Journal of Basic and Applied Engineering Research
Print ISSN: 2350-0077; Online ISSN: 2350-0255; Volume 1, Number 14; October-December 2014 pp. 99-101
© Krishi Sanskriti Publications
http://www.krishisanskriti.org/jbaer.html

Charectoristics of Thin Films for Electrical Insulation Laminate Application

C.B. Gandigudi* and L A Udachan**

**HKES College, Bangalore - 560 080*
***C B Post graduation and Reseach Center Bhalki, Bidar*

Abstract—*The electrical industry largely employ Electrical laminates, in wide variety of application for the purpose of insulation mechanical support, spacers, isolation precise being served as electrical insulation. The characteristics and Optimisation of electrical properties will go to a long way in checking feasibility for specific application. In this direction, the laminates should have optimal electrical characteristics in the environment of outdoor equipment. Here the equipment is exposed to electrical stresses as well as outdoor oriented environment. For the laminates like fibre glass with and without impregnation are applied in the electrical equipment. The physics of these laminates is very important when coated with thin films. The thin films play vital role in achieving intended electrical properties. Important stresses are Arc Resistance, the resistive ability to electrical stress in outdoor application (AR) while arc resistance gives the resistance of the material for arc characterization of the material. In the present study FRP material laminates are given coating of thin films. These samples are subjected to experiments such as important parameter of arc resistance.*
The data obtained has been investigated in the context of with and without thin film coating. The results are analyzed for electrical application for wider application to outdoor usage. The present paper details the importance of outdoor application of laminates with thin film coating, experimental details and interesting results in current research work.

Keywords: *Thin films, Arc resistance, Industrial laminate, Impregnation, Insulating material, Electrode system and Arc formative time.*

1. INTRODUCTION

The industrial laminates are mostly of insulating materials which are various kinds of materials applied in electrical equipment. Fiber glass reinforce material (FRP), Hylam, micaceous laminates, Epoxy laminates are some the materials in vogue. The insulating laminates also called industrial laminates have to meet the technological challenges for intended applications. Mechanical supports, insulation spacers, stress gradient are some of the functional characteristics [1,5]. The requirement of characteristics is different for electrical equipment whether equipment functions in indoor use or outdoor scenario. Irrespective of environment, industrial laminates need to withstand the stresses which are likely to occur in operation and maintenance schedule. Therefore, care has to be exercised in the selection and employment of industrial laminates by optimal characterization of industrial laminates. The degree of severity increases with its demanding environment of outdoor where industrial laminates need to with stand electrical and environmental.

Thin film coatings obtained on industrial laminates with suitable thermal class of varnish provide viable solution. For this optimal characterization of thin film with industrial laminate is needed. Thin film coating will provide characteristics required to meet outdoor application with its own inbuilt structure and resistant to electrical arcs. The internal arcs, discharges, electrical stresses are present in the insulation when the electrical apparatus works in service. The physics and process that occur in the industrial laminates are in infancy stage. It is therefore interesting to research community to understand and characterize thin films on industrial laminates[5].

In the present work, typical industrial laminates are impregnated and thin film layer obtained on the surface. The samples are subjected to electrical experiments to find resistance to arcs as they have been subject of hazardous and detrimental to the the functionality. The characteristics of impregnated and unimpregnaed have been evaluated for arc characteristics.

2. EXPERIMENTAL WORK

The arrangement of experiment consists of electro system, typical thin film coated samples, a source of high voltage generating arc. The electro system consists of two conductive rods of length 30 cms with rectangular cross section. At the end of electro system a small tungsten electrode of length 1cm and circular cross section. The tip of tungsten electrode is shaped Plano circular so that the tungsten electrode rests on the surface of the sample without any air gap.

The typical electrode materials used for experiments are stainless steel electrode, brass electrodes, and tungsten electrodes. The samples for the study are industrial laminates such as Fibre glass, Impregnated fibre glass, Hylam.

Fresh samples and impregnated samples are used for the study. Impregnated samples (IMP) are obtained by dipping the fresh samples in impregnated chamber at predetermined temperature. In this experiment class thermal class furnish is employed to obtain IMP samples. This IMP samples contain thin films on the surface of the sample.

Instrument employed has a high voltage source capable of generating arc at the voltage of 12.5 KV and able to sustain the arc between electrodes throughout the experimental work. The duration of Arc can be timed using inbuilt timer.

The experiments are conducted on five specimen of each type of industrial laminate and the average of five readings has been taken as Arc resistance in seconds [2]. For impregnation class B of temperature 105deg C is used. The curing time is 24 hours in impregnation chamber maintained at temperature of 105deg.C.

3. RESULTS AND ANALYSIS:

The results of experiments conducted on the above lines are furnished in the following paragraphs.

