CH201 PROJECT

TEAM: Dreamers

Cooling Process in Refrigerator & AC

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Roles of Team Members

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Tools Used

DWSIM Simulator

Python

FX-991ES: Calculator

Research paper

wolfram player

Refrigeration

- It is the system of elimination of heat and reducing, in addition to retaining, temperature below surrounding temperature.
- It can also be defined as the science of providing and maintaining temperature below that of surrounding atmosphere.
- Unit of Refrigeration is **Tonne of refrigeration.**

Tonne of refrigeration = 3.51685 KW

Refrigeration System have Four main Components

1. The Compressor

Compression is the first step in the refrigeration cycle and a compressor is a device that increases the pressure of the working gas by reducing the volume of substance. At the compressor, the low pressure gas is changed to high pressure gas.

2.The Condenser

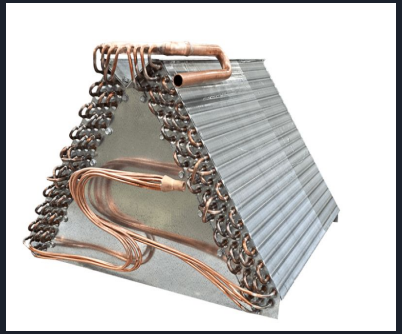
The condenser , or condenser coil, is basically a heat exchanger that converts a vapor to liquid. It does this by reducing the vapor's temperature via thermodynamic contact with an external fluid of lower temperature.

3.The Expansion Device

This component creates a sudden drop in pressure after the refrigerant leaves the condenser, which allows refrigerant to rapidly cool by expansion before entering the evaporator.

4.The Evaporator

The Evaporator is the second heat exchanger in a standard refrigeration cycle. Its work is opposite to that done by the condenser, i.e, the refrigerant liquid absorbs heat from the air until it is converted to vapour.



5.Diffuser

The diffuser is an important element of a compressor or pump.
Its purpose is to reduce the velocity of flow leaving the pump.
In refrigeration systems, diffuser is used at the condenser outlet.

Refrigerant:

A refrigerant is a working fluid used in the refrigeration cycle of air con systems and warmth pumps where, in most instances, they go through a repeated phase transition from a liquid to a fuel and returned again.

