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Design Evaluation and Analysis of Vapor Compression Cooling Cycle With Change In Span of Condenser

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ABSTRACT:

Refrigeration is a procedure of moving warmth starting with one area then onto the next in controlled conditions. This procedure is customarily determined by mechanical energy, however can likewise be driven by providing heat energy, attraction, laser and different means. Refrigeration has numerous applications, and is restricted to: family unit fridges, mechanical coolers, cryogenics, and ventilating. Majority of refrigerator system works on vapour compression refrigeration system. This system consists of compressor, condenser, expansion valve and evaporator. The performance of the system depends upon these system components.
The performance parameters of simple vapour compression refrigeration system (VCRS) were studied functioning under transient conditions during cooling of a fixed mass of R-404A from room temperature to sub-zero temperature.
In this thesis, COP of the VCR system for different diameters of the condenser tube using the specific end conditions is analyzed using ANSYS for the best performance of the system.

Key words: *Vapour Compression Refrigeration System, compressor, condenser, Ansys ,COP etc.*

I.INTRODUCTION

Refrigeration is a procedure of moving warmth starting with one area then onto the next in controlled conditions. The work of warmth transport is generally determined by mechanical work, yet can likewise be driven by warm, attraction, power, laser, or different means. Refrigeration has numerous applications, including, however not restricted to: family unit fridges, mechanical coolers, cryogenics, and aerating and cooling. Warmth pumps may utilize the warmth yield of the refrigeration procedure, and furthermore might be intended to be reversible, yet are generally like ventilating units. Refrigeration has largy affected industry, way of life, agribusiness and settlement designs. Preserving nourishment goes back to at any rate the old Roman and Chinese domains. Nonetheless, mechanical refrigeration innovation has quickly advanced in the most recent century, from ice reaping to temperature-controlled rail autos. The presentation of refrigerated rail autos added toward the westbound development of the United States, permitting settlement in ranges that were not on fundamental transport channels, for example, streams, harbors, or valley trails. Settlements were additionally creating in barren parts of the nation, loaded with newfound normal assets. These new settlement designs started the working of huge urban communities which can flourish in zones that were generally thought to be unwelcoming, for example, Houston, Texas and Las Vegas, Nevada. In most created nations, urban communities are vigorously reliant upon refrigeration in markets, with a specific end goal to acquire their sustenance for day by day utilization. The expansion in sustenance sources has prompted a bigger grouping of rural deals originating from a littler rate of existing homesteads. Ranches today have a substantially bigger yield for each individual in contrast with the late 1800s. This has brought about new nourishment sources accessible to whole populaces, which has largy affected the sustenance of society.

