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The applicability of using biofuel for diesel engines

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Abstract
Initial tests have shown that the characteristics of biodiesel make it a biofuel alternative to diesel No. 2 (D2). Increasing costs and increasing dependence on foreign oil-derived fuel supplies are combined with scientists' concerns about burning these fuels. Global efforts are being made to find non-carbon renewable renewable fuels. Improved biofuels, which are liquid transport fuels derived from the cellulosic biomass of perennial grasses and other non-food crops as well as from agricultural wastes, are considered to have Great potential to replace gasoline, diesel and jet fuels. Unlike ethanol, which is only used in limited quantities in gasoline engines, not in diesel or jet engines, it also corrodes oil pipelines and barrels. The existing storage, improved biofuels are in line with the existing engines as well as the fuel storage and distribution infrastructure. To produce cost-effective, improved biofuels on a national scale, the researchers found sesquiterpenes, a terpene compound containing 15 carbon atoms (conventional diesel fuel has between 10 and 10). 24 carbon atoms). Plant-based biodiesel may be a more environmentally friendly choice for fossil-derived diesel, or petrodiesel, currently in use. In the European Union (EU), commercial diesel engines must have at least 7% biodiesel.

Keywords: Energy, biofuel, biodiesel, marine diesel, Vietnam transportation sector

1. Introduction
As one of the major worlds means of transportation, maritime transport consumes hundreds of Mt of fuel a year and accounts for 2-3% of CO2, 4-9% SOX and 10-15% of NOx global emissions. The main fuels used by big vessels are Heavy Fuel Oil (HFO) and Marine Diesel Oil (MDO), that are a less-refined type of fuel (i.e. it has a high viscosity and a high sulphur level), with severe effects on air and water pollution. Due to this, IMO (International Marine Organization) has tightened regulation measures of fuel sulphur level by establishing Emission Control Areas (ECAs) in coastal waters around the globe where only 0.1% of fuel sulphur is tolerated. By 2020 no ships will be allowed to sail elsewhere if using a fuel with more than 0.5% percentage of sulphur. The introduction of the Energy Efficiency Design Index (EEDI) for ships built from 2013 and the Ship Energy Efficiency Management Plan (SEEMP) for all ships above 400 GT, as well as the creation of guidelines for the voluntary use of the Energy Efficiency Operational Indicator (EEOI), follow this trend. Therefore, low-sulphur fuels or scrubbers are needed to ensure SOX reduction. A feasible alternative to unrefined fuels may be provided by Very low Sulphur Fuel Oil (VLSFO), with a sulphur content from 0.1% to 0.5%, and by Ultralow Sulphur Oil (ULSFO), with less than 0.1% sulphur percentage. A large increase in CO2 emissions because of more refining, however, is generated. Liquefied natural gas (LNG) can be another solution, but it would request a refitting of the engines and the installation of pressurized fuel storage onboard, with a marked peak in general costs. Other fuels such as methanol are used in a smaller degree because of under-developed supply infrastructure. Energy always plays an essential role for socio-economic development and improving the quality of life. Energy issues in the world today and in the future are being concerned and placed on top of all countries [1]. Ensuring more clean energy sources replacing fossil energy is becoming increasingly urgent, especially when oil is running out and becoming expensive [2][3]. The increase in population, economic growth, increasing the energy for life is increasing, leading to increasing demand for energy, leading to a deteriorating natural environment [4][5]. Global climate phenomenon is heating up as one of the biggest challenges of all mankind in this

