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

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ABSTRACT— In the present era, common refrigeration system is Vapour Compression Refrigeration System (VCRS) because of its wide applications. Hence, there is a scope of analysis for the improvement of such application areas. In the present research world, a detailed review of literature has been explored to enhance the performance of simple VCRS. For that the modification in this VCR 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 effects of refrigeration system parameters namely, evaporating temperature (Te), condensing temperature (Tc) and mass of the refrigerant charge used (m), on the performance of the system using theoretical models. The temperature of the vapour refrigerant exit from the evaporator is less than the temperature of the liquid coming out from the condenser.

Keywords- Water cooled Condenser, Refrigerent, Compressor, COP.

I. INTRODUCTION

The vapour compression utilize a circulating liquid refrigerant as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere. A single stage vapor compression system has four components:-

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

Flow refrigerant enters the compressor in the thermodynamic condition known as saturated vapor and in compressed to a higher pressure, resulting in a higher temperature as well. The hot compressed vapor is then in thermodynamic condition known as superheated vapor and it is a temperature and pressure at which it can be condensed with either cooling water or cooling air.[1]

The hot vapor is routed along a condenser where it is cooled and condensed into a liquid by flowing through a coil or tubes with cool water or coil air flowing across the coil or tubes. This is where the flowing refrigerant rejects heat from the system and the rejected heat is carried away by either the water or the air (whenever may be in case). The condensed liquid refrigerant, in the thermodynamic condition known as a saturated liquid is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. The pressure reduction shows in the adiabatic flash evaporation of a part of the liquid refrigerant. The auto refrigeration effect of the adiabatic flash evaporation bottom of the temperature of the liquid and vapor refrigerant mixture to where it is colder than the temperature of the enclosed space to be refrigerant. The cold mixture is then routed through the tubes in the evaporator. A fan circulates the hot air in the enclosed space across the tubes carrying the cold refrigerant liquid and vapor mixture. The hot air evaporates the liquid part of the cold refrigerant mixture. At the same time, the circulating air is cooled and thus bottoms of the temperature of the enclosed space the desired temperature. The evaporator is where the flowing refrigerant absorbs and removes the heat which is subsequently rejected in the condenser and transferred elsewhere by the water on air used in the condenser.[2,3,4]

To complete the refrigeration cycle of the refrigerant vapor from the evaporator is again a saturated vapor and is routed back into the compressor. can be considered as a super thermal conductor that transmits heat along the evaporation and condensation of a working fluid.[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

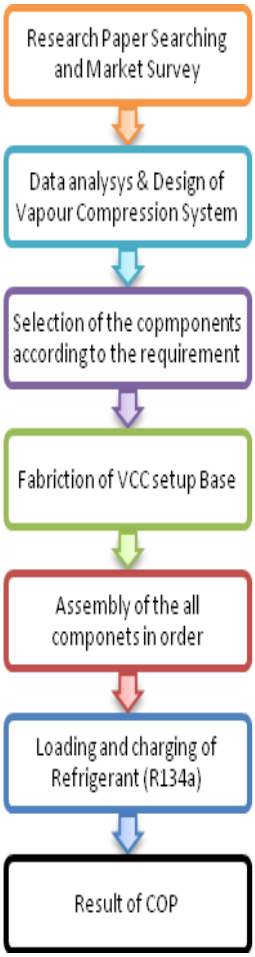

Fig.1. Methodology

IV. AIMS AND OBJECTIVES

i. The main aim is to build a Vapour Compression Refrigeration test rig and perform various experiments on it and calculate the COP of VCS.
ii. To develop Vapour Compression 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) Compressor
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

Compressor

The gas compressor is a mechanical system that increases the pressure of a gas by reducing its volume. An air compressor is specific type of gas compressor. Compressors are same as that pumps both increase the pressure of a fluid and both can transport the fluid through a pipe as gases are compressible the compressor also reduces the volume of the gas. Liquids are incompressible while some can be compressed the main action is to pressurize and transport liquids. In the experiment reciprocating compressor is used. Reciprocating compressors use piston driven by a crankshaft. They can be stationary or portable can be single or multi-staged, and can be driven by electric motors or internal combustion engines. Small reciprocating compressors from 5 to 30 horsepower (hp) are regularly seen in automotive applications and are typically for intermittent duty. Larger reciprocating compressors well over 1000 hp (750 kW) are regularly found in large industrial and petroleum applications. Exit pressures can range from low pressure to very high pressure (>18000psi or 180 MPa)

Types of compressor

1. Hermetically Sealed Compressor
2. Screw Compressor
3. Rotary Compressor
4. Centrifugal Compressor
5. Spiral Compressor

Hermetically sealed compressors

Both compressor and motor are located inside a closed casing which is initially subjected to high vacuum condition. This confines the any leakage area the piston to casing only, which is sucked in by the compressor. Suction vapors cool the electrical motor windings.

