
HEAVY FUEL TREATMENT AS THE MAIN FUEL ON BOARD

Suwarso¹, Yuni Mariah^{2*}, Sunarto³

Maritime academy Djadajat Jakarta, Indonesia

Email: yunimariah71@gmail.com

*Correspondence

| ARTICLE INFO | ABSTRACT |
|---|--|
| Accepted : 10-08-2023 Revised : 18-08-2023 Approved : 19-08-2023 | One of the important factors in the smooth operation of the ship is the use of heavy fuel. Heavy fuel is cheaper than the price of diesel oil which is used as fuel for the main driving engine. Main Machine Tools often experience interference due to fogging of the fog, wear between the liner and the piston spring or other parts due to lack of proper maintenance and understanding. This research is survey research, which is field research and asks for the opinions of respondents who take samples from a population and use interviews or question lists as a basic data collection tool. Maintenance and maintenance of fuel in its implementation carried out regularly will be able to prevent more severe damage and decrease engine work. Integrated fuel handling and maintenance will facilitate the operation of the ship. Where in the effort of regular maintenance and maintenance and planning will extend the operating life of the ship. Maintenance and maintenance of fuel in its implementation carried out regularly will be able to prevent more severe damage and decrease engine work |
| Keywords: heavy fuel; therapy; ship. | |



Attribution-ShareAlike 4.0 International

Introduction

At this time the world of shipping has grown rapidly, including marked by the increasingly modern equipment used and also the increasing number of companies that use commercial ships for sea transportation facilities (Sitorus, 2016). The ship is a means of sea transportation used to transport goods or people from one port to another, in a safe, safe, and timely condition (Purba, 2017).

As a support for the smooth operation of the ship, one of the important factors in its operation is using heavy fuel. This is because the fuel is cheaper than the price of diesel oil which is used as the main driving engine fuel (Paroka, Arjubono, Muhammad, & Asri, 2016). By using heavy fuel, the Company will save considerable fuel costs even though at the time of ship construction it first incurs considerable costs to support maintenance and equipment supporting heavy fuel (Prabowo & REKAYASA, 2020).

However, under actual operational conditions, the Main Machine equipment often suffers from interference due to fogging of the fog, wear between the liner and the piston spring, or other parts due to a lack of proper maintenance and understanding. The main causes of research results so far are a lack of human resource knowledge in fuel demand, the content of materials that cause corrosion, scale deposits, and excessive dissolution of chemical elements in fuel (Irfan Reza, 2019). Other factors causing the failure are non-maintenance of the supporting equipment, inadequate maintenance, lack of support from the Shipping Company for the delivery of the requested spare parts, and delaying the repair of equipment that should be properly maintained following the

Instruction Book for various reasons. As a result of the failure caused ship delays, which meant losses for the Company because it had to pay Port fees, employee salaries, food, fuel, and water (Cahyagi & Kusuma, 2016).

To keep the ship always in a ready-to-use condition, it is very important to take care of the fuel carefully along with its supporting equipment so that the ship is always ready to operate. The heavy fuel must be maintained according to the procedure so that the Main Engine can be operated safely. Means safe for the machine, and also safe for people, cargo, and ships.

Fuel is the most important factor for the smooth operation of the ship. Since the receipt of fuel oil on board, from then on fuel oil was used as a drive for main engines, tire engines, and boiler grinding. The types of fuel oil that are often used on ships include the following:

1. Diesel oil (HSD – High-Speed Diesel)

Diesel oil is a clear yellow-brown distilled liquid oil. This oil is generally used as fuel in almost all types of diesel motors (Malau, 2019). In addition, it is also used as fuel for direct processing in small boiler kitchens where clean combustion is desired.

2. Diesel oil

Diesel oil is a distilled type of fuel oil that contains parts that are heavier than diesel oil and is black (dark) in color but remain liquid at low temperatures (Fahmi, 2020). This diesel oil is often used to drive the main driving machines (when doing motion processing), auxiliary machines, and also boiler kitchens in preliminary (first) combustion, where the boilers are just finished and burned at a relatively short time to facilitate combustion.

3. Residual Oil (MFO-Marine Fuel Oil)

Residual oil is a more viscous oil where its flash point is higher than that of diesel oil and it is dark black. Oil (MFO) residue is widely used as fuel for ship propulsion engines, where in terms of fuel economy the oil is considered. For example, calculated from a cheaper price compared to other fuel oil.

