HEAT TRANSFER ENHANCEMENT FOR HIGH VOLTAGE APPLICATIONS COOLING USING METAL OXIDE NANOFLUIDS

By

Amr Mohamed Naguib Azab Abido

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the Requirements for the Degree of
DOCTOR OF PHILOSOPHY
In
MECHANICAL POWER ENGINEERING

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Under the Supervision of

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Thesis Title:- ***"Heat Transfer Enhancement for High Voltage Applications Cooling Using Metal Oxide Nanofluids"***

Key Words: *Nanofluid, Nanoparticle, Thermal Conductivity, Electrical Conductivity, Viscosity, Heat Transfer Coefficient.*

Summary:
"The high voltage applications' cooling uses the double distilled water (DDW) as a cooling fluid because of its low electrical conductivity. This study was performed for enhancing the cooling of the MGC-20 Cyclotron by using the metal oxides nanofluids as a cooling fluid. The aluminum oxide (Al_2O_3), copper oxide (CuO) and magnesium oxide (MgO) were used as metal oxides nanoparticles for nanofluids synthesizing to examine the availability of using them as cooling fluids in the MGC-20 cyclotron. The Al_2O_3, CuO and MgO nanofluids were prepared with different weight concentrations of nanoparticles oxides. The thermal conductivity (TC) of Al_2O_3, CuO and MgO nanofluids were increased with temperature rising as well as with increase of the oxides concentration in the nanofluid, where the1.2% wt. CuO nanofluid offered about 16 % increase than the DDW TC at room temperature (RT), then the 1.2% wt. Al_2O_3 nanofluid thermal conductivity increased by 7% and the 1.2% wt. MgO nanofluid increased by 3% at RT. The electrical conductivity was measured for the all nanofluids and it increased with increase of the oxides concentration, as well as with temperature increase. The 1.2% Al_2O_3 nanofluid was the most suitable nanofluid for the high voltage applications and it was tested in a heat transfer system. The overall heat transfer coefficients of the 1.2% Al_2O_3 nanofluid were greater than the double distilled water coefficients at the different flow rates (by about 13%: 17%). So the 1.2% wt. of Al_2O_3 nanofluid could be used for enhancing the cooling process in the high voltage applications especially for the MGC-20 Cyclotron."

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