Title: Investigations on the Corona Induced Degradation of PolymericInsulating Samples
Name: Mr. Shakthi Prasad D. (S.R. No.: 04-03-04-10-12-13-1-10512)
Degree Registered: Ph.D. (Department of Electrical Engineering)
Supervisors: Dr. Subba Reddy B. and Prof. B. S. Rajanikanth

Abstract

Insulators play an important role in the reliability and safe operation ofEHV/UHV transmission lines. Recently several utilities in the country andelsewhere are using polymeric insulators for the high voltage transmissionand distribution systems due to their advantages. Since, polymericinsulators are of recent origin and organic in nature, their long-term field performance is not yet fully understood. International standardorganizations like CIGRE, IEC, IEEE etc, are currently working towards thedevelopment of methods for long term performance; some include resistanceto corona, ozone, chemical attack, hydrophobicity etc, for the polymericinsulating samples. The present investigation focuses on two importantaspects:
(1) Investigations on the corona induced degradation on differentpolymeric samples under normal and due to different fog conditions.
(2) Application of digital imaging techniques for the detection of coronadischarges and its analysis.

An experimental facility along with a new methodology is proposed andadopted for the corona induced degradation studies on polymer insulatorsamples. The investigations are conducted on different polymer samples forthe normal and the effect of different fog environments, some interestingresults are obtained, further the treated samples are analyzed usingphysico-chemical analysis, it was found that corona treated samplespresent higher hydroxylation, detection of nitric acid on sample surfacewhich cause brittle fracture of fiberglass rod of the insulator, loss ofAlumina trihydrate (ATH) filler, decrease in tensile strength on theinsulator samples.It was observed from experimental investigations that corona activity isone of the important phenomena responsible for the degradation ofpolymeric insulators. Hence, periodic inspection of polymeric insulatorsand the detection of corona discharges are important in conditionmonitoring. Hence an attempt is made to analyze and quantify the coronadischarges using image processing techniques. A color threshold basedcorona plasma extraction algorithm is adopted. A luminance component ‘Y’parameter is computed from the processed corona images and is shown to correlatewell with the corona released power. A physical model is proposed to explain the phenomenon and is quantified by adoptingthe line-detection based image processing algorithm to compute thecorona spread angle. It is observed that material degradation caused bythe corona with less spread angle is higher in comparison to thewide spread corona. To overcome the limitation of conventional images,high dynamic range imaging technique is employed to accurately identifythe location of corona stress on the polymeric samples. Interestingly, itis observed that the correlation between the degradation patternsestimated by the corona images and Fourier transform infrared spectroscopy(FTIR) show that HDR image provides the true correlation, whereas theconventional images resulted in pseudo-correlation.