**ABSTRACT**

The components of a transmission system known as insulators provide the appropriate insulation between line conductors and supports, thereby preventing any leakage current from the conductors to the earth.

The overhead transmission line's line conductors must be appropriately insulated from the supports in order for the current flowing through the conductors to avoid flowing through the poles or towers where they are supported. Insulators are placed between the line support and conductors to accomplish this.Porcelain is frequently used to make the insulators for overhead transmission lines.

Overhead transmission line’s insulators must be able to endure both mechanical and electrical strain. While electrical stress is primarily caused by line voltage and may result in the failure of the insulator, mechanical stress is caused by conductor load, wind load, etc. Either a flash-over or a perforation can cause the insulator to collapse electrically.

A high-voltage and medium-voltage power line insulator leakage current monitoring optoelectronic sensor was created. All information gathered from the insulator is kept in a structured database that may be accessed online. Multiple sensors must be utilized to cover the monitored area since the leakage current on high-voltage insulators is dependent on the local air quality and moisture.

**CHAPTER 1**

**INTRODUCTION**

* 1. **INTRODUCTION TO THE PROJECT**

An electrical insulator is a substance that does not allow internal electric charges to flow freely under the influence of an electric field, very little electric current will flow through it. In contrast, conductors and semiconductors more readily allow for the flow of electric current. An insulator can be identified by its resistivity, which is higher than that of semiconductors or conductors.



Figure 1.1 Insulator

There is no such thing as a perfect insulator since even insulators have minute amounts of mobile charges (charge carriers) that can carry current. Additionally, when a sufficiently high voltage is supplied to the point where the electric field separates electrons from the atoms, all insulators turn into electrically conductive materials. This is referred to as an insulator's breakdown voltage. High [resistivity] materials with properties like glass, paper, and Teflon are excellent electrical insulators. A considerably greater class of materials are used as insulation for electrical wiring and cables even though they may have lower bulk resistivities since they are still capable of obstructing significant current passage at commonly used voltages.

Electrical equipment uses insulators to hold and separate electrical conductors without allowing current to flow through them. Insulation is an insulating material that is wrapped in large quantities over electrical lines or other equipment. The word "insulator" is also used to refer more particularly to the insulating supports that are used to join transmission or distribution lines of electric power to utility poles and towers. Without allowing the current to pass through the tower to the ground, they maintain the weight of the dangling wires.

Insulators are essential parts of energy distribution systems. Insulator leakage current is the current that passes over the insulator's exterior surface from a high voltage circuit to ground. Any high voltage insulator that is used in transmission lines (TL) or distribution lines deployed outside will leak current due to the environment's progressively coating them with conductive deposit. Dust,smoke, clay powder,ashes,

chemicals from nearby industries are the pollutants which causes insulator failure.Insulator failure causes distribution companies to lose money and operate inefficiently, leaving unhappy customers.Additionally,light rain night dew or boosts the contaminated layer's conductance, which causes arcs.

Depending on the layer's conductivity, these arcs can form and result in a flashover, in which the air surrounding the insulator ionises and turns into a conductor, occasionally resulting in the destruction of the entire insulator followed by outages.

This phenomena often occurs in the steps described below:

* Pollutants settling on the insulator surface
* Soluble pollutants being combined with rainwater or dew to form a conductive layer
* Leakage currents beginning
* The insulator's surface becomes hot, followed by the development of dry patches
* Partial discharges
* The occurrence of flashover.

Failures that can manifest suddenly, sporadically, or even incipiently cause transmission line outages.The early stages of an outage enable for monitoring and fault prediction.Incipient defects are frequently caused by insulating issues, due to  stresses.Insulators frequently have different pollutants deposited on their surface since they work in harsh environmental conditions. A leakage current flows on the insulator as a result of the stress on its dielectric caused by the deposition of impurities, which lowers the surface's resistivity. As pollution levels rise, the leakage current rises as well, eventually causing a flashover and impairing long-term insulating performance. The resistive surface of the insulators starts to exhibit non-linear characteristics as a result of the local heating that leads to the production of dry bands, which ultimately results in a leakage current with a number of strange harmonics. As a result, monitoring based on leakage current enables observation of the insulators' operational state and identification of the most likely reasons for failure. In this project,the input and output currents measured at the substations situated at the terminals in transmission line sections are used to determine the leakage current to be defined to the predictive maintenance approach. The signals collected by sensors and network data that make up the online monitoring of transmission Lines System – MOLLTs. can be used for predictive maintenance.

