

ABSTRACT:

This paper reports an investigation into the leakage current harmonic components of 45 units of glass insulator samples. The insulator units comprise 5 groups of insulators: new insulators and naturally field-aged insulators with different ageing periods >30 , 20, 15, and <10 years from a 132 kV transmission line. Experiments were conducted at different electrical stresses (0.17, 0.24, and 0.34 kV/cm) and salt-fog conductivities (900 and 1500 $\mu\text{S}/\text{cm}$). The results suggest that the insulator samples' leakage current (LC) waveform and the total harmonic distortion (THD) correspond well with degree of ageing. Fast Fourier Transform (FFT) analysis performed on the stored waveforms showed a strong correlation between the ratio of the third to fifth harmonic amplitudes with the degree of ageing and in-service period of the naturally field-aged insulators. Furthermore, this investigation revealed a pattern between the groups of insulator samples in respect to their ageing. These findings were further validated with traditional Dielectric Dissipation Factor tests carried out on the insulators, and the results also correlated well with the samples' degree of ageing as well as service period. In addition, neural networks were trained to recognize the insulator samples' degree of ageing. This study found that, alternative to the diagnosis of insulator ageing through the measurement of loss angles or tangent delta, LC harmonics can be used as diagnostic tools and for the on-line monitoring of in-service aged transmission line ceramic glass insulators based on odd harmonics and third to fifth harmonic ratios.