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Research Article

HYBRID ENGINE: A MAJOR STEP TOWARDS ENVIRONMENT PROTECTION

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ABSTRACT

The paper presented discusses the use of Hybrid Engines as an efficient alternative of the traditional petrol engine and how it reduces pollution. The Hybrid Engine plays an important role as far as environment protection is concerned by consuming the renewable resources and giving less pollutant gases. Most of the vehicles on road and aviation industries run on fossil fuels. The fossil fuels thereby produce pollutant gases there by increasing the carbon fingerprint, greenhouse gases and pollution in the atmosphere. Hybrid Engines can prove to be an ideal alternative using electricity as another power source of energy and using it along with fossil fuel to give the best performance and maximum fuel economy. Here, a critical analysis has been done to focus on the Hybrid Engines and its effects of Environment.

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INTRODUCTION

Hybrid Electric Vehicles (HEVs) are those vehicles which uses more than one form of energy as a power source which in general is electricity. With the inconsistent rise in the population, the transport sector has also seen a steep increase in the in the number of vehicles on road. But the limited amount of fossil fuels has given hike to the fuel prices as well as a motivation to the research and development of modern hybrid vehicles making them more and more sophisticated and enhanced with technology and comfort. As the fossil fuel is declining day by day, due to this, the dependency to fossil fuels for further development of transportation is questionable. The introduction of the Hybrid vehicles will solve a number of problems based on the traditional fossil fuel dependent transportation by reducing the fuel consumption and pollutant, giving better performance along with excellent passenger safety features.

Hybrid Vehicle

A vehicle with multiple power sources that can operate either individually or simultaneously to increase the vehicle's performance is a hybrid vehicle. There are many configurations like fuel cells, hydraulic, ethanol, hydraulic and many more [1]. But among these, the hybrid electric vehicle, integrating two technically and commercially proven well established

technologies, of electric motors and Internal Combustion engine, have been widely accepted by the modern era of industries.

Hybrid Electric Vehicle (HEV)

A hybrid electric vehicle, also known as HEV, is the most popular, and most commonly adapted hybrid vehicle, which combines two most widely used engines, Internal Combustion Engines and electric engines, to power the vehicle. The power supply to the Internal Combustion Engines can be either petrol or diesel. Using Hybrid Engine Vehicles in cities is becoming quite common and efficient type of vehicle, since the HEV provides maximum power transmission by using both I.C. engine and electric engine simultaneously. However, the working of engines can also be separated as an option, or it can also be effectively operated during emergency situations, for example, the power transmission, which was initially drawn by petrol/diesel engine can be switched to electric engine automatically, when the fuel tank becomes empty.

Series Configuration of HEV

The series HEV is composed of ICE, generator, power converter, motor, and battery. The ICE can operate at maximum efficient point by regulating the output of source power i.e. battery to satisfy the required vehicle power. Since

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the motor is the sole driving component, so the power of motor must be large enough to satisfy the vehicle's performance.

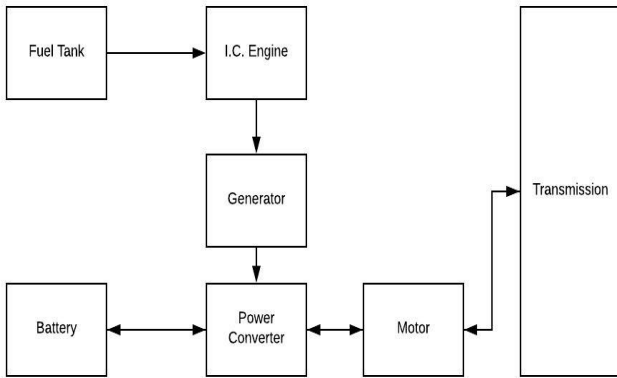


Figure 1 Series Configuration of HEV

Parallel Configuration of HEV

The parallel HEV allows both the electric motor and ICE to deliver power in parallel to drive the vehicle, that is, ICE and motor can drive, respectively, or together. Different from the series HEV, there is mechanical connection between ICE and transmission, and thus the ICE's rotational speed depends on the driving cycle, so the ICE can operate based on optimal operating line by regulating the output power of battery [2].

