Influence of TiO_2 Nano-particle Concentration on Thermal Conductivity of TiO_2 / Water Nanofluid

Priyadarshana H.V.V.[1, 2, 3 *], Induranga D.K.A.[1, 2, 3], Galpaya G.D.C.P.[1, 3], Indupama S.V.A.A.[1, 2], and Koswattage K.R.[2, 3]

[1]*Faculty of Graduate Studies, Sabaragamuwa University of Sri Lanka, Sri Lanka*
[2]*Department of Engineering Technology, Sabaragamuwa University of Sri Lanka, Sri Lanka*
[3]*Center for Nano Device Fabrication and Characterization (CNFC), Faculty of Technology, Sabaragamuwa University of Sri Lanka, Sri Lanka*
[*]*vimukkthi@tech.sab.ac.lk*

Nanofluids are emerging as promising heat transfer fluids for the next generation cooling systems by providing impressive thermo-physical properties. Thermal conductivity stands out as a critical property that underscores the potential of nanofluids as alternative coolants for various industrial applications, including solar thermal collectors, HVAC systems (Heating, Ventilation, Air Conditioning), and automotive systems. Many recent research studies have focused on developing a nanofluid with optimum thermal properties for heat transfer applications. However, there are a number of challenges to overcome when using nanofluids in cooling applications such as particle sedimentation, clogging, higher cost and health concerns. Thus, it's very imperative to study the behavior of thermo-physical properties of water based nanofluids since water is the most commonly used heat transfer fluid in industrial applications due to its superior thermo-physical properties. In this study, the influence on the thermal conductivity of TiO2/Water nanofluid was observed for different TiO2 nano-particle concentrations. Nanofluid samples were prepared following the two-step preparation method using TiO2 anatase-type nanopowder, dispersed in distilled water with four different volume fractions 0.05%, 0.1%. In preparation of nanofluid samples, magnetic stirring was carried out for 1 hour at 40°C temperature with 600 rpm and each sample was sonicated for 2 hours in the bath-type ultrasonicator at 40°C temperature to increase the stability of samples. The thermal conductivity of nanofluid samples with different volume fractions was measured by a lambda thermal conductivity meter using the hot -wire resistance method according to the ASTM D7896-19 standards. The thermal conductivity measurements were collected in the temperature range of 35°C to 70°C. The experimental data indicated that TiO2/Water nanofluids showed higher thermal conductivity than distilled water for all volume concentrations.

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