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High Efficiency Induction Motor

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Abstract: Three phase induction motors consume 60% of industrial electricity. Just 1% increase in efficiency of all the motors in India will save 500 MW powers which needs the initial generation cost of 2000 crores. The efficiency of an induction motor can be substantially improved by controlling the voltage to frequency ratio (V/Hz). Other methods of improving the efficiency of induction motor are

1. Coating enameled copper wire filled with several nanofillers such as Al_2O_3, SiO_2, TiO_2, CNT, ZrO_2 and so on.
2. Coating of induction motor filled with nanofillers.

One such method used in this project was carried out under serious literature survey. Based on the previous project works, actions were taken to use the enamel filled with SiO_2 andTiO_2nanofiller as the coating for the induction motor to improve its efficiency. Definitely, there will be a tremendous improvement in the efficiency of the induction motor and hence the motor can be called as "High Efficiency Induction Motor".

Keywords: Induction motor, Nanocomposite, Performances analysis, Nanofillers

I. INTRODUCTION

Induction motors are widely used in fans, centrifugal pumps, blowers, lifts, cranes, hoists and so on. The efficiency of the induction motor depends upon the insulation used. For motors, the enamel is used for three purposes: impregnation, coating and adhesion. The efficiency of the induction motor can be increased by adding the nanofillers with the enamel which is used as coating for the windings of the motor. In this paper, the efficiency of the normal three phase squirrel cage induction motor and the nanocompositeSiO_2 and TiO_2 in 1:3 filled enamel coated three phase squirrel cage induction motor was analyzed and the results were compared with each other.

II. PREPARATION AND CHARACTERIZATION OF NANOCOMPOSITES OF SIO_2 AND TIO_2

The micropowders of SiO_2 and TiO_2 were crushed into nanopowders by Ball Mill method [1] [5]. The SEM images of SiO_2 and TiO_2 before and after Ball Mill show the particle size of the powders. The particle size was augment by SEM images. These SEM results show that the prepared particles of SiO_2 and TiO_2 were in the nm range.

A. *SEM analysis before Synthesization*

The particle size of SiO_2 and TiO_2 before ball mill method was shown in figure 1 and 2.

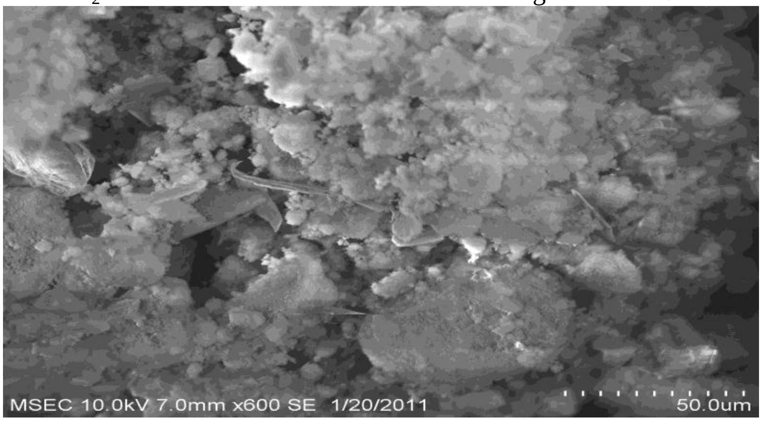

Fig.1 SEM analysis of SiO_2 at 50 µm

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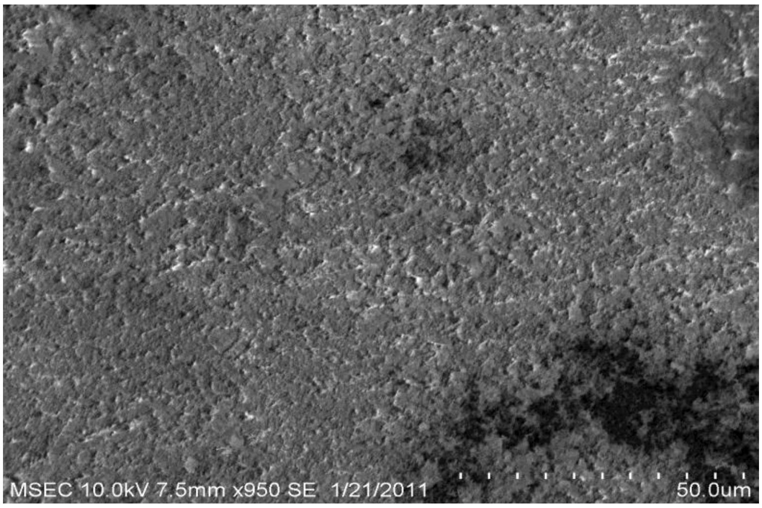

Fig.2 SEM analysis of TiO_2 at 50 μm

B. SEM analysis After Synthesisation

From the analyzed SEM image the particles were in the form of nanometric range varies for one area to other. The sizes of the particles as shown in figure 3 and 4 were in the range from 40 to 100 nm size.