CONDENSER

A condenser is a device 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 transmit to the condenser coolant. Condenser are usually heat exchangers which have various designs and come in many sizes ranging from rather small to large industrial scale units used in plant processes. Condensers are used in air conditioning, industrial chemical operation such as distillation, steam power plant and heat exchanger system. Use of cooling water as the coolant is common in many condensers. A condenser unit is used in central air

conditioning systems It has a heat exchanger section to cool down and condense incoming refrigerant vapor into liquid, a compressor to raise the pressure of the refrigerant and move it throught 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 part 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 along the heat exchange section at the sides and the top through grating. These condenser parts are located on the outside of the building they are trying to cool, with tubing between the system and building, one for vapor refrigerant entering and is need for the compressor and fan inside the system.

Types of Condenser

1. Air Cooled Condenser
2. Water Cooled Condenser

EXPANSION VALVE

IN THE THROTTLING VALVE THE PRESSURE OF THE REFRIGERANT DECREASES INSTANTLY AND EXCESSIVELY. WITH THIS THE TEMPERATURE OF THE REFRIGERANT ALSO DECREASES 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 IN BETWEEN THE CONDENSER AND THE EVAPORATOR. THE THROTTLING DEVICE IS IN THE FORM OF A SMALL ORIFICE. WHEN REFRIGERANT PASSES ALONG THIS SMALL ORIFICE ITS PRESSURE REDUCES SUDDENLY DUE TO THE FRICTION. THE RATE OF THE FLOW OF REFRIGERATION THROUGH THE THROTTLING TOOL DEPENDS UPON THE SIZE AND OPENING OF THE ORIFICE. IT DEPENDS ON THE DIFFERENCE IN PRESSURE ON THE EVAPORATOR AND THE CONDENSER SIDES. THERE ARE MANY 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 compression cycle we can use R-134a (Tetrafluoroethane).

Working of VCC

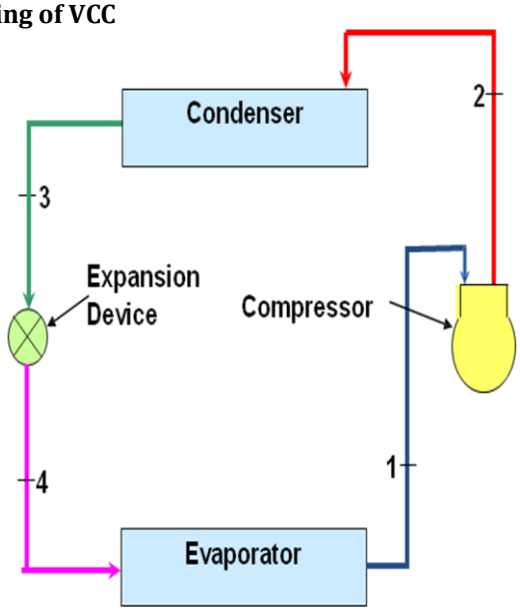

Fig.2. vapour compression cycle

i. Compressor: Low pressure and low temperature vapour refrigerant from evaporator gets compressed to high pressure and high temperature vapour refrigerant then passes to condenser. Follows isentropic process.

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 compressor to continue the cycle. The performance of simple VCRS is not appreciable when differentiate with modified VCRS 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	Compressor	Make- Kirloskar, 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

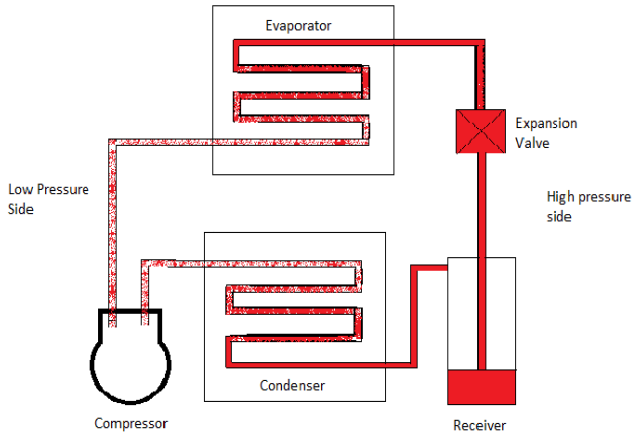

Fig. 3 Block diagram of VCRS.

VIII. CONCLUSION

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

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