Arc resistance (Sec) have been obtained for fresh and impregnated samples. The results are shown in Table-1.

Table 1

Characteristics of Industrial laminates for Arc Resistance characteristics (Seconds)		
Samples	**Arc Resistance forunimpregnated (seconds)**	**Arc Resistance for impregnated (seconds)**
Mica	330	398
Fibre glass(1)	205	246
Hylam	152	167
FRP2	215	248

Table 2: Thickness and Arc resistance

Thickness of thin films(mm)	Arc resistance (sec)
0.25	208
0.5	217
1.0	227
1.5	247

The thickness of film has been studied for thin films on Arc resistance charectoristics. depicts the results. The material of electrode is studied for Arc resistance charectoristics and results are displayed in table-3.

Table 3: Electrode material and Arc resistance (sec) (standard reference of hylam of thickness 3.5mm)

Electrode material	Arc resistance (sec)
Stainless steel	150
Brass	160
Tungesten	170

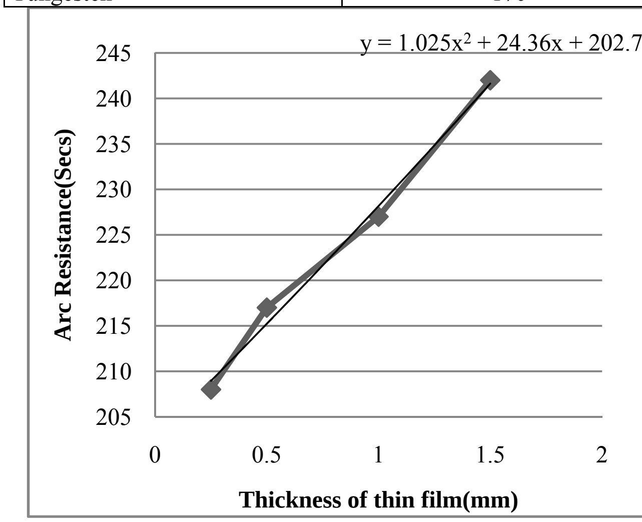

Fig. 1: Variation of Arc Resistance with thickness of thin film

Arc resistance (AR) seems to increase with layer of thin films. However the increase in layer is not linear because of void content and a structural integrity at micro level. In the thickness range of thin film consider, AR seems to follow mathematical relation for the coating thickness of 1.5mm only.

$Y= 1.25\ x^2+24.36\ x+2.207$

Where Y represents Arc resistance in seconds and x represents the thickness of thin films on the surface of industrial laminate. The material of electrode has influence on the magnitude of arc resistance. It is mainly due to work function/energy absorption nature and for tungsten; it shows higher values due to energy absorption and instant emission nature.

For complete development of Arc, there is initiative time and formative time of conducting path this is because transition period is required for electrons to participate in the development of complete conductive path on the surface of the sample. This transition period is dependent on work function W(Φ) of the material of the electrode [1,3]and is independent of thin film. This value ranges from 4sec to 10secs. This transition time can be employed to initiate appropriate measures to avoid degradation of thin films and ultimately insulation material.

Table 4: Arc Transition time

Sample	Arc Initiative time(TI)	Formative time (Tf)	Difference in time (Transition time) Secs
1	163	170	7
2	164	172	8
3	165	169	4
4	166	176	10
5	160	169	9

Table-4 shows the values of initiative time and formative time for a typical insulating material.

4. CONCLUSIONS

The following conclusions are drawn:

1. Proper selections of electrode material is important and tungsten material provides minimum work function so that full arc can be stuck across the electrode system.
2. The thin films on industrial laminates can be usefully characterised using arc resistant experiments and more so for impregnated industrial laminates.
3. Impregnation of industrial laminates shows higher magnitude of arc resistance values. This method ensures optimal electrical resistance of thin films coated on industrial laminates. Thus thin films act as protective coatings for industrial laminates.

5. ACKNOWLEDGEMENTS

The authors are thankful to management of HKES SVP College, Bangalore for their encouragement and support in publishing this research work.

REFERENCES

[1] AJ Decker, " Solid state Physics",MacMillan student edition,1985.

[2] ASTM, D498 "Specifications for arc resistance properties of insulating materials", 2001.

[3] R Murugesahan , K Shiva Prakashan," Modern Physics",S Chand and company,2012.

[4] F K Richtmyer, E H Kennard," Introduction to Modern Physics", McGrawHill Book Company, 1942.

[5] P K Chakrabarti,PK Dasgupta, "General Properties of Matter", Oxford and IBH publishing company,1974

Address for communication

L A Udachan**
Channabasaweshwar P G College
Bhalki-585328
Dist: Bidar
Karnataka
E-mail: cbgandigudi@gmail.com