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Analysis Of The Use HSD, MDO And B-30 On Passenger Ships 2000 GT

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***Abstract*— The ship being analyzed is a Ferry ro-ro 2000 GT sailing from Bali to Lombok via the Lombok Strait crossing route with a distance of 38 nautical miles. Identification of the use of diesel fuel for ship operations is important for ferry vessels, especially in connection with efforts to efficiently use of diesel fuel in ship operations. In solving problems, efficiency analysis is completed by applying technical analytical, correlational-predictive, and comparative methods. The technical analytical method is specifically used to calculate engine characteristics in fuel use, and the correlational-predictive method is used as an approach method to the phenomenon of the relationship between engine characteristics in the use of different fuels in ship operations, in contrast, the comparative method approach will be used to provide a detailed illustration. More complete in a case study of the use of diesel as fuel for the operational main engine of a ferry ship.**

Keywords— ***Ferry Ro-ro; HSD; MDO; Biodiesel B30***

I. Introduction

One transportation system for connecting areas bordered by seas, rivers, and lakes is ferry transportation. The government hopes that transportation that is limited by the water area will be fulfilled, to support the development of the water area. So the efficient use of fuel on ships is very important [1]. Padang Bai Lembar Harbor is one of the sea crossings that connects Bali - Lombok using a Ferry ro-ro. This crossing via the Lombok Strait has a distance of 38 nautical miles and takes around 4-6 hours [2]. The shipping ratio with the comparison between shipping costs and income is very important. The basis of this calculation greatly influences the operational costs of the ship which are influenced by various variables, for example when the ship is sailing and when it is in port. Operational costs, in this case, fuel costs, are one of the causes of high costs, where fuel consumption is influenced by the value of engine power and engine workload in the ship's operational pattern. Problems also arise if the condition of track production quality decreases, thereby increasing ship operational costs and causing a decrease in effective power and efficient power in ship operational patterns [3]. The diesel engine is the most effective and simple. The power produced from the diesel engine is also very adequate. Many ships from small to large sizes use diesel engines. That factors are taken into account when using a diesel engine on a ship including : The main size of the ship, ship resistance, speed, and fuel efficiency [4]. Currently, energy needs are very dependent on fossil fuels. Nearly 36 - 37% of fossil energy use is in the transportation sector. This fuel should be able to be replaced by 2050[5]. Biofuel alternative fuels in the form of alcohol and biodiesel can be recommended as a replacement fuel for HSD. Renewable biodiesel is a promising alternative fuel. It is biodegradable, environmentally friendly, and non-toxic [6]. Many diesel engines use biodiesel because the raw material is mainly obtained from various kinds, such as animal oil, plants, and also used oil. The type of fuel used significantly influences the type of engine. This type is related to performance [7]. This performance is produced by the machine. The type of fuel used affects engine performance. The explanation above shows the need to use engine power according to research according to the dimensions of the ship and the maximum speed required [8]. The cost of ship propulsion engines in terms of fuel use can be reduced by reducing ship operational costs [9]. Regarding fuel usage, studies need to be carried out on ships that use main engines on the same ship operational pattern [10]. Analysis of economical fuel consumption levels in ship operations, can be compared with fuel consumption per mile. The speed obtained and the level of effectiveness of operational patterns can influence the efficiency value of the machine character [11]. The combustion process that occurs in the engine itself is internal combustion. Combustion that occurs from pure air compressed in a cylindrical combustion chamber produces hot air and high pressure. At that time, fuel was sprayed and combustion occurred. Ships with low power generally have high engine speeds, while those with high power have low speeds [12]. The amount of fuel consumed by the engine will affect the tank capacity on the ship. Engines with high fuel consumption require large storage tanks and vice versa. Another influencing factor is the

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type and type of ship assignment. Ship fuel consumption is determined by engine capacity, which affects the engine speed produced. There are three types of machines based on their rotation, namely low rotation, medium rotation, and high rotation [13]. The difference in engine speed and engine capacity will affect the fuel consumption used by the engine. Combustion can produce sudden increases in heat and high pressure in the combustion chamber. The pressure pushes downwards so that the piston continues to rotate with the crankshaft. The corresponding piston movement is the same as getting one process [14]. Diesel engines are generally divided into 2 types:

