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A REVIEW ON PERFORMANCE ANALYSIS OF SOLAR VAPOR ABSORPTION REFRIGERATION SYSTEM USING NANOF LUID

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ABSTRACT

This review paper focuses on the use of Nanofluid additive refrigerants in vapor compression refrigeration system (VCRS) because of their amazing development during Thermo Physical along with heat transfer potential to improve the coefficient of performance (COP) and reliability of refrigeration system. Ammonia absorption refrigeration has attracted attention due to its low refrigerating temperature and the absence of crystallization as well as good performance under vacuum conditions. However, its efficiency is still lower than the mechanical compression refrigeration system at present. The quality of heat and mass transfer in absorption process is vital for improving the performance of ammonia absorption refrigeration.

Keywords: *Nano-fluid, crystallization, thermo-physical properties.*

I. INTRODUCTION

Human life becomes luxurious CFCs and HCFC or HFC these refrigerants are commonly used in air conditioning and refrigeration system. But these refrigerants are harmful to earth's environmental health. Therefore we have to think on it and find a very eco-friendly refrigerants. This paper involves study and solution for such environmental related problems created by conventional refrigeration and air conditioning system. Now a days the main challenging task is the human comfort and food preservation by electronic equipment cooling. . Nano particles could be of metal like nickel, aluminium, copper, oxides like copper oxides, aluminium oxides , titanium oxides. Base fluids like water ,ethylene glycol, propylene glycol, engine oil are caused to green house gas effect. these green house gases absorb infrared radiation (solar radiation)and produces heat in earth's environment. The conventional refrigeration should be replace by new one to minimize the ozone layer depletion. and for this problem the solution is vapour absorption refrigeration system(VARS). In VARS water ,NH_3,LiBr these refrigerants are used and these are not affects to ozone layer. The refrigeration effect getting economical because VARS has no moving parts. this works on low grade energy such as waste heat. In most of our country region electricity is the main problem because they are isolated from developed region, they have need of air comfort and refrigeration system to keep their food and medicine below spoiling temperature. so by considering all these problems we have to develop refrigeration system which works on less energy consumption.

The paper work proposed about cooling system is vapour absorption refrigeration system (VARS) .But VARS has very low coefficient of performance (COP) as compared to vapour compression cycle.for increasing COPthe system should be well engineered and new technology should used. nano material/nano-particle are added to fluid mixture called nano fluid.they are used to enhance the properties of base fluids .these nanofluides has variety of application .some thermal applications are as:Automobile engine coolling, Electronic components cooling ,heat transfer intensification and solar application ,refrigeration application etc..In this paper the new technology is discussed to use nanofluid with water ammonia absorption , to enhance the performance of heat transfer. some research about nano fluid discussed below: boiling heat transfer rate increased by 40% at nano particles adding in water by 1.25%of weight Al2O3 nanoparticles (02). Park found that using Carbon nanotubes (CNT), on nucleate boiling heat transfer rate of R123 and HFCl34a by 36.6% (03). Experimental result getting by the Saw ,that thermal conductivity is increased by 12.2 by mixing 1% of nano Cu powder in base material paraffin wax (04).these nano particles are also used to improve the lubrication properties of lubricant oil for the compressor of vapor compression refrigeration system.

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II. REFRIGERATION SYSTEM

Producing and maintaing below the atmospheric temprature in confined space (i.e.refrigeration) this process is called Refrigeration process. The earliest Method of Refrigeration was melting of snow or ice and this method is same now a days also. In this Process the heat is Extracted from the Refrigerator and then pumped to the Surrounding. The earliest method of refrigeration was melts at 0C. Unit of Refrigeration is Ton of Refrigeration Which is within 1 day able to Convert 1Ton of ice from 32F of water conversion into 32F of ice. Ice is Kept in wormer than 0C space, Heat flow into Space and ice is Refrigerated And the Latent heat of ice is Supplied from Surrounding. The Various methods are Employed to produced refrigeration effect. The refrigeration Cycles are given below:

1. Thermal/work driven system
• Absorption refrigeration cycle
• Adsorption refrigeration cycle
• Chemical reaction refrigeration cycle

2. Electricity (Photovoltaic) driven system
• Vapor compression refrigeration cycle
• Thermo-electric refrigeration cycle

In Vapour compression Refrigeration System the working Fluid undergoes phase change. In which refrigerants evaporates at low temperatures and the Refrigeration is obtained. This method is most commonly used Among all Refrigeration system.