century. Around the world, nearly 2 billion poor people in developing countries do not have access to modern energy [6]. All these can only be achieved when using renewable energy. Economic and environmental experts all share the same comment: The form of policy making and socio-economic development mainly relies on fossil fuels such as oil, gas ... is a model. unsustainable development of energy security and ecological environment in the future [7][5]. Many countries and energy groups in the world have recently adopted policies and strategies to combine the economical and efficient use of existing energy forms, and invest in research on the use of clean fuel forms a part of mineral fuels, including biofuels [8]. Biofuel is understood as renewable fuel (Renewable Fuel) produced from biomass - biomass, including compounds of animal or plant origin such as animal fat, coconut oil, palm oil, cereals (wheat, corn, soybeans), agricultural wastes (straw, corn stalks, beans, etc.), industrial wastes (sawdust, waste wood, etc.) [9]. Depending on the mode of production and use, biofuels can be divided into four main groups: biodiesel; original vegetable oil; biomass fuel and ethanol[10]. Compared to traditional fuels, the advantage of using biofuels is that it does not increase the greenhouse effect, reduce environmental pollution. Currently, the world emits about 25 billion tons / year of toxic gas and greenhouse gas. Concentration of CO2 [11], the main greenhouse gas, increased by over 30% compared to the pre-industrial period (from 280 ppm to 360 ppm), the earth temperature increased 0.2 - 0.4^0C [12]. If there is no positive solution, greenhouse gas concentrations can increase to 400 ppm by 2050 and 500 ppm by the end of the 21st century, the temperature of the earth is 2 - 4^0C hotter, causing unintended environmental consequences living [13]. Studies show that because biofuels contain an extremely small amount of sulfur and contain 11% oxygen, the combustion process is cleaner, 70% less CO2 and 30% toxic gas than mineral oil [14]. With the increasing supply of fossil fuels, rising oil prices, energy safety becomes urgent for all countries in the world. Research and use of biofuels in the world also have great development[15]. Norway, which is an oil exporter, also has 50% of its energy supplied from biofuels. The United States also set a plan to reduce the economy's dependence on oil [16]. Due to the specificity of plant species and actual conditions, in the future, 3 species of Vietnamese plants Men such as cassava, sugarcane and Jatropha need to be specifically researched with appropriate and long-term strategic solutions to meet the biofuel development objective under Decision No. 177/2007 / QD- The Prime Minister on November 20, 2007, approved the biofuel development project to 2015, with a vision to 2025. Energy in the transportation sector has become a hot issue all over the world because it can affect the energy security of nations. Finding a new type of energy to replace fossil energy is a top concern of many countries, including biofuels. Over the past two decades, there have been many studies on the use of biodiesel and its mix for diesel engines, the results are very positive. In Vietnam, there have also been studies on the use of biodiesel and its mixes on road transport vehicles. However, in the field of waterway transport, there has not been any specific research. Through a comprehensive synthesis of the application situation and research directions in the world, as well as the ability to produce biodiesel in Vietnam, the article wishes to create a premise to develop more research to find develop new technology solutions to apply clean fuels, especially biofuels on the domestic fleet, in line with the development trend of the world on the use of biodiesel fuel.

2. Application of biofuels

To this extent, biofuels may represent the best option to reduce SOX and CO2 emissions, with due regard of several aspects. By now, current renewable diesel is mainly produced by plant-based oils or e.g. used oil cooking oil (UCO), but biofuels production is needed to meet the average merchant maritime sector consumption and to be located near major ports or bunker stations. Bioethanol is produced in large quantities, but it is not compatible with contemporary shipping engines and it cannot be used as a drop-in fuel: the development of multifuel engines could solve this kind of issue. High short-term costs may be overcome in the long run thanks to more stringent anti-pollution standards related to Greenhouse gases (GHG) release and due to support measures, such as carbon taxes and subsidies, alongside with further technological development. In addition to that, an increase or a stable maintenance of oil prices at current level would incentive biofuels production. The development of biofuels compatible with marine engines is still at early stage, but the first-generation bioethanol and biodiesel industries have already been established and cost-competitive 2nd generation biofuels areslowly becoming a concrete option. Short sea shipping sector, with fixed routes and high shipping activity, could be the first step towards biofuels supply evolution. Pioneers such as large freight shipping companies, ferry and cruise companies could lead this transition. Transportation is one of the areas with a large proportion of energy consumption, after industry and civil, so the development of clean fuels in general and biofuels in particular in transportation is a problem. extremely urgent[20]. On a small scale, biofuels can be a source of energy for lighting, cooking and transportation[15]. Biomass E5, E10 (ethanol-blended gasoline) has been proven to be widely used in vehicles, reducing fuel consumption and significantly reducing emissions. The use of biofuels is also one of the solutions to sustainable transport development. So far, all countries in the Greater Mekong Subregion (GMS) have built and are implementing a plan to develop biofuels in their country, in which Thailand and Cambodia are currently there is a rapid growth in this type of fuel. In the field of transportation, biofuels are applied including: Clean vegetable oil, ethanol, biodiesel, dimethyl ester (DME), ethyl tertiary butyl ester (ETBE) and products from them, in It is mainly ethanol and biodiesel. Currently there are about 50 countries in all continents exploiting and using biofuels at different levels. In 2006, the world produced about 50 billion liters of ethanol (75% used as fuel) compared to 38 billion liters in 2003, expected to be around 80 billion liters in 2012; in 2005 produced 4 million tons of biodiesel (B100), in 2010 increased to over 20 million tons. The first country to use ethanol as an industrial scale fuel since 1970 is Brazil. All types of gasoline in this country are blended with about 25% ethanol (E25), saving over $ 2 billion a year due to not having to import oil. Currently, there are 3 million cars fully using ethanol and over 17 million cars using E25. The United States is the world's largest ethanol producer, reaching nearly 19 billion liters in 2006, of which 15 billion