- 4 Stroke diesel engine
- 2 Stroke diesel engine

At this time the machine that will be discussed is a 4 - stroke diesel engine. A four - engine completes one cycle in four piston strokes or two crankshaft strokes. So in the four - step process, there are processes of filling, compression and ignition, expansion and exhaust[15]. TDC or the top point reached by the movement of the piston in the cylinder. BDC is the lowest point that can be reached by the top end of the piston on the cylinder. When the piston moves from TDC to BDC it is said to be one step. In the cycle, there are four - piston strokes, namely two up and two down [16]. During the cycle, the crank will rotate twice. To move ships, both individually and in a fleet, fuel oil (BBM) is needed as a combustion medium for the propulsion engine which absolutely must be available to meet the energy needs of ships in their activities as a mode of transportation [17]. In its operational activities, ships have a machinery system consisting of a Main Engine (MU) or Main Engine (ME) and Auxiliary Engine (MB) or Auxiliary Engine (AE). The ship's engine functions as a ship propulsion system or to rotate the ship's propeller which will then propel the ship. The engines commonly used are diesel engines or steam turbines. Meanwhile, auxiliary machines (Auxiliary Machinery) [18]. It is a general term that denotes the machines needed to generate electricity or electric generators. Auxiliary machines also show all the equipment needed, including pumps, refrigerating machines, steering engines, winches, and so on. Generally, MU is 1 (one) unit and for ferries, 2 (two) units are used. Meanwhile, auxiliary machines in the form of electric generators generally consist of 3 (three) units, two of which are used to produce electricity while the other unit is a backup. The types of fuel used on ships are HSD, MDO, and B30[19].

II. Method

The method used in this research is a literature study and collection of ship engine data and abstract report data from ship engine logs in one month in order to obtain data and information to analyze and answer the problems in this research [20].

This research will provide an overview of the factors that influence the efficiency of ship operations, especially engine power, time and ship operating patterns used[21]. In the development of technology and alternative energy, ships are directed towards a pattern of using new products that are more securely available and environmentally friendly[22]. The use of alternative energy as fuel has different characteristics from previous fuels, especially the calorific value which affects the power output of the diesel engine and also the character of the engine itself which is often poorly understood by ship owners when considering the use of engine power and fuel efficiency in ship operations[23].

