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Experimental analysis of copper coated helical coiled tube heat exchanger using nanofluid and water

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Abstract

Many studies focused on improving heat transfer by increasing the electrical, industrial, and transportation processes that are required to achieve a higher heat transfer rate. In general, there are two types of heat transfer enhancement techniques: active and passive. External power inputs such as pulse flow, vibratory force, and a magnetic field are used in the active approach. The heat transfer rate is increased upto 20 % in the passive technique by adding more devices or changing the heat transfer surface. The nanoparticle suspension is a heat transfer improvement approach in this study. An experimental investigation used Al_2O_3-water nanofluid in the counter flow heat exchanger to improve heat transfer in the range of 20 %. Experiments with varied volume concentrations 0.1 and 0.15 and mass flow rates of nanofluid were carried out. The arrangements are utilized to assess the situation. The temperature fluctuations were measured using the setups and the acquired values are compared to prior nanofluid performance results, and the result demonstrates that the heat transfer rate has risen upto 20 %. It also shows that the Al_2O_3-water nanofluid performed better than water.

Introduction

The heat exchanger is a piece of machinery that competently transfer theheat from one medium to another. The medium can be separated by a complete partition or be in direct touch to prevent mixing. Only a handful of the uses [1], [2], [3] include refrigeration and air conditioning, space heating, chemical plants, petroleum refineries, power plants, natural gas processing and petro chemical facilities. An internal combustion engine practices a heat exchanger in which setup coolant operate over radiator tubes and air passes by the coils, chilling the coolant and heating system of air.

The flow arrangement of heat exchangers divides them into four types. In parallel flow heat exchanger, both fluids enter inthe same direction and exit also. In the case of a counter-flow heat exchanger, both fluids in and out take place in the opposite direction. The counter flow preparation is the greatest effect in terms of transferring the heat from one medium to another medium due tothe average temperature variance over a unit length being superior [4], [5], [6]. The cross-flow heat exchanger means flow takes place perpendicular to the flow.

For best effectiveness, the heat exchanger is considered to make the most of the surface area of the wall among both fluids by dropping fluid flow resistances through the heat exchanger. The fins in one or many ways, rise surface area and improve the performance of the heat exchanger. Even though the point that the powerful temperatures crosswise in heat transfer surfaces changes with the location, the suitable mean temperature can be calculated [7], [8], [9]. In the further most the modest system, this is the log mean temperature difference (LMTD). Once direct evidence of the LMTD is unobtainable, then the NTU model is used [10], [11], [12].

Section snippets

Nanofluids

This is the novel method of fluids prepared by sprinkling Nano scale mechanisms with water. The nanofluid is a Nano scale colloidal fluids covering an abbreviated nanoparticle. There is two kind of phase system such as solid, liquid and liquid phase. Nanofluids have greater thermo physical properties than water like thermal conductivity, viscosity and thermal diffusivity [13], [14], [15]. It has shown that it has a wide range of possible applications.…

Principle components

The principle components used for the improvement of heat transfer rate are as follows:…

Procedure for experimentation

- Initially, cold water is pumped into the shell, and the water is allowed to fill completely for a few minutes.…
- The Al_2O_3/water nanofluid is then pumped from the collection tank to the helical tube via the heater.…
- Two flow meters are fixed separately for cold and hot water (nanofluid) respectively.…
- For all sets of readings cold water mass flow rate is kept constant at 0.5 LPM and nanofluid mass flow rate is changing from 0.1 LPM to 0.5 LPM.…
- Then corresponding temperature variations for cold water…

…

Result and discussion

Fig. 1, Fig. 2, Fig. 3 show heat transfer rate increases as the mass flow rates of nanofluid increase. It also indicates that the Al_2O_3/Water nanofluid shows a good heat transfer rate compared with Water. It's because Al_2O_3 nanoparticles have a higher heat conductivity (46W/mK). The heat transfer rate rises as the volume concentration of nanoparticlessurges. Increase the number of nanoparticles added to the water to raise the surface area where heat transfer happens. So the heat transfer rate…

Conclusion

As a consequence, the experimental testing of the Al_2O_3/base fluid nanofluids heat transfer properties using a counter-flow heat exchanger was successful. It is concluded that in terms of thermal performance, nanofluids are superior to basic fluids. Increasing the volume concentration of nanoparticles can increase heat transfer rates by up to 20%. Among the Al_2O_3/water nanofluid and water. For comparable working circumstances, Al_2O_3 has faster heat transfer rates.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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