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Experimental Analysis of Thermal Withstanding Capacity and Efficiency of Single Phase Induction Motor Coated with SiO_2 Nano Filler Mixed Enamel

S. Balamurugan[1], A. Mariya Anthoni Pravin[2], S. Krishna kumar[3], S. Ahamed NishaKhan[4], D.Edison Selvaraj[5], S.Geethadevi[6] and Lieutenant.J.Ganesan[7]

B.E- IV Year EEE, Sree Sowdambika College of Engineering, Aruppukottai, Tamilnadu, India[1- 4]

Assistant Professor (Part time Faculty), Department of EEE, Guindy, Anna University, Chennai, Tamilnadu, India [5]

Senior Assistant Professor, Department of EEE, Aurora Scientific and Technological Institute, Uppal, Hyderabad, India[6]

Assistant Professor, Department of EEE, Sree Sowdambika College of Engineering, Aruppukottai, Tamilnadu, India[7]

ABSTRACT: It has been observed addition of nano fillers to the enamel can greatly improve the thermal, mechanical and electrical properties of enamel. In this research work SiO_2 has been used as nano filler. The micro particles of SiO_2 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 SiO2 was increased by 5% when compared to that of induction motor coated with pure enamel.

KEYWORDS: Single Phase Induction motor, Enamel, Coating, Nano Filler, Load Test, SiO_2.

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 [1-3]. 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 [4-5]. 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 [2-6]. In this paper, the efficiency of the normal single phase induction motor and SiO_2 nano filler added enamel coated with the single phase induction motor was analysed and the results were compared with each other [7]. 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 [14-15]. The enamel used for coating the machine windings were organic in nature and were adversely affected by thermal decomposition.

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

Five percentage of nano powder of SiO_2 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 [12]. The specifications of the single phase induction motor were shown below in the Table 1.

Table 1 Specifications of the Single phase induction motor

Quantity	Rating
Power	1.5 HP
Speed	1470 rpm
Current	4 A
Voltage	220 V

A. SEM ANALYSIS BEFORE SYNTHESISATION

The particle size of SiO_2 before ball mill method was shown in Figure 1.

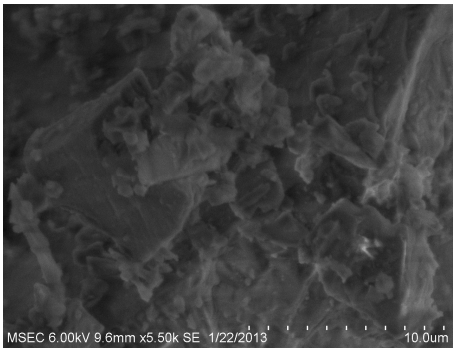

Figure 1 SEM analysis of SiO_2 at 10 μm

B. SEM ANALYSIS AFTER SYNTHESISATION

From the analyzed SEM image the particles were in the form of nano metric range varies for one area to other [13]. The sizes of the particles as shown in Figure 2 were in the range from 10 to 100 nm size.

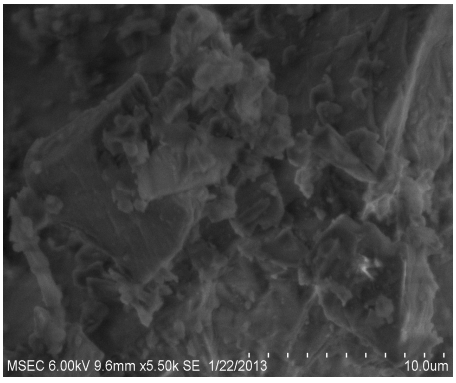

Figure 2 SEM analysis of SiO_2 at 10 nm

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III. EXPERIMENTAL ANALYSIS

A. DIRECT LOADING METHOD

The load test was conducted as per the circuit diagram shown in the Figure 3 and the output power ,current, efficiency, powerfactor and speed of the induction induction was measured [8-9]. The maximum efficiency obtained from an ordinary induction motor was 69%. The maximum efficiency obtained from nano coated induction motor was 75%. Figure shows the 4 circuit arrangement for load test on single phase induction motor.

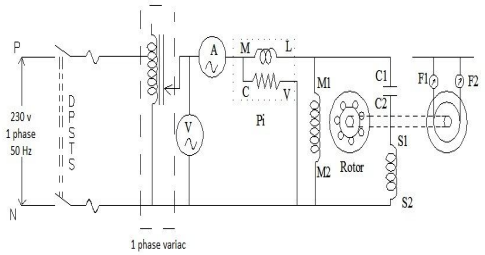

Figure 3 circiut diagram for load test on single phase induction motor

Figure 4 circuit arrangement for load test on single phase induction motor

The following Table 2 shows the efficiency compariosn of normal as well as nano coated induction motor. The efficiency of the induction motor was increased by 5 % by adding nano filler of SiO_2 to the enamel used as the coating for the windings of the single phase induction motor. Figure 5 shows the efficiency comparison of various single phase induction motor.