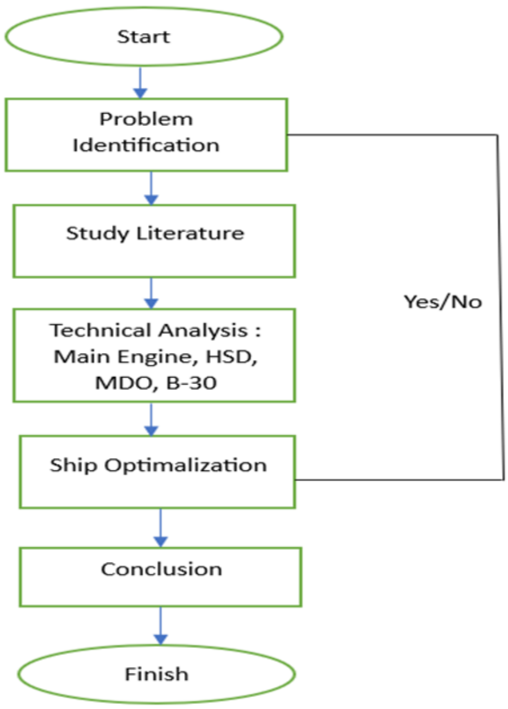

Figure 1. Flowchart

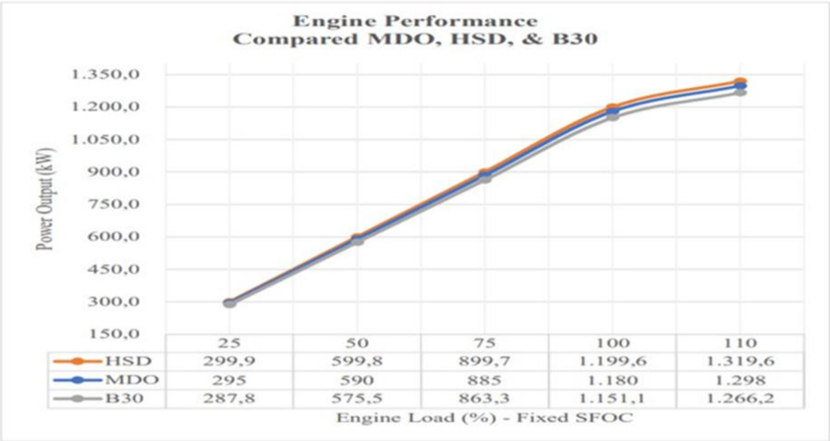

Figure. 2 Power Comparison

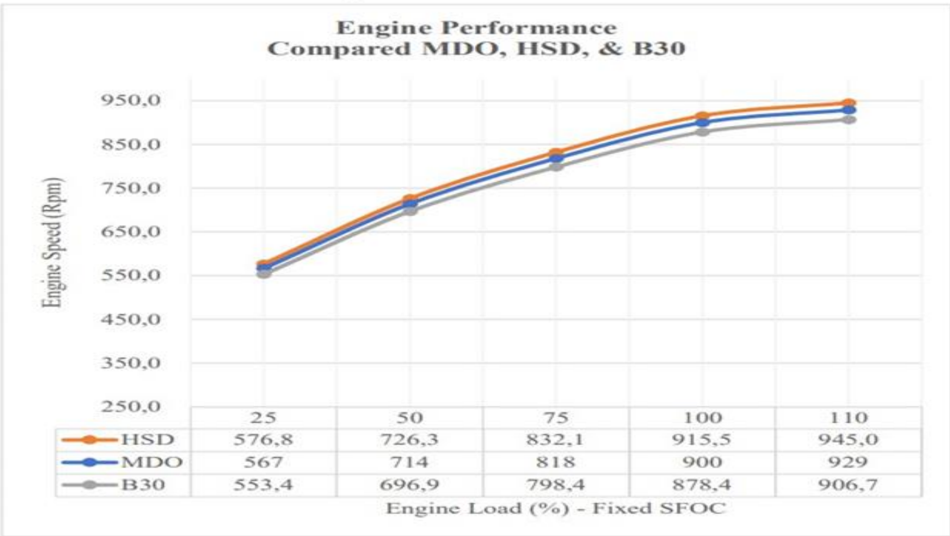

Figure 3. RPM Engine

From the load and engine power, each increase in engine load coincides with an increase in engine output power. From the comparative calculation results, the output power value for using HSD fuel has a power output value that is around 2.5% greater than the power output using Biodiesel B30 fuel.

III. Result and Discussion

This research uses the results of several ship test reports, fuel specifications, and actual fuel use on ships[24]. Characteristics of the main propulsion of the Yanmar 6EY22AW 1180 kW ship regarding the use of High - Speed Diesel (HSD), Marine Diesel Oil (MDO), and Biodiesel B30 fuel, as well as the efficiency of the ship's operational time[25]. To obtain other parameters as analysis data by calculating power and engine speed [26].

1. Power

The diesel engine unit works by producing power and torque where the engine rotation works constantly at a certain load to obtain the desired constant power [27].
This is because of the difference in the heat value of the fuel and the specific gravity value of the fuel that works in the engine combustion chamber.
From the load and engine speed, each increase in engine load coincides with an increase in engine speed. From the results of the calculation, the comparison of engine speed values for fuel use. HSD has a greater rotational output value of around 2.5% compared to the power output using Biodiesel B30 fuel. This is due to the increase in engine output power and average effective

Figure 4. Fuel Oil Consumption

are known. The relationship between output power and engine speed is related to the engine torque output which is useful for turning the ship's propeller.