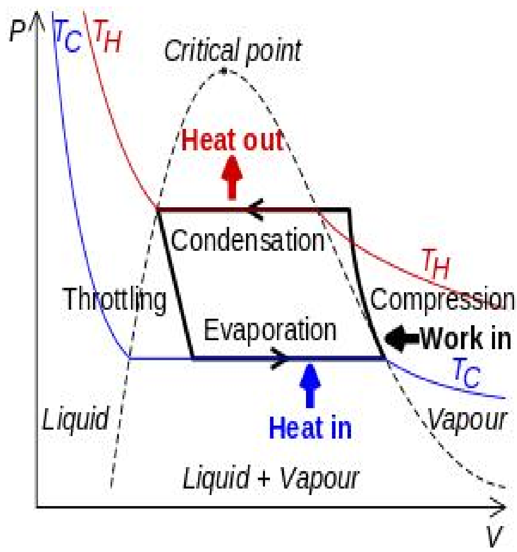

Fig-1: refrigeration cycle

II. DESIGN AND ANALYSIS OF COMPRESOR IN ANSYS

Case-I: Compressor tube diameters 10mm OD, 8 mm ID

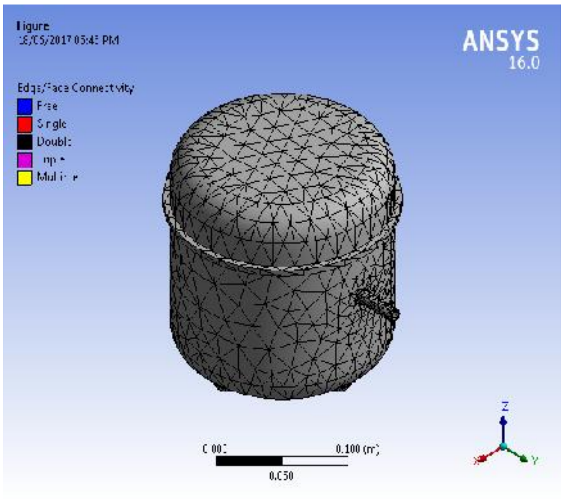

Fig-2: Meshing of Compressor

Suction Temperature T_1 = 27°C
Enthalpy h_1 = 369 kJ/kg
Discharge Temperature T_2 = 52°C
Enthalpy h_2 = 400 kJ/kg
Mass M = 9687e-002 kg

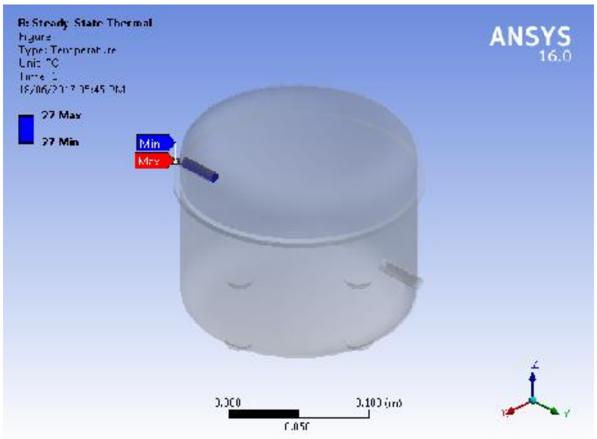

Fig-3: Compressor inlet temperature min, max values

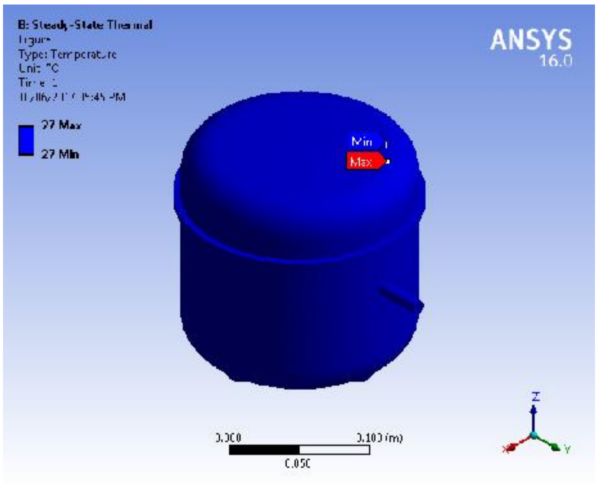

Fig-4: Compressor steady-state condition

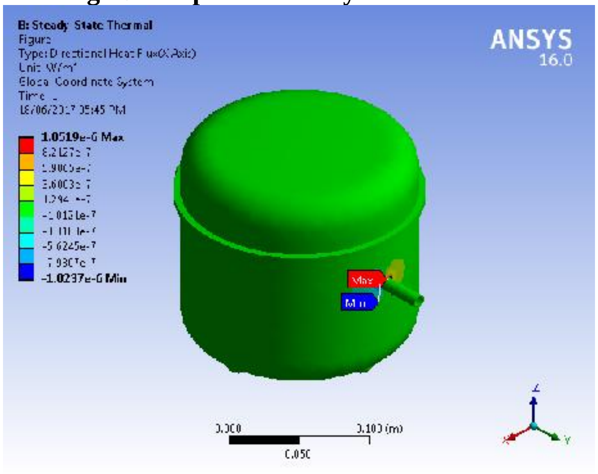

Fig-5: Compressor out let temperature min, max values

Case II: Compressor tube diameters 10mm OD, 7 mm ID

Suction Temperature T_1 = 27 °C
Enthalpy h = 369 kJ/kg
Discharge Temperature T_2 = 53 °C
Enthalpy h_2 = 400 kJ/kg
Mass M = 0.17803 kg

