measure the mass flow rate of the hot coolant. The flow to flow meter is controlled by a controlling valve, which helps in obtaining different mass flow rate of the hot coolant.

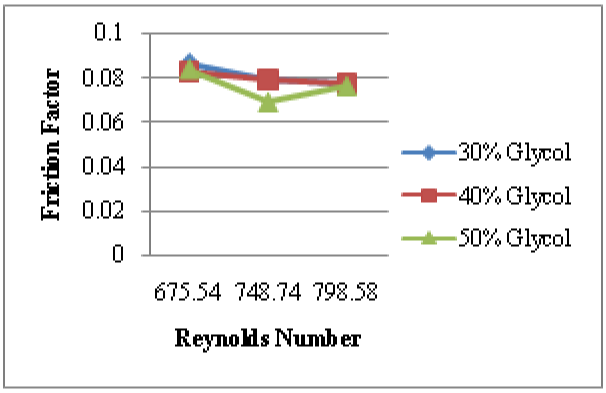
Figure 1: Fabricated model of experimental setup

3. Results and Discussions

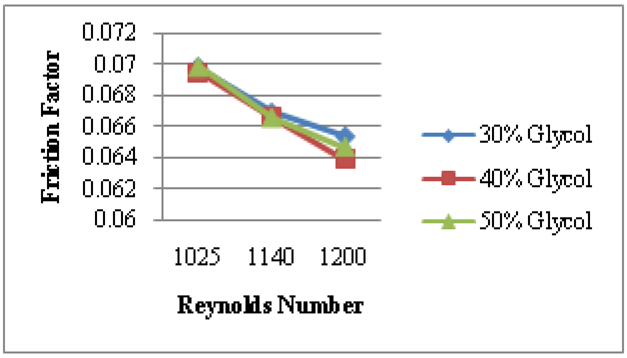
The experiments are conducted on fabricated model of experimental setup by using water as base fluid, 30%, 40%, 50% of ethylene glycol and Al2O3 nanofluids as test fluids. The obtained results are recorded. The parameters like Nusselt number (Nu), Reynolds number (Re), friction factor, heat transfer enhancement are recorded.

4. Performance of Friction Factor at Different Reynolds Numbers

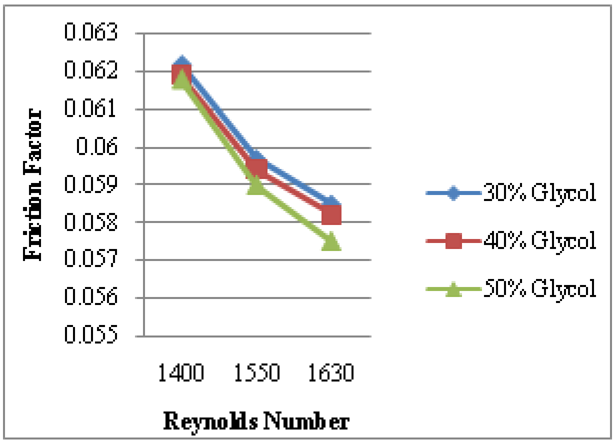
The results obtained for the friction factor at different Reynolds number and nanofluid volume concentration is shown in graphs 1 to 3. It appears that the friction factor decreases with increasing in Reynolds number and nanofluid volume concentration. The figures illustrate the effect of inlet temperature on the friction factor. It seems that slightly effect of inlet temperature and nanofluid volume concentration on the friction factor. Areas on related to the slow flow are generated high friction factor. The friction factor at Reynolds number less than 1000 has been given the maximum deviation but after that the deviation is less.



Graph 1: Variation of Friction factor for different Reynolds number at 4lts/min



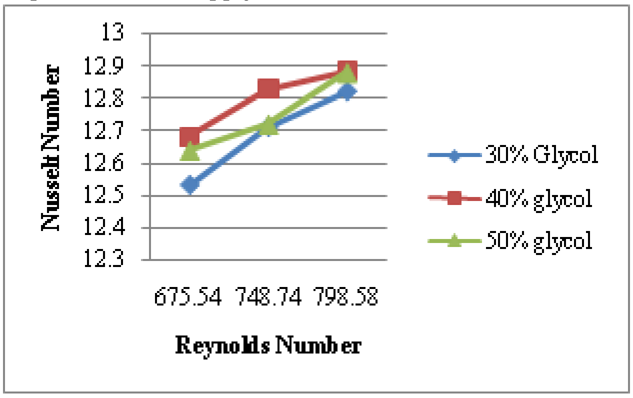
Graph 2: Variation of Friction factor for different Reynolds number at 6lts/min



Graph 3: Variation of Friction factor for different Reynolds number at 8lts/min

5. Performance of Nusselt Number at Different Reynolds Numbers

The Nusselt number increases with increasing of Reynolds number and ethylene glycol volume concentration. The deviation is high when adding the ethylene glycol on base fluid (pure water).It demonstrates the effect of inlet radiator temperature on Nusselt number. The highest values of Nusselt number found at inlet temperature 80ºC followed by at 70ºC and finally at 60ºC inlet temperature. The maximum values of Nusselt number are 19.35, 19.80 and 21.21 at 4lts/min, 6lts/min and 8lts/min respectively. This refers to high heat transfer from the radiator when high inlet temperature would apply.