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Table 2 Efficiency Comparison

S. No	Current (A)	Efficiency of the normal single phase Induction motor (%)	Efficiency of the nano coated motor (%)
1	3.9	41.46	49.7
2	4	51.31	58.85
3	4.2	69.50	74.33
4	4.3	69.22	73.05
5	4.4	68.73	73.85

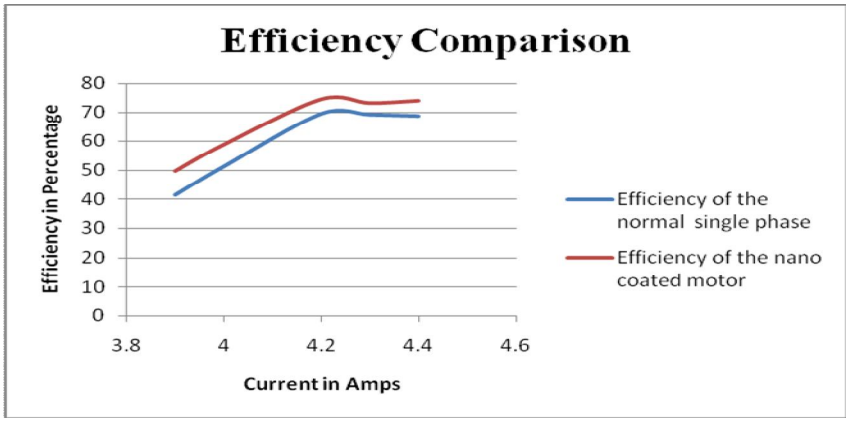

Figure 5 Efficiency Comparison of various induction motor

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 [10-11]. 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. Figure 6 shows the Temperature Comparison of the various Single Phase Induction motor.

Table 3 Temperature Comparison

Time (min)	Normal single phase induction motor (ºC)	SiO_2 nano filler mixed enamel coated single phase induction motor (ºC)
0	30	30
5	44	40
10	48	43
15	50	47
20	53	49
25	55	51
30	57	54

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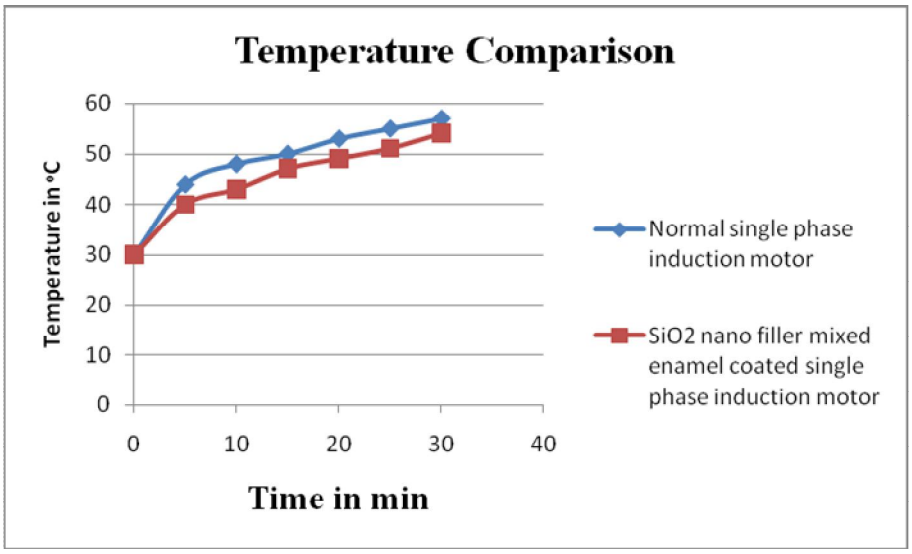

Figure 6 Temperature Comparison of Single Phase Induction motor

IV. CONCLUSIONS

The following observations were clear as per this study:

1. The efficiency of the induction motor was increased by 5 % by adding nano filler of SiO_2 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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REFERENCES

[1] Selvaraj, D. Edison, et al. "Analysis of Efficiency, Thermal Withstanding Capacity and Electromagnetic Interference of Three Phase Squirrel Cage Induction Motor Coated with SiO_2 & TiO_2 nano composite Filled Enamel." International Journal of Science and Engineering Applications 1.1 (2012): 17- 21.

[2] Edison Selvaraj, D., C. Pugazhendhi Sugumaran, and A. Sivaprakash."Characterization of Electrical and Thermal Properties of Enamel Filled with Carbon Nanotubes." Proceedings of the Third International Conference on Trends in Information, Telecommunication and Computing. Springer New York, 2013.

[3] Selvaraj, D. Edison. "Partial discharge characteristics of enamel filled with micro and nano composite of siO_2 and TiO_2." International Journal of Science and Engineering Applications 1.2 (2012): 95-101.

[4] Selvaraj, D. Edison. "Characterization of dielectric properties of the enamel filled with carbon nano tubes for the frequency range of 50 Hz-5 MHz" International Journal of Science and Engineering Applications 1.2 (2012): 102- 106.

[5] Selvaraj, D. Edison, and C. Pugazhendhi Sugumaran. "Comparative Analysis of Dielectric Properties of Enamel Filled with Various Nanofillers such as ZrO_2, Al_2O_3, CNT and ZnO." International Journal of Science and Engineering Applications 1.1 (2012): 51-55.

