



EFFECTIVE WAY FOR THE IMPROVEMENT OF EFFICIENCY AND THERMAL WITHSTANDING CAPACITY OF THREE PHASE SQUIRREL CAGE INDUCTION MOTOR BY COATING THE WINDINGS WITH Al_2O_3 NANO FILLER MIXED ENAMEL

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Abstract

In the recent decades, it was observed that the addition of nano fillers to the enamel can greatly improve the thermal, mechanical and electrical properties of enamel. Al_2O_3 was used as nano filler. The micro particles of Al_2O_3 were converted into nano particles by using ball mill method. Scanning electron microscope (SEM) was used to augment the particle size of the nano powder. The nano filler was mixed with enamel by using ultrasonic vibrator. The enamel filled with Al_2O_3 nano filler was coated on the windings of the three phase induction motor. The performance analysis of the three phase induction motor was carried out by no load test, blocked rotor test and load test. Based on the calculations and result obtained by the above tests, the efficiency of the induction motor coated with enamel filled with nano filler of Al_2O_3 was increased by 4% when compared to that of induction motor coated with pure enamel. Heat run test was also done on this motor to determine the total loss of energy dissipated as heat. The thermal withstanding capacity of the motor was also improved by 11% by adding Al_2O_3 nano fillers to the motor.

Keywords: 3 Φ Motor, Enamel, Nano Filler, Load Test

1. Introduction

In recent days, a great deal of attention has been given to the applications of nano fillers in the field of electrical insulating materials. It has been noted that the use of nano fillers to the enamel can greatly improve the thermal, mechanical and electrical properties of it. The efficiency of the induction motor depends upon the enamel used. For motors, the enamel was used for three purposes: impregnation, coating and adhesion. The

efficiency of the induction motor could be increased by adding the nano fillers with the enamel which was used as coating for the windings of the motor. In this paper, the efficiency of the normal three phase induction motor and Al_2O_3 nano filler added enamel coated with the three phase induction motor was analyzed and the results were compared with each other. Heat run tests were performed on electric machines to determine the total loss of energy dissipated as heat. It was a well-known fact that the operating temperature of an electric machine has a very strong relationship with the life duration of the insulation. The enamel used for coating the machine windings were organic in nature and were adversely affected by thermal decomposition.

2. Coating of the Nano Filler added Enamel to the Windings of the Motor

5% of nano powder of Al_2O_3 was taken and mixed with the enamel by using ultrasonic vibrator. Then this enamel was coated on the windings of the three phase induction motor. The specifications of the three phase induction motor were shown below in the Table 1.

Table 1 Specifications of the three phase induction motor

Quantity	Rating
Power	1.5 HP
Speed	1450 rpm
Current	3.45 A
Voltage	415 V



Figure 1 Al_2O_3 Nano Filler mixed Enamel coated Three phase induction motor

3. Experimental Analysis

3.1 Load Test

The load test was conducted as per the circuit diagram and arrangement shown in the Figure 2 and 3. The output power ,current, efficiency, powerfactor and speed of the induction induction was measured. The maximum efficiency obtained from an ordinary induction motor was 75%.The maximum efficiency obtained from nano coated induction motor was 79 %.

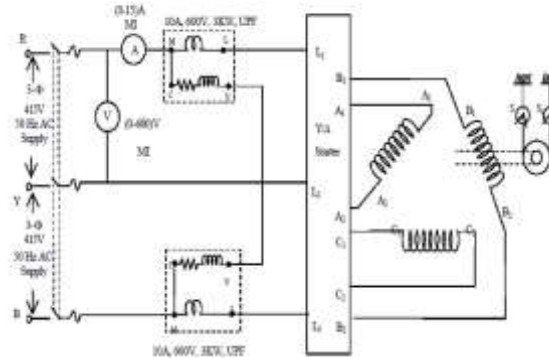


Figure 2 Circiut diagram for Load test on three phase induction motor



Figure 3 circuit arrangement for load test on three phase induction motor

3.2 Temperature Test

Heat run test was performed on electric machines to determine the total loss of energy dissipated as heat. It was a well-known fact that the operating temperature of an electric machine has a very strong relationship with the life duration of the insulation. Heat run tests were conducted on this motor as per IEC 60851. The temperature of the motor was measured under different conditions and the readings were shown in the Table 2. The Figure 4 shows the temperature comparison of various motor.

Table 2 Measurement of temperature

Time in minutes	Temperature of ordinary motor	Temperature of Nano coated motor
0	34	34
2	36	35.5
4	38	37
6	41	38
8	43	40
10	45	41.5

12	47	42
14	48	43
16	49	44
18	49.5	45
20	51	45.5
22	51.5	46
24	52	47
26	53	47.5
28	54	48
30	55	49

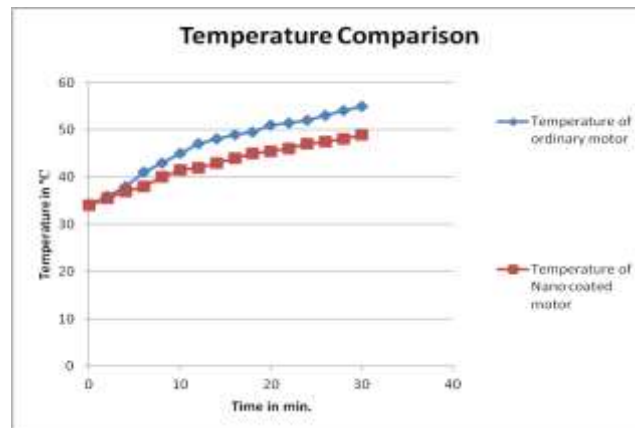


Figure 4 Temperature Comparison of various motor

4. Conclusions

The following observations were clear as per this study:

1. The efficiency of the induction motor was increased by 4 % by adding nano filler of Al_2O_3 to the enamel used as the coating for the windings of the three phase induction motor.
2. The addition of nano fillers to the enamel has increased the temperature withstanding capacity of the induction motor. The thermal withstanding capacity of the motor was also improved by 11% by adding Al_2O_3 nano fillers to the motor. Hence the life time of the motor will be increased.

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Reference

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