Proceedings of the 2023 International Conference on Mechatronics and Smart Systems
DOI: 10.54254/2755-2721/11/20230220

Crucial analysis of traditional engines versus hybrid engines

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Abstract. The hybrid engine is a kind of emerging engine. It can simultaneously use an internal combustion engine and electric motor and other engine driving methods to improve fuel efficiency, reduce pollution emissions, extend the power system's life, improve performance, and have a series of significant advantages. However, hybrids are expensive to sell and maintain, have limited battery life, and can lose their fuel efficiency advantage at high speeds. On the opposite side, the internal combustion engine has a long history of traditional power engines, so it is easier to use, cheaper, and more mature, but it causes more pollution, poor fuel economy, and serious energy loss. These engines are two of the mainstream engines in the market at present. They each have different advantages and characteristics. In the choice of two different types, to combine the needs of users, comprehensive consideration, practical choice in line with the working environment of the engine. This paper aims to compare the advantages and disadvantages of hybrid and traditional internal combustion engines and analyze the reasons for these advantages and disadvantages and the impact of these advantages and disadvantages in detail.

Keywords: hybrid engine, traditional internal combustion engine, hybrid engine.

1. Introduction

Engines can be seen everywhere whether in industrial manufacturing or daily travel and are inseparable from the role of engines. It can be used directly to power vehicles or as an energy source for other devices. In addition, there are many different types of engines, and different types of engines have different applications. This includes internal combustion engines, electric motors, hybrid motors, fuel cell engines and gas liquefaction engines. A hybrid engine is a power system that associates a traditional internal combustion engine with an electric engine. Combining dual drive modes achieves higher fuel efficiency, fewer tailpipe emissions, and higher power output. The engine uses a motor engine to provide power output and start at low speeds, while a fuel engine provides a power source at high speeds and long distances while recharging the battery by recycling braking energy to keep the motor running continuously. An internal combustion engine, on the other hand, is an engine that mixes fuel and air and burns it inside to produce hot, high-pressure gases that further propel the pistons or rotors to spin.

Compared with traditional internal combustion engines, greener emissions, longer driving range, and higher performance are unique advantages of hybrid engines, but the price, difficulty in changing the status quo, and disposal problems after retirement are drawbacks of hybrid cars. Which of these two engines is better? Can emerging hybrid engines replace traditional but reliable internal

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combustion engines? How to evaluate their influence objectively? Therefore, it is of great significance to discuss the advantages and disadvantages and choice of the two, as well as the future development trend and direction.

Based on the network paper search and analysis of hybrid electric vehicles and traditional internal combustion engine data comparison and analysis, trying to put the hybrid electric engine and traditional internal combustion engine these hot social issues under the test of objective data. This paper's fundamental purpose is to analyze whether the hybrid engine, a new engine driving mode, has a development prospect and the competitive relationship between it and the traditional internal combustion engine. Based on the data comparison of existing papers and the actual situation, the advantages and disadvantages of the two different engines are presented in a simple and easy-to-understand, visual, and intuitive table comparison and text narration.

2. Details of both engines

2.1. Internal combustion engine

An internal combustion engine is a type of heat engine. It converts the chemical energy of fuel into kinetic energy. Common fuel and air mixed combustion generates heat, gas expansion by heat, and promotes mechanical devices into mechanical energy for external work. The combustion gas of an internal combustion engine is also the working medium. Internal combustion engines are divided into diesel and spark ignition engines, as shown in Table 1 [1]. At present, the common four-stroke engine on the market, the specific working mode, is shown in Figure 1.

Table 1. Classification of internal combustion engines.

Spark-ignition	Diesel
Air enters the cylinder, and high fuel is injected into the air inlet or cylinder.	In inhaled air, fuel is sprayed into a cylinder before burning.
Spark ignition of fuel and air mixture	Spontaneous combustion of a fuel-air mixture from a fuel nebulizer
Reduce load through air and fuel savings.	Load is reduced by reducing fuel injection in each cycle.
Fuel: Gasoline. Volatile does not readily spontaneous combustion.	Fuel: Distilled oil must ignite easily at high temperatures.
Due to the impact limit, the compression ratio is lower (~10).	Higher compression ratio
Lightweight structure with low pressure and low durability.	The heavier the structure, the higher the strength and durability are more important.