From the results of comparative calculations of engine fuel consumption values for using HSD fuel, the fuel consumption value is around 2.5% greater than the fuel consumption using Biodiesel B30 fuel pressure due to differences in the heat value of the fuel and the specific gravity value of the fuel working in the engine combustion chamber.

From the load and specific fuel consumption,each increase in engine load coincides with a difference in specific engine fuel consumption.

From the results of comparative calculations of engine fuel consumption values for using HSD fuel, the fuel consumption value is around 3% greater than the fuel consumption using Biodiesel B30 fuel. This is because every increase in engine fuel consumption and ship speed is due to the pattern of ship operational requirements required and the performance of the ship's main propulsion engine. In this way, we can find out. What load has technical economic value in terms of fuel consumption when the ship is operating.

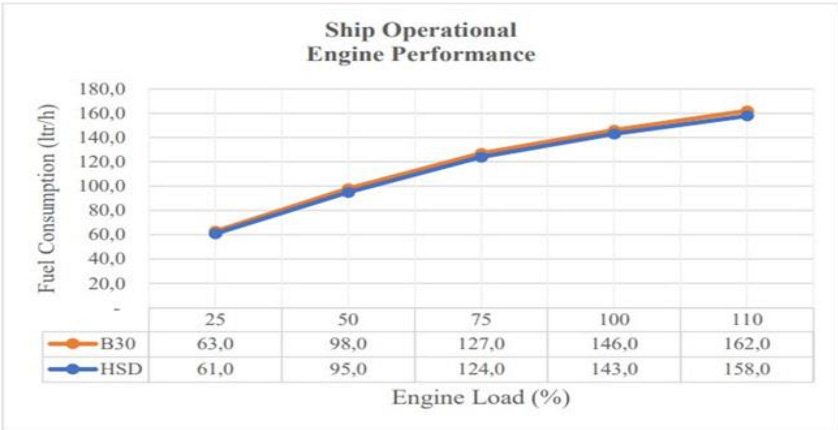

Figure 5. Comparison HSD & B-30

IV Conclusion

During routine operations using B30 Biodiesel fuel, 2000 GT Passenger Motor Ships should be operated at an engine load of between 25% to 50% by adjusting the service operational pattern times on the route. According to the results of ship sea trial reports and calculations of engine output power, the most effective ship speed is at a load of 25% to 50% because the per-load accommodates 20% to 35% of the ship's speed and the smallest at a load of 100% the ship's speed accommodates approximately 15% of ship speed per engine load. And the difference in the use of HSD fuel and Biodiesel B30 has a difference of around 2.5% in the power output of the diesel engine. The engine specifications studied have an idle speed of 400 rpm and a rate speed of 900 rpm. From the engine test results, the output values of engine power and speed From the load and fuel consumption in ship operations and also references to actual fuel consumption, each increase in engine load coincides with an increase in fuel consumption in ship operations.and the difference in the use of HSD fuel and Biodiesel B30 has a difference of around 2.4% in the diesel engine speed.

From the results of the calculation analysis, it is known that the engine output power efficiency and specific fuel consumption efficiency are at an engine load of 75%, where the engine output power has an efficiency of 43% and the specific fuel consumption has the smallest consumption of 195 gr/kW.h.

From engine performance analysis data for HSD and Biodiesel B30 fuel consumption, and ship operational patterns. So it can be seen that for each engine operation with certain load conditions, the value of fuel consumption per liter can be known, and the difference in specific fuel consumption gr/kW.h between HSD and Biodiesel is around 4.2% for each load, and for The fuel consumption per liter has a difference of 2.7% for each load with HSD which is more efficient / has lower fuel consumption.

In terms of the value of economic efficiency in ship operations regarding fuel consumption and ship realization data, we can see that from the results of the economic technical analysis of fuel consumption, the economic value lies between 25% to 50% engine load or at engine speed between 567 rpm up to 714 rpm in accordance with the ship's operational pattern on the track.

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