36\,HP$$
$$B = \frac{be \times Ne}{\rho}$$
$$= \frac{168 \times 64{,}36}{837{,}3}$$
$$= 12{,}91\,liter/jam$$

So, the main engine fuel consumption at 590 rpm is 12.91 liters/hour.

Ship Moving Catch Area

When the ship moves from one fishing area to another, the main motor rotation is around 1150 rpm. From the range of rotation of the main motor, the fuel consumption of the main motor from the overall calculation results when the ship moves to the operating area is 301.8 liters. The calculation method is as follows: (Average pressure (Pe) = 8.81 kg / cm², main motor rotation (n) is 1150 rpm).

$$Ne = \frac{\pi/4 \times D^2 \times Pe \times s \times n \times i}{60 \times 75 \times z}$$
$$= \frac{0,785 \times (13cm)^2 \times 8,81 kg/cm^2 \times 0,14m \times 1150 \times 6}{60s \times 75kg\ m/s \times 2}$$
$$= \frac{1.129.040,17}{9000}$$
$$= 125,44\ HP$$
$$B = \frac{be \times Ne}{\rho}$$
$$= \frac{168 \times 125,44}{837,3}$$
$$= 25,15 liter/jam$$

So, the main motor fuel consumption at 1150 rpm is 25.15.

Ship Back to Base

Similarly, when the ship departs for the fishing area, the rotation of the main motor in this condition is around 1060 rpm. The main engine fuel consumption based on the overall calculation results when returning to the base is 232 liters. The calculation method is as follows:
(Average pressure (Pe) = 8.81 kg / cm², main motor rotation (n) is 1060 rpm)

$$Ne = \frac{\pi/4 \times D^2 \times Pe \times s \times n \times i}{60 \times 75 \times z}$$
$$= \frac{0,785 \times (13cm)^2 \times 8,81 kg/cm^2 \times 0,14m \times 1060 \times 6}{60s \times 75kg\ m/s \times 2}$$
$$= \frac{1.040.680,\ 51}{9.000}$$
$$= 115,63\ HP$$
$$B = \frac{be \times Ne}{\rho}$$
$$= \frac{168 \times 115,63}{837,3}$$
$$= 23,20\ liter/jam$$

So, the main motor fuel consumption at 1060 rpm rotation is 23.20.

Based on the calculations for each operational activity carried out by the ship above, the total amount of fuel consumption on the main motor in theory is 944.25 liters. The average fuel consumption of the main motor is 20.12 liters / hour. More details can be seen in table 2 as follows:

Table 1. Total Calculation of Fuel Theoretical KMN. Lapawawoi Light 01

No.	Main Machine Operation	Average Fuel Consumption (liter/hour)	Time Operational (hour)	Total Fuel Consumption (liter)
1.	Ship Departs Towards Catching Area	21,88	10	218,8
2.	Ship Conducting Capture Operation	17,50	8	140
3	Total Stationary during sailing	12,91	4	51,65
4.	Ship Moving Catch Area	25,15	12	301,8
5.	Ship Back to Base	23,20	10	232
	Total	**100,64**	**44**	**944,25**

Comparison of Theoretical Fuel Use With Reality In KMN. Lapawawoi Light 01

In the measurement of fuel at KMN. Lapawaoi 01 light is done using a Flowmeter because the tank does not have a sight glass, so it can make it easier for the author to measure the actual fuel consumption during fishing operations.

Table 2. Total Fuel Calculations in real terms at KMN. Lapawawoi Light 01

No.	Main Machine Operation	Average Fuel Consumption (liter/hour)	Time Operational (hour)	Total Fuel Consumption (liter)
1.	Ship Departs Towards Catching Area	25,38	10	253,8
2.	Ship Conducting Capture Operation	20,2	8	161,6
3	Total Stationary during sailing	14,9	4	59,6
4.	Ship Moving Catch Area	29,15	12	349,8
5.	Ship Back to Base	26,9	10	269
	Jumlah	**116,63**	**44**	**1.093,8**

The following is a comparison of theoretical fuel use and conditions in the field where the actual fuel use is much greater than the theoretical calculation or in other words, there is a difference in the amount between theoretical fuel use and conditions in the field of 149.55 liters. The graphic image can be seen in Figure 3.

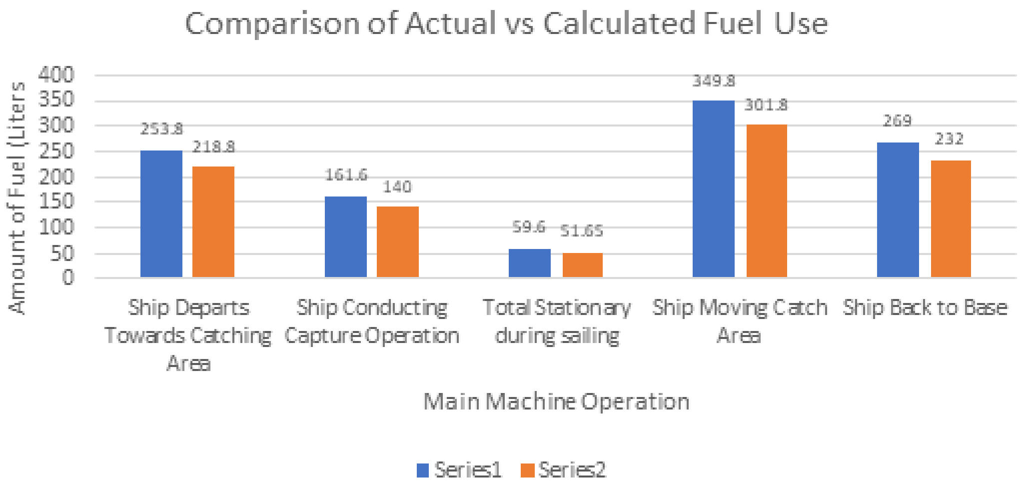

Figure 3. Comparison of Actual vs Calculated fuel Use

CONCLUSION

• From the results of observations in the field during a fishing operation trip, the use of fuel is 944.25 liters and from the results of the use of fuel starting from the start of the ship moving to the fishing area, the ship carrying out fishing operations, total stationary during sailing, the ship moving the fishing area and the ship return to base. The most fuel is used when the ship moves to the fishing area where the use of material reaches 25.15 liters/hour while the least fuel is used when the position is stationary in this case is 12.91 liters/hour. The main factors that affect the level of use of fuel are rotation (rpm) and also the operating time of the main engine. Basically, with the use of high rotation, it can accelerate the speed of the ship's movement to reach its destination.

• Comparison of the amount of fuel with the sales of fish in KMN. Cahaya Lapawawoi 01 for 11 trips of operation captures fuel consumption in theory as much as 944.25 liters with an average fuel consumption of 20.12 liters/hour while the actual amount of fuel consumption consumes 1,093.80 liters with an average fuel consumption as much as 23.30 liters / hour. So from the comparison of the use of fuel in the field and the use of fuel which is calculated theoretically, there is a difference of 149.55 liters.

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