

HYDROGEN ENGINES: PROSPECTS AND CHALLENGES

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Modern society increasingly feels the need to switch to environmentally sustainable energy sources. One of the most promising alternatives is the use of hydrogen engines, which have the potential to significantly reduce environmental pollution and reduce dependence on traditional hydrocarbon resources [1]. This material highlights the key stages of development, prospects and main challenges associated with the introduction of hydrogen technologies.

The growing interest in hydrogen engines is due to their environmental safety. These engines virtually eliminate emissions of carbon dioxide and other harmful substances, such as sulfur and nitrogen oxides [2]. Given the ever-increasing number of cars, especially in countries with developing economies, reducing pollution is becoming a priority. In addition, hydrogen technologies offer the opportunity to significantly reduce dependence on traditional energy resources such as oil and natural gas.

An equally important advantage of hydrogen fuel cells is their high energy efficiency. Compared to classic internal combustion engines, they demonstrate a higher efficiency, which makes them attractive for many transport industries. Hydrogen can be produced from renewable energy sources such as solar or wind power plants, which contributes to the development of a sustainable energy system.

Today, hydrogen-based technologies are actively being implemented in the transport sector. Among the most famous manufacturers of hydrogen-powered cars are Toyota, Honda and Hyundai [3]. Hydrogen trains, such as the Coradia iLint, have already begun operating in Europe, which could potentially replace diesel locomotives. In addition, hydrogen buses and trucks are being developed.

Hydrogen-based technologies are actively used not only in land transport, but also in sea vessels and aviation. Projects are being created for ships with hydrogen engines, which help to significantly reduce greenhouse gas emissions. Experiments with hydrogen fuel cells are also being conducted in aviation, which could lead to the creation of a new generation of environmentally friendly aircraft.

Hydrogen engines have a number of advantages: minimal emissions of harmful substances, high efficiency, versatility of application – from cars to aviation and ships. They also allow the use of renewable energy sources and have a long service life.

However, there are also difficulties. For example, the storage and transportation of hydrogen requires complex infrastructure due to its high volatility and the need for cryogenic cooling. Other problems include the high cost of technology and insufficient energy density, which necessitates the use of large hydrogen tanks which can be rather problematic and costly.

Despite these obstacles, hydrogen technologies are actively developing. Methods of storing and transporting hydrogen are improving, the efficiency of fuel cells is increasing. A number of countries, such as Germany, Japan and the United States, are implementing government programs aimed at supporting hydrogen transport and infrastructure. International cooperation in the field of hydrogen energy, as well as the introduction of subsidies and other incentives, can significantly accelerate the mass implementation of these technologies.

References

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