

# A review on addition of nanoparticles' impact on refrigerants

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## *Abstract*

The nano-particles have ability to change the properties of conventional refrigerants in different aspects. Different researchers had performed the number of experiments to improve the efficiency of a refrigeration system with the addition of nano-particles. An review has been made on the variation in different properties of different refrigerants with the addition of nano-particles. The addition of the nano-particles has increased the specific heat and other properties at different levels of concentration. It increases with increase in amount of nano-particles. The improvement of properties of refrigerants, improve the performance of refrigeration system. It also improves the other properties of refrigerants i.e. thermal conductivity, density and viscosity etc. It has been found that the use of nano-particles with conventional refrigerants also saves the energy required to run the system.

## *Introduction*

Now a day refrigeration system is widely used in domestic as well as for it industrial applications. The refrigeration system is used to main a desired temperature in a chamber as per requirement. It is used to preserve the perishable materials, food, medicine etc. A refrigeration system can be found in every place in our daily life. A refrigerant in a refrigeration system works as a blood in a human body. A refrigeration system cannot work without a refrigerant. A refrigeration system consists of mainly four parts which are as follow:-

- a. Compressor
- b. Condenser
- c. Expansion tube
- d. Evaporator

The material which needs to maintain at desired temperature is kept in evaporator. As shown in figure 1 [10], the refrigerant running in the whole system absorbs the heat in evaporator and releases it in the condenser. The function of compressor is to move the refrigerant through the refrigeration system. The expansion valve reduces the pressure as well as temperature of refrigerant after receiving it from condenser. During the process lot of energy is consumed to run the system or to run the compressor. In this whole process the refrigerants plays the main role because its function is to absorb the heat from perishable material or from the evaporator. The addition of nano-particles increases the efficiency of this refrigerant in terms of thermal

conductivity and specific heat etc. which in turn improves the overall efficiency of the system. It also reduces the pump work or energy required to run the compressor.

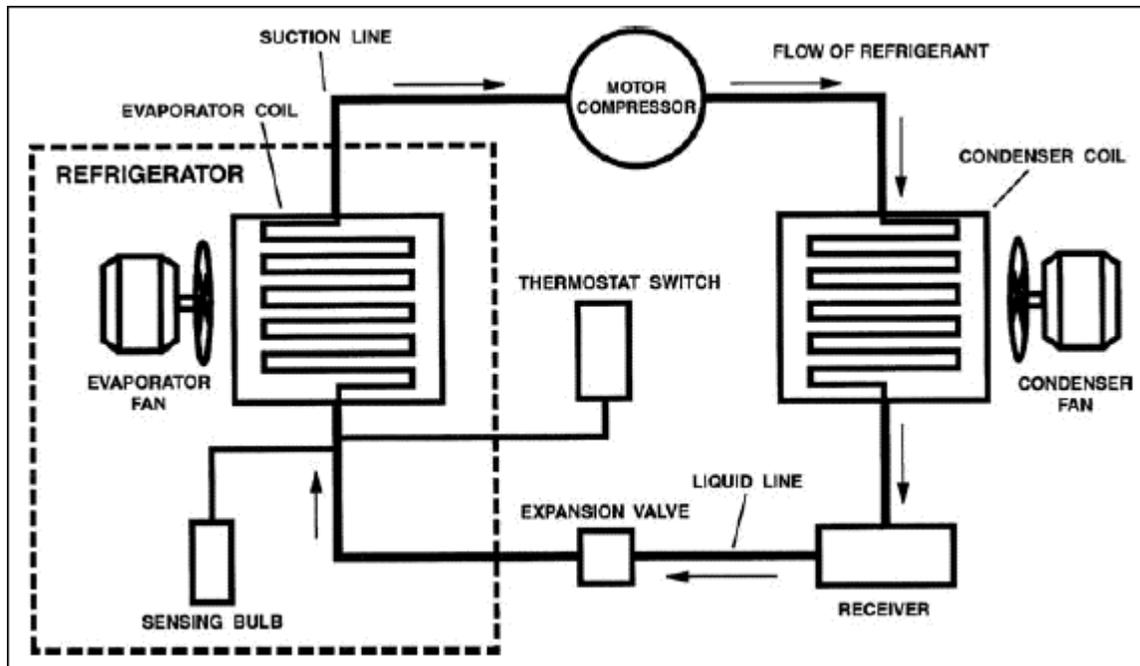


Fig. 1 A Schematic diagram Refrigeration System

### Literature Review

In the history of nano-refrigerants lot of useful results are highlighted by the researchers. The results are very useful for the future work and improvements. It has been resulted that the nano-particles are capable of improving the properties of refrigerants. Few of the results are discussed in this review.

Nasiri et al. [1] compared the Nusselt number of base fluid and the Nusselt number of nano-fluid. It is found that the Nusselt number of base fluid is less as compare to the nano-fluid at equal Peclet number. Javadi et al. [2] resulted the change in co-efficient of heat transfer. It is found that the metal oxides based on titanium and aluminium, are more capable as compare to silicon based metal oxides. Titanium and aluminium oxides, has shown the same capacity of co-efficient of heat transfer. For the titanium oxide based nano-fluid the density is found as high and in aluminium oxide based nano-fluid is resulted with high specific heat. With the application of silicon based oxide, lower pressure drop is observed. Gabriela et. al. [3] studied the efficiency of heat exchangers with the use of nano-fluids and observed the effective results. It is observed that the viscosity and thermal conductivity is affected by different parameters i.e. concentration of particles, its shape and size and also its slip mechanism. The increase in concentration improves the thermal conductivity but also affects the other properties. Due to increased volume concentration, the viscosity and density is also observed as increased. It is noticed that the heat capacity is also reduced. Marilainon et al. [4] examined that the shape of nano-refrigerants also affects the properties of nano-fluid. The cylindrical shaped particles are proved as more efficient as compare to other shapes. The effectiveness of spherical particles are also less than

cylindrical particles. Viscosity is found to be increased with the addition of metal oxides which in turn increases the heat transfer co-efficient. Due to this variation pumping work is reduced. The pressure drop is also depends on the viscosity and density. Kole et al. [5] studied the viscosity of alumina nano-particles used with coolant of car engine. The variation in viscosity depends upon the amount os particles added and variation in working temperature of system. It is observed that viscosity decreases with the increase in temperature of system and increases with increase in concentration of nano-particle. Chook Pak et al. [6] experimental study is made on the behaviour of nano fluids in terms of turbulent friction and heat transfer. The viscosity is found to be increased by 3 times larger than water with 10% addition of alumina and titanium particles. Bhimani et al. [7] found a very effective result by adding the titanium oxide in pure water. The 1% of titanium oxide used with water given rise in heat transfer upto 45%. The experiment is conducted with turbulent flow of water. Bi et al. [8] resulted that the alumina and titanium based metal oxides are safe to use along with mineral oil. It gives the deduction in energy consumption by 26% by adding only 0.1% of titanium oxide. This experiment is held with domestic refrigerator. Saidur et al. [9] found that the use of titanium oxide is very effective with R134a and lubricating oil. It saves the energy by 26% at the volume concentration of 0.1% of titanium oxide.

### **Conclusion**

The addition of nano-particles gives a lot of change in properties of refrigerants. It improves the performance of system by improving its efficiency.

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