[6] Babu, B. Gurukarthik, D. Edison Selvaraj, R. Srinivas, B. Guru Prakash, and R. Vishnu. "Analysis of Relative Permittivity and Tan Delta Characteristics of Silicone Rubber Based Nano-composites." International Journal of Scientific Engineering and Technology , pp.2201-206, 2012.

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International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

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[7] D. Edison Selvaraj, J. Ganesan. "Experimental Analysis of Efficiency and Thermal Withstanding Capacity of Three Phase Squirrel Cage Induction Motor Coated with SiO_2 & TiO_2 Nano Composite Filled Enamel", International Journal of Engineering Sciences, Vol (2), No (4), 2013. pp. 115-118.

[8] Lieutenant Ganesan. J, Jeyadevi.S.Dr, and Edison Selvaraj. D, "Performance Analysis of Single Phase Induction Motor Coated with Al_2O_3 Nano Filler Mixed Enamel" ACEEE International Journal on Recent Trends in Engineering& Technology Vol. 10, No. 1, Jan 2014.

[9] Edison Selvaraj. D, Pugazhendhi Sugumaran. C, Lieutenant Ganesan. J, Ramathilagam. J, "Analysis of Dielectric and Thermal Properties of Polyamide Enamel Filled with Carbon Nano tubes" International Journal of Nano science, Vol.12, Issue 3, June 2013.

[10] Lieutenant Ganesan. J, Edison Selvaraj. D, and Ramathilagam. J,"Experimental analysis of Thermal conductivity of enamel filled with micro and nano composite of SiO_2 and TiO_2" International journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.2, Issue 7,pp. 2907-2912 , 2013.

[11] Lieutenant Ganesan. J, Jeyadevi. S. Dr, and Edison Selvaraj. D, "Reduction of Electromagnetic Interference in Single Phase Induction Motor by coating the winding with Al_2O_3 nano filler mixed Enamel" International journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.2, Issue7,pp. 2913-2916 , 2013.

[12] Lieutenant Ganesan. J, Edison Selvaraj. D, and Selva Kumar. B, "High Efficiency Induction Motor", International journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.2, Issue 2, pp. 750-754, 2013.

[13] Lieutenant Ganesan. J, Edison Selvaraj. D, GuruPrakash. B, Vishnu Prakash. R, Muthupandi. E, and BalaKumar. R, "Analysis of Efficiency and Thermal Withstanding Capacity of Single Phase Induction Motor Coated with Al_2O_3 Nano Filler Mixed Enamel", International journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.2,Issue 3,pp. 960-963, 2013.

[14] Lieutenant Ganesan. J, and Edison Selvaraj. D, "Analysis of Thermal and Electrical Properties of Enamel Filled with Various Nano fillers such as ZrO2, Al2O3 and CNT", International Journal of Engineering Research, Vol.2, Issue 2, pp. 182-186, 2013.

[15] Mohamed Saman Saman. R, Karthikeyan. G, Marirajan. A, Rajasekaran. V, Edison Selvaraj. D and Lieutenant. Ganesan. J, "Analysis of Thermal withstanding capacity of cage motor coated with Al_2O_3 Nano Filler Mixed Enamel" in International Journal of Recent Advance in Engineering and Technology Vol.1, Issue 3, pp.102-105, 2013.

BIOGRAPHY

S. Balamurugan, He is pursuing B.E degree in EEE in Sree Sowdambika College of Engineering, Aruppukottai, India.

A. Mariya Anthoni Pravin, He is pursuing B.E degree in EEE in Sree Sowdambika College of Engineering, Aruppukottai, India.

S. Krishna kumar, He is pursuing B.E degree in EEE in Sree Sowdambika College of Engineering, Aruppukottai, India

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S. Ahamed NishaKhan, He is pursuing B.E degree in EEE in Sree Sowdambika College of Engineering, Aruppukottai, India.

Mr. D. Edison Selvaraj received the B.E. degree in Electrical and Electronics Engineering from Anna University, Chennai in 2007 and M.E. degree in High-Voltage Engineering from Anna University, Chennai, Tamilnadu, India in the year 2010. Presently, he is working as Assistant Professor (Part time Faculty) in the Department of Electrical and Electronics Engineering, Guindy, Anna University, Chennai, India.

Mrs. S. Geethadevi received the B.E degree in Electrical and Electronics Engineering from Anna University, Chennai in 2005and M.E. degree in High-Voltage Engineering from Anna University, Chennai, Tamilnadu, India in the year 2012. Presently working as a senior Assistant professor, EEE department , in Aurora scientific and technological institute, Uppal, Hyderabad, India.

Lieutenant. J. Ganesan received the B.E., degree in Electrical and Electronics Engineering from Thigarajar College of Engineering, Madurai in 2007 and M.E degree in Applied Electronics at Anna University of Technology, Tirunelveli, Tamilnadu, India in the year 2013. Presently he is working as Assistant Professor in the Department of Electrical and Electronics Engineering, Sree Sowdambika College of Engineering, Aruppukottai, India.