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Method for Measuring Fuel Consumption of Fuel Cell Vehicles without Vehicle Modification Using Oxygen Balance Method via Direct Measurements

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To evaluate the conformity of production vehicles, a fuel consumption measurement method for fuel cell vehicles (FCVs) that does not require vehicle modification is strongly demanded. We developed an oxygen (O_2) balance method via a direct measurements to measure fuel consumption without vehicle modifications and investigated the effect on different driving conditions on FCV fuel consumption.

The O_2 concentration was measured using a paramagnetic O_2 analyzers, and exhaust gas flow was measured by a pitot tube flowmeter for a portable emissions measurement system (PEMS). Two types of O_2 analyzers were used, one with this function (O_2_analyzer1) and one without (O_2_analyzer2), to evaluate the effectiveness of the correction function for changes in ambient temperature and atmospheric pressure. Fig.1 shows the evaluation equipment for direct measurement method. The accuracy of the direct measurement method was evaluated by comparing it with the gravimetric method or the flow method that defined in ISO23282. The delay time of each instrument was measured in order to match the tenses used in the fuel consumption calculations.

Fig.2 shows the results of applying the direct measurement method to FCV fuel consumption measurement in the WLTC mode. As the result of the comparison between fuel consumption by the direct measurement method and that by the gravimetric method, the slope of a linear regression was 1.0138 using O_2_analyzer1 with the environmental impact correction function and 1.0148 using O_2_analyzer2 without the correction function. Furthermore, the direct measurement method was applied to FCVs on the constant speed and in the acceleration phase of the JARI-MEC (Japan Automobile Research Institute-Model Emission Cycle) mode, the slope of the regression line between the direct measurement method and the comparison standard was approximately 1.01 to 1.03. In addition, no significant differences were found in the results obtained with the two O_2 analyzers under the conditions of this study. Although a well correlation was observed between the direct measurement method and the comparison standards, errors tended to be larger under high load conditions and in areas with load fluctuations, which is a subject for future study.

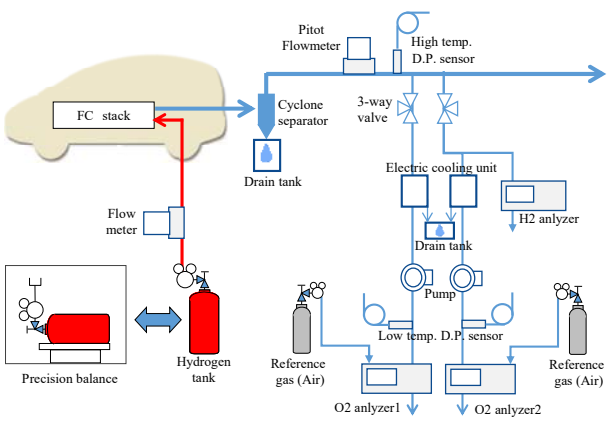

Fig.1 Evaluation equipment for direct measurement methods

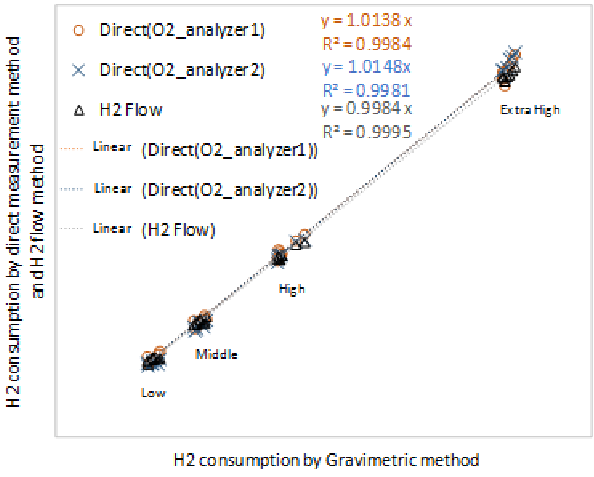

Fig.2 Comparison of H_2 consumption on the WLTC