liters are used for fuel - about 3% of the gasoline market. In 2012, the US will supply over 28 billion liters of ethanol and biodiesel, accounting for 3.5% of the gasoline used. China uses 2.4 - 2.5 million barrels of oil a day, of which 50% must be imported. To cope with the energy shortage, on the one hand, China invests heavily outside the territory to exploit oil, on the other hand concentrates on exploiting and using renewable energy, investing in many scientific research facilities. Save on biofuels. In early 2003, gasoline E10 (10% ethanol and 90% gasoline) was officially used in 5 major cities and expanded to 9 other densely populated provinces of China. In 2005, ethanol fuel produced and put into use was 1.2 billion liters. At the end of 2005, the 600,000 tons / year fuel ethanol factory (the world's largest) was put into operation in Jilin. It is expected that ethanol fuel will increase by over 2 billion liters by 2010, about 10 billion liters by 2020. And many other countries have strategies for developing biofuels for the transportation industry.

GHG / CO2 / carbon negativity for Miscanthus x giganteus production pathways. Relationship between above-ground yield (diagonal lines), soil organic carbon, and soil's potential fo successful/unsuccessful carbon sequestration. Basically, the higher the yield, the more land is usable as a GHG mitigation tool (including relatively carbon rich land.)

However, the simple proposal that biofuel is carbon-neutral almost by definition has been superseded by the more nuanced proposal that for a particular biofuel project to be carbon neutral, the total carbon sequestered by the energy crop's root system must compensate for all the above-ground emissions (related to this particular biofuel project). This includes any emissions caused by direct or indirect land use change. Many first generation biofuel projects are not carbon neutral given these demands. Some have even higher total GHG emissions than some fossil based alternatives. Some are carbon neutral or even negative, though, especially perennial crops. The amount of carbon sequestrated and the amount of GHG (greenhouse gases) emitted will determine if the total GHG life cycle cost of a biofuel project is positive, neutral or negative. A carbon negative life cycle is possible if the total below-ground carbon accumulation more than compensates for the total life-cycle GHG emissions above ground. In other words, to achieve carbon neutrality yields should be high and emissions should be low. High-yielding energy crops are thus prime candidates for carbon neutrality. The graphic on the right displays two CO2 negative Miscanthus x giganteus production pathways, represented in gram CO2-equivalents per megajoule. The yellow diamonds represent mean values. Further, successful sequestration is dependent on planting sites, as the best soils for sequestration are those that are currently low in carbon. The varied results displayed in the graph highlights this fact. For the UK, successful sequestration is expected for arable land over most of England and Wales, with unsuccessful sequestration expected in parts of Scotland, due to already carbon rich soils (existing woodland) plus lower yields. Soils already rich in carbon includes peatland and mature forest. Grassland can also be carbon rich, however Milner et al. argues that the most successful carbon sequestration in the UK takes place below improved grasslands. The bottom graphic displays the estimated yield necessary to compensate for related lifecycle GHG-emissions. The higher the yield, the more likely CO2 negativity becomes. The two most common types of biofuel are bioethanol and biodiesel. Bioethanol is an alcohol made by fermentation, mostly from carbohydrates produced in sugar or starch crops such as corn, sugarcane, or sweet sorghum. Cellulosic biomass, derived from non-food sources, such as trees and grasses, is also being developed as a feedstock for ethanol production. Ethanol can be used as a fuel for vehicles in its pure form (E100), but it is usually used as a gasoline additive to increase octane and improve vehicle emissions. Bioethanol is widely used in the United States and in Brazil.

