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REDUCTION OF ELECTROMAGNETIC INTERFERENCE IN SINGLE PHASE INDUCTION MOTOR BY COATING THE WINDING WITH Al_2O_3 NANO FILLER MIXED ENAMEL

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ABSTRACT - It has been observed that the addition of nano fillers to the enamel can greatly improve the thermal, mechanical and electrical properties of enamel. Al_2O_3 has been tested as nano filler. The micro particles of Al_2O_3 are converted into nano particles by using the ball mill method. Scanning electron microscope (SEM) has been used to augment the particle size of the prepared nano particles. The Al_2O_3 nano filler was mixed with enamel by using ultrasonic vibrator. The enamel filled with the Al_2O_3 nano filler was coated on the windings of a motor. The values of electromagnetic inference produced by normal induction motor and nano coated induction motor was measured and analysed. There was a reduction of 5 to 15% in the values of the electromagnetic interference produced by the normal induction motor when compared to that of Al_2O_3 nano filler mixed enamel coated induction motor at various distances.

I.INTRODUCTION

Dielectric materials were construction materials which were frequently employed in contact with metals. In equipment and installations for the supply of electricity, heat was generated by ohmic losses in conductors, through dielectric losses in insulating materials and through magnetization and eddy-current losses in the iron. The dielectric losses will depend upon the dielectric properties of the insulation such as breakdown strength, partial discharge characteristics, frequency, type of applied voltage, intensity of electric field and loss tangent [1] [2]. The human body will act as an antenna for the electromagnetic waves produced by AC electrical transients, much of it in the 50 to 100 kHz range. High levels of exposure to electric and magnetic fields in the frequency up to 100 kilohertz can affect the nervous systems. For a 60 Hz field with strength of three milli gauss, a current was created in an adult. An AC electric field will also create a current in the body [15]. Armed with this knowledge it only makes good sense to protect humans from these dangerous EMF frequencies. For motors, the enamel was used for three purposes: impregnation, coating and adhesion. Varnishes were composed of a polymer matrix containing inorganic particles such as Al_2O_3, TiO_2, SiO_2 and ZnO to increase PD resistance [12] [13]. This paper focuses on the reduction of the electromagnetic interference in the single phase induction motor by coating the enamel which is filled with Al_2O_3 nano filler.

II.PREPARATION OF NANOFILLERS

The micro powders of Al_2O_3 were crushed into nano powders by Ball Mill method. The SEM images of Al_2O_3 before and after Ball Mill show the particle size of the powders. The particle size was augment by SEM images.

A. SEM analysis Before Synthesisation

The micro size particles of Al_2O_3 were in the range from 10 to 100 µm size. The figure 1 shows the SEM image of Al_2O_3 at 10 µm.

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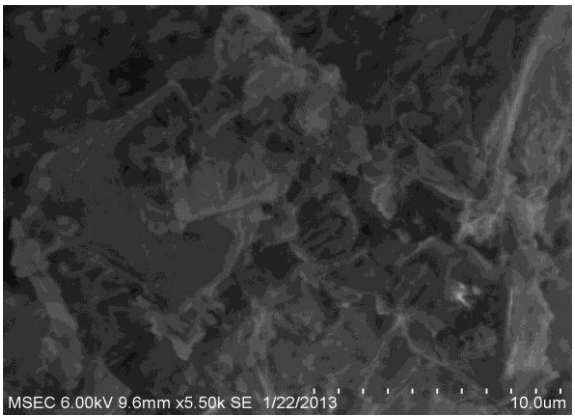

Fig. 1 SEM analysis of Al_2O_3 at 10 µm

B. SEM analysis After Synthesisation

The micro size particles were converted into nano size with the help of Ball Mill. From the analysed SEM image the particles were in the form of nano metric range varies for one area to other. The sizes of the particles were in the range from 180 to 250 nm size. Fig 2 shows the SEM analysis of Al_2O_3 at 5µm.

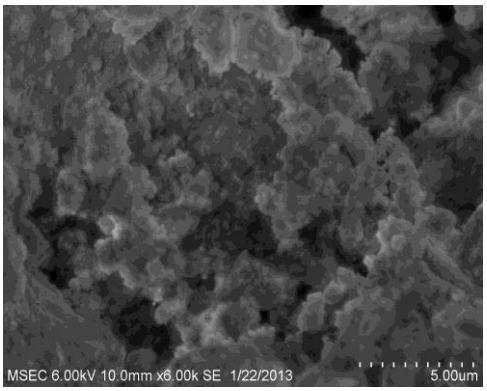

Fig. 2 SEM analysis of Al_2O_3 at 5µm

III.COATING THE NANO Al_2O_3 FILLED ENAMEL TO THE WINDINGS OF THE MOTOR

The Al_2O_3 nano filler 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 I Specifications of the single phase induction motor

Quantity	Rating
Power	0.5 HP
Speed	1500 rpm
Current	4 A
Voltage	230 V

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IV.EXPERIMENTAL ANALYSIS OF ELECTROMAGNETIC INTERFERENCE

The electromagnetic fields are force fields, carrying energy and capable of producing an action at a distance. These fields have characteristics of both waves and particles. An electric current flowing in a wire or coil produces its own magnetic field. The electromagnetic interference will also depend upon the dielectric and magnetic materials used in the motor. The electric field will depend upon the dielectric materials and the magnetic field will depend upon the magnetic materials. But as per Maxwell's equation, there was an inter-relation between the electric and magnetic field [15]. Poisson's equation is called as Electrostatic governing equation and Helmholtz equation is called as Electromagnetic governing equation for the time varying field. The electromagnetic interference was measured by means of Gauss meter and Tesla meter. Table 2 shows the values of electromagnetic inference produced by normal induction motor and nano coated induction motor in terms of Gauss and Tesla. From these measurements, it was observed that there was a reduction of 5 to 15 % in the values of the electromagnetic interference produced by the normal induction motor when compared to that of nano Al_2O_3 filled enamel coated induction motor at various distances. Hence, the effect of electromagnetic interference was reduced to the humans, other electrical devices, communication devices and measuring instruments.

Table II Measurement of Electromagnetic Interference

Distance in cm	Ordinary motor (milli Gauss)	Ordinary motor (Tesla)	Nano coated motor (milli Gauss)	Nano coated motor (Tesla)
7	155	15.32	130	12.71
9	104	10.31	80	7.63
10	78	7.45	65	6.44
12	47	4.86	45	4.33
14	32	3.01	30	2.82
15	26	2.43	25	2.21
20	10	0.89	5	0.42

V.CONCLUSIONS

The following observations were made as per this study:

1. There was a reduction of 5 to 15% in the values of the electromagnetic interference produced by the normal induction motor when compared to that of nano Al_2O_3 filled enamel coated induction motor at various distances.
2. The nano Al_2O_3 filled enamel coated induction motor can be used to reduce the electromagnetic interference produced by the induction motor at the normal cost.

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