Railway/Power | High Sensitivity | Low Thermal Resistance

Resin Temperature Estimation

References: Temperature Coil Resin Temperature Estimation by Heat Flux Sensor Proceedings of the 14th Railway Technical Coalition Symposium 319 - 320(2007)

Goal

① Estimate the temperature inside the resin from the resin surface without causing any damage.
② Find out the heat dissipation characteristics of the coil.

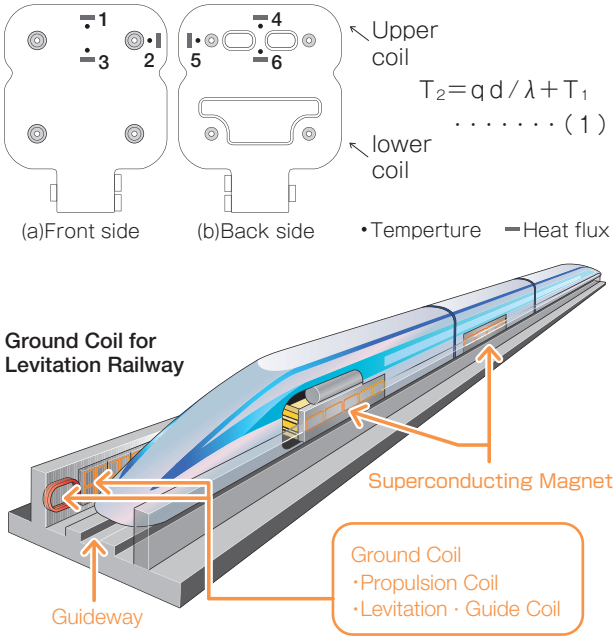
Measurement Method

For the specimen, a ground coil for a superconducting magnetic levitation type railway (linear motor) is used. For measurement of heat flux, a heat flux sensor and a temperature sensor are installed on the resin surface to estimate the internal temperature.

Resin Internal Temperature Estimation Method
As an important control point, it is difficult to estimate only the surface temperature T1 (℃) with respect to the resin internal temperature T 2 (℃) in contact with an important winding by monitoring the T1 at the time of saturation and the heat flux q (W/m²) at the surface, by using the known thermal conductivity λ (W / m · K) and the resin thickness d (m) It is considered that the resin internal temperature T 2 can be estimated.

Test Method
As shown on Fig. 1, a thermocouple and a heat flux sensor were installed side by side on the epoxy resin surface of the ground coil for both propulsion, levitation and guiding, and direct current was passed through the floating system circuit to measure the surface temperature and heat flux. After that, from the value at saturation, the resin internal temperature T 2 in contact with the winding was estimated from the equation (1).

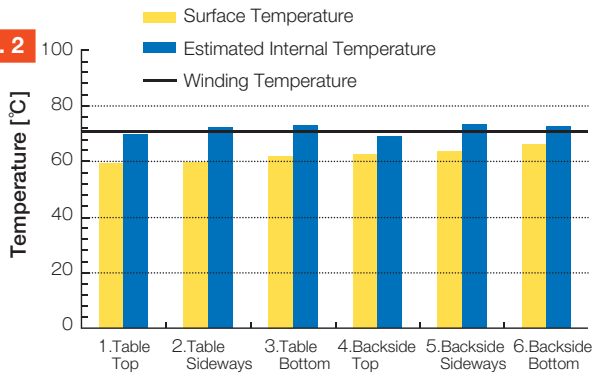
Fig. 1



Results

Figure 2 shows the test results when the DC current is 90 A. It was found that the resin internal temperature estimated value was 6 to 12 degrees higher than the actually measured surface temperature. In addition, it was found that the resin internal temperature estimates of 1. Table Top and 4. Backside Top are lower than in other places. In order to confirm the validity of the estimated value, the upper coil winding temperature measured by the resistance method is also shown on Fig.2. Although the measured value of the resistance method represents the average temperature of the upper coil winding, it is considered that the estimation is as expected, since it is the same value as the internal temperature of the resin contacting the winding.

Fig. 2



Considerations

A method to estimate the resin internal temperature from only a heat flux sensor and a temperature sensor installed on the surface was implemented. In this implementation, we conducted the estimation of the temperature at the time of DC energization as a basic examination, but in the future we will consider the internal temperature monitoring method of resin in an actual energization pattern based on the influence of AC magnetic field and train wind.
Since sufficient strength and insulation durability are required for the resin around the coil, we will also consider the usage as a temperature monitoring tool.

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