Efforts to create a desktop model calibration for exhaust emissions using catalytic reaction models

- Calibration of target air-fuel ratio on engine start for Hybrid electric vehicle -

Tsuyoshi Ishikawa [1)]   Hiroyuki Itoyama [1)]   Atsushi Morohoshi [1)]   Yosuke Kubota [1)]

1)   Nissan Motor Co., Ltd.
560-2, Okatsukoku, Atsugi, Kanagawa, 243-0192, Japan

KEY WORDS: Heat engine, Three-way catalyst, Spark ignition engine, emission gas, (A1)

Calibration of the target air-fuel ratio is important for emissions performance, and until now it has been mainly used in actual vehicle and Engine . In this study, we developed an environment to combine the control target value and the catalytic chemical reaction model, and developed a method to examine the fit value on the desk.

Figure 1 shows the MIL configuration. The system consists of engine out emission (henceforth E.O.E) prediction, gas transport delay, and catalytic chemical reaction models. Various catalytic reactions and catalytic OSA are calculated, and the exhaust gas concentration at the outlet of the C.C. catalyst is output.

The E.O.E. input to the catalyst model is based on the measured values of the gas components involved in the three-way catalytic reaction (HC, CO, CO2, NOx, O2, H2) for each A/F. On the other hand, for the catalytic chemical reaction model of three-way catalyst, OSA was finely adjusted by the library of the catalyst model identified from the actual results of each catalyst species, and it was utilized for Sim in this paper. For the calculation step, 10 ms was selected because of the optimum exhaust gas accuracy and calculation time.

Figure 2 shows the actual measurement results when the A/F at startup was changed and the E.O.NOx concentration by the catalytic chemical reaction model. Since NOx emission sensitivity to fuel increase was reproduced, it was proven to be applicable to exhaust gas calibration.

From the results of this catalytic reaction model, it was found that H2 immediately after engine start is important for reducing NOX at the outlet of the manicatalyst. It was estimated that NOx could be reduced only by increasing the amount of fuel in a pulse manner for 0.4 s at the time of engine start as shown in Fig. 3, and it was verified in an actual machine, and NOx could be reduced as hypothesized. The results are shown in Fig. 4.

For the purpose of development efficiency improvement, MIL environment specialized for engine starting condition was constructed, and the following conclusions were obtained.

(1) By using the newly developed MIL, NOX at the C.C. Cat outlet can be estimated with high accuracy, and it can be used for exhaust gas Calibration. 2) About 40% reduction in man-hours was confirmed in the examination and calibration of the target air-fuel ratio at engine restart.

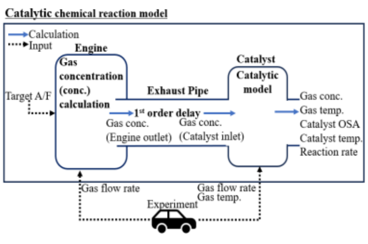

Fig.1 Diagram of a catalytic chemical reaction mode

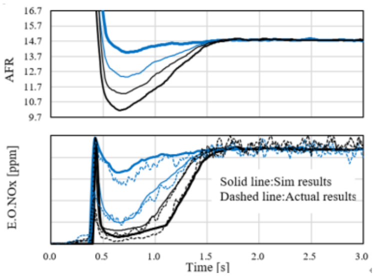

Fig.2 E.O.E input to the catalyst reaction model

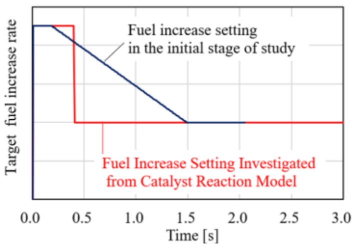

Fig.3 Comparison of fuel increase rate setting

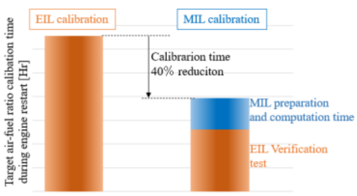

Fig.5 Effectiveness of catalytic reaction model to improve emission calibration

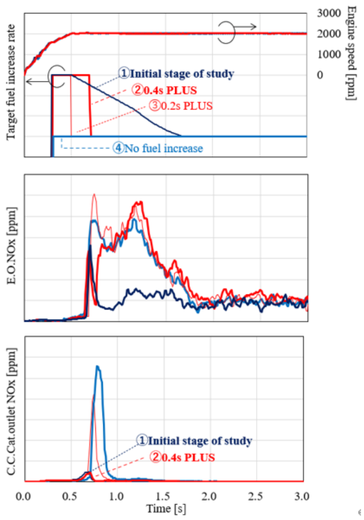

Fig.4 Experimental verification results of catalytic reaction model calibration