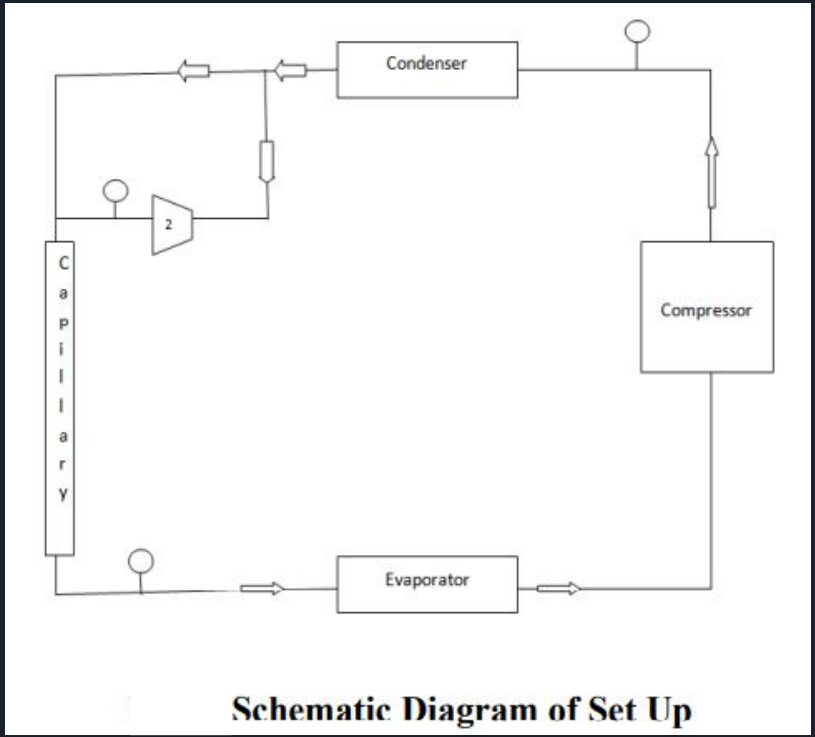
R-134a

R-134a is an HFC, utilized in automotive aircon as an alternative for R12 and R22 in medium and excessive-temperature refrigeration applications, inclusive of commercial and domestic refrigeration and chillers. R-134a is a refrigerant which requires polyester (POE) lubricant to be used in the compressor.

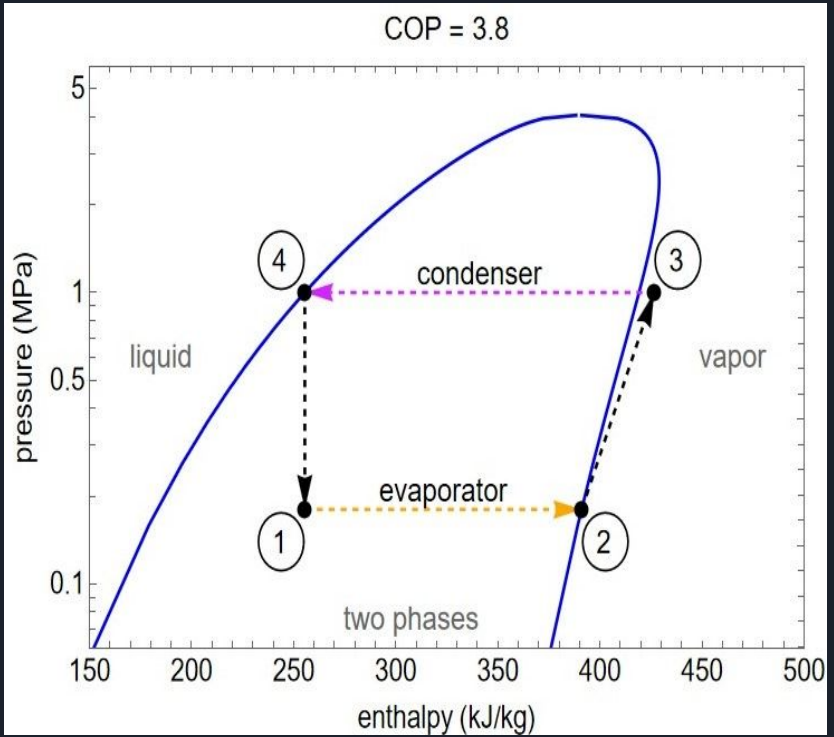
Problem Statement

Consider an ideal refrigeration cycle using R134a (1,1,1,2-tetrafluoroethane) as refrigerant (Cp=0.958). The inlet and outlet temperature and pressure of condenser is 8C, 137.89 kPa and 75 C, 770 kPa . With diffuser, corresponding temperature and pressure is 8 C, 137.89 kPa and 60.4 C, 764.9 kPa. Using these values, we have to calculate the COP of refrigerator in both cases and also find percentage enhancement of COP.

