(1-04) Direct Particulate Sampling Study in a DI Diesel Combustion Chamber

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Key Words: Diesel Engine, Particulate Matter, Particulate Matter Formation, Particulate Sampling

ABSTRACT

Reduction of the Particulate Matter (PM) is very important to achieve the clean diesel engines. Especially, reduction of the Soluble Organic Fractions (SOF) are very important, because the particulate trap can eliminate primarily the Insoluble Fractions (ISF) but does not effectively reduce the SOF, while the latter contains the harmful components for human. A clarification of SOF production in the combustion chamber is required for the SOF reduction. This paper is concerned with the formation of Particulate Matter (PM) in direct injection (DI) diesel engines. A system featuring an electromagnetically actuated sampling valve with internal N2 dilution was developed for sampling of PM directly from the combustion chamber. The concentration of Total Particulate Matter (TPM), SOF and ISF, were measured at the twenty different locations in the combustion chamber at different sample timings (different crank angles). The time resolution of the sampling valve is dominated by the opening duration of the valve, which is an order of 1 or 2 milliseconds. In this study, apparent time resolution was improved by the following measure. The sample timing was determined so that the neighboring sample timings were included within the sampling duration. The measured value at each sample timing could be recognized as an averaged value of the instantaneous value at the sample timing and at the neighboring timings. Instantaneous values can be obtained by solving the simultaneous equations between average and instantaneous values. The weight factor were selected to obtain suitable corrected values by trial and error.

The combustion gases (CO, CO2, O2, THC) were also analyzed by the gas chromatography for the local air fuel ratio calculation. The concentration of SOF was higher at the sampling positions on spray flame axis. The concentration of ISF was higher at the sampling positions on downstream of the spray flame. Both SOF and ISF concentration are higher at near the wall than away from the wall. It is also made clear that the PM formation is strongly affected by the wall quenching at the combustion chamber wall.

Fig. 1 Contour Line of SOF and ISF Concentration at Sample Timing of -4 °ATDC