Ignition Delay Measurements of GCI Blend

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Although there are several researches and studies on alternative energy resources for transportation, still internal combustion (IC) of liquid fuels is the main source of transportation energy. For example, EIA shows that, in 2016, 55% and 21% of transportation energy derived from gasoline and diesel respectively. However, Gasolines engine is known with its limitation in compression ratio and as a result it needs fuel with high octane number (ON) and hence the distillation process for such fuels require more processing steps. Diesel engine has high compression ratio but on the other hand it has high emissions. A blend of J-80 light naphtha (50%), J-80 heavy naphtha (25%) and Reformate 262 (25%) is proposed here as a promising fuel for gasoline compression ignition engine (GCI) which combined the best of gasoline and diesel engines, low emissions and high efficiency respectively.

In this work, we are performing experimental and modeling work to investigate the ignition characteristics of the GCI blend. A global indicator of fuel ignition and reactivity is the "ignition delay time" which is measured in ideal reactors, such as shock tube and rapid compression machine. Here, we measured the ignition delay times of the GCI blend over wide ranges of pressures, temperatures and equivalence ratios. The GCI blend used here has research octane number (RON) of 77 and motor octane number (MON) of 63.9. The ignition delay times of the GCI blend were measured over the following conditions:

Temperature Range: 600 – 1200 K
Pressures: 20 and 40 bar
Equivalence ratios: 0.5, 1 and 2

To perform computational fluid dynamic (CFD) simulations of complex real fuels, such as the GCI blend, a simpler surrogate fuel with small number of components must be proposed which matches the properties of the real fuel. In this work, we have compared the ignition of GCI blend samples with the predictions of two surrogates: (1) a two-components primary reference fuel (PRF) surrogate comprising of n-heptane and iso-octane, which matches the RON of blend, (2) a multi-components surrogate which matches the RON, MON, H/C ratio and distillation curve of GCI blend.