SUPERCRITICAL COMBUSTION STUDIES IN A SINGLE CYLINDER YANMAR DIESEL ENGINE

B. Ahern, I. Djutrisno, K. Donahue, C. Haldeman, S. Hynek, K. Johnson,
J. Valbert, M. Woods, and J. Tester
Quantum Energy Technologies

Mixtures of water and diesel fuel were pumped into a common reservoir and heated to over 700°F. This homogeneous water/fuel mixture with non-ideal gas properties was introduced to compression ignition combustion. The supercritical fluid has a pronounced pressure density relationship that impacts injection into the cylinder. The departure from ideal gas behavior combined with the high compressibility of the supercritical fluid present challenges for injection with current hydraulic technology.

In-cylinder data obtained with a 2.7-kW, single-cylinder, air-cooled Yanmar diesel engine is encouraging. NO_x has been reduced by an order of magnitude, and smoke has been reduced to non-detectable levels on an AVL smoke meter. The low smoke levels are attributed to the lack of nucleation sites for particulate formation. However, the very low NO_x values indicate a fundamental alteration of the reaction sequence. These results are believed to exceed the recently reported performance of HCCI studies, and supercritical technology can be adopted as a retrofit to existing systems.