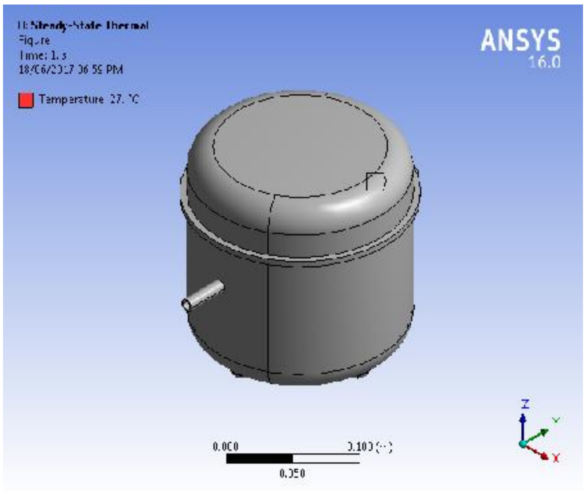

Fig-6: Compressor in steady state condition

Fig-7: Compressor outlet max, min values

Case III: Compressor tube diameters 10mm OD, 6 mm ID

Mass M = 0.17757 kg

Suction Temperature T_1 = 27°C

Enthalpy h_1 = 369 kJ/kg

Discharge Temperature T_2 = 52°C

Enthalpy h_2 = 400 kJ/kg

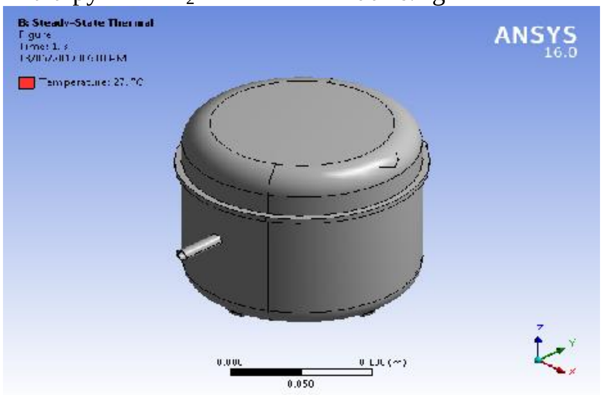

Fig-8: Compressor steady state condition

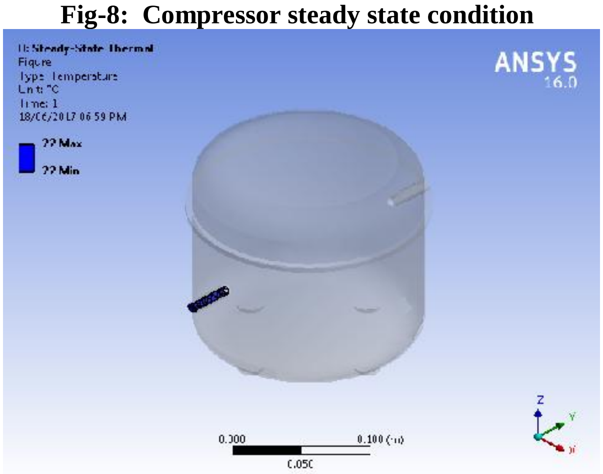

Fig-9: Compressor out let max, min values

III. DESIGN AND ANALYSIS OF CONDENSER IN ANSYS

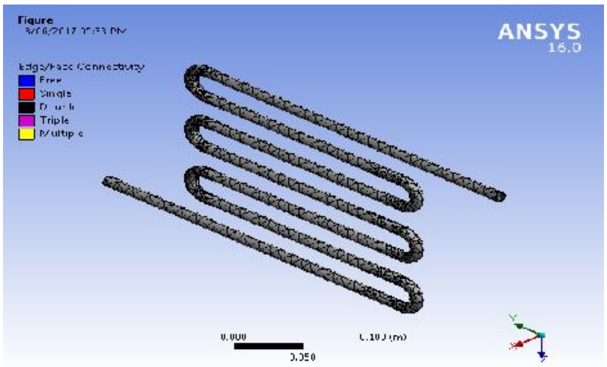

Fig-10:Meshing of condenser