R-134a Cyclic process



Schematic Diagram of Set Up



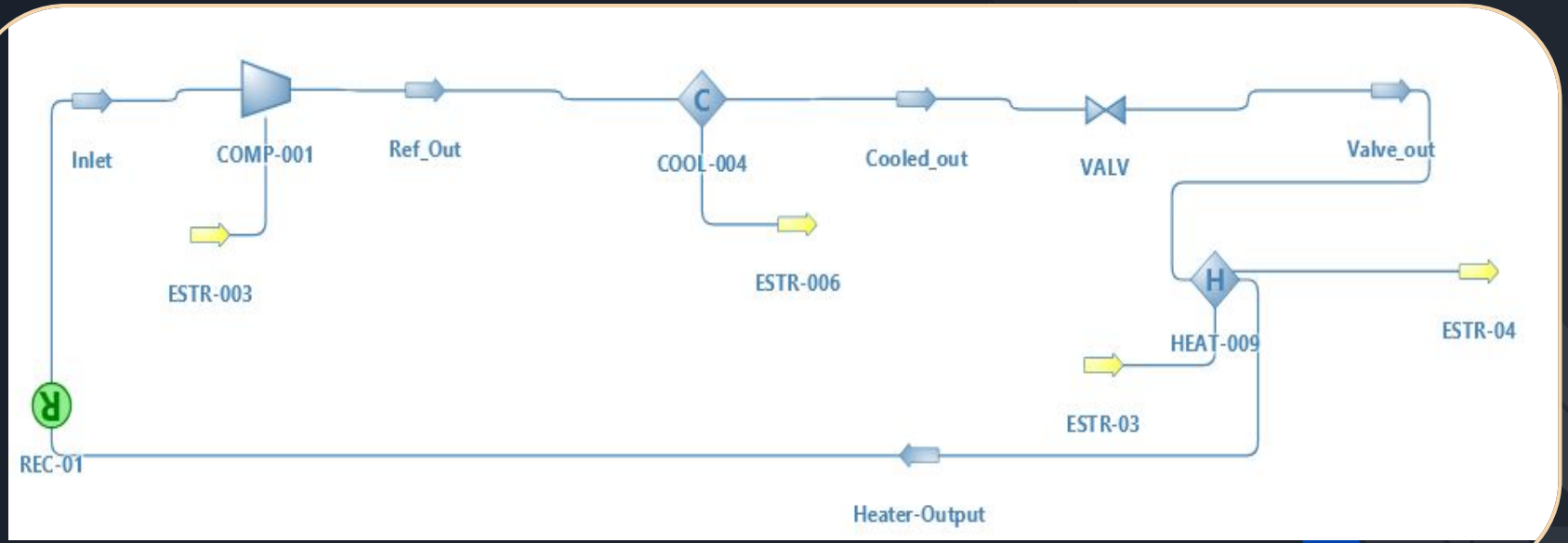
Results from Python Code

```
In [1]: runfile('C:/Users/sanar/Thermodynamics_Project.py', wdir='C:/Users/sanar')
COP without diffuser = 3.8324359334066926
COP with diffuser = 5.550130359736021
Enhancement of COP is 30.948722192013996 %
```

	Refrigeration effect	Work done	COP calculated	%enhancement of COP
Without diffuser	171.835	44.84	3.83	
With diffuser	171.835	30.96	5.55	30.95

From this we can see that when diffuser is used, work done decreases, which increases COP of refrigerator by 30.95%