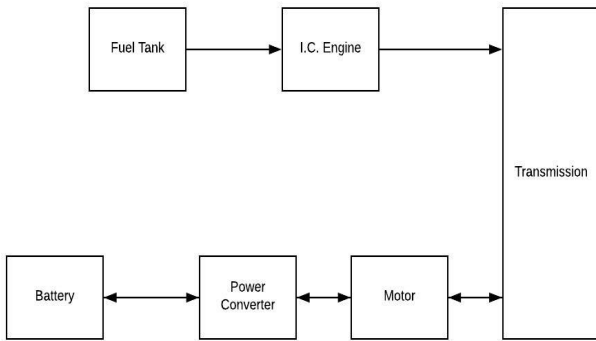


Figure 2 Parallel Configuration of HEV

Combinational Configuration of HEV

Combinational HEVs contexts the features of both series and parallel HEV, with an additional connection between I.C. engine and transmission. Also a generator is added between I.C. engine compared with parallel hybrid. Although it requires more manufacturing technologies and is rather quite complex, it is more flexible to control.

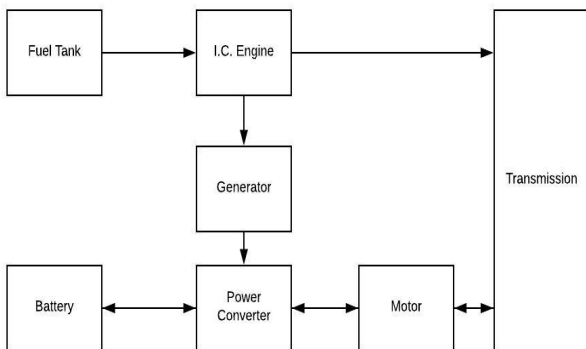


Figure 3 Combinational Configuration of HEV

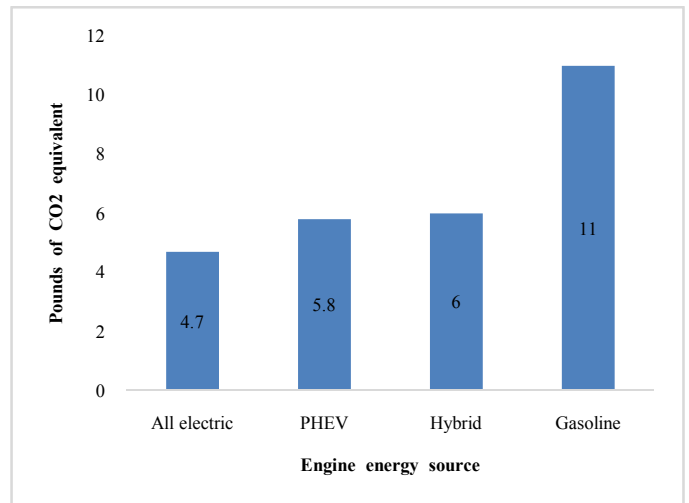
E. Plug-in Hybrid Electric Vehicles (PHEVs)

A Plug-in HEV (PHEV) is a hybrid vehicle containing rechargeable batteries used to power the electric engine, that can be fully charged through an external power source. PHEVs are also known as plug-in hybrid vehicle [3]. A PHEV has the characteristics of both a normal hybrid electric vehicle, and of an all-purpose electric vehicle. As compared to the usual ordinary gasoline-electric hybrid, the plug-in hybrid has an electric motor, and an Internal Combustion engine, for maximum power transmission, and high efficiency [4].

Benefits in Case of Environmental Pollution

In recent years, the level of air pollutions has been risen critically and the air quality in most Indian cities it has already passed the who guideline level for air pollution. The levels of PM2.5 and PM10 (Air-borne particles smaller than 2.5 micrometres in diameter and 10 micrometres in diameter) as well as concentration of dangerous carcinogenic substances such as Sulphur Dioxide (SO2) and Nitrogen Dioxide (NO2) have reached alarming proportions in most Indian cities, putting people at additional risk of respiratory diseases and other health problems.