4. Combustion Value

Liquid fuels generally consist of elements of charcoal substance C, water substance H, acid substance O, limp substance N, sulfur substance S, and others. Each fuel has a different percentage and composition of the elements contained in it.

The combustion value of each kilogram of fuel is strongly contained from the percentage of the elements mentioned above, besides that the material often also contains impurities, water, or ash that are very detrimental. Because these latter substances reduce the combustion values of a fuel. The burning price of a material per kilogram can be calculated using the DULONG formula. The combustion price of fuel according to the DULONG formula.

5. Fuel properties

1. Specific Gravity

Specific gravity is a ratio of the weight of fuel oil referred to as the weight of water at the same volume where the temperature of fuel oil and the temperature of the water are the same high at 60 degrees F.

Fuel oil has a specific gravity that varies from one to another, but in general, the specific gravity is less than 1 (one). The specific gravity of fuel determines the high and low calorific value of the fuel.

2. Viscosity

Viscosity is a measure of the amount of resistance of a liquid fuel oil to flow, or a measure of the magnitude of the shear resistance of a liquid oil material. The higher the viscosity, the greater the deep shear resistance (SYAFRIANI, 2019). This viscosity is calculated by measuring the flow time of a liquid whose amount is determined through the viscosimeter hole (Shoaliha, 2019).

On the magnitude of viscosity, results must always be affixed the name of the viscosimeter used and the high temperature of the liquid at the time of measurement. Diluted fuel oil is said to have low viscosity, while thick fuel oil is said to be high viscosity.

3. Sulfur content S (sulfur)

This sulfur is present in all fuel oils in small amounts. However, since sulfur is very destructive, limiting the amount of sulfur is very important in fuel specifications. During the combustion process, sulfur oxidizes to sulfur dioxide (SO₂) or sulfur trioxide (SO₃). These sulfuric oxide acids are substances that are very destructive / consuming on the metals of the same when in contact with water.

This is very important for the fuel that will be used for propulsion and auxiliary engines on ships. Materials with a sulfur content of more than 1.5% will result in high corrosion levels. When the bunker is attempted, the percentage of sulfur demanded has a low sulfur content.

4. Charcoal C (Carbon) Content

Carbon examination in fuel oil is also needed to assess the possibility of charcoal formation from the fuel oil. Because this will cause scale on the injectors of diesel engines. In addition, charcoal scales attached to exhaust valves and piston springs" can result in less than perfect engine work (Ahmad & Sudarmanta, 2017).

5. Water Content

The water found in fuel oil is very small, even in HPO oil. This water is undesirable because it lowers the combustion value, thus practically increasing fuel consumption. A lot of water in fuel oil will disrupt diesel engines or combustion fires in the boiler kitchen room. So the water in the oil is tried to be removed or the levels are pressed as low as possible. Water may be mixed in the fuel because of the lack of cleaning of the tank when a ship conducts tank cleaning or ballast disposal so that there is still less water which consequently mixes with fuel.

6. Freezing Point (Pour Point)

The freezing point of liquid fuel oil is the lowest temperature at which it can still flow due to its weight. The cost of fuel oil can often still be pumped even if the

temperature is below freezing, which is necessary due to the conditions of storage or stockpiling and the use of fuel oil. It is necessary to arrange heating equipment on fuel tanks associated with shipping routes, for tropical regions heating equipment is not needed, except for heavy fuel oil. If the freezing point of an oil is greater than 0-5 degrees Celsius, then this indicates that the fuel contains high levels of paraffine. Paraffine when cooled will become scale on the inside of the fog and fuel pump so that it can complicate and close the fuel line.

7. Flash point

The flash point of fuel oil is the lowest temperature of oil where there will be a fire in a short time if the surface of the fuel oil is close to the fire. This flash point is necessary in connection with considerations regarding the safety of storage and transportation of fuel oil against fire hazards.

8. Ash's content

Ash content is the parts of fuel oil left over from combustion. This ash content comes from the fuel oil itself and can also be from rust, dirt, and sand in fuel tanks, also in pipes per road of fuel oil from the time of supply to the ship to the use of machinery, ash from fuel oil contains many parts can form a sharp paste which can jam piston springs when hot, and cause wear from piston springs and cylinder coatings.

