A Comparison of Methanol, Methane and Hydrogen Fuels for SI Engines: Performance and Pollutant Emissions

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Abstract

The urban mobility electrification has been proposed as the main solution to the vehicle emission issues in the next years. However, internal combustion engines have still great potential to decarbonize the transport sector through the use of low/zero-carbon fuels. Alcohols such us methanol, have long been considered attractive alternative fuels for spark ignition engines. They have properties similar to those of gasoline, are easy to transport and store. Recently, great attention has been devoted to gaseous fuels that can be used in existing engine after minor modification allowing to drastically reduce the pollutant emissions. In this regard, this study tries to provide an overview on the use of alternative fuels, both liquid and gaseous in spark ignition engines, highlighting the benefits as well as the criticalities. The investigation was carried out on a small displacement spark ignition engine capable to operate both in port fuel and direct injection mode. Engine was fueled with gasoline and methanol in port mode to exploit the advantages of this technology for liquid fuels. Gaseous fuels were injected directly in the chamber to prevent the drawbacks of power loss and abnormal combustion. Tests were performed at different operating conditions typical of urban and extra-urban patterns. Combustion behavior of the tested fuels was analyzed through indicated data. Gaseous fuels were measured at raw exhaust. Particles were characterized in terms of number and size at diluted exhaust. In general, it was found out a benefit in terms of pollutant emissions with alternative fuels compared to gasoline. The interesting result regards the particle emissions that depend on the combination of the fuel characteristics and the operating conditions. In particular, at some test points, hydrogen shows high particle emissions with values comparable to those of other tested fuels highlighting the contribution of lubricating oil that plays a more significant role when low/zero carbon gaseous fuels are used.