# Study the effect of Nanoparticles Behaviour with Different Refrigerants in VCRS-A review

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**Abstract**: Many author is used nanorefrigerants and nanolubricants for the enhance performance of refrigeration system in the zone of heating, ventilation and air conditioning (HVAC). So effect of nanoparticles on the physical model of VCRS system is still to be investigated, very fewer literatures are available on this concept. Therefore, this paper presents a review on the effect of nanoparticles behaviour with different type of refrigerants. The transfer of heat performance was increased by using the nanoparticles while the solubility and miscibility is not affected by this; however it helps in the oil return ratio. The nanolubricants in the refrigerants are minimizing the friction and wear rate. So nanorefrigerants are the best method to improving the COP (coefficient of performance) of the vapour compression refrigeration system (VCRS).

**Keywords: Nanoparticles, refrigerants, COP, VCRS.**

## 1. Introduction

Now days the application of refrigerants have a very vast in the areas of industrial, domestic, as well as vehicles. All during last year's, for the purpose of CFC's were extensively utilized. Yet, Montreal protocol banned CFC due to the fact CFC was destroying the ozone layer in stratosphere. From the preceding years, refrigerants HFC/134a became strongly developed and frequent in automotive air-conditioning machine. Although, from the remaining many years Kyoto protocol has been given suggestion to control green residence gases additionally with hydro fluorocarbon (HFC) due to global warming problem [1]. So, environmentally friendly refrigerants are those refrigerants that are based on HFC refrigerants consisting of R134a. The replacement of R-134a becomes strongly saved in action till the EU F-Gases Regulation and MAC directive forbids the usage of R-134a [2]. Nano refrigerants are especially producing very low temperature used and its packages in refrigeration and air-conditioning cycle, Vapor compression machine [3].

To increase the coefficient of performance of VCRS the nano based additive refrigerants and nanolevel lubricants can be used and hence improved in tribological behaviour of the system, overall performance, solubility and transfer of heat [4-7]. When have looks at of $Al_2O_3$ -R123 nanorefrigerant experimentally this was performed by Jiang Et Al. [8] With the supply of heat, heat exchange rate increases in natural Rankine cycle as compared to natural R-123a cycle. The mean of heat exchange coefficient become increase up to 20% is located than that of natural R141b, when the take a look at glide of boiling features of the Al-R141b by Sun and Yang [9] in copper tube with internal thread.Maheshwarya Et Al [10] studied the properties of R-134a refrigerant using the additive Zno nanoparticle sizes of cubical and spherical form. For cubical nanoparticles of Zno in R-134a the thermal conductivity is increased by 42.5% and for cubical nanoparticles of ZnO in R-134a is increased by 25.26%. Mahbubula et al. [11] studied the properties of the R-141b using nano based additive $Al_2O_3$,they increase the extent of $Al_2O_3$ nanoparticles in R-141b from 0.1% to 0.4% and found that by increasing the extent of nano additive $Al_2O_3$ the thermal conductivity,viscosity,density all these properties have been increased.

## 2. Method for improve the performance of VCRS

Three methods for improving the performance of VCRS
2.1- Improve the transfer of heat performance
2.2-Concern on solubility and miscibility
2.3-Concern about tribological enhancement of nanolubricants

