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Improving Performance of Ethyl Vinyl Acetate in Power Cables

By

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To the memory of my Husband

STATEMENT

This thesis is submitted to Ain Shams University for the Degree of Master of Science in Electrical Power 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 institute.

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ABSTRACT

High technological age is to a high extend due to the reliability achieved in the transmission and distribution of power.

Cables are one of the key elements in the hierarchy of the system. Extending the life of the cables is an important factor on keeping the system safe and functioning.

Power cables are provided with layers of coatings that are extruded on the conductor to provide protection and to extend the life of the cable.

In particular, high voltage power cables have an inner semiconducting layer (referred to as conductor shield) surrounding the conductor, an intermediate layer insulation and an outer semiconducting layer surrounding the insulation layer (referred to as insulation shield). The purpose of the inner semiconducting layer is to relax or relief the heterogeneous electrical stress attributed to irregularities in the conductor and insulation. The external semiconducting layer, which could either be a bonded layer or a strippable layer, homogenizes the electrical stress on the insulation surface.

The semiconducting layer, which is also known as the conductor shield, is typically formed from ethylene based polymers (ethylene vinyl acetate or ethylene ethyl acrylate or ethylene alkene copolymers). The ethylene based polymer is blended on conducting carbon black as furnace black or acetylene black, appropriate antioxidants and an organic peroxide cross-linking agent.

Studying the semiconducting layer can give us evidence for what is going to happen for the cable, as it can reveal the early partial discharge and can cause the reduction of the water treeing which are two main factors which decrease the life time of the power cable.

Trying to enhance the semiconducting layer can reflect on increasing the performance of the power cable life by which saving both energy and money can be obtained.

The aim of this work is to improve the performance of the ethylene vinyl acetate as a semiconducting layer in power cables to increase the life expectancy of the power cable.

TABLE OF CONTENTS

CHAPTER TWO: ETHYLENE VINYL ACETATE AS A POLYMER

CHAPTER THREE: PREVIOUS WORK DONE BY OTHERS

CHAPTER FOUR: EXPERIMENTAL TECHNIQUES AND TEST PROCEDURES

CHAPTER FIVE: MEASUREMENTS AND ANALYSIS OF ELECTRICAL AND MECHNICAL PROPERTIES OF EVA

LIST OF ABBREVIATIONS

ASTM	American Standard Test Method
BDV	Break Down Voltage
CB	Carbon Black
CPE	Chloride Sulphene Polyethylene
EEA	Ethylene Ethyle Acrelate
EHV	Extra High Voltage
EPDM	Ethylene Propylene Diene Monomer
EPR	Ethylene Propylene Rubber
EVA	Ethylene Vinyl Acetate
HAF	high Abrasion Furnace Black
HALS	Hindered Amino Light Stabilizers
HDPE	High Density Poly Ethylene
HMWPE	High Molecular Weight Polyethylene
HPFF	High Pressure Fluid Filled Pipe
HV	High Voltage
LDPE	Low Density Polyethylene
LIPP	Laser Induced Pressure Pulse
LV	Low Voltage
MV	Medium Voltage
MWCNT	Multi Walled Carbon Nanotubes
PD	Partial Discharge
PE	Polyethylene
PCR	Poly Chloride Rubber
PILC	Paper Insulated Lead Covered
PP	Poly Propylene
PVA	PolyVinyl Acetate
PVC	PolyVinyl Chloride
SCFF	Self Contained Fluid Filled
SiR	Silicon Rubber
TIV	Treeing Inceiption Voltage
TRXLPE	Tree Retardant Cross Linked Polyethylene
UVA	Ultra Violet
VA	Vinyl Acetate

VLDPE	Very Low Denisty Polyethylene
XLPE	Cross Linked Polyethylene

LIST OF TABLES

Table (5.8)	The elongation percentages values for samples of EVA loaded with Carbon Black filler with various percentages of concentration of the weight.
Table (5.9)	The average of the elongation percentages values for samples of EVA loaded with Carbon Black filler with various percentages of concentration of the weight.