CHAPTER 7

CONCLUSIONS AND SCOPE FOR FURTHER WORK

The present work is aimed to study the performance of Al₂O₃-water nanofluids in an automobile radiator. Stable nanofluids are prepared with the optimum process parameters identified from Response Surface Methodology. Properties of the nanofluids are evaluated through experimentation. Nanofluids are applied as coolant in an automobile radiator and performance evaluation is carried out. Experiments are conducted at various nanofluid and air flow rates. The $\varepsilon$-NTU method is adopted for heat transfer analysis. Modified Wilson plot method is used for predicting convective coefficients of fluids in the radiator.

7.1. CONCLUSIONS

Based on the experimental results and formulated mathematical models the following conclusions are drawn.

- Measurement of turbidity is done to test stability of nanofluids. With the increase in volume fraction of nanoparticles turbidity is found to be decrease indicating less turbidity for more suspended nanoparticles.
- With the addition of Sodium Dodecyl Sulphate (SDS) surfactant the dispersion stability of nanofluid first increases to a maximum and then decreases with further addition.
- Nanofluid stability is observed to be influenced by the pH value of base fluid and enhancement in the stability is observed at higher levels irrespective of particulate concentration.
- The nanofluids prepared with the obtained optimum parameters are found to be stable over a period of 30 days even after the continuous working of 10 hours.
- Due to the addition of Al₂O₃ nanoparticles, the thermal conductivity of nanofluid increases and progresses with particulate concentration. Higher thermal conductivity is observed at temperatures more than 60°C and within the range of equipment and is more pronounced for nanofluids compared to base fluid.
• With the addition of nanoparticles, the specific heat of nanofluid decreases but the decrement is dwarfed with the temperature of fluid.
• Increment in viscosity with the addition of particulate is observed for nanofluids at a particular temperature, with increase in temperature the same tends to decrease.
• Density of nanofluid increases with particulate loading at lower temperatures and increment decreases at higher temperatures.
• With the addition of nanoparticles, a reduction in Reynolds number is observed whereas heat transfer coefficient increases under similar operating conditions of the engine. The enhancement in heat transfer coefficient is more at higher engine speeds.
• Significant enhancement in heat transfer coefficient is obtained as the volume fraction increases while Reynolds number is kept constant.
• The experimental results have demonstrated that the heat transfer rates of the nanofluids are dependant on the particle concentration and the fluid flow conditions. Heat transfer rate is promoted with the addition of nanoparticle and an enhancement of 83% is observed for 1.0% volume fraction.
• With particle loading Nusselt number is found to increase and this progression is prominent with enhancement in volume fraction of nanofluids. The values of Nusselt numbers obtained are in good agreement with the published model of Xuan and Li [102].
• Heat transfer enhancement is observed with increase in air flow rate over the radiator and is prominent for nanofluid compared to water (base fluid) as coolant.

7.2. SCOPE FOR FUTURE WORK

Other fluids like ethylene glycol, propylene glycol and their mixtures with water can be chosen as base fluids and proper suspensions can be selected to enhance the heat transfer performance.
In the present work, Al₂O₃ nanoparticles of approximately 50-100nm sizes are used. It can be extended to other nanomaterials like SiC and CNTs in various sizes considering thermal conductivity of particulate.

The present work can be extended to analyse the wear aspects of radiator material due to the nanoparticles being added to the base fluid.