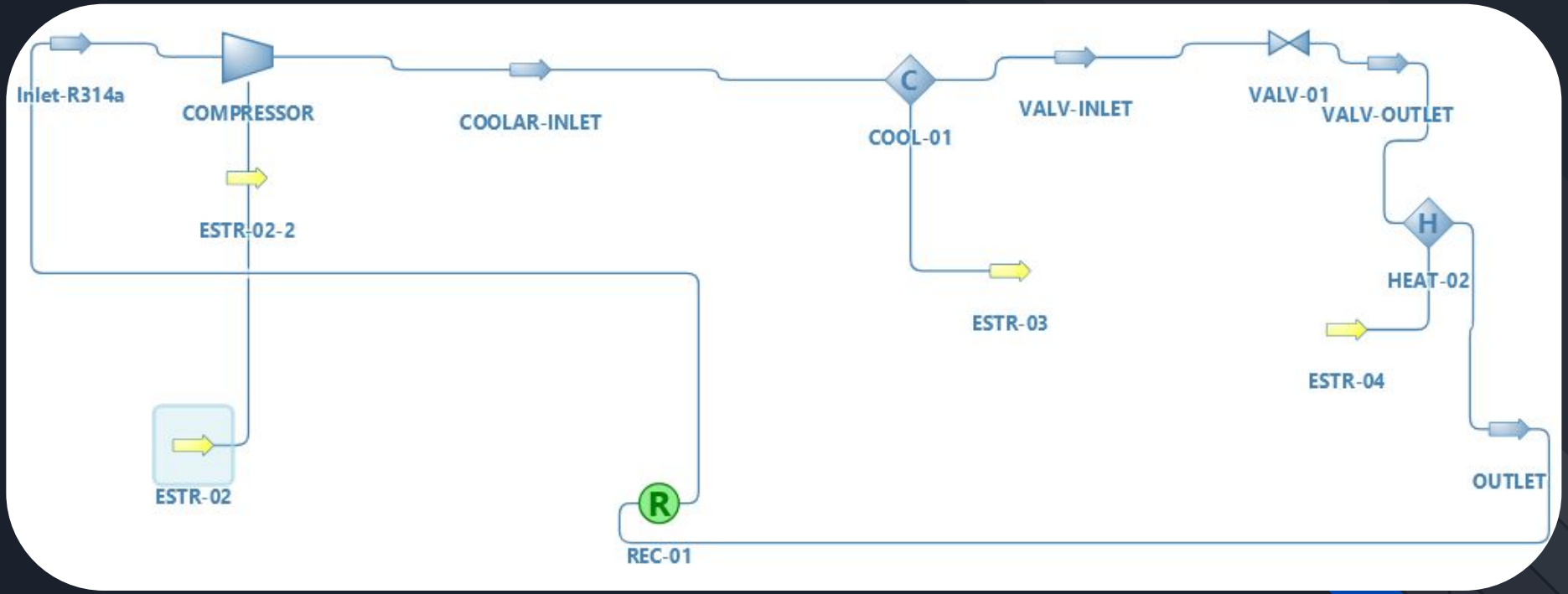
DW-SIM SIMULATION MODEL OF PROPANE



Property table of Propane Simulation Model

Master Property Table						
Object	Valve_out	Ref_Out	Inlet	Heater-Output	Cooled_out	
Temperature	240.191	230.789	230.649	230.649	273.91	K
Pressure	150000	500000	100000	100000	490000	Pa
Mass Flow	1.22492	1.22492	1.22492	1.22492	1.22492	kg/s
Molar Flow	27.7778	27.7778	27.7778	27.7778	27.7778	mol/s
Volumetric Flow	0.0699357	0.00209763	0.124379	0.124379	0.00231516	m3/s
Mass Flow (Vapor)	0.236518	0	0.291923	0.291923	0	kg/s
Molar Flow (Vapor)	5.36358	0	6.62002	6.62002	0	mol/s
Volumetric Flow (Vapor)	0.0682089	0	0.122781	0.122781	0	m3/s

Flowsheet of R134a



How to Increase Efficiency

Methods that we have used to improve Coefficient of Performance(COP)

1.By changing the refrigerant used:

Here, we have used the refrigerant R134a as its COP is larger than that of the refrigerant R290 (propane). Propane is also not advised to be used since it is highly flammable.

2.Using Diffuser:

By using the diffuser, we can reduce the work done in the refrigeration cycle, and hence enhance the COP, as demonstrated in the problem statement given.

Conclusions

Refrigerator and Air Conditioner are basic necessities of everyday life. They work on the basis of heat flow. Through this project, we can conclude that efficiency of refrigeration system can be increased by decreasing the work done. This is done by the introduction of diffuser into the refrigeration cycle. Therefore, we can reduce the energy consumption also.

References

- Wolfram Player
- R-314a Simulation Article
- COCO Simulator
- COP of Vapour Compression Research Paper
- Enhancement of COP of Vapor Compression Refrigeration Cycle using CFD Research paper

THANK YOU