The Mechanical energy is used to run the Compressor which is input of the Refrigeration system. Therefore the System is also known as Mechanical Refrigeration system.The Vapour Compression Refrigeration system have capacity of Ranging from Few watts to Megawatts.To suit Capacities and different applications , the wide variety of refrigerants can be used in this systems.The actual Vapour Compression Cycle is based on the Reverse Rankine Cycle which is also Known as Evans-Perkins cycle.But it is essential to find The upper Limit of Performance of Vapour compression cycles before analyzing the actual vapour compression bycycle.The proposed Refrigeration system is modified version of Einstein-Szilard refrigrator. It include three fluids Ammonia water and Hydrogen.It uses waste heat to run genrator instead of a Compressor,opposed to standard refrigerator.A low grade heat source heats up the absorber -absorbent pair realising the refrigerants in vapour form.At the condenser this vapour form air is cooled ti liquid state.finaly hydogen reduces the vapour preesure of the ammonia liquid which is entering evaporator and from the cabin it causes liquid to boil absorbing the heat and in turn cooling it.

III. VAPOR ABSORPTION REFRIGERATION SYSTEM:

The vapor absorption process works on the principle of the absorption of one solution by another solution. In absorption system minimum number of primary units are essential ,includes Condenser, Evapourator, Absorber, Pump and. Fig (2): shows the flow diagram of absorption system. the refrigerant used are ammonia(NH_3),water or,(LiBr).in which ammonia serves as a refrigerant and water as a absorbent. here the pair of ammonia-water used because they have much affinity to each other. the only difference between vapour absorption refrigeration and vapour compression refrigeration is that in vapour compression cycle requires a compressor to compress large volume of refrigerant vapour which require large mechanical power for its operation. But in vapour Absorption refrigeration system the compressor is replaced by an Absorber, Generator,and Pump. And the another difference is that the method of suction and compreesion of the refrigerant in the refrigeration cycle. In VCR system the compressor sucks refrigerant from Evapourator and compresses it to the high pressure .and in VAR system process of suction and compression are carried out by two different devices called as Absorber and Generator. The refrigerant ammonia gets condensed in condenser and gets evapourated in Evapourator. the refrigerant produces cooling effect in the evapourator and released the heat to the atmosphere via the condenser.

Just like in the traditional condenser of vapour compression cycle the refrigerant enters the condenser at high pressure and temperature and gets condensed. when the refrigerant passes through the Expansion valve, its pressure and temperature reduced suddenly.this refrigerant(ammonia) at very low pressure and temperature enters rhe evapourator and produce cooling effect. When ammonia from the evapourator enters the absorber, it is absorbed bythe absorbent due to which the pressure inside the absorber reduces further leading to more flow of refrigerant from evapourator to absorber. at high temperature water absorb more ammonia, hence it is cooled by external coolent to increase it ammonia absorption capacity. when the absorbent absorb refrigerant strong solution of refrigerant-absorbent(ammonia-water)is formed. this solution is pumped by the pump at high pressure to the generator. the refrigerant-ammonia solution in the generator is heated by external source of heat. this can be steam, hot water or any other suitable sources. due to heating the temperature of solution increases. the refrigerant in the solution gets vaporized and it leaves the solution at high pressure. The high pressure and high temperature refrigerant then enters the condenser, where it is cooled by the coolent, and then it enters the expansion valve and then finally into evapourator where it produces the cooling effect.

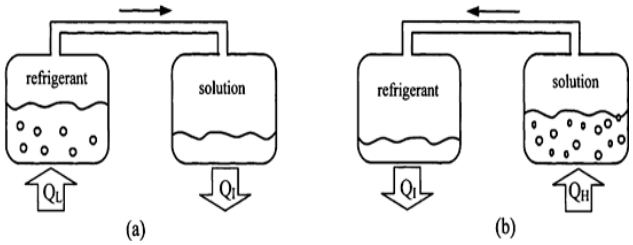

Figure1 Working principle of VARS

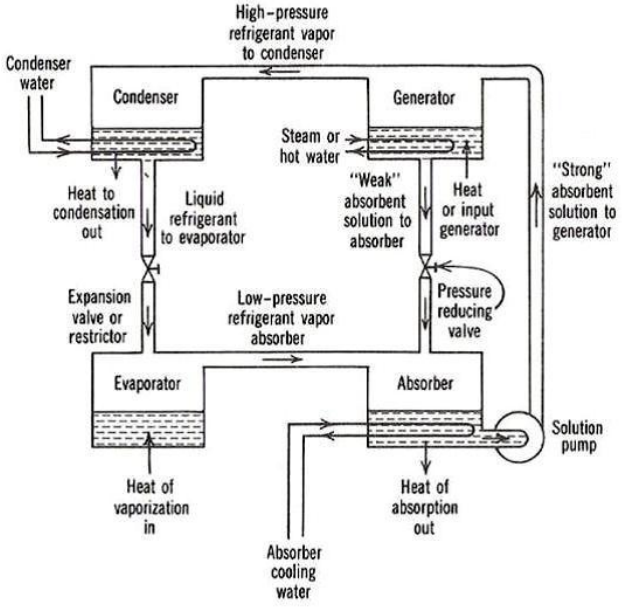

Figure 2 working setup of VARS

IV. SOLAR ENERGY

Solar power is the world's largest renewable energy source the sun. it is 99% of the world's available renewable energy sources. Increasing environmental and climate awareness, the use of solar energy has been growing

