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Effects from Ambient Temperature and Humidity on Emission Measurements of Light Duty Vehicles

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The ambient conditions in the emission measurement test procedure for light duty vehicles are defined as an almost constant temperature (23 deg C) and humidity (50 %RH). However, in the real driving situation, the temperature and humidity are widely dispersed, for example, high temperature and high humidity during the rainy season, and low temperature and low humidity during the winter season. Even during a real driving emission (RDE) test, the temperature and humidity are fluctuated. Fig.1 shows time vatriations of ambient temperature and relative humidity during a RDE test. The difference between the maximum and the minimum ambient temperature is around 5 deg C. And the difference between the maximum and the minimum ambient relative humidity is around 30 %RH. In the RDE test procedure, the emissions should be recalculated after the whole driving test to transform the results to be compareble to the regulation values. In this process, the effects from temperature and humidity on the emissions are not considered except some extended temperature conditions.

In this study, several couples of ambient conditions have been adopted for the emission measurements. The measurements have been conducted on a chasis dynamometer with a wide range temeprature and humidity controlable air conditioning system. The test cycle was Worldwide harmonized Light vehicles Test Cycles (WLTC) Class 3b, 4 phases (Low, Medium, High, and Extra-High). The temperature conditions were set at -7, 23, and 38 deg C. The humidity conditions were set at 30, 50, and 70 %RH under 23 deg C constant temperature. The measurement were carried out by a Portable Emission Measurement System (PEMS) on CO_2 and NOx emissions.

The results from the temperature parameter experiments show the CO_2 emissions at -7 deg C were higher than the resutls from other temperatures throught all phases. The NOx emission results also show high value at -7 deg C in the Low phase. Other research groups have reported that the emissions become higher at a low temperature conditions. It seems that the same temperature dependence has been appeared. The results from the humidity parameter experiments show the CO_2 emissions were almost same throught the measurement. The NOx emission results show high value at 30 %RH. It is considered that the the increasing of the NOx emissions is caused by the increasing of the combustion temperature due to the decreaseing the amount of water vapor in the intake air at low humidity conditions. Ministry of Land Infrastructure, Transport and Tourism have published a standarised test procedure "Measurement Method of Light and Medium-Duty Vehicle Exhaust Gas" (Attachment 42). In the method, effects from the absolute humidity are corrected by humidity correction factor (KH). The KH was applied to the NOx emission corrections and the corrected results are shown in Fig.2. The difference between each result from different humidity became closer after the correction. However there were still difference. It is necessary to consider the applying and revising methods of KH with increasing the number of samples.

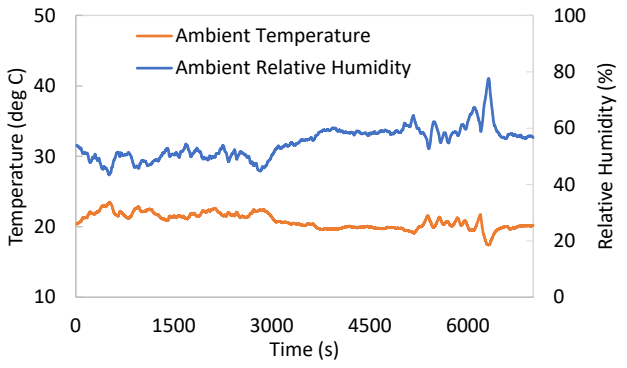

Fig.1 Ambient temperature and relative humidity

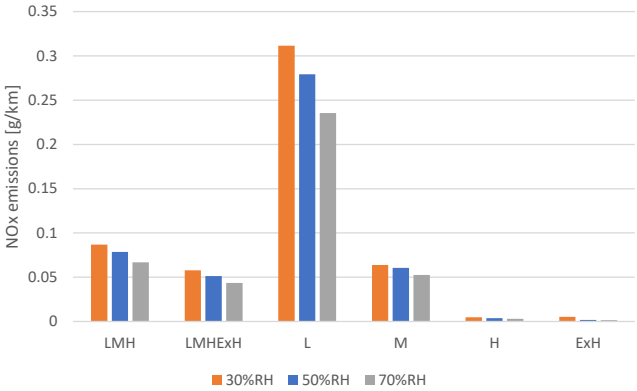

Fig.2 Corrected NOx emissions measured by the PEMS