Graph4: Variation of Nusselt number for different Reynolds number at 4lts/min

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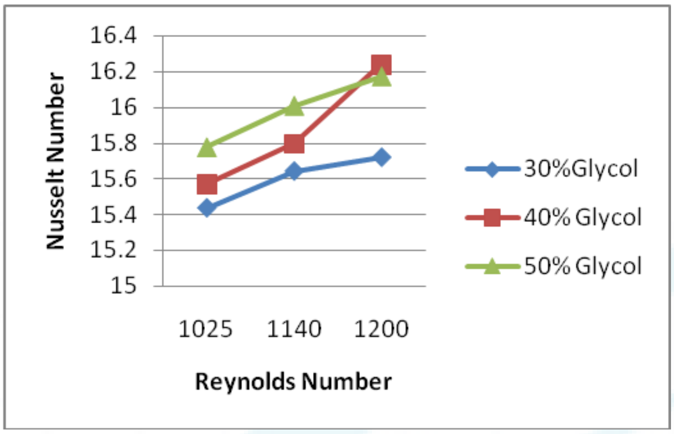
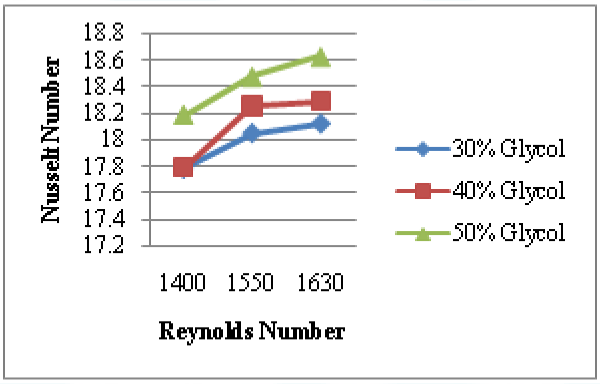


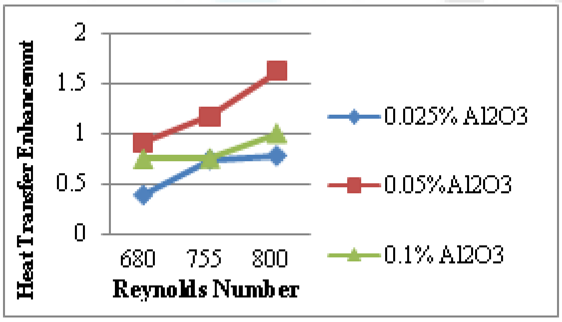
Graph 5: Variation of Nusselt number for different Reynolds number at 6lts/min



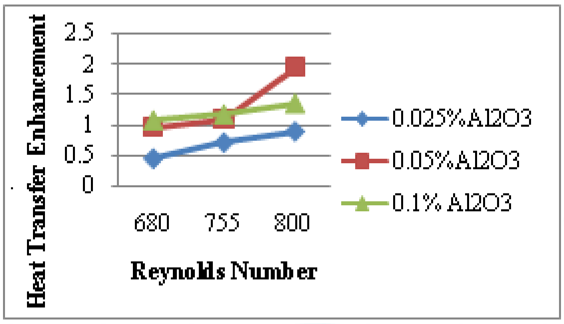
Graph 6: Variation of Nusselt number for different Reynolds number at 8lts/min

6. Effect of Reynolds Number on Heat Transfer Enhancement

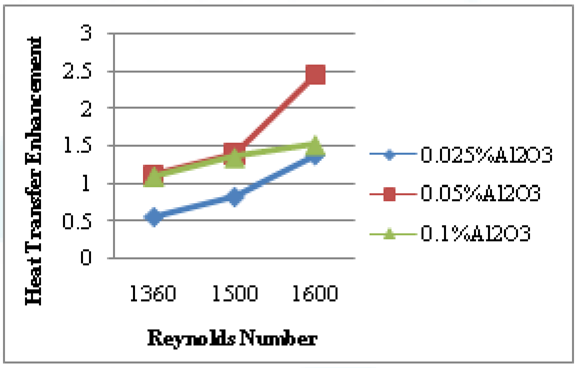
Effects of the Reynolds number, nanoparticle volume fraction and fluid inlet temperature on enhancement in heat transfer are shown in graphs 7 to 8. The enhancement in heat transfer has increased by augmentation in the concentrations of nanoparticle, Reynolds number and fluid inlet temperature. For the water based nanofluid it is obvious that *E* increases with Reynolds number and in higher concentrations of nanoparticle the effect of Reynolds number becomes pronounced. Improvement in the heat transfer rate when ϕ = 0.1% and the E value is about 4.56% for 0.025% Al2O3 nanofluid at 80ºC and this value is about 12.4% for 0.1% Al2O3 nanofluid at 80ºC.



Graph 7: Effects of the Reynolds number on heat transfer enhancement at 4lts/min



Graph: Effects of the Reynolds number on heat transfer enhancement at 6lts/min



Graph: Effects of the Reynolds number on heat transfer enhancement at 8lts/min

7. Conclusions

The convective heat transfer performance and flow characteristics of ethylene glycol flowing in an automotive radiator have been experimentally investigated. Significant increase in heat transfer was observed with the used different volume concentrations of nanoparticles mixed with water. The results showed that the variation of the friction factor and Nusselt number of the ethylene glycol were highly depended on the volume concentration and Reynolds number. The friction factor decreases with increasing of volume flow rate and the inlet temperature of ethylene glycol.The experimental results have shown that theNusselt number behavior of the ethylene glycol was highly depended on the volume concentration and the volume flow rate. The heat transfer enhancement was about 4.56% for 0.025% ethylene glycolat 80ºC and this is about 12.4% for 0.1% ethylene glycolat 80ºC.The results have shown that ethylene glycolhas a high potential for hydrodynamic flow and heat transfer enhancement in an automotive radiator.

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