explosively the past few years. However it has some technological and economical developments issues, the huge research has to be done on the same. Sun light comes on earth in two components. One is direct beam of light another diffused sun light. Direct beam of sunlight brings about 90% of the solar energy, and the diffuse sunlight carries the remainder. The diffuse portion is the blue sky on a clear day and increases proportionately on cloudy days. The most of the solar energy carries direct beam, so maximum collection of energy should collected in this phase. In The proposed work of VARS setup is using parabolic Concentrator, which has 40% of efficiency

V. NANOFLUID

Nanoparticles are crystalline having below 100 nm. This can be used to improve the base fluid property (Mechanical, thermal, physical, chemical etc). firstly, nanofluid ware developed by Choi (09) at Argonne National Laboratory. he defined as suspensions of nanoparticles into base fluids with the typical length scale of particles is 1–100 nm. K. Wang, G. Ding, W. Jiang, developed nanofluid for refrigerants. It can enhance the performance of a refrigeration system (10). By using nanoparticles in refrigeration system, three main advantages can be obtained (11); (i) nanoparticles increase the solubility between the refrigerant and lubricant. (ii) Thermal conductivity and heat transfer characteristics enhances. (iii) Nanoparticles dispersion into lubricant may decrease the friction coefficient and wear rate. However, there are contradictory results as well available in literature.

This paper focused on the use of the nano fluid in VARS to enhance its performance. The four types of anofluids in this study were prepared by mixing a-Al2O3 with PAA, a-Al2O3 with CTAB, g-Al2O3 with PAA and g-Al2O3 with SDBS in ammonia water base solution, respectively. Fig. 1 (a) and (b) shows the SEM image of a-Al2O3 and g-Al2O3 nanoparticles, respectively. The nano-particles are spherical or analogously spherical and the purity is more than 99.8% through the use of Ultraviolet emission spectrometer. The mean size of a-Al2O3 and g-Al2O3 nano-particles is less than 20 nm and 30 nm respectively. All the three kinds of surfactants used inthe experiments are analytical reagent and the ammoni water is homemade.

VI. THERMAL CONDUCTIVITY OF NANO FLUID

Thermal conductivity is the property of material to conduct the Heat.and it plays an important role in the development of the energy efficient thermal system.

These thermal conductivity measured by using analyzerin the temperature range between 10-40^{0}C .And after measuring ,it has been observed that the thermal conductivity ofAl_2O_3 at 40 ^{0}C is improved by 2.0%,4.6% and 2.5% for 1.0,1.5 and 2.0 wt % .and it has been observed that nano fluids show better effect for high temperature.mahbululet .al.have conducted experimental analysis by using Al_2O_3/R134a as nano refrigerant for 1.0 to 5 vol.% concentration and temperature range was 300 K to 325K. On flow boiling inside the horizontal smooth tube.and in that experiment velocity of nano refrigerant was observed to be 5 m/s.and vapour quality was 0.2 to 0.7.
Thermal conductivity of nano fluid have higher conductivity as compared to base fluids .Thermal conductivity of nano fluids can be improved in two ways:
1] By using nano-particles with high thermal conductivity.
2]By increasi upng concentration of nano-particles in base fluid.

VII. CONCLUSION

Many Researchers tried the Performance Enhancement of Simple Vapour compression system by usingNano fluids either in the form Nano refrigerant or Nano lubricant. Here, nano-refrigerants have used because it have high thermal conductivity than traditional refrigerants. By increasing the nano- particle concentration on volume basis the thermal conductivity also increases.

To determine the thermal conductivity of nano- particles temperature ,particle size, dispersion are important factors. because the size of material of nano-particles also affects the performance of VCR system. If the particles are of

higher size they caused to some problems like erosion, sedimentation, fouling and the important is the pressure drop. If the nano- particles increases, the viscosity also increases and decreases with increasing temperature.
The compressor work can be reduced by adding nano-particles upto the certain limits and then increased.

These nano-lubricants can be used in many Industries and for domestic purpose to enhance Heat transfer performance,and energy consumption in compressor also decreases. But in commercialization of nano fluids ,nano fluid stability and its production cost is the Main issue.

Correct mechanism of improved Heat transfer for nano fluid is still unclear as per the investigations of many researchers.

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