Investigation of Magnetic Field on Vapour Compression Cycle

Prof. Prashant Maske[1], Mr.Mohit S. Lonagre[2], Mr.Rakesh N. Lothe[3], Mr.Sameer M. Shinde[4], Mr.Akash P. Narwade[5]
[1, 2, 3, 4, 5] Dept of Mechanical Engineering
[1, 2, 3, 4, 5] (PCET'S Nutan Maharashtra Institute Of Engineering And Technology, Talegaon Dabhade), Pune, Maharashtra, India.

Abstract- *Magnetic field system being a source of energy shows influence on various fluids which reacts to the magnetic field. The energy of permanent magnets operation is used for the treatment on hydrocarbon refrigerant reduces energy consumption of the compressor enhances cooling capacity, condenser heat rejection in the vapour compression cycle. In this current research all depending work four pairs of permanent magnet of 3000 gauss field strength; will be installed at fixed distance on the refrigerant liquid line of the VCC system setup. The comparison of the set up performance will be done with and without magnetic field to estimate the improvement in the VCC system. Experiments will be carried out on hydrocarbon process (R-404a) refrigerant. The test results mainly focus on the application of magnetic field which has a positive effect on the COP processing and power consumption setup of the system for the refrigerant. The net result is improvement in the COP of the VCC and reduction in the compressor power consumption.*

I. INTRODUCTION

Vapor compression cycle is the most frequently used refrigeration cycle, traced in 1748 by Professor Williams Cullen of Glasgow University who produced refrigeration by partial vacuum over ethyl ether. Several studies have reported in all process the use of magnetic elements system for the improvement in the vapour compression cycle. The Magnetism is a property of materials that respond on a process time at an atomic or subatomic level to an applied magnetic field. The study of magnetic refrigeration system was started with the discovery of magneto caloric effect. Warburg first discovered the thermal effect of metal iron when applying it in a varying magnetic field in the year 1881. Magnetic refrigeration is a cooling technology processed operation based on the magneto caloric effect (MCE). Application of the magnetic field is important in many aspects of research and practical applications operation. This is essential so as to utilize the high specific energy content of liquid hydrocarbon refrigerant since conversion of hydrocarbon refrigerant Woking processor power even with a relatively low efficiency would pave the way for increased lifetime as well as reduced weight of an electronic or mechanical operation system. A possible means all operastion to achieve the realization of these hydrocarbon fuelled power devices/sources could be the application of magnetic fields to fluid flow operation. This is concerned with the interactions between magnetic fields and electrically operation conducting fluids. However, this interaction is not limited to electrically conducting fluids system process. Magnetic fields can affect fluids that can exhibit paramagnetic and diamagnetic behavior

Para magnetism

It is a result of unpaired electrons which is within an atom that can cause a magnetic system dipole to form in the presence of a magnetic field and, as a result, in the presence of a magnetic system field this effect causes the fluid to be drawn in the direction of increasing magnetic field strength.

Magnetic refrigeration

Magnetic refrigeration system is a cooling technology based on the magneto caloric effect. This technique can be used to attain extremely low temperatures operation, as well as the ranges used in common refrigerators. The effect was first observed by French was done to all process physicist P. Weiss and Swiss physicist A. Piccard in 1917. The first working magnetic refrigerators process were constructed by several groups beginning in 1933. Magnetic refrigeration was the first method developed system for cooling below about 0.3K

Objective

The main objective of this study is to compare the performance of this vapour compression cycle when it is applied to different magnetic field on the condensate line and suction line. To compare the cycle performance the compressor power, inlet and discharge temperatures and pressure ratio, refrigeration effect and the condenser capacity will be measured.

Problem Definition

In conventional refrigeration cycles use different physical effects to cool things off. When a gas is compressed, it heats up, but if it is cooled and then allowed to expand, its temperature drops much lower than it was originally; this principle keeps food in your home refrigerator cool. But conventional gas-compression refrigerators have their own drawbacks. They commonly use hydro fluorocarbons system (HFCs), greenhouse effect gases that can contribute to climate change if they escape into the atmosphere. In addition, process it is becoming increasingly difficult to improve traditional refrigeration system.