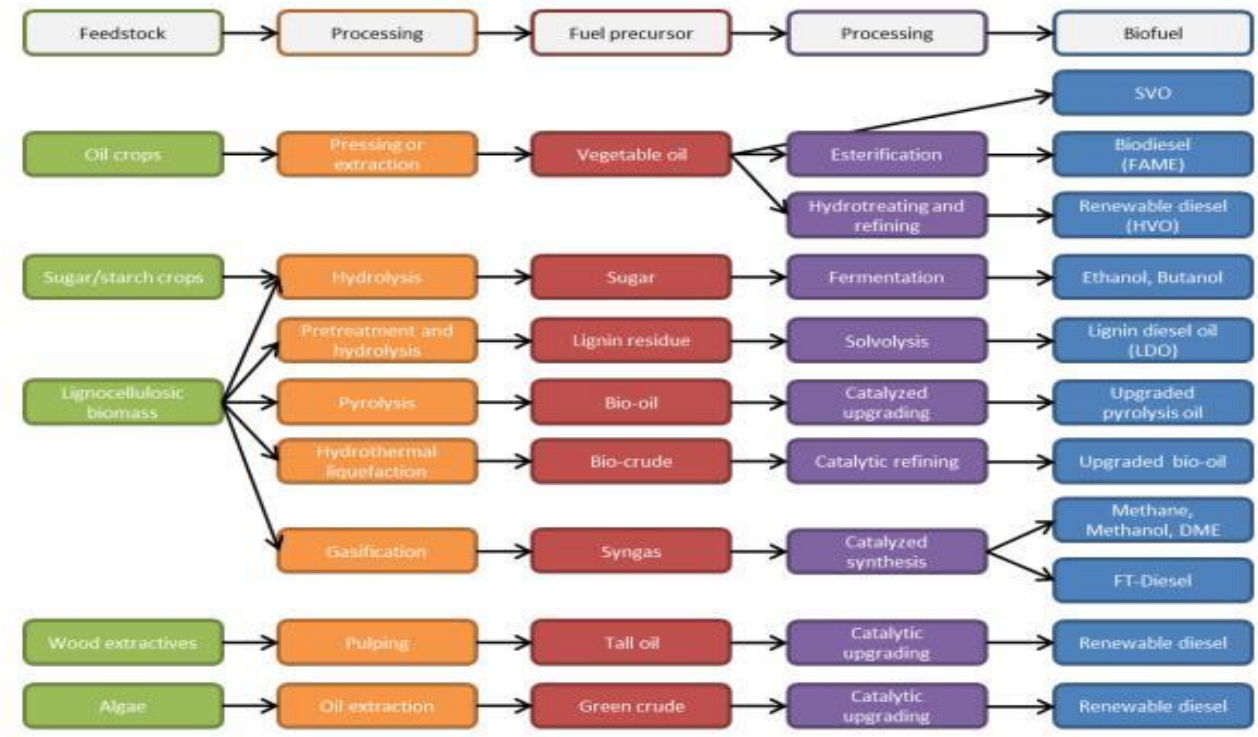

Fig. 1: Biofuels production

Components due to different origins of FAMEs will create different properties of the fuel. Also according to ASTM, the differences in the properties of biodiesel and diesel diesel are comparable. In terms of structure, biodiesel has lower carbon content (C), sulfur (S) and water than diesel, but has more oxygen content in the component. Biodiesel has a higher solubility index than diesel due to the oxygen content in the component. The index of tanning is a characteristic quantity for the combustion ability of the fuel when sprayed into the engine, the quality of combustion and the time of fire is delayed. The biodiesel content of biodiesel ranges from 48 to 65 and varies depending on the difference in the fatty acid composition of the fuel material of this type and the degree of saturation of fatty acid s[11]. Normally, diesel oil has a value of 40 - 46 and high quality diesel oil with values from 45 - 50. Biodiesel has a higher flash point than diesel. Pure biodiesel (B100) has the smallest flash point of 130^{o}C, while diesel is 60^{0}C. The more biodiesel in the mix, the higher the flash point. Due to this characteristic, biodiesel as well as its mixture will reduce the risk of fire and increase safety when transporting or storing on transport vehicles. Biodiesel has high lubricating properties, reduces friction and engine wear. In fact, 1% of biodiesel in the mixture can increase the lubricating properties of the fuel by 65%. Biodiesel is more soluble in water than diesel because its structure is relatively simple, including straight carbon circuits with 2 oxygen atoms at the end, very susceptible to changes by bacteria in the environment. Country. At the end of the 28-day period, 95% of biodiesel decays in water, while only 40% of diesel is decomposed.