Hence by the introduction of hybrid engine, the engine does not completely depends on fossil fuels which help in lowering the usage of fossil fuels. Hybrid electric vehicles are energy efficient vehicles that run on an internal combustion engine of a gas vehicle along with the battery and electric motor of an electric vehicle. Thus the fuel economy of the engine becomes twice. The hybrid vehicles consume less natural resources compared to gas vehicles and emits almost no fumes compared to the standard gas vehicle.

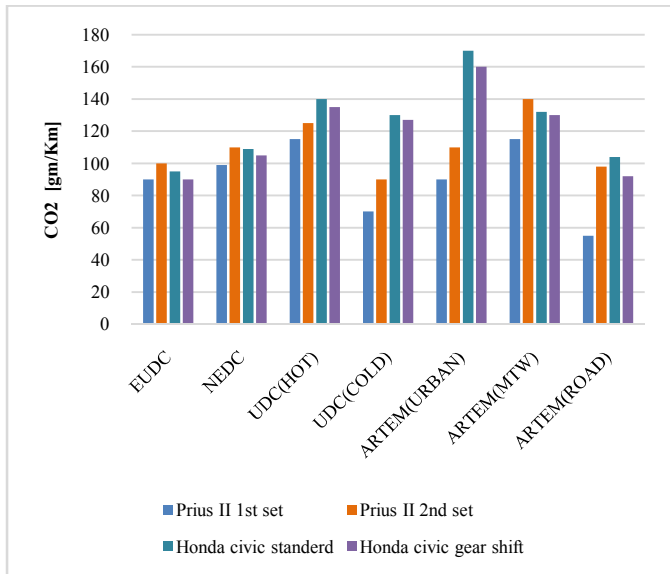


Graph 1 CO2 emissions measurement results

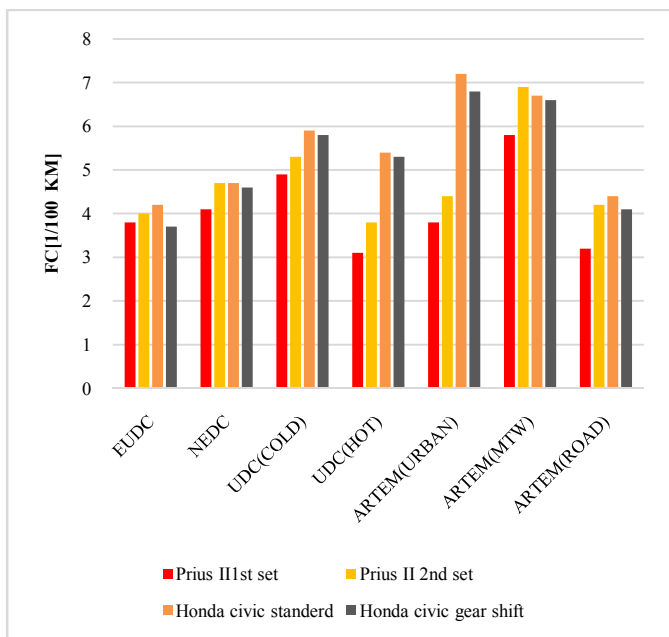
Method Used In the Study of Pollution

Two vehicles of have similar engine-weight characteristics, but different level of hybridisation were used. Toyota Prius II was a fully hybrid engine were as Honda Civic IMA was a mild hybrid engine. The main aim of the study was to measure and compare the emission of gaseous pollutant as well as consumption of fuel. Assessment and Reliability of Transport Emission Models and Inventory Systems (ARTEMIS) protocols were used for the measurement which includes flowingly the Artemis driving cycles, a hot Urban Driving

Cycle-UDC (urban sub-cycle of NEDC) and a cold New European Driving Cycle-NEDC (the combined legislated driving cycle), the Artemis cycles are distinguished into three driving cycles: ARTEMIS urban cycle (URBAN), a semi urban cycle (ROAD), and the extra urban cycle (MOTORWAY).



Graph 2 CO2 emissions measurement results.

