

論文の要旨

題目 Experimental Study on Heat Transfer of Flat-Wall-Impinging Diesel Spray Flame
(平板に衝突するディーゼル噴霧火炎の壁面熱伝達に関する実験的研究)

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In internal combustion engines, a substantial amount of the fuel's energy input is lost due to heat transfer through the walls of the combustion chamber. This heat loss reduces thermal efficiency, as spray/wall impingement plays a crucial role in direct-injection diesel engines. The engine's heat loss occurs during combustion, mainly due to the heat transfer between the impinging spray/flame and the piston cavity wall. This study investigated the mechanism of the heat transfer from the spray flame to the impinging wall under conditions similar to those of a small diesel engine.

To investigate the correlation between the diesel flame and wall heat loss, this research studied natural luminosity photography of the flame and measured transient heat flux to the wall. Using a constant volume vessel with a fixed impingement wall, the study measured the surface heat flux of the wall at the locations of spray flame impingement using three thin-film thermocouple heat-flux (TFTHF) sensors. The effects of impingement distance, injection pressure, nozzle hole diameter, and oxygen concentration and their combined effect on heat transfer were investigated parametrically.

The results show the effects of various experimental parameters on the spray/flame impingement behavior, with heat loss occurring significantly under some conditions. In some of the investigated parameter conditions, decreasing the oxygen concentration was effective in reducing the heat transfer through the wall due to the lower temperature distribution. Regarding the ratio of total heat transfer between non-combustion and combustion, around 30% of the heat transferred through the wall was caused by the convection of non-combustion evaporating spray. Moreover, we confirmed that the relationship between the Nusselt number and the Reynolds number was a useful measure for describing heat-transfer phenomena in diesel combustion.