

THEORITICAL ANALYSIS OF HEAT TRANSFER RATE IN VAPOUR COMPRESSION REFRIGERATION SYSTEM IN COLD STORAGE BY USING R-442A

By

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ABSTRACT

By preserving food products in the cold storage, good quality of food can be supplied throughout the year, minimizing the damage and enhancing the agricultural economy. For this purpose vapor compression refrigeration systems are vividly using because of their high efficiency. At present, in vapor compression refrigeration systems R-22 and R-404A refrigerants are used in cold storages.

Many refrigerants are upcoming to replace the existing refrigerants like R-404A and R-22 but R-442A which is also known as RS-50 completely replaces the R-404A in new and existing installations and it can also be used as a replacement for R-22 because of its lowest global warming potential and higher energy efficiency.

The main objective of this project is to improving the heat transfer rate of vapor compression refrigeration system by using R-442A. This analysis will be carried out in Catia and ANSYS. The modeling of copper coil in evaporator will be carried out in Catia and then analysis of heat transfer rate of refrigerants will be carried out in ANSYS.

I – INTRODUCTION

Refrigeration

Literal meaning of refrigeration is the production of cold confinement relative to its surroundings. In this,

temperature of the space under consideration is maintained at a temperature lower than the surrounding atmosphere. To achieve this, the mechanical device extracts heat from the space that has to be maintained at a lower temperature and

rejects it to the surrounding atmosphere that is at a relatively higher temperature. Since the volume of the space which has to be maintained at a lower temperature is always much lower than the environment, the space under consideration experiences relatively higher change in temperature than the environment where it is rejected.

The precise meaning of the refrigeration is thus the following: Refrigeration is a process of removal of heat from a space where it is unwanted and transferring the same to the surrounding environment where it makes little or no difference

Air conditioning

Merely lowering or raising the temperature does not provide comfort in general to the machines or its components and living beings in particular. In case of the machine components, along with temperature, humidity (moisture content in the air) also has to be controlled and for the comfort of human beings along with these two important parameters, air motion and cleanliness also play a vital role. Air conditioning, therefore, is a broader aspect which looks into the simultaneous control all mechanical

parameters which are essential for the comfort of human beings or animals or for the proper performance of some industrial or scientific process. The precise meaning of air conditioning can be given as the process of simultaneous control of temperature, humidity, cleanliness and air motion. In some applications, even the control of air pressure falls under the purview of air conditioning. It is to be noted that refrigeration that is control of temperature is the most important aspect of air conditioning.

Applications of refrigeration and air conditioning

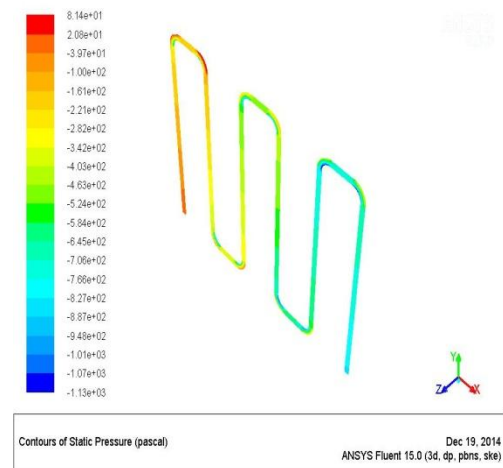
- Air conditioning of residences and offices
- Industrial air cooling
- Environmental laboratories
- Spot heating
- Spot cooling
- Printing
- Textiles
- Precision parts and clean rooms
- Computer rooms
- Photographic products
- Air conditioning of vehicles