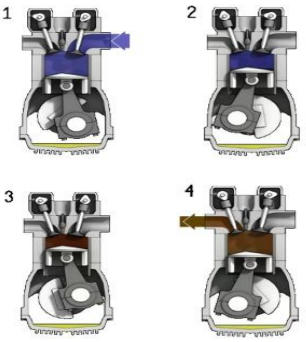

Figure 1. Operation diagram of a four-stroke engine (1) First step, (2) Second step, (3) Third step, (4) Fourth step [2].

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2.2. Hybrid engine

Hybrid engines generate power from two or more sources and can have one or more drive systems. Commercial energy sources include fuel, batteries, fuel cells, solar cells, and compressed gas, while commercial drive systems include technologies such as internal combustion engines, electric motors, and turbines. Hybrid cars that use a gasoline-powered internal combustion engine and a battery-powered electric motor are called genetic hybrid cars or hybrid electric cars, and the majority of hybrid cars on the market now use this method. Hybrid cars use motors when efficiency decreases when the internal combustion engine is slow. In addition, during normal driving, the inertial drive generator recovers some kinetic energy to charge the battery. At present, hybrid engines have been successfully used in the market, such as the first patent published by Gao et al.: one includes a shell, a thermal engine arranged in the shell, and a spindle rotating and assembled at one end of the shell. The clutch and ISG motor are connected between the output shaft of the thermal engine and the spindle in the shell. The transmission connection mode is that the output shaft of the thermal engine and the rotating shaft of the ISG motor are respectively connected with the active and driven part of the clutch, and one end of the spindle extends out of the shell, and the other spindle The end extends into the housing and is connected with the rotating shaft of the ISG motor [3].

3. Advantages of hybrid engine

Through consulting the data, it is concluded that the advantages of hybrid electric vehicles over fuel vehicles are mainly reflected in the driving range, performance, environmental protection, and energy saving.

3.1. Cruising range

According to the experiments of Kwasi-Effah and co-workers, hybrid cars can indeed provide a longer cruising range [4].

Table 2. Recoverable energy under high way fuel economy test (HWEFT).

Reference Point	Vehicle Speed (km/h)		Duration of Braking (s)	Instantaneous Energy		Recovery Energy	%Increase in SOC
	Before	After		Before	After		
130	110	75	10	618.556	287.533	331.023	2
150	90	50	10	414.112	259.712	154.422	2
162	70	68	2	250.533	236.412	14.0912	1
Total						499.536	

Table 3. Recoverable energy using urban dynamometer driving schedule (UDDS).

Reference Point	Vehicle speed (km/h)		Duration of Braking (s)	Instantaneous energy (kJ)		Recovery Energy (kJ)	% Increase in SOC
	Before	After		Before	After		
40	48	0	9	129,850	0	129,850	1
80	50	42	4	138,040	97.4	154,400	1
110	52	0	10	112,690	0	112,6900	2
150	50	0	7	138,040	0	138,040	1
180	55	0	10	167,030	0	167,030	1
Total						702,010	

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They came up with these tabular data, and based on that data and their calculations, they came to this conclusion. Because hybrid electric vehicles are equipped with a series of devices such as a power recovery system and multiple engines, these systems have been shown to make up for at least 1% of the energy loss in every 1.789 km and 3.756 km of drive in both cities and highway cycle, respectively. This reduced energy loss can be used for further mileage [4].