Case-I: Condenser tube diameters 10mm OD, 8mm ID

Inlet Temperature T_3 = 52 °C

Outlet temperature T_4 = 38 °C

Mass of the refrigerant = 5.9687e-002 kg

Condenser pressure P_3 = 18.66 bar

Enthalpy h_3 = 256 kJ/kg

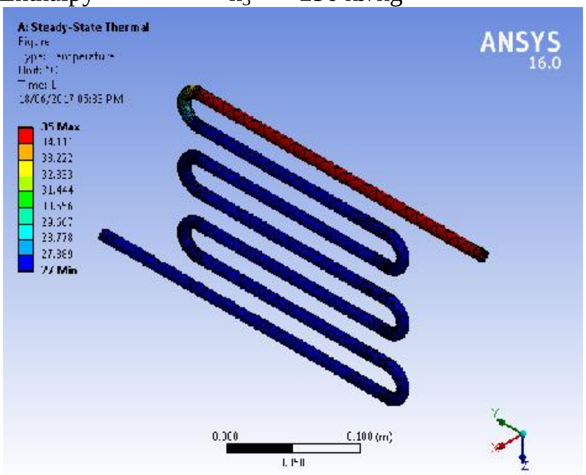

Fig-11: Condenser in steadystate condition

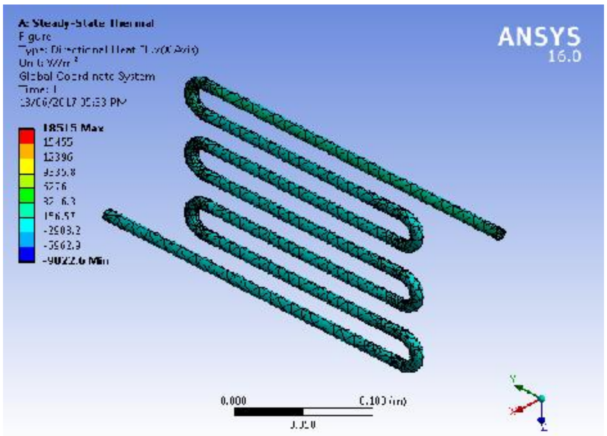

Fig-12:condenser out let min, max tempereture values

Case-II: Condenser tube diameters 10mm OD, 7mm ID

Inlet Temperature T_3 = 52 °C

Outlet temperature T_4 = 38 °C

Mass of the refrigerant = 5.9687e-002 kg
Condenser pressure P_3 = 18.62 bar
Enthalpy h_3 = 254 kJ/kg

