

Research and application analysis of marine diesel engine energy saving and emission reduction technology

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Abstract—In order to protect the environment and check the emission of polluted gas, this article conducts research on energy saving and emission reduction technologies for marine diesel engines and their applications. In order to achieve this goal, we can improve and optimize combustion efficiency, improve combustion efficiency and combustion efficiency of diesel engines, and use new engines with higher and cleaner energy sources when using new energy sources with higher efficiency and less diesel, thus reducing pollution and achieving environmental protection objectives. The application of energy-saving and emission reduction technology in marine diesel engines can make them more efficient, improve efficiency, and facilitate combustion of diesel engines, reduce nitrogen oxides, recover heat generated by diesel engines, and improve energy consumption.

1. Introduction

Since the reform and opening-up, China has made great efforts to learn and absorb foreign advanced technology, and all walks of life have undergone revolutionary development, resulting in the phenomenon of letting a hundred schools of thought blossom and a hundred schools of thought contend [1]. With the strong support of the state, marine undertakings are developing vigorously. What followed was the mass production of ships, and further exploration of the marine cause. However, with the rapid development, there are also

some drawbacks, that is, the ecological problems of the ocean. Marine pollution is an important problem that restricts development. If we want to develop, we must protect the marine ecology, and energy conservation and emission reduction is an important solution [2]. Figure 1 shows the energy conservation design of a new marine diesel engine. This article will delve into energy-saving and emission reduction technologies for marine diesel engines and their applications, providing technical support for the sustainable development of marine economy in the future [3].

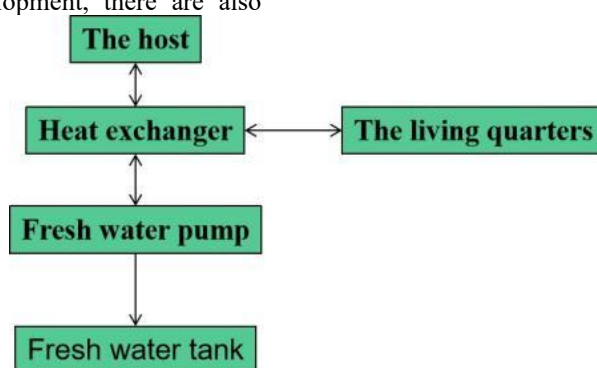


Figure. 1 New energy-saving design of marine diesel engine(Arrows indicate that they can go back and forth with each other)

2. Research on energy saving and emission reduction technologies for marine diesel engine combustion

The main power of the vessel comes from the combustion of fuel, and the chemical energy of the fuel is converted into thermal energy and high energy in the combustion chamber. Marine diesel engines mainly rely

on pressure energy to push the piston up and down to realize secondary energy conversion [4]. Diesel engine is the main propulsion power source of the ship. Improving the combustion process and strengthening management to make the diesel engine run under low load conditions are the effective ways to save energy and reduce emissions of the ship, and at the same time, ensure the service life of the diesel engine. For example, Table 1

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shows the matching integration of marine low-speed diesel engine [5].

Table 1. Matching integration of marine low-speed diesel engine.

index	Parts properties	Parts name	Selection and description	Manufacturer selection
1	Welding blank	Sweep box, smoke exhaust pipe, air cooler shell	1. Supporting local production; 2. Comprehensive evaluation of welding by manufacturers; 3. High requirements for manufacturing technology; 4. Assembly and supply; 5. Self-machining.	Welding supplier A1
2	Welding+machining	Road supports, covers, frame doors, common hardware.	1. Local production facilities 2. High requirements for production coordination.	Welding supplier A2
3	Casting blank	Cylinder liner, cylinder block, sprocket box, flywheel, frequency modulation wheel and bearing seat.	1. Supporting local production; 2. Comprehensive evaluation of casting by manufacturers. 3. High requirements for manufacturing process 4. Self-machining.	Foundry supplier B1
4	Casting+machining	Slider, thrust block, bearing cap, water guide sleeve, common casting.	1. Supporting local production; 2. Comprehensive evaluation of casting by manufacturers. 3. High requirements for manufacturing process 4. Designated casting channel.	Casting+Machine Supplier C1
5	Casting+machining	Colored castings	1, the demand is small and there are many kinds.	Casting+Machine Supplier C2

2.1. Improve fuel spray

The quality of fuel injection directly affects the formation of combustible mixture, but the formation of combustible gas plays a decisive role in the combustion quality of diesel engine. There are three main stages of fuel injection: injection delay stage, main injection stage and tail injection stage [6-7]. In daily management and maintenance, engineers must check the timing of diesel engine injection, find abnormal injection in time and deal

with it in time. The following measures are taken to prevent abnormal injection:

The design must ensure that after the main injection process, there can be no high pressure fluctuation at the nozzle to avoid secondary injection. The main measures that can be taken are:

- A. appropriately reduce the length and inner diameter of the high-pressure oil pipe.
- B. Choose the injector with larger injection hole area.
- C. Enhance the decompression and unloading capacity of the oil outlet valve [8].

