Editorial

Alternative Fuels in Automotive Vehicles

Zhengbai Liu

School of Innovation and Entrepreneurship, Southern University of Science and Technology, Shenzhen 518055, China; liuzb3@sustc.edu.cn

Received: 20 March 2023
Accepted: 24 March 2023
Published: 24 March 2024

Driven by environmental concerns, economic benefits, and energy security, along with government support, alternative fuels have been widely used in automotive vehicles in many countries. Among alternative fuels, more attentions are paid to natural gas, methanol, and ammonia. These alternative fuels can reduce vehicle harmful pollutants and operation costs. In this issue of the International Journal of Automotive Manufacturing and Materials (IJAMM), three articles respectively discuss natural gas, methanol, and ammonia as alternative fuels.

Liu et al. [1] reviewed the development of natural gas engines. Compared to diesel or gasoline engines, natural gas engines emit fewer pollutants, making them an eco-friendlier alternative. As concerns about climate change grow, there is an increasing demand for cleaner energy sources, and natural gas engines are becoming a popular solution. Natural gas is generally less expensive than diesel or gasoline, making it an attractive choice for businesses and fleets looking to reduce their operational costs. Additionally, natural gas engines can provide higher fuel efficiency, leading to further cost savings. Since natural gas is domestically produced, using it as fuel can reduce a country's dependence on foreign oil, enhancing energy security and reducing the economic impact of volatile oil prices. Governments worldwide are promoting the development of natural gas engines through various policies and incentives. In the United States, for instance, the federal government provides tax credits for natural gas vehicles, and some states offer additional incentives. Overall, these factors are driving the development of natural gas engines.

The development of natural gas engines can be categorized into several generations based on technological advancements and design changes. The number of generations may differ depending on the classification criteria, but typically there are three generations of natural gas engine development. The first generation of natural gas engines used carbureted systems for fuel delivery and was often based on gasoline or diesel engine designs. These engines were not optimized for natural gas combustion and had limited efficiency and power output. The second generation of natural gas engines used electronic fuel injection (EFI) systems for precise control of fuel delivery and combustion. These engines were specifically designed for natural gas and had improved efficiency and power output compared to first-generation engines. The third generation of natural gas engines includes engines with advanced combustion technologies, such as lean-burn and stoichiometric combustion, as well as improved EFI systems and engine management software. These engines are even more efficient and eco-friendly than second-generation engines, with lower emissions and improved fuel economy. It is important to note that some sources may use different classifications or terminology to describe the generations of natural gas engine development, but the general idea is that advancements in technology and design changes have led to more efficient and effective natural gas engines over time.

Over the years, various developments and research efforts have been carried out on natural gas engines. Engine manufacturers have designed natural gas engines that are optimized for natural gas combustion, using advanced combustion technologies, improving fuel injection systems, and optimizing engine components. Research has focused on reducing emissions from natural gas engines, including particulate matter, nitrogen oxides (NOx), and greenhouse gases. This has led to the development of aftertreatment systems like selective catalytic reduction (SCR) and exhaust gas recirculation (EGR), which can reduce emissions and comply with increasingly stringent emissions standards. Additionally, efforts have been made to improve the fuel efficiency and performance of natural gas engines. These include optimizing engine control systems, designing engines for specific applications, and using advanced materials. The future of natural gas engines is promising, with continued research and development efforts focused on improving their efficiency, reducing emissions, and expanding their use in various applications.

Yao and Yao [2] highlighted their research on the methanol combustion in internal combustion engines. The development of methanol engines is primarily driven by the need to find alternative fuels that are more environmentally friendly and sustainable than traditional fossil fuels. Methanol is a promising alternative fuel source because it is renewable and can be produced from various sources, including biomass, natural gas, and coal. In addition, methanol has a higher-octane rating than gasoline, enabling engines to run more efficiently with fewer emissions. Methanol also produces lower levels of pollutants such as carbon monoxide, nitrogen oxides, and particulate matter, making it an attractive option for reducing air pollution.

Research on methanol engines has focused on developing and optimizing engines to run on methanol fuel. This has involved investigating the effects of methanol on engine performance, emissions, and durability, as well as developing new engine designs and technologies to improve efficiency and reduce environmental impact. Several studies have explored the potential of methanol engines to use renewable sources of methanol, such as biomass and waste materials, as a more sustainable fuel source. In addition, research is ongoing to develop infrastructure for methanol distribution and fueling and to address safety concerns associated with methanol handling and storage. Overall, the continued research and development of methanol engines offer promising prospects for a more sustainable and environmentally friendly transportation sector.

The future of methanol engines looks promising as they have the potential to provide a cleaner and more sustainable alternative to traditional fossil fuel engines. Methanol is a renewable resource that can be produced from various sources such as biomass, natural gas, and even CO2 emissions from other industrial processes. Methanol engines have a lower carbon footprint compared to gasoline and diesel engines, and they emit fewer harmful pollutants such as particulate matter, sulfur dioxide, and nitrogen oxides.

In addition, methanol has a higher-octane rating than gasoline, which means that it can be used to produce more powerful engines. Methanol fuel cells also have the potential to provide a clean and efficient source of power for various applications, including transportation, stationary power generation, and portable devices.

Zhu and Shu [3] reviewed the recent progress on the combustion characteristics of ammonia-based fuel blends and their potential in internal combustion engines. Research on ammonia-based fuel combustion in engines has been ongoing for several decades. Early studies focused on using ammonia as a hydrogen carrier for fuel cells, but more recent research has explored the use of ammonia as a direct fuel for combustion engines. Ammonia is an attractive fuel option due to its high hydrogen content and lack of carbon emissions when combusted. However, there are several challenges that need to be addressed, including its low energy density, corrosive properties, and the need for specialized storage and delivery systems. Research has been conducted to investigate the feasibility of using ammonia as a fuel in diesel and gasoline engines, as well as in gas turbines. Some studies have shown promising results in terms of fuel efficiency and emissions reduction, but further research is needed to fully understand the potential of ammonia as a viable alternative fuel for combustion engines. Additionally, ongoing research aims to develop ammonia production methods that utilize renewable energy sources, such as wind and solar power, to produce "green" ammonia with lower carbon emissions. This could further enhance the environmental benefits of using ammonia as a fuel for combustion engines.

The future of ammonia-based fuel in engines appears promising due to its potential as a sustainable and carbon-free fuel. With continued research and development, it has the potential to be used as a primary fuel for transportation and power generation, particularly in heavy-duty applications. However, further technological advancements and infrastructure developments are required to ensure its widespread adoption. Additionally, safety concerns related to the storage and handling of ammonia fuel need to be addressed.

Based on the discussions above, it can be concluded that alternative fuels have the potential to play a significant role in the future of automotive vehicles.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Liu, L.; Zhang, M.; Liu, Z. A Review of Development of Natural Gas Engines. *International Journal of Automotive Manufacturing and Materials* **2023**, *2*(1), 4.
2. Yao, A.; Yao, C. Study of Diesel/Methanol Dual Fuel Combustion in CI Engines and Its Practice in China. *International Journal of Automotive Manufacturing and Materials* **2023**, *2*(1), 2.
3. Zhu, D.; Shu, B. Recent Progress on Combustion Characteristics of Ammonia-Based Fuel Blends and Their Potential in Internal Combustion Engines. *International Journal of Automotive Manufacturing and Materials* **2023**, *2*(1), 1.

Citation: Liu, Z. Alternative Fuels in Automotive Vehicles. *International Journal of Automotive Manufacturing and Materials* **2023**, *2*(1), 7. https://doi.org/10.53941/ijamm0201007