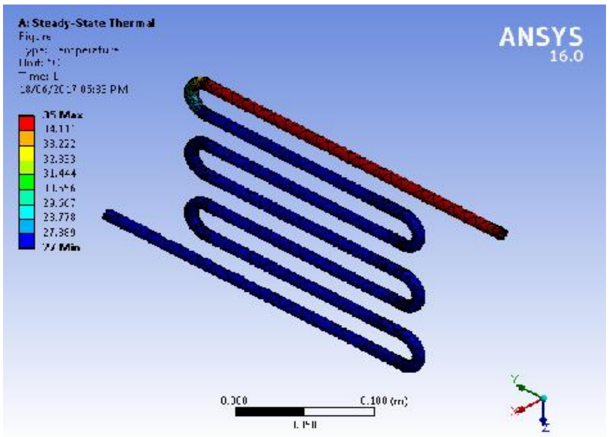

Fig-13: Condenser in studystate condition

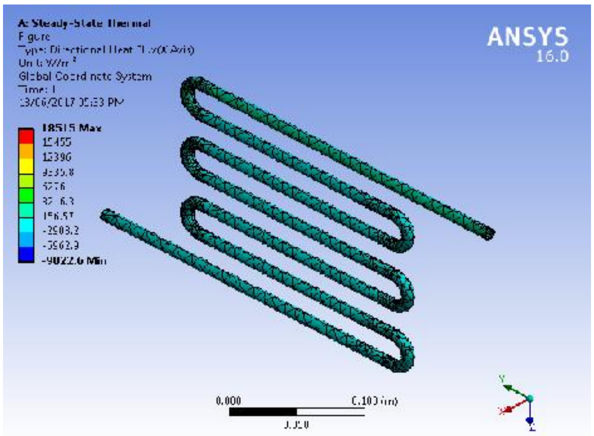

Fig-14: condenser out let min, max tempereture values

Case -III: Condenser tube diameters 10mm OD, 6 mm ID

Inlet Temperature T_3 = 52 °C
Outlet temperature T_4 = 38 °C
Mass of the refrigerant = 5.9687e-002 kg
Condenser pressure P_3 = 18.62 bar
Enthalpy h_3 = 254 kJ/kg

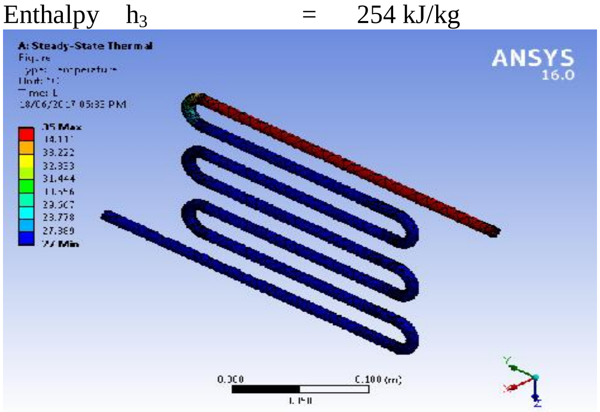

Fig-15: Condenser in steadystate condition

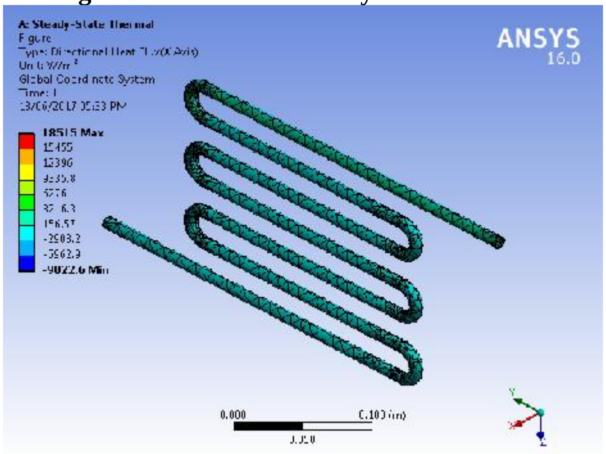

Fig-16: condenser out let min, max tempereture values

IV.CONCLUSION

Case	Condenser Tube Dia, mm		Temp Change ^{0}C	COP
	ID	OD		
I	8	10	38	3.5
II	7	10	39	3.6
III	6	10	36	2.22

From the analysis of condenser and compressor of the VCR system the change in temperature (39^{0}C and COP =3.6 for condenser tube OD 10 mm and 7 mm ID) is the best solution in terms of performance of VCR system from the above table.

V. SCOPE FOR FUTURE WORK

Advances in chemical engineering in future can bring up a new refrigerant with suitable properties for the best performance of the vapor compression refrigeration system. Furthermore optimization in the span and diameter of the condenser tubes play a key role in better working of the VCR system. More removal of latent heat from the space by the advanced refrigerant can focus much on optimization of the remaining components of VCR system.

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