NONCONTACT IRON LOSS MEASUREMENT OF MOTOR STATOR CORE USING RADIATION THERMOMETER IN THE ATMOSPHERE

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Abstract. The use of a low iron loss motor core is required to develop the low loss and high efficiency motor. The main material of the motor core is electrical steel sheet. Usually, the magnetic properties of the steel sheet are measured according to standard measurement methods (IEC, JIS, etc.). On the other hand, it is difficult to evaluate the characteristics of the iron core state because of the complicated shape. In this paper, we report the result of noncontact measurement of iron loss of motor using thermal measurement method in the atmosphere.

1. Introduction

A non-oriented electrical steel sheet is used for the motor core. The iron loss measurement of a electrical steel sheet is evaluated from the relationship between the magnetic flux density and the magnetic field strength using a standard measurement method such as an Epstein flame or a single sheet tester[1]. On the other hand, iron loss measurement of a motor core is difficult due to its complicated shape, and in general, it is equivalently evaluated using a ring core or the like. Moreover, in the motor core, since it processes and laminates a single sheet, it is different from the iron loss characteristic at the time of single sheet in many cases. This is known as a building factor problem, and stress due to processing affects the magnetic properties and appears as an increase in iron loss[2]. In addition to the iron loss evaluation of the motor core, if iron loss increase by the manufacturing process can be performed more simply, it can contribute to high efficiency motor development.

One of the iron loss evaluation methods is a method of evaluating from the heat generation time gradient[3]. In recent years, radiation thermometers that can measure heat generation with non-contact and small spots have become inexpensive, and their use in research and development and manufacturing processes has spread. A system has been developed that can accurately measure iron loss that occurs during actual driving of an actual motor using a non-contact thermal method[4]. It is a vacuum environment to eliminate the influence of motor rotation. On the other hand, the cost of the equipment is high and the measurement is not easy. We aim to be able to evaluate motor iron loss in the atmosphere and in a short time so that it can be used in the manufacturing process as well.

In this paper, the iron loss generated in the motor stator core is compared with the iron loss obtained from the magnetic characteristics for measurement in air using a noncontact radiation thermometer, and the accuracy is shown.

2. Measurement method

Figure 1 shows a motor stator core. An excitation winding and a magnetic flux density detection B-coil are wound around the outer periphery. Figure 2 shows a measurement system. The magnetic field strength of the core is calculated from the terminal voltage of the shunt resistor connected in series to the excitation winding, and the magnetic flux density is calculated by integrating the induced voltage of the B-coil. Install a noncontact radiation thermometer (Keyence, FT-H20) near the core and record it with a data logger (GRAPHTEC, GL240).

The iron loss W_c due to heat is calculated by the following equation.

$$W_c = C\frac{\partial T}{\partial t} \quad (1)$$

where, C is specific heat, T is temperature, and t is time. The iron loss due to heat generation can be evaluated by measuring the temperature gradient.

3. Experimental Results

The measurement results are shown in Figure 3. Figure 3(a) shows a time change of heat generation generated in the motor stator core after the start of excitation. The third temperature measurement shows a similar temperature gradient. The result of having calculated the iron loss using this temperature gradient using Formula (1) is shown in Figure 3(b). The black plot shows the iron loss obtained from the average magnetic properties of the core. Thermal iron loss increases with magnetic flux density as well as core loss obtained from magnetic properties. In the case of thermal iron loss, since it is a local iron loss measurement, it may increase or decrease compared with average iron loss.

Conclusions

In this paper, the thermal iron loss of the motor stator core using a non-contact radiation thermometer is measured in the atmosphere and compared with the average iron loss, and the accuracy is shown. In addition, in full paper, we will report on the results of comparisons by the location of the motor stator core surface and the evaluation of the lamination surface.

Acknowledgments

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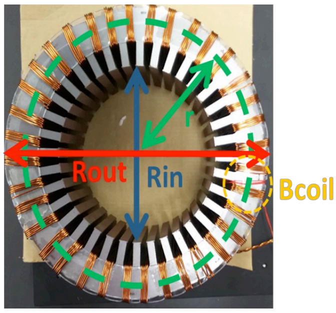

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Rin[mm]	100
Tickness[mm]	65
r[mm]	72
Turn of Ex-coil	180
Turn of B-coil	3

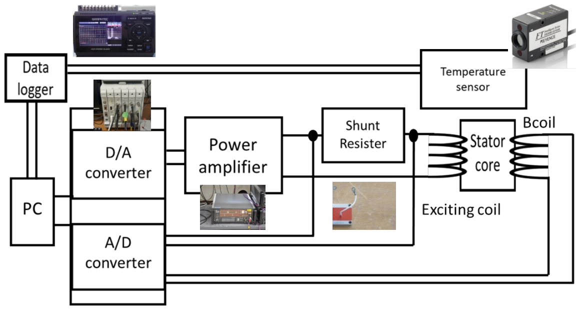
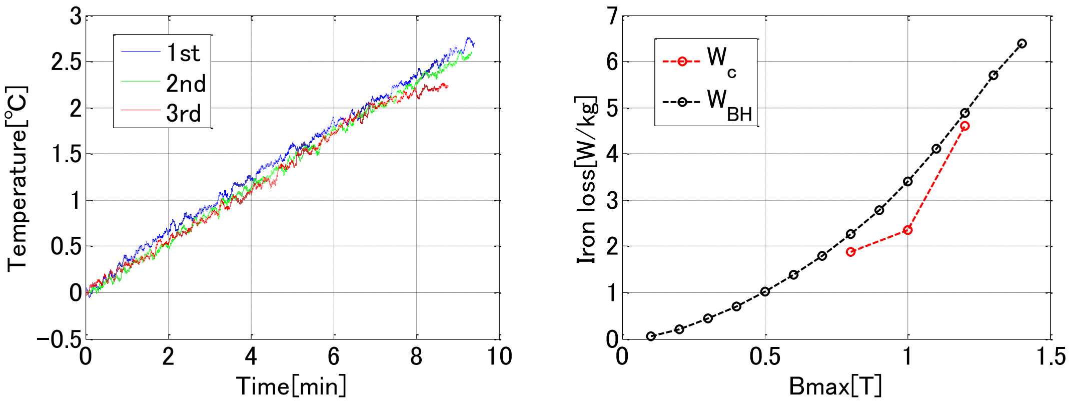


Fig. 1 Specimen (motor stator core); Fig. 2 Measurement system



(a) (b)

Fig. 3 Experimental results: (a) Temperature gradient; (b) Iron loss

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