### 2.1 Transfer of heat performance

Up to the present, numerous strategies are used to raise the heat transfer features. The use of active strategies and passive strategies to raise the transfer of heat thermal capacity [12].Active techniques are typically used for change in boundary layer and to increase surface area. Passive techniques are use to increase thermal conductivity, heat capacity, decrease the viscosity and increase the density of working fluid [13]. With the help of development of nanotechnology while the nanoparticles are dispersed in lubricants and refrigerants are referred to as nanolubricants and nanorefrigerants this is the passive techniques for increasing the heat transfer properties of the working fluid [14, 15, 16]. Kedzierski and Gong [16] offers the effectiveness of nanorefrigerants or nanolubricants with increment of heat exchange rate. It changed into received through experimentally that the 0.5% mass fraction of CuO/R134a/POE (among 50% and 275%). The use of 2% mass fraction of CuO/R134/POE the boiling heat exchange rate increased by means of a mean of 12%. The Park and Jung [17] make use of carbon nanotube for increasing nucleate boiling heat transfer via experimentally. it changed into observed that using the carbon nano tube within the R-134a and R-123 refrigerants upward thrust the nucleate boiling heat exchange coefficients when the addition of $Al_2O_3$ nanoparticles with R134a/POE refrigerant they have got to display the most critical function in pool boiling transfer of heat coefficients. The absolute planes of surface densities of nanoparticles are accumulated on the heat exchange floor. This is one of the main reasons for the enhancement of boiling transfer of heat. Bartelt et al. [18] studied, and it turned into found that once the nanorefrigerants of R134a/POE/CuO flow within the horizontal tube the raise transfer of heat coefficient about 50 to 101% at ac concentration of 2%. They also determined that once the insertion of nanoparticles there may be no effect change of pressure on the system. These results shows that the nanoparticle based additives assist in growing the boiling transfer of heat process without any problem in the system.

Researchers have additionally studied the about the nanorefrigerants on the behalf flow of condensation. Akhavan-Behabadi et al. [19] studied, and it was located that once using nanoefrigerants CuO/R600a/ inside smooth of horizontal tube and indicates that the condensation transfer of heat changed into more desirable with mixing nanoparticles of CuO compared to without use of CuO nanoparticles in base mixture of refrigerant. The Peak amount of heat transfer became also increased by means of 83% at 1.5 percent mass fraction of CuO/R600a/POE. Many experiments are suggests that when using nanorefrigerants in the machine the thermal conductivity also increased. Mahbubul et al. [20] studied approximately the thermal conductivity and viscosity of $Al_2O_3$/R-134a nanorefrigerants. it observed that thermal conductivity enables in drift of boiling transfer of heat coefficients and while inside the easy horizontal tube the convective transfer of heat coefficient are effects. From the above statement it proved that once the raise in concentration of volume and temperature, the thermal conductivity and transfer of heat coefficient of nanorefrigerants are improved. After some, Mahbubul et al. [21] Preceding and It takes new nanorefrigerants $Al_2O_3$/R141b and formed the relationship among the concentration of nanoparticles and thermal conductivity, concentration of nanoparticles and viscosity, temperature and thermal conductivity, temperature and viscosity of latest nano refrigerants. It became determined that the thermal conductivity influences because of exchange of particle concentration. So when concentration of particle and temperature are increases then the thermal conductivity will increase and will increase of particle attention, viscosity can be additionally increases .From the above take a look at it found that most excellent concentration of nanofluid or nanorefrigerants are needed to get better transfer of heat performance. Sharif et al. [22-25] have a look at with extent awareness of the $Al_2O_3$/PAG nanolubricants from experimentally for the automobile air conditioning (AAC) and it said that after we use 1% volume concentration then thermal conductivity growth about 4% and when the use of 0.4% extent awareness then the viscosity more advantageous higher than the baseline PAG lubricants.

After few yr Zawawi et al. [26-30] preceding, and he used nanoparticles of $SiO_2$ and this nanoparticles blended with the PAG lubricants. It was observed that when the nanoparticles concentration will increase then each thermal conductivity and viscosity will increase while decreases with temperature .So he determined that and journalist advice for the automotive air conditioning special form of nanonolubricants will designed and also choicest use of $SiO_2$/PAG and $Al_2O_3$.because of motive that the use of big amount of lubricants will raise the strength intake in vapor compression refrigeration cycle.