D. Choose a more rigid outlet valve spring.

E. moderately increase the oil pressure of fuel injection valve.

Intermittent injection: Intermittent injection will cause poor fuel combustion. Unstable injection and alternate injection will lead to the unstable speed of diesel engine, and even lead to automatic shutdown when the speed is low. However, when the fuel is supplied twice and the fuel is injected once, the combustion will be rough.

2.2. Improve the formation of combustible mixture.

Open combustion chamber: Multi-air nozzle is mostly used, the diameter of nozzle hole is very small, and the valve starting pressure of needle valve is high, usually 20Mpa-30Mpa. The amount of combustible gas mixture formed during the ignition delay period should be controlled. The formation of excessive combustible gas

Table 2 .Specific application of energy-saving technology.

System/technology	content
Fuel system	Optimize the operation of injection system to ensure the quality of fuel.
gas handling system	Design of intake pressure and temperature, intake mode and optimization of intake composition.
Combustion technology	Mean premixed combustion and double-ring premixed swirl combustion
Post-processing technology	Trapping technology and selective catalysis technology

3.1. Energy-saving design of diesel fuel system

In the design of energy saving and emission reduction system in oil system, corresponding strategies should be adopted according to the actual situation. In order to reduce the carbon content of pollutants, it is necessary to accelerate combustion. At the same time, in order to ensure the compatibility and compatibility of fuel and air, it is necessary to adjust the pressure measurement and reduce the size of the injection to ensure the total atomization of the fuel[12].

3.2. Adopt advanced combustion technology.

When the combustion temperature reaches a certain level, the gas will be uneven, which may lead to explosion or incomplete combustion. Usually, homogeneous premixed combustion is adopted to improve combustion efficiency, thus reducing the content of nitrogen oxides in emissions. On the one hand, in homogeneous premixed combustion, the flame formed by combustion cannot be accurately identified, so there is no local high temperature phenomenon. The mixed gas in the fuel gas can be fully mixed, and nitrogen oxides will not exist in the emissions. After multi-point injection, gasoline can fully mix and absorb air, and then enter the cylinder body to achieve homogeneous combustion [13].

3.3. Improve the intake air composition.

mixture will lead to the increase of combustion pressure and pressure load, rough combustion, and higher combustion temperature will easily generate more NOx.

Vortex chamber type: It uses regular strong compressed air flow to promote the formation of combustible mixture, so the vortex chamber combustion chamber does not rely on a large amount of excess air. Excessive air leads to the decrease of diesel engine power [9-10].

3. Practical application of marine diesel engine energy saving and emission reduction technology

The application scheme proposed based on the above content is given from different aspects according to the operation of various parts of diesel engine and the basic situation of application operation, as shown in Table 2 [11].

When a diesel engine burns, the entrained air contains a lot of gases, such as nitrogen and oxygen. Indoor combustion velocity is influenced by oxygen content, and nitrogen and oxygen content in exhaust gas are influenced by nitrogen. At present, the optimization of composite materials mainly relies on adding vegetables and oxygen additives to the air inlet to increase the oxygen content of the composite. However, this can be achieved by other technologies, so has not been widely used[14]. Humidification technology is often combined with water and gas, which can achieve better vaporization and promote the production of higher water vapor. Water vapor will absorb more heat, and at the same time, it will enter the cylinder, causing the internal temperature to increase. In addition, nitrogen free technology can be used to control nitrogen content in leaching, and the best configuration should be made when using nitrogen free technology[15].

3.4. Adopt post-processing technology.

At present, the internal structure of marine diesel engine has been improved to a great extent, but there is still a certain gap with the international emission quality requirements. Therefore, it is imperative to improve the emission quality. In the specific emission practice, the post-treatment technology should be closely combined with other technologies. At present, it is a common post-treatment technology in China to choose the incubation plan and capture technology. The selection plan mainly

uses ammonia as a reducing agent to directly convert nitrogen oxides into nitrogen.

4. Conclusion

The marine diesel engine energy saving and emission reduction are gradually developing, so we can't blindly rely on the progress of science and technology and ignore human factors. It makes it possible for scientific and technological marine diesel engines to be more efficient and environmentally friendly. The careful care of diesel engines by engineers ensures that diesel engines are safer, more energy-saving and less atmospheric emissions. The earth is the foundation of our survival, and human beings blindly ask for it, ignoring the awareness of protecting the earth. When we can't stop this kind of demand, we should try to reduce the demand for resources, which in itself is a kind of protection. The deterioration of the earth, the global warming, the melting of icebergs and the exhaustion of resources are the resistance of the earth and the call for human love. Energy conservation is imminent. Oil is the biggest source of energy for industrial production, and it will also be the first energy to challenge human needs. Let's take action together to save energy and reduce emissions and care for the earth.

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