Alcohol based automotive fuels from first four alcohol family in compression and spark ignition engine: A review on engine performance and exhaust emissions


Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600, Malaysia
Mechanics of Biosystem Engineering Department, Tarbiat Modares University, Tehran, Iran
Faculty of Industrial Science & Technology, University Malaysia Pahang, 26600, Pekan, Malaysia
School of Manufacturing Engineering, Universiti Malaysia Perlis, 01000, Kangar, Malaysia

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ABSTRACT

Alcohol fuels have some significant advantages over other alternative fuels, including the ability to work in existing engines as well as the capability to reduce greenhouse gas emissions. This paper analyses the performance and emissions of compression and spark ignition engine using alcohol fuels from the first aliphatic alcohol family; methanol, ethanol, propanol and butanol. The literature relevant to methanol, ethanol, propanol and butanol was reviewed and summarized to demonstrate its viability as an alternative fuel. The fuel properties of methanol, ethanol, propanol and butanol present the most important properties that allow such fuels as suitable candidates as an alternative fuel for compression and spark ignition engines. The performance and engine emissions indicators such as brake torque, brake power, BTE, BSFC NOx, PM, CO, CO2, HC and soot have been evaluated regarding tone at diesel and gasoline fuels. The results showed that alcohol fuels give different results to engine performance and emissions. Surprisingly, some research yield favorable results to the alcohol as compared to neat diesel and gasoline fuels. It can be concluded that methanol, ethanol, propanol and butanol are capable of reducing harmful engine exhaust emissions, however, at the expense of lower engine performance characteristics.

1. Introduction

The development of internal combustion engine began in the late of 1800s. The emergence of automotive researchers between the period of 1800–1930 namely; Nicolaus Otto, Karl Benz, Gottlieb Daimler, Henry Ford and Rudolph Diesel directed to the invention of spark and compression ignition engine [1]. For decades, their outstanding discoveries proved to play a vital role in vehicular systems to this very day. The internal combustion engine has been the foundation for the successful achievements for many industrial technologies especially in the applications of power generation, transportation, agriculture, offshore drilling, military, marine, telecommunication and generator [2]. However, the rapid progression in internal combustion engine activity broad major energy consumption and undoubtedly uses most of the depleting fossil fuel energy [3]. This brings about negative impact on the atmosphere, hydrosphere, geosphere and ecosphere of the planet Earth [4]. On top of that, the transportation sector is responsible for a large and growing share of emissions that affects global climate change [5]. Owing to the growing concern on the adverse effect of exhaust emissions towards climatic and environmental issues, an international summit was held in Kyoto, Japan back in 1997. The main issue deliberated is the means to stabilize the atmospheric concentration of Greenhouse gases (GHG) which causes global warming. One of the main factors identified is the combustion of hydrocarbon from fossilized fuel [6,7]. In the recent world’s climate change conference (COP21) in December 2015, a historic agreement among 195 countries amongst the members of United Nation (UN) and European Union (EU) was made. The main goal of the summit is to