

# Improvement of Efficiency and Thermal Withstanding Capacity of Single Phase Induction Motor using organic Nano Filler Mixed Enamel

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**Abstract** - It has been found that the addition of nanofillers to the enamel can greatly improve the thermal, mechanical and electrical properties of enamel.  $Al_2O_3$  has been used as nano filler. The micro particles of  $Al_2O_3$  were converted into nano particles with the help of ball mill. Scanning electron microscope (SEM) has been 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 nano filler was coated on the windings of the single phase induction motor. The performance analysis of the single 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 6% when compared to that of induction motor coated with pure enamel. Heat run test was also performed on this motor to determine the total loss of energy dissipated as heat.

**Index words** – Single Phase Induction motor, Enamel, Coating, Nano Filler, Load Test,  $Al_2O_3$

## I. 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. Single phase Induction motors are widely used in fans, centrifugal pumps, blowers, lifts, washing machines, hair driers, toys and so on. 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 single phase induction motor and  $Al_2O_3$  nano filler added enamel coated with the single 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.

## II. COATING OF THE NANO FILLER ADDED ENAMEL TO THE WINDINGS OF THE MOTOR

Five percentage of nano powder of  $Al_2O_3$  was taken and it was mixed with the enamel by using ultrasonic vibrator. Then this enamel was coated on the windings of the single

phase induction motor. The specifications of the single phase induction motor were shown below in the table 1.

**Table 1 Specifications of the Single phase induction motor**

Power	0.5 HP
Speed	1470 rpm
Current	4 A
Voltage	220 V



**Figure 1 Nanocomposite filled enamel coated induction motor**

### III. EXPERIMENTAL ANALYSIS

#### A. PERFORMANCE ANALYSIS OF SINGLE PHASE INDUCTION MOTOR – DIRECT LOADING METHOD

The load test was conducted as per the circuit diagram shown in the figure 2 and the output power, current, efficiency, power factor and speed of the induction motor was measured. The maximum efficiency obtained from an ordinary induction motor was 69%. The maximum efficiency obtained from nano coated induction motor was 75%. The efficiency of the induction motor with and without nanocoating was measured and their readings were shown in the table 2.

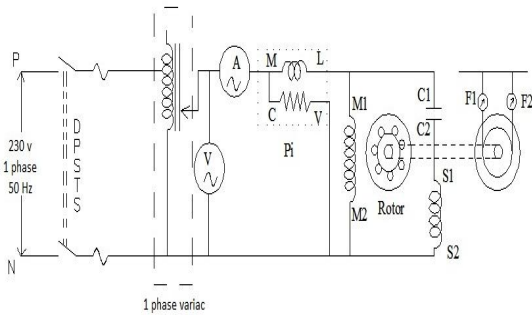


Figure 2 circuit diagram for load test on single phase induction motor

Table 2 Measurement of efficiency

Normal IM		Nanocoated IM	
current	Efficiency	Current	efficiency
3.9	41.46	4	53.65
4	51.31	4.1	65.15
4.2	67.79	4.2	69.50
4.3	69.22	4.3	72.40
4.4	68.73	4.4	74.49

#### B. 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 3.

Table 3 Measurement of temperature

Time	Normal motor	Nano coated motor
0	30	30
5	44	40
10	48	43
15	50	46
20	53	49
25	55	50
30	57	53
35	58	53

### IV. CONCLUSIONS

The following observations were clear as per this study:

1. The efficiency of the induction motor was increased by 6 % by adding nano filler of  $Al_2O_3$  to the enamel used as the coating for the windings of the single phase induction motor.
2. The addition of nano fillers to the enamel has increased the temperature withstanding capacity of the induction motor. Hence the life time of the motor will be increased.

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