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REVIEW ON EXPERIMENTAL INVESTIGATION OF ENHANCEMENT IN COP OF VAPOUR ABSORPTION CYCLE

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ABSTRACT— The improvement in the quality of life has increased the demand for Refrigeration systems throughout the world. In the, vapour absorption refrigeration systems are looks upon with renewed interest as and they work on heat operated system with environment friendly working fluids. In the review of literature has been found to enhance and investigate the performance of vapour absorption system. For that the modification in this VAR cycle is the important parameter to improve the COP of the system. For that we using water cooled type condenser instead of the air cooled condenser.

The water cooled absorber and condenser are Utilizing the generator-absorber heat exchange principle in ammonia-water system reduces the generator heat input and thereby enhancing the system coefficient of performance. The effects of refrigeration system parameters namely, evaporating temperature (Te), condensing temperature (Tc) and mass of the refrigerant (m), on the performance of the system using theoretical models.

Keywords: Condenser, Absorber, Refrigerant R134a, COP.

I. INTRODUCTION

The vapour Absorption system uses a liquid refrigerant as the medium which absorbs and removes heat from the substance to be cooled and rejects that heat elsewhere. A vapor Absorption system has four components:-

1. Absorber
2. Condenser
3. Thermal expansion valve
4. Evaporator

A vapour absorption system uses heat sources like steam, exhaust gas, hot water etc to produce cooling. This can be used for space cooling as well as process cooling in various industries like food processing, beverages, chemical processing, pharmacies, textile, breweries, semiconductor etc.[1]

In an absorption system, the evaporator is where the refrigerant gets evaporated due to lower pressure at a lower temperature by using the heat from the chilled water and thus cooling the chilled water. The refrigerant vapours are then absorbed by the working fluid (because of its affinity towards refrigerant vapours) in the absorber. The dilute solution is pumped to the generator where by a heat source like steam,exhaustgas,hot water etc the refrigerant gets boiled out (separated) from the cooling tower) and the condensed refrigerant falls into the evaporator and the cycle continues. The solution which was dilute now becomes strong (as the refrigerant has been boiled out) and falls into the absorber and absorbs the refrigerant vapours.[2,3,4]

If there is waste heat available (like exhaust gas, excess steam, oil vapours, hot water from process) the cooling produced becomes extremely economical which is a major advantage of the vapour absorption system. Some other advantages are low power consumption (hence less electricty costs), less maintenance costs (as fewer number of moving parts compared to a compression system and good performance at part load.[5,6]

II. LITERATURE REVIEW

We have studied few research papers from that we conclude that,Water cooled type condenser is very efficient than air cooled condenser. [1]

The refrigerating effect and COP is can be increased by water cooled type condenser.

The adaption of suction liquid heat exchanger is a profitable choice to prevent flash gas formation at the inlet of the Expansion device [3]

III. METHODOLOGY

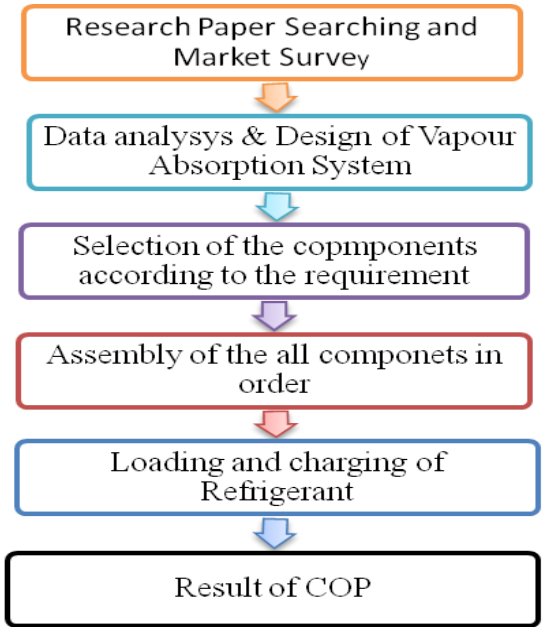

Fig.1. Methodology

IV. AIMS AND OBJECTIVES

i. The main aim is to build a Vapour Absorption Refrigeration test rig and perform various experiments on it and calculate the COP of VAR.
ii. To develop Vapour Absorption Refrigeration test rig for study purposes.
iii. To study the performance using Water cooled type condenser.
iv. To conduct a repeatability test to find a deviation in COP by this process we can increase the COP of the system.

