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A Paper on Vapour Absorption Refrigeration System using NH_3-H_2O Absorbent

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Abstract: ***At the present time refrigeration plays a very important role in our daily as well as industrial life. But due to some problems for example, refrigerant the CFC is also affecting our ecosystem very rapidly. We are focusing on the need of the alternatives for the conventional energy source. Ozone layer depletion potential (ODP) is considered a very high threat to the environment. Under these circumstances ODP of vapour absorption system is zero. This gives us tremendous environmental benefits refrigerants. Also global warming & Carbon dioxide emission are producing very big environmental hazards. This paper focuses on the construction of a two fluid gas absorption refrigeration unit, intended to operate in an atmospheric environment. Vapour absorption systems, unlike vapour-compression systems, use a heat source to facilitate refrigeration. Two fluid gas absorption refrigerators use energy based heater installed generator and no moving parts, such as pumps and compressors, and operate at a single system pressure. Since the most common vapour absorption refrigeration systems (VARS) works on NH_3-H_2O solution with H_2O as the absorbent and NH_3 as the refrigerant, research has been devoted for the betterment of the performance of NH_3-H_2O absorption refrigeration systems in recent years.***

Keyword: absorption, ozone layer depletion, vapour absorption refrigeration.

I. INTRODUCTION

Refrigeration is the process of removing heat from enclosed system or space and rejects it to the system or surrounding. The refrigeration is used to lower the temperature of the enclosed system. Refrigeration has become an essential part of the way we live our life. Almost everyone has a household refrigerator, but not many know of the process required to produce the drop in temperature that we know as refrigeration. Nature works much like a heat engine, heat flows from high-temperature elements to low-temperature elements. As it does this, work is also done to its environment. Refrigeration is a process to keep a cool element or to reduce the temperature of one element below that of the other. The refrigeration process is, in essence then, a reverse heat engine, where heat is taken from a cold element to be transferred to a warmer element, generally by adding work to the system. In a heat engine, work was done by the system; so in order to do the reverse; work must be done to the system. This work input is traditionally mechanical work, but it can also be driven by magnetism, lasers, acoustics, and other means. Several different types of refrigeration systems which utilize different work input were considered for this work. They are: the vapour-compression system, and the absorption refrigeration system. In recent developments of thermal engineering, the Refrigeration technologies play an important role in today's industrial applications. But as far as COP of this refrigeration system is concerned; it is always a challenge to the researchers to significantly increase the COP for these systems. The most popular refrigeration and air conditioning systems at present are those based on the vapour absorption systems. A vapour absorption refrigeration system is similar to a vapour compression refrigeration system. The vapour absorption system comprises of all the processes in the vapour compression refrigeration system like compression, Condensation, expansion and evaporation. In the vapour absorption system the refrigerant used is ammonia-water. Ozone layer works as protective shield for ultraviolet rays of the sun. This Ozone layer (O3) disintegrates to O2 and thus protective shield from ultraviolet rays are removed. Ultraviolet rays enter the earth and produces tremendous health hazard like skin cancer etc. For that reason it has become essential to remove CFC Refrigerants from use in Refrigeration & Air-conditioning Industry. Solar operated vapour absorption system with H2O-LiBr & NH3-H2O as refrigerant-absorbent solutions serves that purpose very well. Another important effect is Global Warming Potential (GWP). A suitable working fluid is probably the single most important factor in any refrigeration system. The cycle efficiency and operation characteristics of an absorption refrigeration system depend on the properties of refrigerant, absorbent and their mixtures. The most important thermo-physical properties are: heat of vaporization of refrigerant, heat of solution, vapour pressure of refrigerant and absorbent, solubility of refrigerant in solvent, heat capacity of solution, viscosity of solution and surface tension and thermal conductivity of the solution.

Apart from this, the other selection criteria for the working fluids are their toxicity, chemical stability and corrosively. The ultimate objective of the strategy paper is the security of energy supply, encompassing environmental principles.

II. LITERATURE SURVEY

Dr. R. R. Arakerimath Professor and HOD (Mech.), GHRCEM, Wagholi, Pune, Maharastra, India and Subhash Kumar, ME Student, GHRCEM, Wagholi, Pune, Maharashtra, India have made a Comparative Study on Performance Analysis of Vapour Absorption Refrigeration System Using various Refrigerants and derived a conclusion that The performance of NH3-H2O, LiBr-H2O as working fluids for refrigeration temperature below atmospheric were presented in this paper. The preferable working fluid can be considered as a solution with the highest COP, lower required generator temperature and circulation ratio as low as possible. It is evident that COP strongly depends on working conditions such as generator, absorber, condenser and evaporating temperature. We observed, the range of C.O.P for the aqueous ammonia system is (0.1o - 0.8) when the generator temperature is up to 65°C and the range of LiBr-H2O system are (0.1-0.7) when the generator temperature is up to 95 °C .The range of minimum evaporator temperature is (10°C - 15°C). The range of NH3 and LIBR is (15% maximum).