Vietnam is a country that is endowed by nature with sufficient energy resources. However, the ability to exploit, process and use energy resources is limited. According to the analysis of the situation of economic development and energy supplies, it is expected that in the coming time (by 2020) our country will continue to import petroleum products, while oil prices are always under pressure. great to economic development[1]. To solve this problem, many research projects on biofuel production have been conducted: diesel production from soybean, sesame, waste oil; ethanol production from sugarcane, corn, rice, and cassava ... The research and production of clean fuels for transportation has been assigned to a number of agencies such as Petrolimex, Petro Vietnam, and Technical University. Da Nang and had an encouraging initial application result.

Potential application of biodiesel

Our country with oil and gas potential is not large, the annual exploited reserves according to Vietnam Oil and Gas Group's data are 15-17 million tons of oil and about 8-10 billion m3 of gas. In the next 15 years, we will have to import fuel (currently importing petroleum and gas from abroad), forecasting the import rate of about 11-20% by 2020, increasing to 50 - 58% in 2050 - not to mention nuclear energy. In 2003, commercial energy consumption was 205 kg OE / person (equal to 20% of the world average). According to calculations by energy experts, if no new energy sources are found to balance supply and demand, the rate of dependence on foreign energy will be up to 28.2% by 2020. Gasoline used for delivery Transportation often accounts for 30% of the country's needs and must now be fully imported. In 2010, oil imports were 2.1 million tons, and is expected to continue at 2020 to 4-5 million tons / year. When the first refinery in Dung Quat was put into operation in 2008, it only provided about 5.3 million tons of gasoline and diesel for transportation in the total demand of 15.5-16 million tons (34%). Before 2020, when all 3 refineries with a total capacity of 20-22 million tons of crude oil put into operation will provide 15-16 million tons of gasoline and diesel in the total demand of about 27-28 million tons (56%). The amount of fuel consumed per capita in 2020 is only equal to 65% compared to Thailand in 2005 [2]. The necessity of finding a kind of energy to support the current fuel demand is an inevitable trend to ensure national energy policy in the next few decades, gradually reducing the dependence on fuel and oil from abroad. The maritime industry is one of the economic sectors affected by fluctuations in the oil market. Along with the strong development of the economy, the demand for transporting goods, especially shipping by sea is growing. According to the latest statistics of Vietnam Maritime Administration, there are 1,445 ships with a total tonnage of up to 5,579,523 DWT. The number of ships increased rapidly, especially the fleet of specialized vessels (container ships, oil tankers), with an average growth rate of about 17% per year, the average age of Vietnamese fleets is 12.77 [1]. Most of these vessels are equipped with diesel fuel powered by diesel fuel. Meanwhile, diesel fuel prices are on the rise due to growing demand. With such a large number of ships, annual fuel consumption of up to thousands of tons will be consumed and a lot of toxic substances as well as greenhouse effects will be released to the environment. If the use of biodiesel and its mix of engines on these vehicles will help shipping companies significantly reduce their reliance on fuel imports and reduce emissions. Toxic substances cause environmental pollution. Since the past 10 years, our government has oriented and has policies to develop biofuels in the country, and most recently, in November 2007, the Government approved the Project "Development of biofuels. By 2015, vision to 2025 ", facilitating and opening up mechanisms for agencies, organizations and individuals in the transportation, industry and energy sectors to study biofuels. On that basis, a number of companies, institutes and universities have been experimenting with gasoline ethanol and biodiesel. Lam Son Sugar Company (Thanh Hoa), Saigon Petro, Binh Tay Wine Company, Chi Hung Company also had a project to produce ethanol as fuel. Recently, a number of companies in An Giang, Can Tho and Long a like AGIFISH Company have invested in biodiesel production from basa fat with a total capacity of about 40,000 tons / year. Tests of biodiesel extraction from Jatropha curcas L. of TS. Thai Xuan Du - Institute of Tropical Biology, and TS. Le Vo Dinh Tuong - City Institute of Natural Products Chemistry Ho Chi Minh ... recently all showed positive results with oil extraction rate up to 32-37%. In 2007, the National Biofuels Company researched the production of biodiesel from materials such as flakes, fish fat, dry palm oil ... and successfully ran tests on diesel engines of some Road transport vehicles with the use of B5 biodiesel blends (5% biodiesel and 95% traditional diesel). With the initial successes as well as research on the use of biodiesel and its mixes in the world, there is a great prospect in the application of biodiesel on marine diesel engines in country. Due to specific characteristics, diesel engines equipped on water transport vehicles have relatively strict operating modes and are