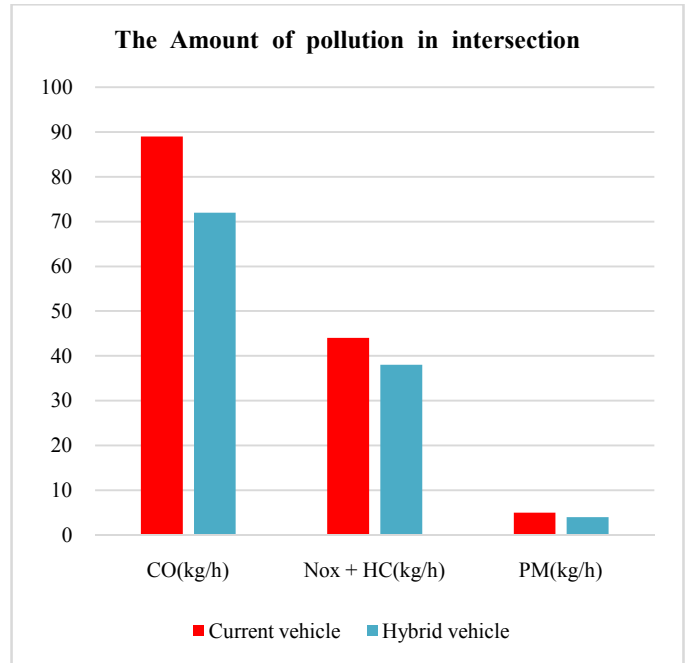


Graph 3 Fuel consumption measurement results.

The above bar diagrams represent the results of CO2 emission and fuel consumption results. The CO2 emission in both the vehicle were less. Despite Prius II has shown a better fuel economy in spite of having bigger engine capacity and power compared to civic IMA. driving cycles. The results of the Gaseous pollution emission were in line with the manufacturer’s specifications. The emission of CO2 in Prius II was less compared to Civic IMA. Moreover the NDEC results were also higher than the official results value. It was observed that there were no differentiations between the two sets of measurements. Hence the effect of temperature due to the NOx,HC and CO can be considered as negligible. The strategy

of gear shifting resulted in higher emission of CO and HC and Lower the emission of NOx. Therefore both the hybrid vehicles can be considered as clean to the environment compared to their conventional equivalents. [5]

The emission of main pollutants like CO, HC + NOx and PM are calculated for the current fossil fuel power vehicles and the hybrid engine vehicle.



Graph 4 The amount of pollution(kg/h) due to fuel powered vehicle and hybrid engine.

With the introduction of hybrid engine vehicles the emission of pollutants on daily basis will be reduced to 1050 kg CO,540 kg(NO + HC) and 60 kg PM per day. Moreover the results of the study also shows that there will be decrement in the pollution level by 22% after the introduction of hybrid vehicles. [6].

The hybrid engines are effective as they are not totally dependent on the fossil fuel of their energy source. Hence the vehicles will consume less fuel and this will lead to the reduction in the emission of pollutants by the vehicles. The environmental pollution caused by vehicles before 1996, was almost thrice compared to emissions after 2000. With the involvement of 5% of hybrid vehicles replacing the vehicles before 1996, helped in the reduction of environmental pollution by 22%.

Petrol Engine

Now a days petrol engine is one of the most popular engines in the field of automobile, Over the last century the usage of petrol engine increased from 39.2 million to 81.5 million [7]. The first successful working petrol engine was invented by Nikolaus August Otto in 1876, before him many other scientist tried to develop a fully working petrol engine but they failed.

Most of the engine use fuel (generally petrol) and air for combustion and the mixing of fuel and air is done after the compression, the mixing is done in the carburetor but with the enhance in technology fuel injection which is controlled electronically is used for the same purpose .unlike diesel engine

compression is not enough for combustion of mixture of fuel and air, for this purpose spark plugs is used. After the compression the gases are allowed to move outside of the engine. Even though this model of engine works perfectly the efficiency of this engine is very poor, according to some sources the efficiency of a petrol engine is around 20% but with the advancement in technology, 38% of thermal efficiency [8] is achieved in the modern engine.