Research Methods

This research is survey research, which is field research and asks for the opinions of respondents who take samples from a population and use interviews or question lists as a basic data collection tool. The authors break it down into population and sample.

Efforts to obtain data by coming directly to the research location using the following methods:

1. Instruction Book from the aircraft on board the ship that has been provided by the manufacturer (Maker) at the time of handing over the new pal.
2. From the repair maintenance manuals provided by the shipping fleet service.
3. Manuals when attending training and courses.
4. Books related to fuel theory.
5. Experience

The author does a series of work directly ranging from maintenance and analysis and repair of the heavy fuel.

To get supporting data in this writing, the author collects data by:

1. Interview
2. Observation
3. Study Document

Data Analysis techniques used by researchers are descriptive, analysis through:

1. Observe, see, analyze, and conclude from cases of damage that are often experienced
2. Analyze the causes of these cases
3. Apply knowledge to overcome the occurrence of these cases

4. Discussion with experts who master in handling the aircraft.

Thus, if the instructions are carried out correctly by the operator on the ship, the main engine can be operated safely and can work for a long time.

Results and Discussion

How to Maintain Heavy Fuel on a Ship

After knowing the properties of the fuel, it must be separated from the useless parts before the fuel is not used in the combustion chamber or for boiler oppression. Especially for the main engines and boilers on ships at this time heavy fuel is used to save operating costs. For this reason, it is necessary to free the fuel oil from impurities that will clog the fogging holes before entering the combustion chamber.

The mixing of these impurities with oil can be caused by rust released in fuel tanks, pipes, and also from the materials contained in the oil itself. It is possible that dirt or water can be carried from oil transport ships where at the time the ship-held tank cleaning could not be completely clean. Water in fuel oil is very undesirable, especially in seawater. In addition to water earlier, it lowers the caloric value of fuel combustion, also water disrupts the fuel system.

1. Use of Elements and Properties of Fuel

The specific gravity of a fuel also determines the combustion value of a fuel. A smaller combustion value, coupled with a large specific gravity, generally increases the fuel consumption per shaft TK, although this law is not always applicable, as there have been many instances in which an engine using heavy fuel has been found to have a higher total thermal utility. This is often evident when the ship is in motion. When it is moving where the engine still uses MDF fuel. At one time when the fuel handle is at a certain position the rotation of the engine is approximately 90 RPM. It turns out that after full away and the fuel is moved to MFO, the rotation of the engine rises approximately 100 RPM. Here it is clear that a higher specific gravity produces greater power or combustion. For fuel weight, fuel heating on ships with type B & W engines is usually determined to be approximately 110 degrees C. It also applies that a lower specific gravity will produce the best power, but it is not. For example, fuel is heated past a predetermined site, so the specific gravity automatically becomes lower. But it turns out that combustion becomes incomplete because the fuel evaporates faster which leads to too fast combustion and the engine becomes hotter. Temperatures that are too low also result in late evaporation of fuel and affect combustion.

2. Addition of Chemicals / Fuel Oil Treatment

Various types of chemicals have been made by factories in the world, all of which are for the maintenance of ship engines and equipment. Usually, the addition of chemicals to the right fuel oil is when the ship is receiving the bunker. The ratio between chemical and heavy fuel depends on the manufacturer's instructions. Suppose in the example of Drew Ameroid:

- a. 1 (one) liter of chemical for 4000 liters of fuel.

- b. 1 (one) liter chemical for 8000 liters of fuel.

Meanwhile, the uses of adding chemicals to fuel include:

1. Improving fogging and burning, the fog will always be cleaner.
2. Prevents corrosion in tanks and fuel pipelines as well as corrosion at high temperatures due to vanadium sodium.
3. Break the sludge and separate it from the fuel, separating the water emulsion from the fuel oil.
4. Reduces deposits. Dust in the system ture and exhaust gas valves and reduce the problem of grooves in the valve seat.
5. Reduces fouling of pistons and springs, and extends the life of springs and cylinder liners.
6. Prevents the formation of charcoal deposits in exhaust gas lines and rinse holes.

