



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Mrutyunjay Maharana
Roll Number : 146151009
Programme of Study : Ph.D.
Thesis Title: DEVELOPMENT OF ALTERNATIVE DIELECTRIC FLUID FOR POWER AND DISTRIBUTION TRANSFORMER
Name of Thesis Supervisor(s) : Dr. Sisir Kumar Nayak and Prof. Niranjan Sahoo
Thesis Submitted to the Department/ Center : Centre for Energy
Date of completion of Thesis Viva-Voce Exam : 2nd April 2019
Key words for description of Thesis Work : Nanofluid, Liquid insulation, Dielectric fluid, transformer oil, Vegetable oil

SHORT ABSTRACT

The thesis presents development of alternative dielectric fluid for power and distribution transformer. It addresses the nanofluid (NF) development and modification in the transformer oil (TO). It also addresses the development of vegetable oil (VO) based TO is a potential insulating liquid dielectric for the transformer.

In the present study deals with the development of stable mineral oil (MO) based nanofluid (NF) for transformer application. Due to an extraordinary thermal and insulating properties of the hexagonal boron nitride (h-BN) nanoparticle (NP), it is selected as a material to be dispersed in MO to prepare the NF. Bulk h-BN NP of size 1 μm is exfoliated into 2-D nanosheets of size 150-200 nm subsequently enhancing the surface area of exfoliated h-BN (Eh-BN).

An open beaker, single temperature oxidative thermal ageing experiment is performed at 115°C for different ageing times, i.e. 164, 328, 492 hours. A concentration of 0.01wt% of NP for both titanium oxide (TiO_2) and Eh-BN/MO are selected to prepare the NFs for ageing. The superiority in physicochemical and insulation performance of Eh-BN/MO-NF are observed compared to TiO_2 NF and MO at post ageing condition.

A comparative accelerated thermal ageing study of the kraft paper is carried out to stud the electrical breakdown, tensile strength and the degree of polymerization of the oil impregnated paper (OIP). To understand the degradation of the aforementioned properties of the OIP, accelerated thermal ageing study has been performed. An ageing study of both MO impregnated kraft paper (MOIKP) and NF impregnated kraft paper (NFIKP) is performed in two different ageing vessels at 160°C for different aging durations such as 100, 500, 1000 and 2000 hours respectively.

This work presents a vegetable oil (VO) specifically crude karanji oil (CKO) based TO as an alternative liquid dielectric. The nature of biodegradability, environment friendly and easy availability makes this oil a suitable candidate for liquid insulation. The dispersion of nanofillers into the VO is expected to improve the physicochemical and electrical performance. Surface modified insulating NP is dispersed into the VO to prepare the VO based NF. An open beaker oxidative ageing study is carried out at 115°C for VO and NF at three distinct ageing duration such as 100, 300 and 500 hours. The fluorescence-based analysis is carried out for VO and NF at fresh and aged condition to monitor the comparative ageing degradation. Oxidative ageing of VO and NF results in the formation of flammable and harmful gasses, which are analyzed using dissolve gas analysis technique. A comparative analysis of the electrical properties such as ACBDV, DC and DDF for fresh and aged sample of VO and NF are studied.