

Review

Hydrogen Internal Combustion Engine Vehicles: A Review

Kamil Wróbel ^{1,*}, Justyna Wróbel ^{1,*}, Wojciech Tokarz ¹, Jakub Lach ¹, Katarzyna Podsadni ²
and Andrzej Czerwiński ³

- ¹ Industrial Chemistry Institute, Łukasiewicz Research Network, Rydygiera 8, 01-793 Warsaw, Poland
- ² Institute for Engineering of Polymer Materials and Dyes, Łukasiewicz Research Network, Marii Skłodowskiej-Curie 55, 87-100 Toruń, Poland
- ³ Faculty of Medicine, Medical University of Warsaw, 61 Żwirki i Wigury Str., 02-091 Warsaw, Poland
- ⁴ Faculty of Chemistry, University of Warsaw, Pasteura 1, 02-093 Warsaw, Poland
- * Correspondence: kamil.wrabel@ichp.pl (K.W.); justyna.wrabel@imgib.łukasiewicz.gov.pl (J.W.)

Abstract: Motor vehicles are the backbone of global transport. In recent years, due to the rising costs of fossil fuels and increasing concerns about their negative impact on the natural environment, the development of low-emission power supply systems for vehicles has been observed. In order to create a stable and safe global transport system, an important issue seems to be the diversification of propulsion systems for vehicles, which can be achieved through the simultaneous development of conventional internal combustion vehicles, electric vehicles (both battery and fuel cell powered) as well as combustion hydrogen-powered vehicles. This publication presents an overview of commercial vehicles (available on the market) powered by internal combustion hydrogen engines. The work focuses on presenting the development of technology from the point of view of introducing ready-made hydrogen-powered vehicles to the market or technical solutions enabling the use of hydrogen mixtures in internal combustion engines. The study covers the history of the technology, dedicated hydrogen and bi-fuel vehicles, and vehicles with an engine powered by a mixture of conventional fuels and hydrogen. It presents basic technology parameters and solutions introduced by leading vehicle manufacturers in the vehicle market.

Keywords: hydrogen internal combustion engine; commercialized hydrogen vehicle; hydrogen

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1. Introduction

Currently, the transport sector is heavily dependent on fossil fuels, leading to major contributions to emissions of carbon dioxide and pollutants. In the face of increasing environmental pollution and at the same time the rising demand for energy, the so-called “hydrogen economy” is one of the most promising pathways for the development of sustainable energy [1–4].

Hydrogen internal combustion engines are an important technology in the accelerated path to decarbonization. The beginnings of the technology date back to the 19th century, and intensive development took place in the early years of the 21st century. Since about 2010, a decline in interest in this technology has been observed, mainly due to the entry into the market of electric vehicles (powered by batteries), widely recognized as “zero-emission” solutions. However, taking into account the production process of batteries requiring the use of rare and sometimes toxic raw materials and problems with recycling, the use of electric vehicles on a large scale places a heavy burden on the natural environment, and their zero emission status is highly questionable. Battery technology is perfect for passenger cars and selected utility vehicles. Meanwhile, the transport sector includes vehicles with a diverse set of work cycles and uses. Some of these vehicles and devices are currently not prioritized for applications in electric battery technology, which indicates that hydrogen technology could be a promising zero-emission solution for many utility vehicle operators.

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