Fuel Deposition

Precipitation is the simplest way to separate fuel oil from water and impurities. The settling tank can hold a large amount of fuel oil depending on the size of the ship. In the fuel storage tank (as pictured) some of the substances in the liquid (such as water) due to differences in specific gravity and gravity will descend to the bottom of the tank and will arrange themselves according to their respective specific gravity (Saputra, Kalsum, & Junaidi, 2023). The solids are at the bottom, then the water is on top, and finally the fuel oil. To speed up the deposition process on heavy fuel oil such as MFO, the fuel oil tank must be heated to our temperature-approximately 70 degrees C.

In settling tanks or fuel settling tanks, fuel is heated between 60–70 ° Celsius using steam produced from a steam boiler. Auxiliary steam boilers with a pressure of 7 Bar will produce wet steam with a steam temperature between 170° Celsius (Bratha & Putri, 2023). The heating is done so that the oil becomes thinner and speeds up the separation between water and fuel. Water with a greater density also dirt will settle on the bottom of the tank, then be discharged through the spout valve (drain valve). Water and dirt are accommodated in the Sludge Tank so that dirt and oil are not wasted into the engine room sewer (Rudi, 2023). This is done to prevent marine pollution if water from the engine room sewer is pumped out. From the settling tank, the oil will then be moved to the service tank through a purifier so that the oil is completely free from water and dirt.

Fuel Filter Usage

The filter is useful for separating fuel from solid impurities. So water can still escape this filter. The fuel received during the bunker often contains solid impurities or rust coming from tanks or pipes. With the installation of a filter, it reduces the possibility of carrying dirt into the combustion chamber. In addition, the filter is very useful if there is negligence when cleaning these parts so that there is a possibility of leaving clothes or cleaning threads behind. Therefore, from the sediment tank to the combustion chamber, filters are installed that are useful to prevent the entry of solid impurities.

Types of Filters Commonly Used

1. Stream Line

Streamline filters have patron-pat-ron filters that look like rods made from stacks of thin paper rings and placed in a special vessel. All these rings are held together around the filter rod by a strong spring, but there are still holes between the non-slippery paper that are about 1/20 microns in size. The fuel oil to be filtered is assisted by a pressure of 1.5 Kg/cm².

2. Auto Clean

The auto-clean filter uses patrons composed of thin metal plates in the shape of a circle, arranged with very little allowance. Fuel oil flows from the outside inward between thin plates, while dirt is left on the outside of the patrons. These patrons can be rotated with the help of a crank outside the filter housing so that the inherent dirt will be scratched falling on the base of the filter housing.

Cassa Sieve

Cassa sieves are made of woven stainless steel wire with a braid of 0.6 – 1 mm on a suction light and a braid of 0.2 – 0.5 mm on a pressure sieve. With the use of different filters, the fuel will become cleaner with the retention of solid impurities that are carried in the fuel.

Fuel Heating

Apart from the methods described above, heating the fuel before entering the combustion chamber is very necessary. As is known, the arrangement of fuel grinding and combustion on ships ranging from multiple basic storage tanks to combustion chambers can be seen in the sketch below.

The journey of oil starts from the fuel storage tank, which is the storage tank at the time of the bunker. In the storage tank, when the oil condition will be pumped (transferred) to the sediment tank; It must be heated first with steam so that the oil is thin enough to be pumped into the sediment tank. In this tank, the oil is heated to a temperature of approximately 40-50° degrees C in a Double Bottom Tank so that there is a preliminary separation from impurities of solids and water that may be present in the fuel. Generally, these substances have a specific gravity that is heavier than oil, so they will settle to the bottom of the tank which can then be discharged out through the spout faucet or more easily separated.

Conclusion

Integrated fuel handling and maintenance will facilitate the operation of the ship. Where in the business of regular maintenance and maintenance and plans to extend the operating life of the ship. Maintenance and maintenance of fuel in its implementation carried out regularly will be able to prevent more severe damage and decrease engine work. To support the maintenance and maintenance of good equipment in planning by a shipping company leader, both on board, and managers in the company's office in the implementation of administrative and management functions both which include

planning, organizing, supervising, and controlling will not be separated from the application of human relations.