Scope

The scope of this study is to compare the compressor energy consumption and system coefficient of performance with and without the effect of magnetic field. Pressures were measured using calibrated pressure gauges with an accuracy of ±1* psi. The temperatures and pressures of the refrigerant system and secondary fluid temperatures process were measured at various locations in the experimental setup. An expansion device was used to regulate the mass flow rate of refrigerant operation system and to set pressure difference. The working fluids were R134a used. Drop in experiments were carried out without any modifications process system to the experimental apparatus.

II. LITERATURE REVIEW

[1] "Behaviour of new refrigerant mixtures under magnetic field"

Samuel M. Samin, and R. J. Kita

The behaviour of some new alternative refrigerant mixtures such as R-410A, R-507, R-407C, and R-404A under various conditions of magnetic field are discussed, analysed and presented. The effect of magnetic field on mixture behaviour varies from one mixture to another depending upon the mixture's composition and its boiling point and consequently on the thermo-physical properties. Furthermore, the use of magnetic field appears to have a positive influence on the thermal capacities of the condenser and the evaporator depending upon the refrigerant mixture's thermo-physical properties. Author concludes that, During the course of this experimental study, the performance characteristics of some new proposed substitutes under various magnetic field levels have been investigated, analysed and compared to that of no magnet condition. The test results under heating conditions demonstrated that increasing the magnet capacity has a positive effect on the COP. The study showed that the effect of magnetic field on the mixture behaviour varied depending upon the mixture's composition and its boiling point.

[2] "Effects of Magnetic Field on Fuel Consumption and Exhaust Emissions in Two-Stroke Engine"

Ali S. Farisa, Saadi K. Al-Naserib, Nather Jamal, Raed Isse, Mezher Abed, Zainab Fouad, Akeel Kazim, Nihad Reheem, Ali Chaloob, Hazim Mohammad, Hayder Jasim, Jaafar Sadeq, Ali Salim and Aws Abas

Authors convey that, the energy of permanent magnets was used in this research for the treatment of vehicle fuel (Iraqi gasoline), to reducing consumption, as well as reducing the emission of certain pollutants rates. The experiments in current research comprise the using of permanent magnets with different intensity (2000, 4000, 6000, 9000) Gauss, which installed on the fuel line of the two-stroke engine, and study its impact on gasoline consumption, as well as exhaust gases. For the purpose of comparing the results necessitated the search for experiments without the use of magnets. The overall performance and exhaust emission tests showed a good result, where the rate of reduction in gasoline consumption ranges between (-1) %, and the higher the value of a reduction in the rate of 1 % was obtained using field intensity 6000 Gauss as well as the intensity 9000 Gauss. It was found that the percentages of exhaust gas components (CO, HC) were decreased by 30%, 40% respectively, but CO_2 percentage increased up to 10%. Absorption Spectrum of infrared and ultraviolet radiation showed a change in physical and chemical properties in the structure of gasoline molecules under the influence of the magnetic field. Surface tension of gasoline exposed to different intensities of magnetic field was measured and compared with these without magnetization. When fuel is exposed to a magnetic field, we find that its properties are changed. Magnetic treatment does not need energy and thus be economically feasible. Change some properties of the fuel by the magnetic field, and take advantage of some of the applications that belong to the industry and the environment. Increase the efficiency of most equipment and machinery that using hydrocarbon fuel and reduce consumption up to 14%. We can understand the mechanism of magnetization of fuel through the impacts of external magnetic field in the microscopic structure, which is the displacement and polarize the fuel molecules. Clear changes in the value of surface tension of the fuel, which used in this study and employment of these changes in the applied fields. Reduce the amount of environmental pollutants in the exhaust gases up to 40%.