3.2. Better performance

From our comparison between Audi and Mercedes-Benz, we can see that although the engine data of Audi is slightly better than that of Mercedes-Benz, the acceleration performance of Mercedes at 0-100 km/h is much higher than that of Audi at the same level due to the aid of a motor, which is enough to prove that hybrid cars do have more advantages in power. At the same time, according to the information we checked on Wikipedia, petrol-electric hybrid vehicles generally have better fuel efficiency and acceleration performance than the same type of pure internal combustion engine vehicles. When the low-speed efficiency of the internal combustion engine is not good, the use of motor assistance inertia drive generator to recover part of the kinetic energy to charge the battery during ordinary driving. So, the second big advantage of hybrid cars is their performance.

3.3. Effects on environmental protection

Finally, the impact on environmental protection. According to The Economist, about two-thirds of U.S. oil consumption is done on roads, with most of the rest being made using crude oil as a byproduct to produce gasoline and diesel. Such massive consumption is bound to cause great environmental damage. According to the National Resources Defense Council, that number will increase as electric vehicles become more efficient, and power grids become more environmentally friendly. Regional air pollution will also be reduced. The World Health Organization says outdoor air pollution is responsible for 3.7 meters of yearly deaths, making it the biggest environmental health hazard. One study shows that vehicle exhaust is responsible for 53,000 American deaths [5]. Hybrids combine existing cars' benefits with electric vehicles' environmental advantages. These vehicles carry energy storage and electric drive, restore brakes, and fuel engines work most efficiently, thus achieving increased fuel efficiency and reducing pollution. In contrast, plug-in hybrid vehicles (PHEVs) that run on gasoline can reduce emissions by 20 to 60 percent [4]. Diesel engines usually achieve better fuel efficiency to achieve sturdier and more efficiency. Diesel engines usually achieve better fuel efficiency to achieve sturdier and more efficiency. The current topic is the emission of atmospheric pollutants, which have not been fully developed due to the complexity of NOx and fine dust emission reduction technologies. All electric cars have no emissions problems. None of this has been developed yet. Although electric vehicles do not have problems with exhaust emissions, they have problems such as limited driving range and long charging time due to the power supply (battery). It's expensive now. Gasoline-electric hybrids are gaining popularity for a good reason. Combined with both advantages, low exhaust and low fuel efficiency are achieved [1]. Another driver said the big improvements in gasoline engines could also be used to electrify vehicles. Switching directly from gasoline to a gasoline-powered hybrid would add 11 percent and 23 percent to the total, proving that hybrids are more environmentally friendly than existing internal combustion engines [6].

4. Disadvantages of hybrid engine

Everything has two sides; although hybrid engines have obvious advantages, they also have disadvantages that cannot be ignored, such as the cost of use and maintenance disposal of discarded batteries.

4.1. Cost of use and maintain

Cost of Use and maintenance means hybrid electric cars have been on the market since 1997. But until now, the problem has been that manufacturing costs are high. Because hybrid cars would cost money on both powertrains. At the same time, the consequences are higher selling prices, higher maintenance

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costs, and so on. Just as the comparison between the Audi and Mercedes above: the price of the two cars with the same performance. According to the official data of Audi and Mercedes-Benz, the price of Audi is around 480,000 ¥, while the price of Mercedes-Benz is around 520,000 ¥. Mercedes is still higher than Audi, even though the Mercedes were the product that was designed two years ago.

4.2. Regarding the disposal of discarded batteries

Although the hybrid system has contributed to the protection of the environment, we have to consider the recycling of such vehicles. Unlike ordinary vehicles, modern hybrid electric cars generally use a battery, which has to consider the disposal and destruction of batteries. The recycling of waste batteries and pollution treatment of electric cars is difficult. Through interviews and data collection, it is found that the common way to dispose of waste batteries is to dump electrolytes and recycle panels, which not only wastes energy but also easily causes new environmental problems in land and groundwater. This is enough to show the harm of batteries to human life. Therefore, while supporting the popularization of hybrid vehicles, consider the problem of disposing of dead batteries.

4.3. The status quo is hard to change

The internal combustion engine has been mankind's main power source for a hundred years. This has made the internal combustion engine such an integral part of our lives that it is hard to change its status as a power source (Figure 2).

