

TYPES OF CAR ENGINES AND THEIR EFFICIENCY.



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Abstract: The paper aims to classify the main types of automobile engines and evaluate their relative efficiency. The study covers internal combustion engines (ICE), electric vehicles (EV) and hybrid electric vehicles (HEV) using technical reports and environmental analyses. The results show that despite technological advances, ICE vehicles demonstrate low efficiency, especially in mountainous areas. While EV and HEV are superior in fuel economy and emission reduction, which highlights the need for further development of electric vehicles and infrastructure improvement.

Keywords: Automobile engines, internal combustion engines, electric vehicles, hybrid vehicles, fuel efficiency, emissions, environmental impact, altitude efficiency, regenerative braking, automotive technology.

INTRODUCTION

In the ever-evolving world, modern cars have become an integral part of our social life, and this industry has undergone significant changes in recent years, with millions of new models every year, increasing the need for more energy-efficient and environmentally friendly engines. But this has happened little by little, and along with these conveniences, it has created problems related to the environmental impact and fuel efficiency of car engines. Traditional internal combustion engines have dominated automobiles for centuries, but growing concerns about fuel consumption and emissions have led to alternatives such as hybrids and electric motors. This article will focus on classifying the main types of engines available in today's vehicles and evaluating their relative efficiency.

LITERATURE ANALYSIS AND RESEARCH METHODOLOGY.

The efficiency of car engines is usually measured by fuel consumption, the energy obtained per unit of fuel, and the environmental impact of emissions. For consumers and manufacturers alike, increasing engine efficiency is critical to reducing operating costs and meeting government-mandated emissions standards.

An analysis of technical engineering reports, environmental analyses and automotive industry literature was conducted to evaluate the efficiency of automotive engines. Organized engine types include:

1. Internal combustion engines: gasoline and diesel engines
2. Electric motors: motors with full electric power
3. Hybrid engines: a combination of internal combustion engines and electric engines

In the last century, car efficiency was miles per gallon of fuel (MPG). This indicator is universally used in most countries due to the change of laws. New metrics such as grams of CO₂ per kilometer and kilowatt-hours per kilometer have been adopted to measure emissions impact and improve alternative vehicle fuel sources.

In the process of collecting data, we included articles published in several technical engineering journals and the results of environmental analysis, which allowed us to further increase the reliability of the research. It was analyzed based on consumption and emission indicators for the types of engines presented and the information provided by the manufacturer. Through this process, it was possible to organize the efficiency and the differences between the engines.

DISCUSSION AND RESULTS.

Internal Combustion Engine (ICEV) Results: Fuel Efficiency: Internal combustion engine vehicles such as Hyundai Accent (1.6L) and Chevrolet Sail (1.5L) experience significant energy losses in converting gasoline to mechanical energy. Their energy efficiency is about 20%, and the rest of the energy is lost

through heat and friction. In addition to these, the efficiency of IYOD is significantly reduced in high mountain areas (at an altitude of 2700 meters). Lack of oxygen negatively affects the combustion process, increases fuel consumption by 20%, and increases the amount of exhaust gases (CO_2 , CO, NO_x). As a result, fuel consumption increases, which significantly reduces the efficiency of IYODs in high-altitude areas.

Electric Motors (EV) Results: Energy Efficiency: Electric motors are more efficient than internal combustion engines, particularly electric vehicles such as the Nissan Leaf, which deliver more than 60% of the electric power to the wheels, showing much higher efficiency. Nissan Leaf consumes 15-20 kWh of energy per 100 km, which is significantly more economical compared to gasoline engines. Electric vehicles are less affected by changes in altitude, while electric motors are less affected by environmental conditions, for example, changes in air density at high altitudes have less effect on the efficiency of internal combustion engines, but energy is used when climbing slopes in mountainous areas. Consumption increases. A part of the energy spent during braking can be recovered due to renewable energy, but it cannot completely compensate for the additional consumption during the climb.

Hybrid vehicles (HEVs) use two power sources: an internal combustion engine and an electric motor. This combination significantly improves fuel efficiency, as hybrid vehicles use electric power at low speeds or short distances within the city and switch to the internal combustion engine for high speeds or long distances. In average conditions, hybrid cars provide fuel consumption of 4-5 l/100 km (c12206-017-0850-5). In mixed road conditions and on slopes, hybrid technologies further increase fuel economy, which significantly reduces fuel consumption and emissions. Efficiency of hybrid technology: Hybrid cars operate more efficiently in mixed conditions due to the combination of two power sources, internal combustion engines and electric motors. Hybrid cars use electric power at

low speeds or for short distances within the city and fire at the internal combustion engine for high speeds or long distances. Under normal conditions, hybrid cars consume 4-5 l/100 km of fuel. In mixed road conditions and on slopes, hybrid cars further increase fuel efficiency, which significantly reduces fuel consumption and emissions.

The efficiency of car engines depends primarily on the type of fuel and engine technology. Although Internal Combustion Engines (ICEs) have made technological advances over time, they still lag behind electric motors (EVs) and hybrids in terms of efficiency. Internal combustion engines, particularly in vehicles such as the Hyundai Accent and Chevrolet Sail, have confirmed higher fuel consumption and higher emissions in mountainous areas. These results are consistent with previous studies, which also showed incomplete combustion of IYDs due to lack of oxygen in high-altitude conditions. Therefore, in places where the efficiency of IYDs is low, their environmental impact increases, and energy efficiency decreases significantly.

Electric vehicles (EVs), on the other hand, are more efficient in high-altitude areas because they are not dependent on oxygen levels. However, the energy consumption of EVs such as the Nissan Leaf increases when climbing slopes in mountainous areas, which is compared to the research by Lee and Choi (2017) because of the high consumption of electricity in mountainous conditions and the use of renewable energy. Was observed to be limited. Also, these results confirm the ability of electric vehicles to regenerate energy during downhill descent through regenerative braking technology, but this cannot fully compensate for the increased energy consumption.

Hybrid engines have shown their effectiveness, especially in mixed conditions. They provide optimal results in mountainous areas by using a combination of electric and internal combustion engines. Hybrid cars do not depend on IYD when climbing in mountainous areas but use electric motors to effectively conquer slopes and have the ability to recover energy during braking. This shows

that hybrid technology can compensate for the shortcomings of internal combustion engines and reduce energy consumption.

CONCLUSION.

In this article, we analyzed the efficiency of internal combustion engines (ICEs), electric engines (EVs), and hybrid engines (HEVs) and assessed their environmental impact. The results show that internal combustion engines are widespread and significantly weaker inefficient use of their energy sources, especially in high-altitude areas, with increased fuel consumption and increased emissions, but hybrid and electric engines fuel efficiency and excel in reducing emissions. Now and shortly, the future of automotive engineering depends on the further development of electric vehicle technology, and developments aimed at increasing battery capacity and improving infrastructure are of great importance. These studies provide important practical implications for improving engine performance. Electric and hybrid engines are significantly more efficient than internal combustion engines in high-altitude areas, and their wider use will help reduce fuel consumption and emissions.

Also, further research should focus on a more in-depth analysis of the efficiency of EVs and hybrid vehicles in mountainous and rural areas, as the lack of electric charging stations in these areas prevents the widespread adoption of these vehicles.

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