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Analysis Methods of Real-world Ammonia Emissions Using Small Type On-board Emissions Measurement System

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In place of the PEMS used for RDE regulations, lightweight and compact on-board emission measurement devices (mini-PEMS) that do not affect vehicle weight are attracting attention. In this study, the new method for ammonia (NH_3) analysis with small type on-board emissions measurement system and NO_x sensor has been proposed. In addition, the dry-wet correction, delay time correction, and mass emission calculation necessary for analyzing ammonia emission were investigated based on the results of on-road measurements and chassis dynamometer testing using a mini-PEMS installed in a gasoline vehicle.

By appropriately selecting measurement data obtained from the engine, catalyst, tailpipe, and mini-PEMS, and performing cross-correlation analysis, it became possible to analyze emissions while taking into account the travel time of exhaust gases. The H_2O concentration was calculated using a theoretical combustion reaction equation based on the fuel H/C ratio and air excess ratio, and this value was used for dry-wet conversion. By comparing the theoretically calculated O_2 concentration with the O_2 concentration measured by the NO_x sensor, it became possible to accurately determine the H/C ratio. Verification of the proposed NH_3 concentration calculation method through chassis dynamometer testing revealed that it possesses sufficient accuracy. On-road driving test results under medium-cold conditions showed that a peak in CO emissions occurred at startup, followed shortly thereafter by a peak in NH_3 emissions. It was also found that NO_x and NH_3 were emitted at comparable levels.

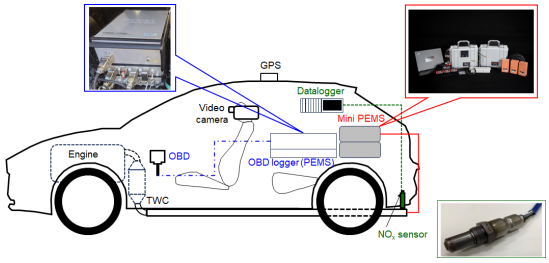

Fig. 1 The overview of the on-board measurement system

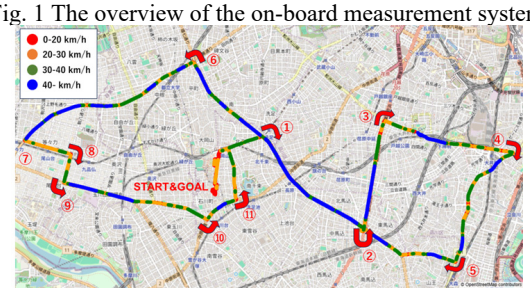

Fig. 2 The on-road driving test route

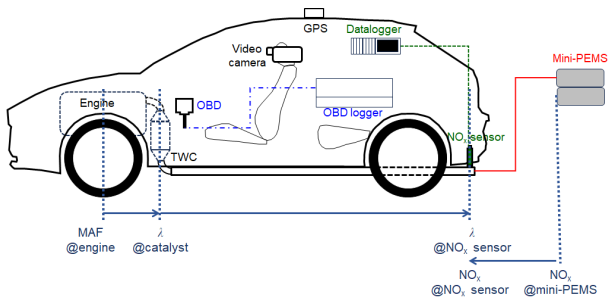

Fig. 3 The outline of the 2nd time alignment

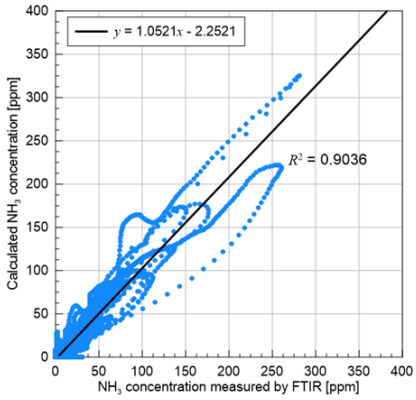

Fig. 4 The correlation between calculated NH_3 concentration, and NH_3 concentration measured by FTIR (chassis dynamometer test)

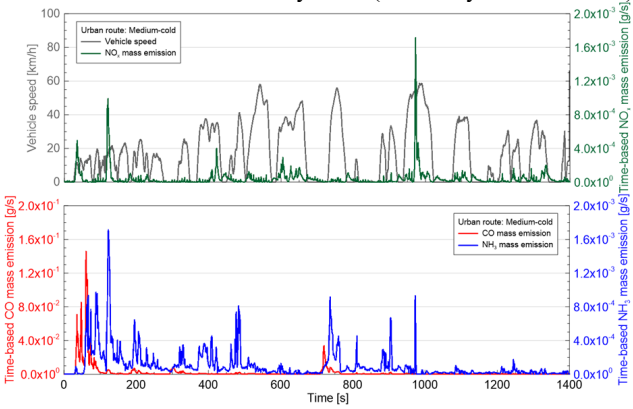

Fig. 5 Mass emissions results of NO_x, CO, and NH_3 emissions under the medium cold start conditions (on-road driving test)