EXTENDED ABSTRACT **(Draft)**

Gas engine research at Aalto University

Aalto University

High-speed dual fuel gas engine experimental studies

A single-cylinder high-speed research engine was converted from a direct injection diesel engine to a dual-fuel engine running on methane as the main fuel and diesel fuel as the ignition fuel. The conversion included a new exhaust system, methane feed line including injectors, several new sensors and other devices related to the methane injection. Engine control system was updated for dual-fuel operation. The research engine was equipped with fully flexible valve actuators.

The combustion and emissions research **in a dual-fuel research** engine was started **with variable valve timings (VVA)**. Five different valve actuation profiles were used with several diesel substitution rates. The effects of each parameter combination on the cylinder pressure and engine-out emissions were recorded.

The main conclusion of the VVA-studies was the fact that the dual-fuel combustion is very sensitive to internal exhaust gas recirculation (IEGR), most likely due to high mixture temperature. High temperatures promote the partial pre-combustion oxidation of methane which causes a substantial increase in the heat release rate even with very lean mixtures. Low temperatures have the opposite effect, although it is not as pronounced. A significant amount of the HC emissions originate from the scavenging if methane is injected prior to the exhaust valve closing. Furthermore, high substitution ratios tend to increase the cycle-to-cycle variation.

Besides the VVA-studies also **external EGR** was studied **in the dual fuel gas engine**.

Cold EGR was used in the thesis, so there was a cooling system integrated in order to cool down the recirculated exhaust gases before entering the intake manifold.

In dual-fuel combustion NO_x emissions are lower, while THC and CO are higher than diesel. EGR causes a clearly decrease on NO_x emissions, reducing also THC, especially at higher amounts of methane. However, EGR effect on CO emissions is low until EGR rates are around 20%, moment in which there is a large increase.

Modelling mixture formation for direct injection gas engines …

Coming gas engine/ dual fuel engine research in Aalto University

Single cylinder dual-fuel combustion research will continue with parametric studies and as master thesis studies in 2016 and 2017.

Modelling mixture formation for gas engines …

Modelling dual fuel combustion …

Optical measurements of dual fuel gas combustion 2015 to 2016…