II- ANALYSIS

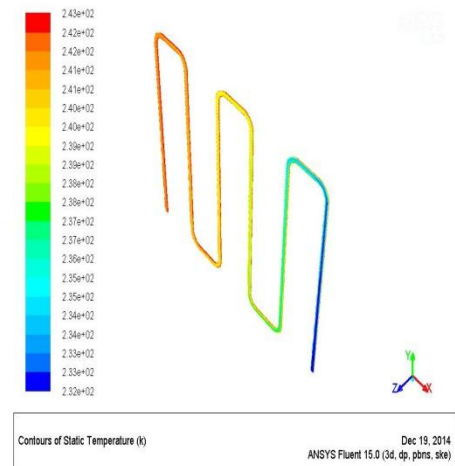
Velocity Magnitude



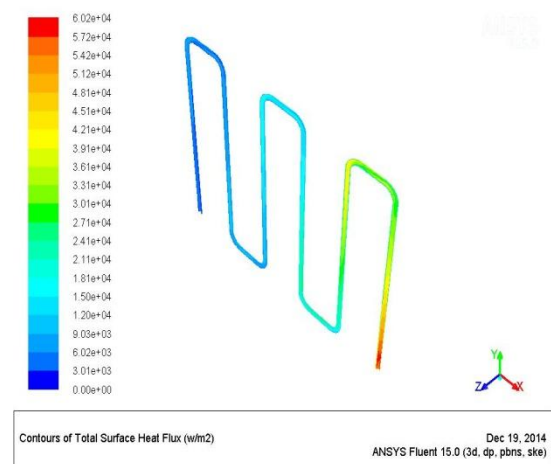
Static Pressure



Static Temperature



Total Surface Heat Flux



Mass Flow Rate Results

"Flux Report"

Mass Flow Rate	(kg/s)

Inlet	0.052138539
Interior-____msbr	88.740069
Outlet	-0.051996436
Wall	0
Wall-____msbr	0

Net	0.00014210257

Total Heat Transfer Rate Results

"Flux Report"

Total Heat Transfer Rate	(w)

Inlet	-5432.9072
Outlet	4606.7706
Wall	812.71201
Wall-____msbr	0

Net	-13.424514

III - REPORT

Material	Velocity Magnitude	Static Pressure		Static Temperature		Surface Heat Flux
		min	max	min	max	
R22	1.38E+00	-	8.50	2.27	2.43	2.98
		1.12 E+03	E+01	E+02	E+02	E+04
R404A	1.47E+00	-	8.97	2.27	2.43	3.91
		1.10 E+03	E+01	E+02	E+02	E+04
R442A	1.43E+00	-	8.14	2.32	2.43	6.02
		1.13 E+03	E+01	E+02	E+02	E+04
R500	1.75E+01	-	2.55	3.00	3.00	8.50
		1.42 E+02	E+01	E+02	E+02	E+00
R502	5.07E-02	0.00	1.80	3.00	5.10	7.50
		E+00	E+00	E+02	E+02	E+00

Comparison result table

IV - CONCLUSION

In this thesis, a refrigeration system is designed and modeled in Catia. The design and parameters are taken from journal papers. We have considered five refrigerant materials - R22, R404A, R442A, R500 and R502.

CFD analysis is done on all the considered materials of Refrigeration system and by observing the analysis results, the mass flow rate and Total heat transfer rate is higher for material R 442A among R22, R404A, R500 and R502.

V - REFERENCE

- ❖ Refrigeration & Air Conditioning Technology by William C. Whitman, William M. Johnson, Weinstein Publications, 1998
- ❖ *Refrigeration: Theory and Applications* by James K Carson, Tata McGraw-Hill Education, 2002
- ❖ *Basic Refrigeration and Air Conditioning* by Ananthanarayanan. Tata McGraw-Hill Education, 2005
- ❖ EPA, A Rule by the Environmental Protection Agency on 04/03/2013

<https://www.federalregister.gov/articles/2013/04/03/2013-07758/protection-of-stratospheric-ozone-adjustments-to-the-allowance-system-for-controlling-hcfc/>

- ❖ EPA Consumption Allowance, § 82.16 Phase out schedule of class II controlled substances.

<https://www.federalregister.gov/articles/2013/04/03/2013-562358/protection-of-ozone-adjustments-to-the-allowance-hcfc#t-5/>