Investigation of Thermophysical Properties of Transformer Oil Based Nanofluids

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There have been many research efforts dedicated to improving the thermophysical characteristics of heat transfer fluids by suspending nanoparticles in different engineering fields. Various nanoparticles have been used in these research studies, such as organic nanoparticles, metallic nanoparticles, and metal-oxide nanoparticles. The presented research has selected transformer oil as the base fluid, which is responsible for the transformer's cooling and electro-insulation. The experiments were carried out for two different nanofluids of transformer oil to identify the behaviour of several important thermal properties. A multifunctional thermal conductivity meter was used to measure the thermal conductivity and thermal diffusivity using the transient hot wire method from 30 ℃ to 120 ℃. These measured values were used to calculate the volumetric heat capacity. The flash point was measured using the Pensky-Martens closed cup method. Following the two-step method, nanoparticles and base fluid were first mixed, and then magnetic stirring and ultrasonication were carried out for 1 hour and 4 hours, respectively, to prevent the agglomeration of particles from achieving stable nanofluids. In the first experiment, a Fullerene nanofluid sample was created with a 0.1 gL^{-1} concentration, but the nanofluid did not represent any recognizable improvement in thermophysical properties compared to the base oil. In the second attempt, three TiO_2 nanofluid samples were made at weight concentrations of 0.01 %, 0.03 %, and 0.05 %. Also, CTAB (Cetyltrimethylammonium Bromide) was used as the surfactant to improve the nanofluid sample's stability, according to the literature. However, TiO_2 could improve the thermal properties of transformer oil, and the greatest improvement was observed at the 0.05 % weight fraction; CTAB also positively contributed to enhancing the thermophysical properties.

Keywords: *Nanofluids, Transformer Oil, Thermal conductivity, Fullerene, TiO_2*