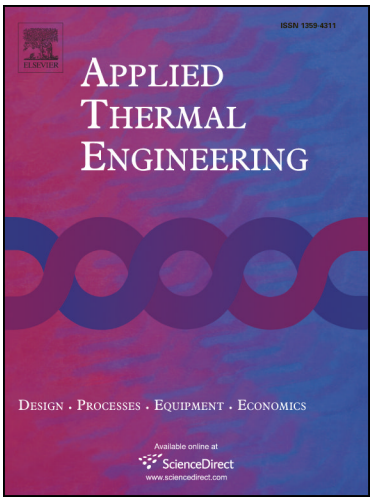

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Exploring optimal operating conditions for wet ethanol use in spark ignition engines

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HIGHLIGHTS

- Wet ethanol reduces fuel costs while contributing for increased engine efficiency
- Higher water content allows substantially higher compression ratios with directly increase in conversion efficiencies
- Combustion duration is not significantly affected by the higher water content
- Ethanol with higher water content shows up to 7% efficiency increase
- Lower NO_x and higher HC emissions are found with increased water content

Abstract

Of all the biofuels available in the market, ethanol seems to be the most promising one for spark-ignited engines. However, its lower calorific value makes operation more expensive due to increased volumetric fuel consumption, when compared to gasoline. Measures that further increase efficiency and that reduce fuel costs are necessary for a more widespread use. Hence, the use of ethanol with increased hydration may be the answer for reducing fuel costs while contributing for increased efficiency should the properties of this blend are properly addressed. Previous studies reported an important increase in knock resistance for ethanol-water fuel blends with high water content, the so-called "wet ethanol". This work explored this phenomenon by increasing the compression ratio of the engine. It was investigated the limiting conditions with respect to spark advance and compression ratio through ignition timing sweep. The direct impact on combustion and emissions parameters of using wet ethanol with higher compression ratios was also evaluated. Ethanol-water fuel blends containing 4%, 10 %, 20% and 30 % v/v of water in ethanol were tested and compared in engine tests. For each of the fuel blends it was assessed three different compression ratios (12.5, 13.5 and14.5:1). The results showed that ethanol-water fuel blends with high water content allow working with optimum combustion phasing even for compression ratios of 14.5:1. It leads to an increase of 7% in the indicated efficiency values for E80W20 when compared to commercial ethanol with 4% hydration. Emissions results were similar to those of commercial ethanol. Thus, this work shows that E80W20 is an optimum blend for increased engine efficiency and similar emissions of those of E4W96 while reducing fuel production costs.

Keywords: wet ethanol; SI engines; compression ratio; efficiency; emissions