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An Investigation Of Nox Emissions And Fuel Consumption From SI Engines Using Blends Of Gasoline, Hydrogen-Rich Synthesis Gas, And Hydrous Ethanol

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Extended Abstract

Internal combustion engines (ICEs) have been the primary source of power for vehicles and industrial machines for decades. However, the combustion process of ICEs has considerable environmental implications, leading to the release of undesirable emissions into the atmosphere. These emissions have a detrimental impact on global warming and human health, highlighting the need for alternative and sustainable solutions. The combustion process of ICEs generates various pollutants that can significantly affect our planet's climate and pose significant risks to human health [1-2]. Pollutants released during combustion, such as nitrogen oxides (NOx), can adversely affect respiratory health. The transportation sector, which is one of the most severe emitters of greenhouse gases, is one of the sectors that could benefit from alternative fuels [3-4]. Alternative fuels offer a challenge and promise to meet emission restrictions and protect the environment. In this study, five and ten percent blends of anhydrous ethanol-gasoline blended fuel (E5 and E10) and hydrous ethanol-gasoline (HE5 and HE10 with water concentrations of 5%, 10%, 30%, and 40%) and syngas produced by plasma reforming are added to two Saudi fuels: RON91 and RON95 to test the impact on NOx emissions and fuel consumption [5-6]. Under lean and stoichiometric conditions, the engine operates. A maximum reduction in NOx emissions can be achieved with hydrous ethanol mixed with 40% water, resulting 60% reduction in NOx emissions under stoichiometric conditions without adding hydrogen-rich syngas. Injecting hydrogen-rich syngas further reduces emissions to 70%. The NOx emissions of hydrous ethanol-gasoline blends were significantly lower under lean conditions than those of other fuels and further reduced as the air-fuel ratio of equivalence decreased. The results of this experimental work indicated a significant reduction in NOx emissions while a slight increase in fuel consumption was observed. The study used four support systems: a modified gasoline engine, a feeding system, a plasma converter, and a load system. Syngas is produced by partially oxidizing gasoline with air in a plasma-assisted fuel converter using an entirely automated engine and plasma converter system. To increase plasma reactor reliability and operational life, steam was added to gasoline–air converter fuel mixtures to reduce soot production [7]. A few modifications are made and experimentally tested to enhance the production of hydrogen-rich syngas and improve the anti-erosion properties of the materials. We tested four different anode designs, two swirl rings, and two different air-fuel flow rates to determine their erosion resistance. To maintain the desired engine speed and oxygen content in the exhaust gas at a fixed electric load, a semiautomated algorithm is used. This involved adjusting the throttle position and fuel injector timing. The fuel injectors are adjusted proportionally by changing their timing relative to the values obtained for stoichiometric conditions to achieve the desired oxygen concentration in the engine exhaust for lean mixtures with λ values of 1.13 and 1.26 [8]

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