Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 86 (2016) 389 – 392

Procedia Computer Science

2016 International Electrical Engineering Congress, iEECON2016, 2-4 March 2016, Chiang Mai, Thailand

The investigation of insulation breakdown strength for the Nano-composite oxide doped epoxy resin insulator by using positive impulse voltage in comparison with negative impulse voltage

Mingkhouan Xayyavong[a], Kittipong Tonmitr[a]*, Norrawit Tonmitr[b], Eiji Kaneko[b]

[a]*Department of Electrical and Electronics Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen, Thailand 40002*
[b]*Department of Electrical and Electronics Engineering, Faculty of Engineering, University of the Ryukyus, Okinawa, Japan 903-0213*

Abstract

This article presents the nano-composite oxides in dielectric materials which are suitable for increasing the efficiency of the destruction of strength and durability against voltage. Tests were conducted to compare the characteristics and details of epoxy resin materials doped with nano zinc oxides by using positive and negative impulse standard voltage to test the destruction of specimen in order to make insulators more efficient and durable against the positive and the negative impulse voltage. This research also studied the abilities of nano-composite oxides to be used as electrical insulators - epoxy resin doped with zinc oxides nano-composite in ratios of 0, 5, 10, 15 and 20% by weight. After that, there were destruction tests by using impulse voltage at levels of 75, 90, 98, and 115 kV connected to the specimen's electrodes immersed in oil transformer by using each voltage level against specimen usage in each of the aforementioned ratios to investigate the damages on insulator surfaces and the number of breakdowns. In viewing damages on insulator surfaces, microscopes with magnification levels of 20-800X were used. From experimental results, it was found that regarding specimens used to doped an epoxy resin with zinc oxides nano-composite and each level of standard positive impulse voltage, in the first round of voltage feeding it was observed that the period of specimens surface destruction was higher than when negative impulse voltage were used, and the breakdown occurrences were also faster increasing than that the of standard negative impulse voltage were used. In conclusion, a 5% doped epoxy resin with nano-composite zinc oxides tested with negative impulse voltage has better properties as an insulator than other samples in ratios of 0, 10, 15, and 20%, respectively, as the 5% ratio has a breakdown occurrences also happened later with smaller periods of insulator surface destruction in the first round of voltage feeding than the other cases.

Peer-review under responsibility of the Organizing Committee of iEECON2016

* Corresponding author. Tel.: +66-089-711-0635; fax: +66-43-347032.
E-mail address: kitton@kku.ac.th

Peer-review under responsibility of the Organizing Committee of iEECON2016
doi:10.1016/j.procs.2016.05.039

Keywords: Doped zinc oxide; Electric field; Epoxy resin; Insulator strength; Nano-composite

1. Introduction

In high voltage dielectric system design, it normally uses an epoxy resin technology to be an insulator material in different conditions. When insulator materials contacted with large electrical tension, insulator properties will be decreased as usage period. Thus, there was need to design and developed insulator materials for using in long period hours. To design and develop an insulator, Masahiro Kozako [1] had done the tests by doped nano-fillers in ratios of 2, 4, and 5%, which were tested by using partial discharges according to IEC electrodes. When used scanning electron microscopes and atomic force microscopes, it was found that on the surface of the sample with nano-fillers, small-sized roughness was higher than that of samples without nano-fillers. The weight ratio of 2% was seen to be sufficient for improving rough surfaces; this can also be explained that differences in the roughness of deteriorated surfaces were because partial discharges in the examples were from differences in structure. Due to the study results, outcomes have shown that polyamide nano-composites became more resistant with partial discharge. A research article by Lewis [2] mentioned the opening of nano-fillers in insulator materials to enhance electrical and mechanical properties of thermal nano-composite insulators. Furthermore, manufacturing techniques improved due to the birth of nanotechnologies that affected the renewal of the focus of researcher groups to investigate the possibility of developing strong, compact electrical insulators/thermal insulator systems related to energy equipment.

The main objectives of this research were the testing of electrical insulator properties of epoxy resin beneath differences of electrical field tension to evaluate their strengths and to compare epoxy resin with nano-composite zinc oxides. In the case of defective electrical insulators, this will come from mechanical and thermal defects of thermal insulators, which increased with the addition of nano-composite substances. This research assists the insulator to becomes mechanically stronger as well as being more durable against the increasing heat even if the amount was smaller than that of the thermal insulators, but can also withstand the high voltage [3], [4]. Thus, research details analyze the thermal insulator systems composed of nano-composite substances, lead to new innovative solutions for thermal insulation systems in their variety of applications.

2. Experimental Preparations

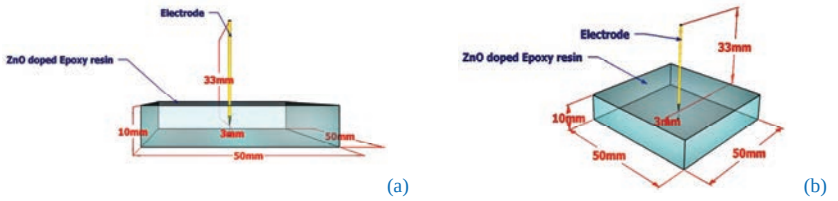

Fig 1. (a) front view and (b) isometric view of specimen

The materials used for these tests were chemical epoxy resin substances fabricated at Khon Kaen High Voltage Engineering Research Laboratory, Thailand. The reason for this choice of materials in this experiment was due to the properties of this solid insulator because of durable against heat and widely used in the industrial works. These insulators could be used as a sample of the solid insulator in the experimental studies. This epoxy resin contains the following doped ratios of solid substances (solid substance 1: Resin 500 by weight). These resins would change in phase from liquid to solid by pouring to a silicon mold. These samples would harden into a solid insulator within 24 hours. The work material used in testing was designed to be a square with an area of 50 mm^2 and a thickness of 10