[3] "ENERGY SAVINGS WITH THE EFFECT OF MAGNETIC FIELD USING R290/600a MIXTURE AS SUBSTITUTE FOR CFC12 AND HFC134a"

Kolandavel MANI and Velappan SELLADURAI

This paper presents an experimental study on there placement of CFC12 and HFC134a by the new R290/R600a refrigerant mixture as drop-in replacement refrigerant with and without the effect of magnetic field. Without any modification to the system components drop-in experimental tests were per formed on a vapour compression refrigeration system with a reciprocating compressor, which was originally designed to operate with CFC12. The test results with no magnets showed that the refrigerant R290/R600a had 19.9-50.1% higher refrigerating capacity than R12 and 28.6-87.2% than R134a. The mixture R290/R600a consumed 6.8--17.4% more energy than R12. The co efficient of performance of R290/R600a mixture increases from 3.9-25.1% than R12 at lower evaporating temperatures and 11.8-17.6% at higher evaporating temperatures. The effect of magnetic field force reduced the compressor energy consumption by 1.5-2.5% than with no magnets. The coefficient of performance of the system was higher in the range 1.5-2.4% with the effect of magnetic field force. The R290/600a (68/32 by wt.%) mixture can be considered as an excellent alternative refrigerant for CFC12 and HFC134a systems.

Author concludes that, an experimental study on a vapour compression refrigeration system with the new pro pane and iso-butane mixture as substitute for CFC12 and HFC134a was made under the effect of magnetic field force and com pared with that of no magnetic field condition. The propane isobutane mixture has been identified as a drop-in replacement refrigerant for conventional CFC12 and HFC134a.

[4] "Design and Development of Mini-Scale Refrigerator"

Mohan M. Tayde, Lalit B. Bhuyar and Shashank B. Thakre

Cooling for military, civilian and aviation applications and other electronic equipment has become an important issue. Many electronic systems, components, and processors create heat which must be effectively removed in order to ensure lower temperatures. Classical refrigeration using vapour compression has been widely applied over the last decades to large scale industrial systems. Now, the mini-scale (miniature) refrigerator using VCR seems to be an alternative solution for the electronic cooling problem. Fabrication of very small devices is now possible due to advances in technology. In this investigation a mini-scale refrigerator of 300W cooling capacity using R-134a as refrigerant is designed, built and tested. This test indicates that the actual COP of the developed system is 1.6 and second law efficiency is 19%. The experiments also show that the system was able to dissipate heat fluxes of 48 W/cm2 and keep the junction (chip) temperature below 82˚ C. Author concludes that, a mini-scale scale vapour compression refrigeration system of 300 Watt cooling capacity using R134a as a refrigerant was designed, built and tested. This system includes a commercial miniature compressor, capillary tubes, a custom-made condenser and cold plate i.e. micro channel evaporator. The experimental results show that the system was able to dissipate CPU heat fluxes of approximately 48 W/cm2 and keeps the junction temperature (Predicted chip) below 82 ˚C for a chip size of 25X25 mm2. After extensive experimental investigation, the main energy losses occurring in the condenser, evaporator and compressor were highlighted. The experimental results also indicate that the compression ratio of the compressor was 3 and the coefficient of performance of the developed system was 1.6 with second law efficiency of 19%. The refrigerant charge quantity was 200 gm and the optimal capillary tube length was 850 mm.

[5] "Experimental Investigation of Cyclic Variation of Combustion Parameters in Catalytically Activated and Magnetically Energised Two-stroke SI Engine"

P. Govindasamy and S. Dhandapani

Author says, the two stroke spark ignition engine is the major contributor of the total vehicular pollution in a country like India. It is therefore an area that requires great attention to reduce fuel consumption and hence pollution. The use of strong magnetic charge from the magnet put into the fuel line gives a complete and clean burn so that power is increased with reduced operating expenses. The magnetic flux on the fuel line dramatically reduces harmful exhaust emissions while increasing mileage, thereby saving money and improving engine performance. It increases combustion efficiency and provides higher-octane performance. The experimental results show that the magnetic flux on fuel reduces the carbon monoxide emission up to 13% for base engine, 23% in copper coated (inside the cylinder head) engine and 29% in zirconia coated (inside the cylinder head) engine.

