Nanocellulose as heat transfer liquid in heat exchanger

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ABSTRACT

Nanocellulose with water and Ethylene Glycol addition to coolant for car radiator application has benefits of improving efficiency of the radiator. Improved efficiency leads to more compact design of the radiator and increases the durability of the engine. The research is conducted to prove that addition of nanocellulose originating from plant base with varying concentration provides a better heat transfer efficiency compared to usage of distilled water as radiator coolant. The objective of the research is to improve and create a new radiator coolant based on collaboration of nanocellulose with readily available coolants which is Ethylene Glycol and to investigate the erosion of nanocellulose coolant on automotive radiator. The scopes of the research are the nanoparticles used in the experiment is nanocellulose between ranges of size 40-80 nm. The tested concentration of the cellulose nanofluids are as of 0.1%, 0.5%, 0.9% and 1.3%. The preparation of cellulose nanofluids are carried out at Advance Automotive Liquid Lab (A^2LL) of Universiti Malaysia Pahang. The experiment is carried out by running the radiator test rig with distilled water as radiator coolant. This is done so that the result obtained through experimental analysis of distilled water is a bench mark for the comparison of heat transfer efficiency. The thermal coefficient test indicates that all the cellulose nanofluid with varying concentration possess better heat conducting properties compared to Ethylene Glycol. Furthermore, this proves that cellulose nanofluids can transfer the absorbed heat from the radiator to the surrounding air much faster compared to conventional Ethylene Glycol. Experimental analysis shows that cellulose nanofluids have higher specific heat capacity compared to distilled water. Thus, cellulose nanofluids can absorb and store more heat compared to distilled water. Heat transfer coefficient result supports that application of cellulose nanofluids as car radiator coolant leads to increase in thermal absorption enhancement. However, as the concentration of cellulose nanofluid increase from 0.1% to 1.3% and so on, the heat transfer coefficient decreases rapidly. This is because formation of sediments of cellulose nanoparticles causes inactive involvement in heat transfer process but the sediments do no clogs in the flat tubes or trigger erosion on the internal wall of car radiator. It can be concluded that application of cellulose nanoparticles integrated with Ethylene Glycol as coolant in car radiator is acceptable and provides better heat transfer efficiency.

Keywords: Nanocellulose, heat transfer, radiator, glycol