Even though the efficiency of the petrol engine is not great the power output of this engine is good compare to other engines to due to the Ideal Otto cycle. Due to its great power output this engine become ideal for heavy duty work. With the enhancement in the field of engines the demands for the petrol engine increased, but due to sudden increase in number of petrol engine the amount of use of petrol which is a nonrenewable source of energy is also increased and because of this in very near future the world may face a crisis in fuel.

Due to the sudden increase in the usage of petrol engine the gases which is released due to the combustion of petrol is also increased drastically. there are many harmful gases which is released due to the combustion and some of them is even almost impossible to filter, **Carbon monoxide (CO), Nitrogen oxides (NO_x) and Sulfur dioxide (SO₂) are some of the example of these harmful gases.** Now a days cars release around 333 million tons of carbon dioxide every year, which is 20 percent of the world's total, according to the Environmental Defense Fund [9]. According American Lung Association 30,000 people died due to car emissions annually in the US [10].

The Petrol is very volatile, so the 'Compression Ratio' for petrol engine is lower. It may vary from 10:1 to 14:1. The petrol engine compresses the air & fuel with 10:1 to 14:1 ratio, the compression ratio of an diesel engine is higher due to which the thermal efficiency of diesel engine is higher, so diesel engines generally have a better fuel efficiency but in case of power petrol engine is winner.

Electric Engine

Thomas Parker built the first successful working electric car in 1884, he used his own designed high-capacity rechargeable batteries for this task. In the late 19th century and early 20th century the demand of electric car was very high due to the high comfort level and ease of operation which gasoline car at that point of time did not able to provide. Due to the advancement in internal combustion engines (ICE) during the early 20th century increased the popularity of gasoline engine because of which the demand of electric engine decreased. Due to the global warming and air pollution the California Air Resources Board (CARB) decided to that lower-emissions vehicles should be promoted to avoid air pollution, with this decision automobile entered a new era of electric and hybrid engine. Tesla motor global sales reached around 250,000 units in September 2017 [10].

The Renault–Nissan–Mitsubishi Alliance sold 500,000 units electric vehicles by October 2017 [11]. Now a days the electric car are less expensive to run compare to internal combustion engine vehicles due to the lower repairing cost. However cost of purchasing a electric car is still high. According to a study done in 2018, the average operating cost of an electric vehicle in the

US is \$485 per year, and for Internal combustion engines cost is around \$1,117 per year [12].

Electric motors provides high power-to-weight ratios, and batteries are designed to supply the currents to support the motors. Most of the electric vehicles have very small motors of 15 kW (20 hp) or less and have modest acceleration. Electric vehicles can also use a direct motor-to-wheel configuration which generally increases the power. The motors are connected directly to each wheel which allow the wheels to be used both for propulsion and as braking systems. There is a huge disadvantage which electric engine face till today and that is speed, for example, the Venturi Fetish which is consider as supercar has the top speed of around 160 km/h (100 mph). Some DC-motors have simple two-speed manual transmissions to improve top speed but it is not enough to compete with the petrol engine [13].

Internal combustion engines did not have good efficiency due to thermodynamic limits but it is not same in case of electric engines, on-board electric engine has the efficiency of over 90% and practically when counted against stored chemical energy the efficiency come down to around 80% [14]. To maintain a good efficiency a powerful and reliable battery is required and for this purpose Lithium-based batteries are used. Lithium-based batteries are used for its high power and energy density, even though it did not have the power to store charge long period of time but is much more reliable compare to Nickel metal hydride (NiMH), zinc-air battery etc. The range of the electric car is depend upon the number and type of battery used in the car, the cars which was produce in the 2017 has the range in between 100 kilometers (62 mi) (Renault Twizy) to 540 kilometers (340 mi) (Tesla Model S 100D) [15].

CONCLUSION

This project enhances efficiency of the current transport system by using both petrol and electric engines. IOT will reduce the complexity of switching the control between the engines. Cost of travelling will be reduced. This project helps to establish a sustainable development in this world.

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