Optimizing the Performance of a 50cc Compression Ignition Two-Stroke Engine Operating on Dimethyl Ether - DTU Orbit (05/10/2019)

The paper describes the optimization of a 50cc crankcase scavenged two-stroke diesel engine operating on dimethyl ether (DME). The optimization is primarily done with respect to engine efficiency. The underlying idea behind the work is that the low weight, low internal friction and low engine-out NOx of such an engine could make it ideal for future vehicles operating on second generation biofuels. Data is presented for the performance and emissions at the current state of development of the engine. Brake efficiencies above 30% were obtained despite the small size of the engine. In addition, efficiencies near the maximum where found over a wide operating range of speeds and loads. Maximum bmep is 500kPa. Results are shown for engine speeds ranging from 2000 to 5000 rpm and loads from idle to full load. At all speeds and loads NOx emissions are below 200 ppm and smokeless operation is achieved. Design improvements relative to an earlier prototype are described. The major alterations are related to air intake arrangement, exhaust tuning and the fuel injector. Comparison is made to the first prototype engine and the effects of fuel injection rate, injection pressure, cylinder head geometry and injection timing are evaluated at selected engine operating conditions. Cylinder pressure, crankcase pressure and rate of heat release were determined. The engine uses an oversize fuel injector so that fuel delivery happens within a few crank angle degrees. Since DME is very volatile a large degree of premixing occurs before auto-ignition of the fuel. This results in approximately 65% of the fuel being burnt rapidly in the premixed phase of combustion. The engine mode of operation can be characterized as premixed compression ignition (PCI).