MIXING OF CO-AXIAL NATURAL GAS/ LIQUID DIESEL FUEL SPRAYS

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Alternative fuels for engines such as natural gas are not suited to CI (diesel) engines because of their low cetane numbers. However, the dual-fuel concept using lean, alternative fuel ignited by a pilot diesel fuel spray provides a solution. While pre-mixing the alternative fuel in the inlet manifold has been the most common approach, direct in-cylinder injection of both fuels more or less simultaneously has advantages. This minimises the fuel in the end-gas and hence reducing SI type knock, eliminates the extended ignition delay by injecting the diesel fuel into air only and minimises flame quench problems as much of the burning takes place within the spray zone. The current phase of the project is aimed at developing a combined unit natural gas/diesel injector. At UNSW, a new type of HEUI diesel injector is under development using diesel fuel as the amplification driver instead of an alternative oil supply. It has been tested in an engine to an injection pressure of 230 MPa, has a very high turndown ratio to less than 1% of the maximum delivery while maintaining high injection pressures and is of compact size. It is therefore an ideal device to couple with a co-axial natural gas injection system. To commence this development, CFD studies of the combined injection are now being undertaken both for their dynamic and fluid characteristics. The gas flow has been modelled as co-axial around the diesel spray. This has allowed the interaction of the streams to be examined to determine the mixing advantages of different nozzle hole sizes, spacing, orientation, starting interval between and the duration of the flows.