UNIVERSITI TEKNOLOGI MARA

DIELECTRIC AND PHYSICAL STUDY OF THE PETROLEUM (MINERAL OIL) MIXED WITH REFINED, BLEACHED AND DEODORIZED PALM OIL (RBDPO) AND SIO2 NANOFLUIDS AS POTENTIAL ALTERNATIVE FOR TRANSFORMERS OIL

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Thesis submitted in fulfillment
of the requirements for the degree of
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Electrical Engineering

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Mineral Oil (MO) has been the main insulation liquid in power systems. Nowadays, due to environmental concern regarding the use and disposal of MO, researchers explore into renewable sources such as vegetable oils and palm oils. The later have shown having good dielectric properties for use in electrical powers transformers. However, the kinematic viscosity does not fulfil the IEC 60296 standard requirements and need to be improved. In this work, the Refined Bleached Deodorized Palm Oil (RBDPO) and Refined Bleached Deodorized Palm Olein (Palm Olein) were chosen for investigation, with MO as base reference. The RBDPO and Palm Olein, separately, were mixed with MO in proportion ranging from pure 0% form until 90%volume of MO. The addition of the MO is to have a relative comparison of the dielectric strength of the RBDPO. Also, processed silica gels (SiO_2 nanoparticles) were added to the samples of RBDPO and Palm Olein forming new samples, alongside with the ones with no SiO_2. The samples were then subjected to physical and electric, including dielectric tests, and measurements subjected to varying temperatures of 40, 50 and 60°C since these are the recommended transformer's insulation liquid by IEE 2008/2010. The physical measurements were performed on density and kinematic viscosity. The dielectric properties of the oil mixture were made on dc resistivity, dissipation factor (tan δ), partial discharges (PD's) and breakdown voltages (BDV) has been determined. The effect of the oil mixture's mixing ratio and temperature variances on its dielectric properties has been investigated. The dielectric properties of RBDPO and RBDP Olein also have been compared with MO. All samples exceed the IEC 60296 limit for kinematic viscosity. However, the addition of SiO_2 does help in maintaining the viscosity value although subjected to varying temperatures. Also found out, the SiO_2 addition helps to improve the dc resistivity. All samples have very high PD's (pC) with exception for pure MO, RBDPO and RBDP Olein, whose values are close to that recommended by IEC 60272. With the inclusion of SiO_2, the RBDPO with 20%vol MO reached 45.8kV, a 43% higher than pure MO. RDBP Olein with added SiO_2 improved on its breakdown voltages, and the best mixture was RDBP Olein with 30%vol MO. The SiO_2 added to RDBPO has high potential to be a candidate to replace the MO, or at least reduced to minimum usage as additive to RBDPO or other vegetable oils.

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