





performance.

- iii. It seems that the increase in the effective thermal conductivity (of about 3% in this study) and the variations of the other physical properties are not responsible for the large heat.[8]

#### **4.5 Performance investigation of an automotive car radiator operated with nanofluid-based coolants (nanofluid as a coolant in a radiator)**

As volume concentration of nanoparticles (ranging from 0% to 2%) increases Heat transfer rate also improves. About 3.8% heat transfer rate improvement are possible with addition of 2% copper particles at 6000 and 5000 Reynolds number for air and nanocoolant respectively.

- i. In radiator Thermal performance of using nanofluid or ethylene glycol coolant is better with air and coolant. Reynolds number about 42.7% and 45.2% heat transfer enhancement were observed for pure ethylene glycol and ethylene glycol with 2% of copper nanoparticles respectively when air Reynolds number was increased from 4000 to 6000. Only 0.9% and 0.4% heat transfer enhancement were observed for pure ethylene glycol and ethylene glycol with 2% copper nanoparticles respectively when coolant Reynolds number was increased from 5000 to 7000.
- ii. Projected 18.7% reduction of air frontal area is extended by adding 2% copper nanoparticles at Reynolds number of 6000 and 5000 for air and coolant respectively.
- iii. Additional 12.13% pumping power is needed for a radiator using nanofluid of 2% copper particles at 0.2 m<sup>3</sup>/s coolant volumetric flow rate compared to that of the same radiator using only pure ethylene glycol coolant.[9]

#### **4.6 Application of nanofluids in heating buildings and reducing pollution by,**

Nanofluid viscosity decreases exponentially as temperature increases from a subzero value. As the volume concentration of nanoparticles increases, the viscosity of nanofluid increases. From the nanofluids tested, the CuO nanofluid has the highest viscosity followed by the Al<sub>2</sub>O<sub>3</sub> nanofluid and then by the SiO<sub>2</sub> nanofluid.

- i. As the volume concentration of nanoparticles (ranging from 0% to 6%) increases, the heat transfer coefficient increases at the same Reynolds number.
- ii. The CuO nanofluid has the highest heat transfer coefficient followed by the Al<sub>2</sub>O<sub>3</sub> nanofluid and the SiO<sub>2</sub> nanofluid.
- iii. Pressure loss is also highest for the CuO nanofluid, followed by the Al<sub>2</sub>O<sub>3</sub> nanofluid and then the SiO<sub>2</sub> nanofluid.
- iv. Replacing conventional ethylene glycol/ water mixture with nanofluids as heat transfer fluid, one can reduce the volumetric flow rate, mass flow rate and the pumping power for the same heat transfer rate.
- v. Use of nanofluids to heat buildings can reduce the size of the heat transfer system and reduce the accompanying pressure loss and the subsequent pumping power. This will reduce energy consumption that comes from power plants and will thus indirectly reduce environmental pollution.
- vi. Similar benefits can be derived by considering

nanofluids in place of chilled water in building cooling coils. An investigation similar to the one presented in this paper can quantitatively establish the benefits.

- vii. Use of nanofluids will reduce material volume necessary for heat exchanger, pump, piping and associated components plus the fluid inventory, thereby reducing the environmental pollution. [10]

**Following is the summary of the applications of nanofluid**

1. Diesel engine.
2. Chillers
3. Cooling system
4. Generators
5. Cooling and heating exchanger
6. Power plant generator
7. Ordinary cars. [1]

### **5. Challenges, drawback and proposed work of nanofluids**

The following are the challenges, drawbacks and proposed work of nanofluids.

#### **5.1 Challenges**

- Deficiency of agreement of results by researcher.
- Shortage of mechanism understanding.
- Reduced characterization of suspension. [6]

#### **5.2 Drawbacks of nanofluid**

- Lack of knowledge at atomic level.
- Some of nanoparticles present in the nanofluid makes toxicity.
- Erosion.
- Some of nanofluids are costly.[11]

#### **5.3 Proposed Work**

The work required for preparation of nanofluid includes followings

- Literature review
- Study of various nanofluid using different theories.
- Study of ZnO properties.
- Preparation of nanoparticles.
- Preparation of nanofluid.
- Measurement of thermal properties of nanofluid. (Like thermal conductivity, density, viscosity, specific heat.)
- Compare prepared nanofluid with available synthetic coolants.
- Study the performance & emission analysis parameters.
- Compare the nanofluid by changing concentration of nanofluid testing performance on radiator.

### **6. Conclusion**

It is concluded that Nanofluid such as TiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, CuO, CH<sub>3</sub>CH<sub>2</sub>OH are new type of nanofluid which have ability to improve the efficiency of automotive cars especially in and hybrid-powered engines, Engine cooling/vehicle thermal management, heat exchanger, and nuclear reactor mostly in automobiles. When concentration of nanoparticles increases

with different temperature thermoconductive properties, heat transfer rate increases. Therefore they exhibit enhanced thermal conductivity and the convective heat transfer coefficient compared to the base fluid. Research are to be needed to overcome the drawbacks and face the challenges of nanofluid.

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## Author Profile



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