V. LIST OF COMPONENTS

It has four principal control volumes involving these components:-

1) Evaporator
2) Absorber
3) Condenser
4) Expansion valve
5) Circulation Pump
6) Water Heater
7) Measuring Instruments
   a. Voltmeter and Ammeter
   b. Temperature Indicator
   c. Rotameter
   d. Digital Watt Meter
   e. Pressure Gauge

Absorber

The refrigerant-ammonia solution in the generator is heated by the external source of heat. This is can be steam, hot water or any other suitable source. Due to heating the temperature of the solution increases. The refrigerant in the solution gets vaporized and it leaves the solution at high pressure. The high pressure and the high temperature refrigerant then enters the condenser, where it is cooled by the coolant, and it then enters the expansion valve and then finally into the evaporator where it produces the cooling effect. This refrigerant is then again absorbed by the weak solution in the absorber. The purpose of the generator is to deliver the refrigerant vapour to the rest of the system. It accomplishes this by separating the water (refrigerant) from the lithium bromide and water solution. In the generator, a high-temperature energy source, typically steam or hot water, flows through tubes that are immersed in a dilute solution of refrigerant and absorbent. The solution absorbs heat from the warmer steam or water, causing the refrigerant to boil (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 migrates to the condenser. Material of generator box is stainless steel and the generator used is shown below in the purpose of the generator is to deliver the refrigerant vapour to the rest of the system. It accomplishes this by separating the water (refrigerant) from the lithium bromide and water solution. In the generator, a high-temperature energy source, typically steam or hot water, flows through tubes that are immersed in a dilute solution of refrigerant and absorbent. The solution absorbs heat from the warmer steam or water, causing the refrigerant to boil (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 migrates to the condenser. Material of generator box is stainless steel.

CONDENSER

A condenser is a device or unit used to condensate a substance from the gaseous to liquid state, typically by cooling it. In so doing the latent heat is given up by the substance, and will transfer to the condenser coolant. Condenser are generally heat exchangers which have various designs and come in many sizes ranging from rather small to large industrial scale units used in plant processes. For example, a refrigerator uses a condenser to get rid of heat extracted from the interior of the unit to condensate the outside air. Condensers are used in air conditioning, industrial chemical processes such as distillation, steam power plant and heat exchanger system. Use of cooling water or surrounding air as the coolant is common in many condensers. A condenser unit is used in central air conditioning systems typically has a heat exchanger section to cool down and condense incoming refrigerant vapor into liquid, a Absorber to raise the pressure of the refrigerant and move it along and a fan for blowing outside air through the heat exchanger suction to cool the refrigerant inside. In this heat exchanger section, the refrigerant goes through multiple tube passes which are surrounded by heat transfer fins through which cooling air can move from outside to inside the unit. There is a motorized fan inside the condenser unit near the top, which is covered by some grating to keep any objects from accidently falling inside the fan. The fan is used to blow the outside cooling air on through the heat exchange section at

the sides and the top through grating. These condenser units are located on the outside of the building they are trying to cool, with tubing between the unit and building, one for vapor refrigerant entering and is need for the Absorber and fan inside the unit.

TYPES OF CONDENSER

1. Air Cooled Condenser
2. Water Cooled Condenser

EXPANSION VALVE

In the throttling valve the pressure of the refrigerant reduces suddenly and excessively. With this the temperature of the refrigerant also reduces drastically. This low pressure 23 and low temperature liquid refrigerant then enters the evaporator and absorbs heat from the substance or the space to be cooled. The throttling valve is fitted between the condenser and the evaporator. The throttling or expansion device is in the form of a small orifice. When refrigerant passes through this small orifice its pressure reduces suddenly due to the friction. The rate of the flow of refrigeration through the throttling device depends upon the size and opening of the orifice. It also depends upon the difference in pressure on the evaporator and the condenser sides. There are different types of throttling devices, but in refrigerating and air-conditioning-system the two most commonly used types are capillary tubes and thermostatic expansion valves.

Types of Expansion Valve

1. Capillary Tube
2. Automatic Expansion Valve
3. Thermostatic Expansion Valve

EVAPORATOR

The evaporator is usually a closed insulated region where the refrigerant absorbs heat from the substance or food to be cooled. The volume comprising the evaporator is an enclosed volume. For instance, in the case of a household refrigerator, the small enclosed freezer region has an evaporator embedded into it. In the case of the freezer the evaporator is enclosed in the volume where ice or ice cream is to be made. The evaporator region of refrigerators is usually insulated by using insulating materials. The polyurethane foam (PUF), the low temperature

Refrigerant flowing through the evaporator absorbs heat from the food, substance or any other enclosed volume and gets converted into 27 a gaseous state as its temperature rises.

