
Ain Shams University, Faculty of Engineering,
Electrical Power and Machines Department

# *Effect Of Vulcanization Temperatures On The Electrical Performance Of Ethylene Propylene Diene Monomer Rubber As H.V Insulators*

**By**

Eman Labib Fared Mohamed Mabrok

B.Sc. Electrical Engineering, Ain Shams University, 1999

A Thesis Submitted in Partial Fulfillment of the Requirement for the Degree of Master of Science in Electrical Engineering

**Cairo 2009**

Ain Shams University, Faculty of Engineering,
Electrical Power and Machines Department

# *Effect Of Vulcanization Temperatures On The Electrical Performance Of Ethylene Propylene Diene Monomer Rubber As H.V Insulators*

**By**

Eman Labib Fared Mohamed Mabrok

B.Sc. Electrical Engineering, Ain Shams University, 1999

A Thesis Submitted in Partial Fulfillment of the Requirement for the Degree of Master of Science in Electrical Engineering

Supervised By

***Dr. Mahmoud Abd Al Hamid***

**Electrical Power& Machines Dept.**
**Faculty of Engineering**
**Ain Shams University**

***Dr. Loai S. Nasrat***

**Electrical Power& Machines Dept.**
**Faculty of Engineering**
**South Valley University**

***Dr. Ahmed Ibrahim Abou- Kandil***

**Polymer Metrology & Technology Dept.**
***National Institute of Standard***
**Cairo 2009**

# STATEMENT

This thesis is submitted to Ain Shams University for the degree of Master of Science in Electrical Engineering.

The work included in this thesis was carried out by the author. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

Name: Eman Labib Fared Mohamed

Signature: ……

Date: ……..

# ACKNOWLEDGEMENT

I have the great honor to express my deepest gratitude and sincerest thanks to my supervisors committee: Dr. Mahmoud Abd Al Hamid, Dr. Loai S. Nasrat and Dr. Ahmed I.Abou-Kandil for their continuous guidance and support. Their helpful and valuable discussions were the core reason for a completing this work.

My deep gratitude and respect is dedicated to Dr. Mahmoud Abd Al Hamid, for his wise supervision, guidance and continuous encouragement and for his helpful and fruitful discussions in the preparation of this thesis.

I would like to thank Dr. Loai S. Nasrat and Dr. Ahmed I.Abou-Kandil for their valuable advices, great assistance, all facilities and raw material offered during the progress of this work .

I've greatly indebted to for his guidance and unfailing discussions and for every good help until the thesis has been developed.

I am indebted to Dr. Loai S. Nasrat enthusiasm and his continuous discussions. I feel deeply thankful to Prof. Dr. Nabila Darwish head of Polymer Metrology & Technology Department – National Institute of Standard and all stuff members who helped me in preparing and testing the rubber mixed.

Finally, I owe a greet part of research study to the High voltage Laboratory staff in Electric Department and to all those who assisted me my family, specially my father and my mother, for their continuous encouragement, and for their patience and understanding all along the way.

عن عمر بن الخطاب رضي الله عنه قال :

سمعت رسول الله صلى الله عليه و سلم يقول:

*" إنما الأعمالُ بالنياتِ ، و إنما لكل امرئٍ ما نوى ، فمن كانت هجرتُهُ إلى دنيا يصيبُها أو إلى امرأةٍ ينكِحُها فهجرتُهُ إلى ما هاجرَ إليه "*

(رواه البخاري)

# ABSTACT

Inorganic material such as Porcelain and Glass have been used as H.V insulators for prolonged period of time, but, the main obstacles that has been encountered using these materials are its high cost, susceptibility to erosion; therefore, efforts were dedicated to develop alternative materials such as polymers.

Ever since their introduction in the early 1970's, polymers insulators have been increasingly accepted by utilities as a suitable replacements for Porcelain & Glass insulators. Recently, rubbers are widely be used as out door insulators, such as Silicon rubber (SIR), Ethylene Propylene rubber (EPR) and Ethylene Propylene Diene Monomer (EPDM).

Once the polymer is manufactured, it needs to be compounded into a suitable material in order to be used as an H.V insulator. Polymer compounding is the science of mixing the polymers with other chemicals to produce a polymer compound of which has specific properties for an application such as electrical insulators.

Vulcanizing agents are ingredients used to cause chemical reaction resulting in the cross-linking in elastomer molecules. Through chemical cross-linking an elastomeric compound is converted from soft, tacky material to stiff, temperature stable material. There are many types of vulcanizing agents that have an effect on the physical properties of the polymers, thus, enhancing their service capabilities as H.V insulators.

Polymer formulated to provide performance characteristics better than those of Porcelain. Because of the wide deviation in the physical properties of Porcelain and polymers, comparison between the two materials should be focused on specific functional parameters in order to obtain conclusive results; however, liking is usually given to polymers over porcelain based on short term electrical characteristics of complete insulators.

There for the present work studied the effect of vulcanization temperatures such as room temperature vulcanized and high temperature vulcanized on the Electrical Performance of EPDM rubber as H.V insulators. Circular EPDM composite samples have been examined experimentally in atmospheric air and after immersion in [water ,NaCl solution ].

The ac ( 50Hz ) dielectric strength has been measured for different sets of samples under different testing condition.

Inorganic fillers such as kaolin ,feldspar and Quartz are incorporated into EPDM to improve the electrical ,mechanical, thermal and physical properties in addition to maximize dielectric strength and decreasing the erosion phenomena .

The effect of adding inorganic fillers used on the electrical performance of EPDM have been studied .The conclusion and the suggestion have been taken according to this studied .

# CONTENTS

## CHAPTER (5): GENERAL CONCLUSION AND RECOMMENDATIONS

# LIST OF ABBREVIATIONS

**HV : High Voltage**

**EPR : Ethylene Propylene Rubber**

**EPDM : Ethylene Propylene Diene Monomer**

**SR : Silicon Rubber**

**UV : Ultra Violet**

**RTV : Room Temperature Vulcanized**

**HTV : High Temperature Vulcanized**

**ATH : Alumina Tri-Hydrate**

**$SO_2$ : Silica**

**ASTM : American Standard Tested Method**

**DST : Dielectric Strength Test**

**K : Kaolin**

**F : Feldspar**

**Q : Quartz**

# LIST OF TABLES

# LIST OF FIGURES