Bibliography

- Ahmad, Arizal Sita, & Sudarmanta, Bambang. (2017). Studi eksperimen unjuk kerja mesin diesel sistem dual fuel dengan variasi tekanan penginjeksian pada injektor mesin yanmar TF 55R-DI. *Jurnal Teknik ITS*, 4(1).
- Bratha, Rama Wide Kasih, & Putri, Naya Rahma. (2023). Inovasi Teknologi Pirolisis Sederhana Pengolah Sampah Plastik Menjadi Bahan Bakar Minyak (KEROSENE). *Jurnal Studi Inovasi*, 3(2). <https://doi.org/10.52000/jsi.v3i2.132>
- Cahyagi, Danang, & Kusuma, Indra Ranu. (2016). *Simulasi Otomatisasi Sistem Transfer Dan Separasi Bahan Bakar Kapal Hfo Dengan Menggunakan Plc Siemens*. Institut Teknologi Sepuluh Nopember Surabaya.
- Fahmi, Rifaldi Lutfi. (2020). *Pengaruh Penambahan Bioaditif Fraksi Sitronelal Dan Sitronelol-Geraniol Minyak Serai Wangi Terhadap Konsumsi Bahan Bakar Pertamina-Dex Pada Mesin Diesel*.
- Irfan Reza, Muhammad. (2019). *Rancang Bangun Simulator Pergerakan Bahan Bakar Pada Tangki Bahan Bakar Pesawat Terbang Pada Saat Rolling (Pengujian)*. Politeknik Negeri Sriwijaya.
- Malau, Nya Daniaty. (2019). *Modul Fisika Lingkungan*. Program Studi Pendidikan Fisika Fakultas Keguruan dan Ilmu Pendidikan
- Paroka, Daeng, Arjubono, Arjubono, Muhammad, Andi Haris, & Asri, Syamsul. (2016). Estimasi kebutuhan bahan bakar kapal penyeberangan antar pulau berdasarkan performa olah gerak. *Prosiding SENTRA (Seminar Teknologi Dan Rekayasa)*, (2), 53–64. <https://doi.org/10.22219/sentra.v0i2.1796>
- Prabowo, Gilang Lukito, & Rekayasa, Fakultas Teknologi Industri D. A. N. (2020). *Studi Eksperimen Pengaruh Penyimpanan Bahan Bakar Biodiesel Terhadap Sifat Bahan Bakar, Performa, dan Emisi Mesin Diesel 4-Langkah Silinder Tunggal*. Institut Teknologi Sepuluh Nopember.
- Purba, Juniar. (2017). *Sejarah perkembangan Pelabuhan Tanjung Laut di Bontang, Propinsi Kalimantan Timur*. Kepel Press.
- Rudi, Hartono. (2023). *Analisis Meningkatnya Kandungan Minyak Hasil Proses Oily Water Separator Di Atas Kapal Mv. Aliyah Pertiwi*. Politeknik Ilmu Pelayaran Makassar.
- Saputra, Nandi Tri, Kalsum, Leila, & Junaidi, Robert. (2023). Pemurnian Biogas dari Co-Digestion Limbah Cair Industri Tahu dengan Kotoran Sapi Menggunakan Absorben MEA Pada Kolom Isian. *Jurnal Serambi Engineering*, 8(3). <https://doi.org/10.32672/jse.v8i3.6490>
- Shoaliha, Khaeratin. (2019). *Analisis kualitas minyak goreng berdasarkan suhu pemanasan dengan metode koefisien viskositas falling ball*. UIN Mataram.

- Sitorus, Sugianto Antoni. (2016). Identifikasi Perceived Quality Pelayanan Perizinan Dinas Penerbangan dan Maritim Berdasarkan Pendekatan Kepuasan Masyarakat di Lingkungan Direktorat Jenderal SDPPI. *InComTech: Jurnal Telekomunikasi Dan Komputer*, 7(2), 155–178. <https://doi.org/10.22441/incomtech.v7i2.1167>
- Syafriani, D. E. A. Widya. (2019). *Rancang Bangun Reaktor Pirolisis Untuk Konversi Limbah Plastik Menjadi Bahan Bakar Cair (Ditinjau Dari Variasi Temperatur Pirolisis Terhadap Karakteristik Minyak yang Dihasilkan dan Konsumsi Energi)*. Politeknik Negeri Sriwijaya.