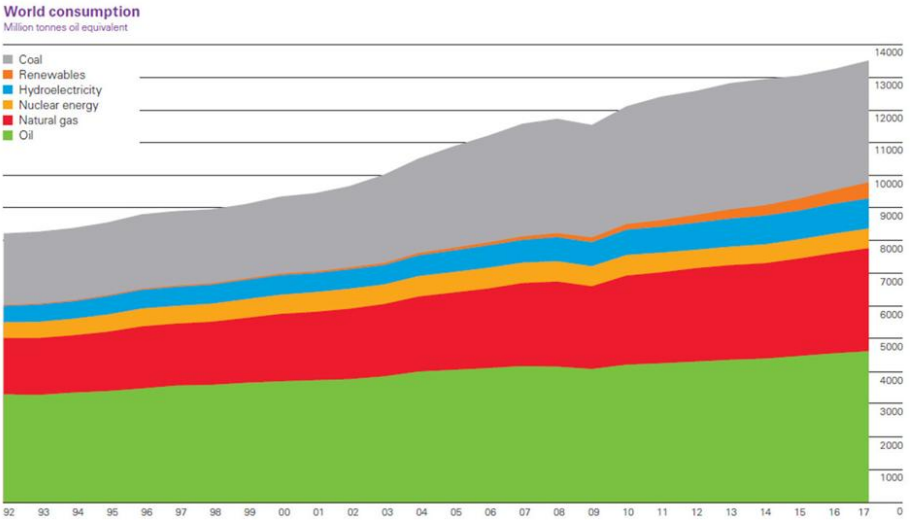

Figure 2. The world's energy consumption in the last 25 years [7].

As can be seen from the picture, about 70% of the chemical fuel is consumed by the internal combustion engine, showing that human life is not achieved without the energy produced by the internal combustion engine. In reality, the entire earth is connected by a massive transportation infrastructure. Most of them are based on internal combustion engines. It also said cheap energy is important in improving global living standards, especially in developing countries. Burning fossil fuels or biofuels has been the only reliable energy source in human history. Burning fossil fuels, or biofuels, has always been the only reliable energy source. This is how this traditional internal combustion engine power source is needed in some economically undeveloped areas to improve local living standards [8]. Hybrid engines are impossible where economies are poor and power infrastructure is not in place, like in Africa. Traditional, highly reliable internal combustion engines are still favored. Also, as technology advances, scientists always optimize how internal combustion engines work, reduce emissions, and optimize efficiency. The internal combustion engine is still being improved [6,9]. In the United States, it is estimated that we will be able to reduce the fuel consumption of vehicles by up to 50 percent compared to the current average. As a result, one can reduce carbon dioxide emissions

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from tailpipes. Using conventional catalyst and control systems can also reduce diesel and spark ignition engines [10].

5. Conclusion

To sum up, a hybrid engine does have great advantages in driving range, performance, environmental protection, and energy saving, but it still has shortcomings in economy and follow-up processing. For thousands of years, man has been innovating, innovating, and developing, and his tools have evolved along with these developments. From the Industrial Revolution, when steam engines replaced manual labor to power, to the second, when internal combustion engines replaced horse-drawn carriages, as today's hybrid engines will eventually replace conventional engines. Compared with traditional power engines, hybrid engines have their advantages and disadvantages. In general, their comprehensive capabilities are not much different. As a result, many people have spotted this business opportunity and future trends, and domestic auto manufacturers have already introduced hybrid models. With the development of society, better driving experiences and more environmentally friendly ways of travel will be the inevitable trend in the future, and outdated old methods and tools will gradually be replaced. Although today's hybrid engine is not perfect, there are still shortcomings. With the development of The Times and the advancement of technology, hybrid engines will gradually overcome their defects and defects in the near future. Thus, with the continuous development of technology and the continuous improvement of environmental awareness, hybrid engines are gradually replacing conventional internal combustion engines and are positioned as an important direction of future engine development and an important trend of future development.

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