**1.2. EXISTING METHOD**

**1.3. DISADVANTAGES IN EXISTING METHOD**

**CHAPTER 2**

**LITERATURE REVIEW**

“Measurement of Leakage Current for Monitoring the Performance of Outdoor Insulators in Polluted Environments” by Isaias Ramirez-Vazquez et al., discussed about leakage current is measured to keep an eye on how well insulators are working and to reduce system failures that can be attributed to pollution. The method is used on transmission lines subjected to extreme and diverse levels of pollution.

“Dynamic Simulation of Power Systems Considering Transmission Lines Icing and Insulators Flashover in Extreme Weather” by lizheng chen et al., discussed about extreme weather conditions have had a severe effect on the exposed equipment and parts of the power grid, such as insulators and transmission lines.

“Sensor Network for Monitoring the State of Pollution of High-Voltage Insulators Via Satellite” by Eduardo Fontana et al., discussed about the design and development of a sensor system network for remote monitoring of the level of pollution on high-voltage insulators .One of the main causes of the reduction in insulation between phase and ground in transmission-line towers is the buildup of contaminants on the surface of high-voltage (HV) insulators.

“Detection and Monitoring of Leakage Currents in Power Transmission Insulators” by Marcelo Martins Werneck et al., discussed about the high-voltage and medium-voltage power line insulator leakage current monitoring optoelectronic sensor was created. Leakage current powers an incredibly bright LED that emits an amplitude-modulated light signal. A plastic optical fibre cable is used to couple the optically intensity encoded signal and send it in ground potential from the high potential measuring site to the distant unit.

“Testing Method for Composite Insulators Interface Based on Nonlinear Ultrasonic” by Sida Zhang et., discussed about the Composite insulators are weak at the interface. The uniform distribution of the electric field will be impacted as the interface bonding fails, hastening the ageing of composite insulators and impacting the secure operation of transmission lines.

“Failure Analysis of Decay-like Fracture of Composite Insulator” by Jiafu Wang et al.,discussed about summarising and analysing the general characteristics the failure, Decay-like Fracture was given, and the decay-like fracture of composite insulator was regarded and examined as a new type of composite insulator mechanical failure.

“A New Current Transducer for On-Line Monitoring of Leakage Current on HV Insulator Strings” by Rodrigo J.Villalobos et al., discussed about the HV insulator string pollution level estimation has frequently employed leakage current .In this study, a transducer for detecting and online monitoring of leakage currents on high-voltage insulator strings is designed, put into practise, tested, and experimentally validated.

“Leakage Current Response Mechanism of Insulator String With Ambient Humidity on Days Without Rain” by Jianguo Wang et al.,discussed about the most fundamental online monitoring parameters for the surface contamination state of insulators is the leakage current.The time-domain waveforms of leakage current of an insulator string were compared with those of the ambient temperature and humidity in this study using data from leakage current online monitoring. Results show that on days without rain, the leakage current exhibits a saddle-shaped curve, and that there is a striking positive association between the leakage current and humidity as well as a negative correlation between the leakage current and temperature and the current.

“In-Situ Monitoring of Leakage Current on Composite and Glass Insulators of the Cahora Bassa HVDC Transmission Line” by Robert R.Van Zyl et al.,discussed to guarantee acceptable operational performance, high voltage transmission line design necessitates careful insulator selection. In-situ leakage current (LC) measurements on composite and glass insulators of the Cahora Bassa high voltage direct current (HVDC) transmission line are discussed in this work. The findings indicate that, with the exception of conditions of high humidity or rain, the behaviour of composite and glass insulators is identical

“The Evaluation of Daily Comparative Leakage Currents on Porcelain and Silicone Rubber Insulators Under Natural Environmental Conditions” by Dini Fauziah et al., discussed about the storage digital oscilloscope was used to evaluate the applied voltage and leakage current (LC) waveforms on samples of silicone rubber (SIR) and porcelain (Porcelain) insulators that were mounted outside, along with measurements of humidity, temperature, and illumination. Essentially, measurements were made everyday at intervals of three hours for a period of thirty days, and correlation coefficients, box plots, and exponential regressions were used to examine the data.

“Pollution Performance of HVDC SiR Insulators at Extra Heavy Pollution Conditions” by A.Abbasi et al., discussed about the measurement and analytical findings for DC flashover of SiR insulators in terms of various voltage polarities, levels of hydrophobicity, and geometrical SiR insulator properties in extremely contaminated situations. The results show that the strength of the flashover is 4% more in positive voltage than in negative voltage.

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