REFRIGERANT

Refrigerant is a fluids that is used in refrigeration cycles and heat pumps. Most of the time, a refrigerant will experiences a transition from liquid form to gas back and forth. The main criteria that a refrigerant has to meet are safe use, flammable-free and toxic-free properties. Most refrigerants todays are especially designed to avoid causing climate changes or ozone depletion, created to have the best thermodynamic abilities possible. In this vapour absorption cycle we can use R-134a (Tetrafluoroethane).

Working of VAC

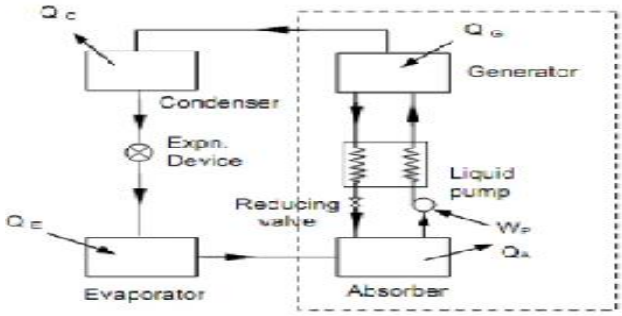

Fig.2. vapour absorption cycle

i. Absorber : The refrigerant-ammonia solution in the generator is heated by the external source of heat.Due to heating the temperature of the solution increases. The refrigerant in the solution gets vaporized and it leaves the solution at high pressure.

ii. Condenser: Vapour refrigerant gets condensed by rejecting latent heat and changes to liquid state then passes to expansion valve. Follows constant pressure process.

iii. Expansion Valve: Liquid refrigerant pressure, temperature got reduced to low and converts to wet state condition due to throttling then passes to evaporator. Follows isenthalpic process.

iv. Evaporator: Wet refrigerant abstracts latent heat from surroundings/room to be cooled and produces required refrigeration. The refrigerant change to vapour and passes to Absorber to continue the cycle. The performance of simple VARS is not appreciable when differentiate with modified VARS designed by addition of components to boost its performance.

VI. SELECTION OF COMPONENTS

Table No. 1

Sr.no	Name of components	Specification
1	Evaporator	Size-290mm x 290mm x 300mm (L x W x H). Made in M.S Sheets with evaporator coil inside the tank.
2	Absorber	Make-Electroflux, Capacity-1/4 TR.
3	Condenser	Size- 254mm x 279mm x 3 Row, Covered with M.S Tank size-460mm x 200mm x 300mm(L x W x H)
4	Expansion Valve	0.50 Gauge, Length 5 Feet.
5	Circulation Pump	18 W Tma cooler pump
6	Water Heater	Capacity-1KW.
7	Voltmeter and Ammeter	0-500V & 0-15A
8	Temperature Indicator	Digital type upto 100°C
9	Rotameter	50LPM
10	Watt Meter	1000W
11	Pressure Guage	0-30PSI

VII. BLOCK DIAGRAM

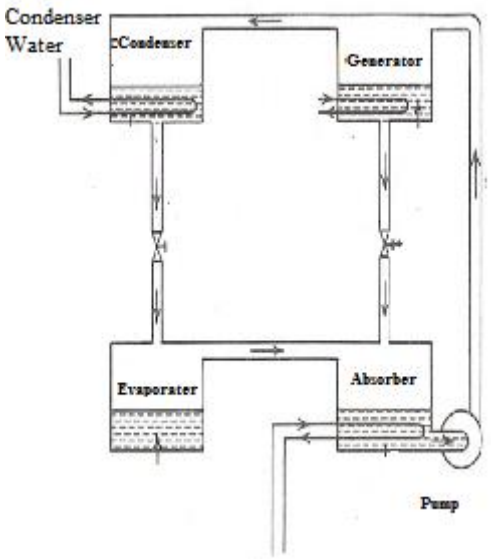

Fig. 3 Block diagram of VARS.

VIII. CONCLUSION

It is concluded that, a vapour Absorption cycle is an improved system in which a suitable working substance, terms as a refrigerant is used to produce cooling effect. A vapour Absorption refrigerant cycle results, by eliminating impracticalities associated with reverse Carnot cycle and working on clausius statement. Vapour absorption refrigeneration system used in various appliances such as domestic refrigerant water cooler, milk chiller and ice plant.

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