**2.2 Solubility and miscibility**

In the vapor compression refrigeration system, nanolubriants are playing very important role with solubility and miscibility development inside the refrigerants and lubricant. Wang et al. [31] gave the improvement of solubility and miscibility with nanolubricants. For example combination of nanoparticles of $TiO_2$ with mineral oil and HFC (hydro fluorocarbon) refrigerant used for growing the solubility of the refrigerant –lubricant aggregate. After some times, aggregate of nanoparticles of $TiO_2$ and $Al_2O_3$ with refrigerantR134a the crew of author was executed on domestic refrigerators [32-37]. They were discovered that once the used combination of nanoparticles of $TiO_2$ and $Al_2O_3$ with the POE oil then the oil return ratio improved. The author, Wang et al. [38-41] examine approximately the residential air conditioning (RAC) and take refrigerant R410a with nanoparticles of (NiFeO4) and mixed with the naphthalene based B32 mineral oil. When the refrigerants R134a, R407C, R425 and R410a are used with the nano refrigerants (NiFe2O4) in HFC refrigerants then the solubility of nanorefrigerants are progressed close to about 12%. For the present, the author Bobbo [42-47] became studied and gave the relationship of nanoparticles with the lubricity, solubility of POE oils and refrigerants. It changed into found by using experimentally that thermodynamics miscibility and solubility are not significantly affect with the nanolubricants.

**2.3 Tribological enhancement of lubricants**

In VCRS (vapour compression refrigeration system) coefficient of performance is provide relationship among the refrigerating effect and work input. If the price of work input decreases then COP of VCRS will be also increased. Earlier many authors are used of nanoparticles for the increments of tribological behaviour of lubricant minimize the friction and wear, and enhance the lubrication properties of refrigerants [48-52]. While, growth of friction will destroyed the additives of refrigeration device. So high-quality make of nanolubricants in such concentration that enhance the components of refrigeration machine and COP of VCRS.

Early, In the VCRS lubricants of compressor POE and PAG are used because of its affinity with the HFC refrigerants. So Montreal protocol was eliminated some refrigerants which highly provide to ozone depletion capability. Bobbo et al. [42] studied and it was located that once use combination of carbon nanohorns (SWCNH) and nanoparticles of $TiO_2$ then the enhancement of tribology with nanolubricants of POE. The lubricity features of the large amount-stress properties and anti-wear of the nanolubricants were compared to the base fluid for in addition expertise of the ability employment in a refrigeration system. However, the have a look at revealed that of nanolubricants does not affect the anti-put on residences even though the nanoparticles of $TiO_2$, provide the first-class overall performance in extreme-stress behaviour. Later, Zawawi et al. [26] studied qualities about wear resistance PAG lubrication and COF compressor with nanoparticls $SiO_2$ and$Al_2O_3$. These nanolubricants of $Al_2O_3$-SiO2/PAG were done on a ring of piston tribology check with wonderful attention of volume. Their study reported that when the volume of attention 0.06% used then hybrid nanolubricants was increased the COP and rate of wear approximately 4.78% and 12.96%,respectively.Therefore, hybrid nanolubricants is the most essential role within the enhancement of tribology and COP of VCRS.

### 3. Conclusions

In this review paper studied about the solubility, heat transfer characteristics and VCRS performance. From the former papers it was found about increment of transfer of heat solubility and also improvement of vapor compression refrigeration machine with nanorefrigerant and nano lubricants. So outcome acquired , when using nanorefrigerants and nanolubricants the thermal conductivity become improved close to approximately 4% and also transfer of heat coefficient raised from 12%-101%. When the use blending of nanoparticles then the solubility and miscibility of refrigerant-oil combination became raised approximately 12% at the same time as many authors described that the nanoparticles does not modify the miscibility and solubility of refrigerant –oil aggregate. The friction and wear price became minimized approximately 32% to 13% with help of nanolubricants. So use of nanorefrigerants and nanolubricants extended overall performance of VCRS along with minimized the compressor work close to about 11% and COP elevated approximately 24%.

The following point may be received from the existing evaluate.
i-In the VCRS system the transfer of heat rate and overall performance parameters were improved with assist of nanorefrigerants and nanolubricants and also particularly to the pool boiling and nucleate boiling heat transfer.
ii-In the VCRS gadget, nanoparticles are assisting within the oil return ratio. However, the miscibility and solubility of refrigerant oil combination couldn't be laid low with adding nanoparticles.
iii-The nanolubricants are reduced friction and wear rate because of its better tribology residences when in comparison to base compressor lubricants.
iv-The COP and refrigerating effect of the VCRS were progressed with assist of nanolubricants and nanorefrigerants and also improve overall performance of the VCRS.

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