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# Combustion and Emission Behavior of N-propanol as Partially Alternative Fuel in a Direct Injection Spark Ignition Engine

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**Abstract:** Alcohols have always been the important alternatives to gasoline. Propanol is expected to be widely used in a spark ignition engine due to the higher heating value than ethanol. In this study, the combustion and emissions of n-propanol/gasoline surrogates were studied. The proportions of n-propanol in blends are 10%, 30% and 50% by volume, and the mixed fuels were named as PRTRF0.1, PRTRF0.3, and PRTRF0.5, respectively. The proportions of n-heptane and iso-octane of gasoline surrogates were adjusted to maintain the same research octane number at 95. Results show that the blends with higher proportions of n-propanol lead to higher maximum in-cylinder pressure, higher maximum in-cylinder mass averaged temperature, shorter flame development duration, and shorter rapid combustion duration. The CO, THC, alkane, acetylene and aromatic emissions decrease as the proportion of n-propanol increases. However, PRTRF0.3 has the highest alkene and aldehyde emissions. Both of the geometric mean diameter of particle matters and the accumulation-mode particle ratio in particle matters decrease as the proportion of n-propanol increases. The effective thermal efficiency of the engine increases with the increase of the proportion of n-propanol. PRTRF0.5 has the highest effective thermal efficiency at the medium load up to 33.1%.

**Key words:** n-propanol; gasoline surrogate; alternative fuel; direct injection spark ignition engine; combustion and emissions

## 1. Introduction

Alcohols have always been the important alternative fuels for internal combustion engines [1, 2]. Due to the high-octane number and oxygen in molecules, alcohols were considered to have the inhibitory effects on the knock of the engine and can promote the full combustion of fuel [3, 4]. Among the alcohol fuels, ethanol is the most used gasoline alternative fuel due to its excellent combustion performance and wide production methods [5]. In Brazil, for instant, ethanol has been mixed with gasoline as fuel for over 30 years [6, 7]. The extensive experimental

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