There is significant increase in brake thermal efficiency and peak pressure whereas decrease in CO, HC and cyclic variation in case of copper and zirconia coated engines as compared to base engine. Table 2 presents the changes in different parameters with base, copper and zirconia coated engine with 9000 gauss magnetic flux. The variation of peak pressures for continuous cycles of coated engine (9000 gauss) is less than that of the base engine. Among the various combinations at a leaner side (AFR=16.7), zirconia coated engine with 9000 gauss magnetic flux has higher IMEP (4.05 bar) and lower cyclic variation (0.791 bar).

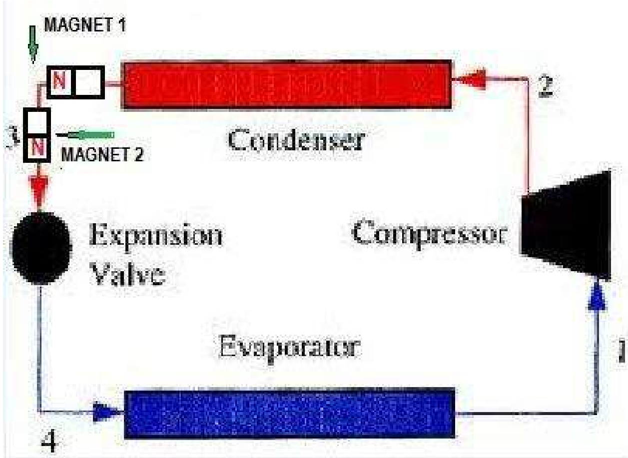
[6] "Experimental Study of Improving the COP of VCRS system by using Single and Double Cellulose pad in Cooling Tower"

Rahul Wandra,Taliv Hussain , Gourav Roy and Rahul Thukral

In subtropical region where the outside climate air is humid and hot. Here water cooled condenser system is more effective as compared to air cooled condenser system. As the standard VCRS (water cooled condenser) approach practical limits, experimental modification should be performed to increase the system efficiency and capacity. One possible mean to increase the COP of VCRS (water cooled condenser) is by using cooling tower. Cooling tower consist of single or double thickness cellulose pad within the system. Related studied focus on to improve the COP of VCRS system. Here the cooling tower performance is improved due to good water wet ability of cellulose pad that cause a uniform water circulation over the entire surface of pad and a perfect contact between water and cooling air. A VCRS (water cooled condenser) has been built attached with a cooling tower consist of two different same thickness cellulose pad. In first case when single pad 2inch thickness is used in cooling tower at two different ambient temperatures 27°C and 30°C.The COP changes from 4.93 to 4.68 as ambient temperature increase. Similarly in second case when double pad of same 2inch thickness is used in cooling tower COP change from 5.15 to 4.98 as move from 27°C to 30°C.

A VCRS With cooling tower is experimentally investigated. Experimentally result shows that there is considerable change in compressor work when we vary the thickness of cellulose pad at same ambient temperature. But when we compare compressor pressure work at two different ambient temperatures 27°C and 30°C for a same thickness of two cellulose pad i.e. single and double pad, compressor work is more in case of single pad. Also experimental result shows that there is increase in COP, when we increase the single cellulose pad to double at same ambient temperature. But when we compare COP at two different temperatures 27°C and 30°C, COP is more at 27°C for both cellulose pad single and double. There is increase in the COP 0.22 from Single pad to double pad at same ambient temperature 27°C and at the ambient temperature 30°C there is increase in COP 0.3 from single to double .It is also seen that COP decrease 0.25 from ambient temperature 30°C to 27°C when we using single thickness pad. Similarly, COP decrease 0.17 from ambient temperature 30°C to 27°C by using double thickness cellulose pad. Thus increase in double of the cellulose pad increase the COP of the system at same ambient temperature.

III. CONCEPTUAL DIAGRAM



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