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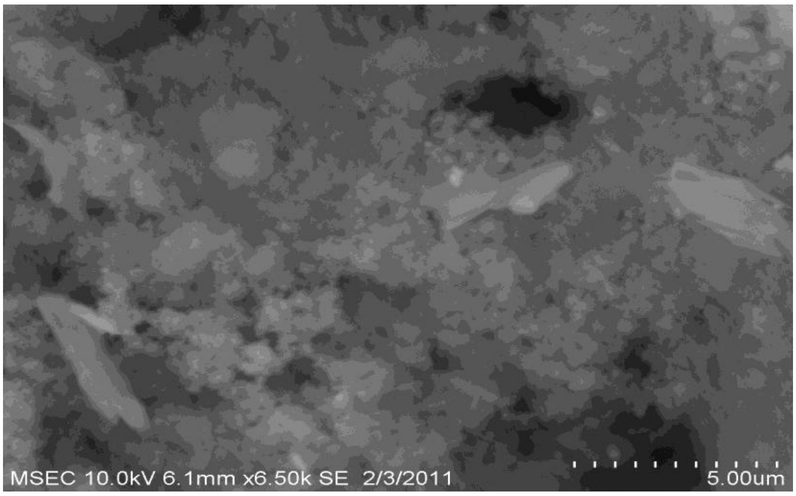

Fig.3 SEM analysis of SiO_2 at 5 μm

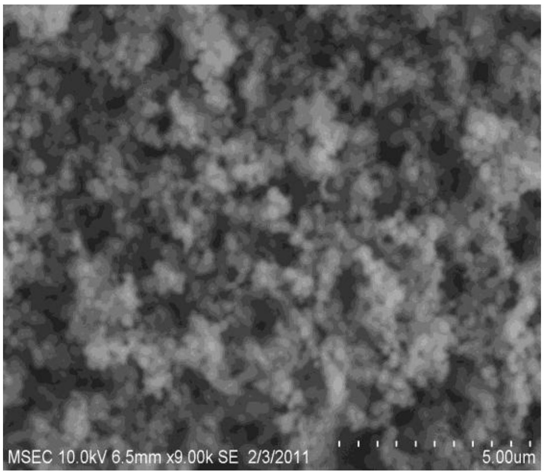

Fig.4 SEM analysis of TiO_2 at 5 μm

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III. COATING OF THE NANOCOMPOSITE FILLED ENAMEL TO THE WINDINGS OF THE MOTOR

The nanopowders of SiO_2 and TiO_2 were taken in the proportion of 1:3. Then, the nanocomposites of SiO_2 and TiO_2 taken in 1:3 were mixed with the enamel by using ultrasonic vibrator. Further, this enamel was coated on the windings of the three phase squirrel cage induction motor.

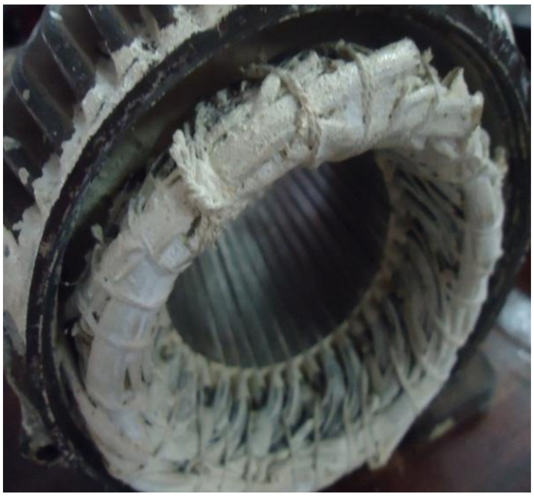

Fig.5 Nanocomposite filled enamel coated Induction motor

The specifications of the three phase squirrel cage induction motor were shown below in the table I.

Table I Specifications of the three phase squirrel cage induction motor

QUANTITY	RATING
Power	1.5 HP
Speed	1450 rpm
Current	3.45 A
Voltage	415 V

IV EXPERIMENTAL ANALYSIS

A. *Performance Analysis of Squirrel Cage Induction Motor – Circle diagram Method*

This analysis was done by doing open and short circuit test. By calculating the open and short circuit current and voltage the losses were found using cirvle diagram method. From the circle diagram it was found that the losses were reduced in nano coated motor. It was shown in the table II and III.

Table II Open circuit and short circuit test readings for ordinary induction motor

Open circuit test	Voc	Ioc	Woc
	415	1.9	176
Short circuit test	Vsc	Isc	Wsc
	90	3.45	360

Table III Open circuit and short circuit test readings for Nanocoated induction motor

Open circuit test	Voc	Ioc	Woc
	415	1.9	110
Short circuit test	Vsc	Isc	Wsc
	90	3.45	320

Fig.6 Snap shot of open and short circuit test

Efficiency was analyzed by conducting load test in ordinary as well stator enameled with nanocomposite motor. The results obtained were successful for nanocoated motor. The efficiency of nanocoated motor increased to 4 percent. This is mainly due to reduction of dielectric losses in Nanocoated motor. The readings were calculated for various slip values and shown in table IV.

Table IV Efficiency comparison for ordinary and nanocoated motor

Slip	Efficiency of normal induction motor in %	Efficiency of nanocoated induction motor in %
0.02	77	83.5
0.04	75.4	82
0.06	74.04	77
0.08	68.15	73
0.1	63	69

B. Performance Analysis of Squirrel Cage Induction Motor – Direct loading Method

The load test was conducted on the ordinary induction motor and the nano coated indution motor. The performance of the motor were obtained for induction motor by this method. The output power, current, efficiency, powerfactor and speed of the motor were measured during this testing. The maximum efficiency obtained from an ordinary induction motor was 78%. The maximum efficiency obtained from nano coated induction motor was 83%.

IV. CONCLUSION

The efficiency of the induction motor was increased by 5% by adding nanocomposites of SiO_2 and TiO_2 (1:3) to the enamel used as the coating for the windings of the three phase squirrel cage induction motor. Hence, the overall performance of the induction motor was also increased by adding nanocomposites of SiO_2 and TiO_2 to the enamel used in the induction motor. The speed fluctuations were also less and smooth when compared to that of the ordinary induction motor.

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Biography

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