Manish Kumar Tated, M.Tech, Mechanical Engineering, Lovely Professional University, Punjab, India have made studied and presented paper on review paper on analysis of vapour absorption refrigeration system and concluded that in absorption systems there is no danger of depletion of ozone layer, all renewable sources of energy could be used such as, solar energy, wind energy, bio-gas etc. The system is also free compressor less, as a result of which the life span of system is longer than vapour compression one"s. The only disadvantage with such system is low COP and requires longer time duration to perform the complete operation.

A. Shende Onkar, S.B. Patil College of Engineering, Indapur have presented a survey on

Vapour Absorption Refrigeration System by using Solar Energy and concluded that it is better to use the Vapour absorption refrigeration system which gives scope of utilizing low grade energy source i.e. solar panel for generating cooling effect which is dominated by high grade energy driven compression technology. Absorption refrigeration system provides large potential for reducing heat pollution of the environment. Therefore, in future it is decided to compare the performance between conventional systems and vapour absorption system.

B. Components of Vapour Absorption Refrigeration System

The Components of vapour absorption refrigeration system are

1) Absorber
2) Generator
3) Condenser
4) Expansion valve
5) Evaporator
6) Aqua pump

C. Absorber

It is used to store the mixture of water and ammonia in particular proportion. Function is to produce the required aqua ammonia solution. Low pressure NH_3 vapour is absorbed by the weak solution of NH_3 which is stored in the absorber. Inside the absorber of a vapour absorption system, the refrigerant vapour is absorbed by the solution. As the refrigerant vapour is absorbed in absorber, then it condenses from a vapour to a liquid so that the heat it acquired in the evaporator is being released.

D. Generator

It is used to heat the strong aqua ammonia solution up to the boiling temperature of ammonia solution to produce ammonia vapours. It separates the dissolved ammonia solution from the water ammonia solution. In the generator, the solution vertically falls over horizontal tubes with high temperature energy source typically steam or hot water flowing through the tubes. The solution absorbs heat from the warmer steam or water, causing the refrigerant to vaporize and separate from the absorbent solution. As the refrigerant is boiled away, the absorbent solution becomes more concentrated. The concentrated absorbent solution returns to the absorber and the refrigerant vapour move to the condenser.

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E. Condenser

Condenser is a device or unit used to condense a substance from its gaseous to its liquid state. Application areas include air conditioning, industrial chemical processes such as distillation, steam power plant other heat exchange system. The purpose of condenser is to condense the refrigerant vapours. In the condenser, heat is extracted from refrigerant at constant pressure. The phase of the refrigerant changes from vapour to liquid state. As heat transfers from the refrigerant vapour to the water, refrigerant condenses on the tube surfaces. The condensed liquid refrigerant is collected at the bottom of the condenser before proceeding to the expansion valve.

F. Expansion Valve

It is used to control the amount of refrigerant flow into the evaporator. As it cause a pressure drop (isenthalpic) of the working fluid. It cause sudden drop in temperature. The liquid refrigerant flows from the condenser, through an expansion device into the evaporator. The expansion device is used to maintain the pressure difference between the high-pressure (condenser) and low-pressure (evaporator) sides of the refrigeration system. As the high pressure liquid refrigerant flows through the expansion valve, it causes a pressure drop that reduces the refrigerant pressure to that of the evaporator.

G. Evaporator

The refrigerant i.e.NH_3 at very low pressure and temperature enters into the evaporator and produces the cooling effect by the heat exchange. At a lower pressure in the evaporator, the refrigerant gets evaporated by absorbing heat from the circulating water and the thus refrigerant vapours formed tend to increase the pressure in the vessel. With increase in pressure, the boiling temperature increases and therefore desired cooling effect is not obtained. Therefore the refrigerant vapours are removed from the vessel into the lower pressure absorber

H. Aqua Pump

As the absorbent absorbs the refrigerant i.e. pure NH_3 ,strong solution of refrigerant-absorbent (ammonia-water) is formed. This solution is then pumped by the pump at high pressure to the generator. The pump increases the pressure of the solution.