controlled by a lot of regulations related to maritime safety and environmental pollution prevention. School Without adequate research on biofuel, it is very easy for incidents for diesel engines in the exploitation process as follows:

- First of all, because biodiesel has the chemical properties of a softener (this substance is also in the material composition of fuel pipes, gaskets, rubber seals), it will replace the substances soft in these tubes and gaskets. The material will initially inflate and when using petroleum-derived diesel will wash biodiesel. Without softeners, the material will become hard and absorb water.
- Second, it is the structural destruction of engine lubricating oil. In the process of working motors, especially small load modes, transitional modes, non-combustible fuel droplets form on the combustion chamber wall. These biofuel droplets will destroy lubricant film on the mirror surface of the cylinder, increasing the level of abrasion of shirts and cuffs. In some cases, it may cause jamming in the shirt due to increased friction. In addition, sticking on the cylinder mirror surface of the biofuel droplets will increase the level of fuel leakage to the crankcase, damaging the lubricating oil, causing abrasion of bearings.
- Thirdly, biodiesel is harder to burn than diesel diesel, so how to use it, how much is the mixing ratio on marine diesel engines with very changing characteristics of continuous working regime. Specific and thorough research and testing is required.

A biofuel is a fuel that is produced through contemporary processes from biomass, rather than a fuel produced by the very slow geological processes involved in the formation of fossil fuels, such as oil. Since biomass technically can be used as a fuel directly (e.g. wood logs), some people use the terms biomass and biofuel interchangeably. More often than not however, the word biomass simply denotes the biological raw material the fuel is made of, or some form of thermally/chemically altered solid end product, like torrefied pellets or briquettes. The word biofuel is usually reserved for liquid or gaseous fuels, used for transportation. The EIA (U.S. Energy Information Administration) follow this naming practice. If the biomass used in the production of biofuel can regrow quickly, the fuel is generally considered to be a form of renewable energy. Biofuels can be produced from plants (i.e. energy crops), or from agricultural, commercial, domestic, and/or industrial wastes (if the waste has a biological origin). Renewable biofuels generally involve contemporary carbon fixation, such as those that occur in plants or microalgae through the process of photosynthesis. Some argue that biofuel can be carbon-neutral because all biomass crops sequester carbon to a certain extent – basically all crops move CO2 from above-ground circulation to below-ground storage in the roots and the surrounding soil. For instance, McCalmont et al. found below-ground carbon accumulation ranging from 0.42 to 3.8 tonnes per hectare per year for soils below Miscanthus x giganteus energy crops, with a mean accumulation rate of 1.84 tonne (0.74 tonnes per acre per year), or 20% of total harvested carbon per year.

Conclusion

Transportation and shipping activities are major contributor to air pollution at sea where most of it occurs as a result of exhaust emissions from ships. Stringent emission limitations enforced by the International Maritime Organization have hastened the need to find a new alternative fuel for marine diesel engines. Thus, biodiesel fuel was chosen as one of the environmentally friendly alternative energy that can reduce ship toxic gas emissions and at the same time reduces dependence on petroleum-based fuels. Therefore, the purpose of this paper is to provide a comprehensive review of biodiesel as an alternative fuel for marine diesel engine applications. This review covers the biodiesel fuel background, engine performance, history, recent progress, engine warranty, issues, challenges, and possible solutions on using biodiesel for marine applications. A significant number of literatures from indexed journals were cited accordingly. The results of previous studies had shown that the use of biodiesel would mostly increase the amount of brake specific fuel consumption and nitrogen oxide gas while conversely reducing other toxic gas emissions. Although a number of issues and challenges arise, most marine engine manufacturers give conditional warranty against the use of biodiesel in the engines. The study concluded that biodiesel and its blends have a bright future in the marine sector, provided some of the highlighted issues can be solved.

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