Running Test of Experimental Fuel Cell-Driven Car

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With the aim of saving energy, reducing the environmental and conserving fossil oil and other depletable fuel resources, Railway Technical Research Institute is developing railway cars driven by fuel cells. Through a series of driving tests using actual railway car bogies equipped with a 30 kW class fuel cell system, we have already confirmed that fuel cells are viable as a power source for driving railway cars. Recently, we developed a 100 kW class fuel cell system that can be mounted on a car (Fig. 1), together with a high pressure hydrogen tank system, etc. The fuel cell system was mounted on a test car (Fig. 2), which was made to be capable of running for itself. This car was provided with a current collector, which was intended for use primarily as a static inverter (SIV) for auxiliary use. As long as the air pressure for braking is sufficient, the car is capable of running with the current collector folded down. This test car does not have a way to store energy, and therefore cannot absorb the power regenerated during braking or provide extra power during acceleration. A test track (about 650 m) laid in the yard was used to carry out a running test of the test car. It was the first running test of an actual railway car driven by a fuel cell system: all the tests of fuel cell-driven cars that had been carried out to that point were static ones. In the running test, it was also necessary to confirm whether the fuel cell system would be adaptable to an environment under which it would be subject to the vibration, acceleration, etc. of the test car in operation. Fig. 3 shows the results of the running test of the test car driven by the fuel cell system. It was confirmed that the fuel cell system was unaffected by the vibration and acceleration caused by the running of the car and that it could operate stably up to a car speed of about 40 km/h and a fuel cell output of about 90 kW. In order to confirm the running performance at higher car speeds, a simulation running test on a test platform was carried out. The test results are shown in Fig. 4. The maximum stable running speed was about 105 km/h. At a speed of about 40 km/h, the output began to decrease. This was due to an insufficient supply voltage. In another test carried out to confirm maximum output, the maximum output was 115 kW, indicating that even under load fluctuations a maximum output close to the rated output (120 kW) could be secured. Based on those test results, the fuel consumption and efficiency were evaluated. The evaluation results are shown in Table 1. It can be seen that fuel consumption varies markedly according to the mode of operation. The efficiency was confirmed to be as high as about 50%. In the future, we plan to develop an energy accumulation system and establish fuel cell hybrid technology. Part of the present R&D was carried out with a subsidy granted by the Ministry of Land, Infrastructure and Transport.

Fig. 2 Experimental fuel cell-driven car

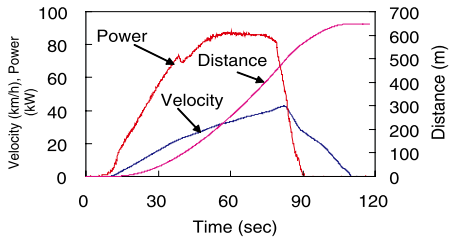

Fig. 3 Results of running test in yard

Fig. 1 100 kW class fuel cell system

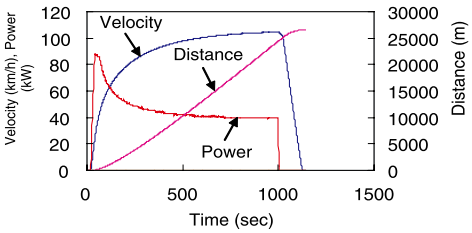

Fig. 4 Results of traction test on platform

Table. 1 Evaluation of fuel consumption and efficiency

	Maximum speed	Maximum output	Running distance	Running time	Fuel consumption	Efficiency
	km/h	kW	m	Min	km/kg	%
Running test in yard	42.9	87	650	1.7	7.6	49.9
Traction test on platform	105	88.5	26600	18.5	34.6	52.7