

**DEVELOPMENT OF A METHOD TO PREDICT THE  
PLASTICIZER EVAPORATION OF PVC INSULATED  
ELECTRICAL CABLES**

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Degree of Master of Science

Department of Materials Science & Engineering

University of Moratuwa

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## **DECLARATION**

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## **ABSTRACT**

Though insulation is critical to the performance of an electrical cable the assessment of the status of an insulation is still a major challenge. Since the root cause of most electrical cable failures is due to insulation deterioration, if the rate of aging can be predicted, properly scheduled, appropriate maintenance programs can nearly eliminate cable failures.

The kinetics of plasticizer evaporation of polyvinyl chloride based locally manufactured electrical cable insulations were investigated. Plasticizer evaporation is a slow process under low temperatures and would take years to study under such conditions. Therefore, accelerated conditions were used to get readings within the limited timeframe. Nevertheless, data obtained under accelerated conditions was mapped to normal conditions through Arrhenius approach.

Deconvoluted derivative thermograms were used to identify the initial plasticizer percentages and Arrhenius approach was used to map accelerated condition measurements to ambient temperature evaporation rates.

As cables are subjected to time varying temperature profiles a method for finding the equivalent temperature could be developed using kinetics of plasticizer evaporation whereby the operating life of the cable can be determined. The developed method could be applied for an electrical cable under a roof which is subjected to fluctuating thermal stress throughout the day and required time to evaporate critical level of plasticizer was determined.

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## **LIST OF ABBREVIATIONS**

|                |                                  |
|----------------|----------------------------------|
| PVC            | Poly(vinyl chloride)             |
| PPVC           | Plasticized poly(vinyl chloride) |
| PB             | Partial Discharge                |
| UV             | Ultra Violet                     |
| T <sub>g</sub> | Glass Transition Temperature     |
| EVA            | Ethylene Vinyl Alcohol           |
| GI             | Galvanized Iron                  |
| PE             | Polyethylene                     |
| PP             | Polypropylene                    |
| CPE            | Chlorinated polyethylene         |
| PU             | polyurethane                     |
| TPR            | Thermoplastic Rubber             |
| SBR            | Styrene Butadiene Rubber         |
| EPR            | Ethylene Propylene Rubber        |
| CSPE           | Chlorosulfonated polyethylene    |
| EPDM           | Ethylene Propylene Diene Monomer |
| FEP            | Fluorinated Ethylene Propylene   |
| ETFE           | Ethylene Tetrafluoro Ethylene    |
| PVDF           | Polyvinylidene Fluoride          |
| TPE            | Thermoplastic Elastomer          |
| DEHP           | Di-2-ethylhexyl Phthalate        |
| DOP            | Dioctyl Phthalate                |
| LOI            | Oxygen Index                     |
| TGA            | Thermogravimetric Analysis       |
| DTG            | Differential Thermogravimetry    |

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