iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36772

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

Analysis on Condenser with Different Refrigerants

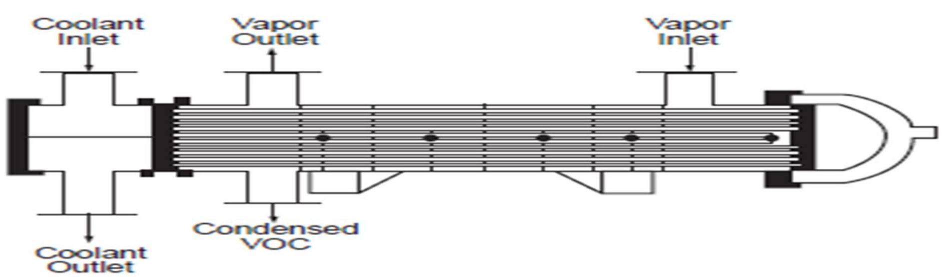
T. Anusha[1], K. C. Harsha[2], N. Ranjith[3], G. Haswanth[4]
[1]Assistant Professor, Dept. of Mechanical Engineering, DMS SVH College of engineering, Machilipatnam, India.
[2, 3, 4]B.tech student, Dept. of Mechanical Engineering, DMS SVH College of engineering, Machilipatnam, India.

Abstract: This research considered the analysis of condensers by using refrigerants R-134A, R-22 and R-744. The optimal values were obtained by varying different performance parameters. The simulation can be done by using CFD ANSYS Software. Experiments were conducted in order to justify the performance of refrigerants on the fins in condensers and compare the performance of refrigerants on the condenser and fins and find which one has the best Eco-friendly results. The simulated Ansys results showed that R-744 has better and more Eco-friendly results than R-134A and R-22. The main drawback for R22 depletes the ozone layer and is harmful to the environment and for R-134A has the metal particles of Al2O3 which heats the refrigerant immediately.

I. INTRODUCTION

A. Condensers

The two most common types of condensers used are surface and contact condensers.In surface condensers where the coolant does not contact either the vapors or the condensate. In contact condensers,cools the vapor stream by spraying either a liquid at ambient temperature or a chilled liquid directly into the gas stream. Most surface condensers are the shell and tube type in refrigerated systems (McCabe and Smith, 1976). The coolant circulates through tubes in shell and tube condensers. In surface condensers the coolant does not contact the vapour steam, so it can be recycled.

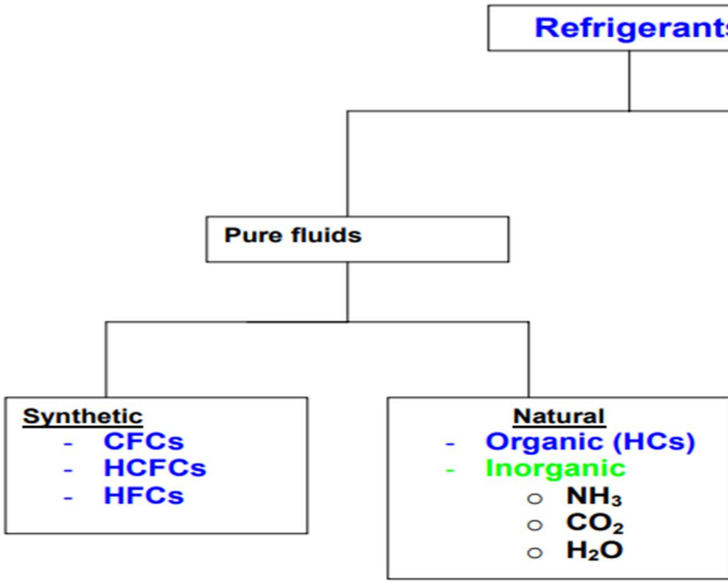


B. Refrigerants

The thermodynamic efficiency of a refrigeration system mainly depends on its operating temperatures. The important issues such as the system design, size, initial and operating costs, safety, serviceability etc. depend on the type of refrigerant selected for a given application. The selection of a suitable refrigerant for the V.C.R system has become one of the most important issues in recent times due to ozone layer depletion and globalwarming. Replacement of an existing refrigerant by a completely new refrigerant due to harmful effects of refrigerants on the environment. Hence it is very important to understand the selection criteria of refrigerants and their use in an effective manner. In this lecture the attention is on the eco-friendly type of fluids that can be used as refrigerants in vapour compression refrigeration systems only.

II. PRIMARY AND SECONDARY REFRIGERANTS

Refrigerants can be classified into primary and secondary refrigerants. Refrigerants which pass through the refrigerant cycle are called primary refrigerants. Example of primary refrigerants are R12 – R-22, CO2, NH3 etc. Secondary refrigerants doesnot undergo a refrigeration cycle but are used as a medium for cooling. Primary refrigerants cool secondary refrigerants and inturn secondary refrigerants are used to cool products. eg – H2O, Brine (water + salt), calcium chloride solution. In this lecture attention is focused on primary refrigerants used mainly in vapour compression refrigeration systems.



A. Azeotropic Mixtures

R 500: Mixture of R 12 (73.8 %) and R 152a (26.2%)
R 502: Mixture of R 22 (48.8 %) and R 115 (51.2%)
R503: Mixture of R 23 (40.1 %) and R 13 (59.9%)
R507A: Mixture of R 125 (50%) and R 143a (50%)

B. Zeotropic Mixtures

R404A : Mixture of R 125 (44%), R 143a (52%) and R 134a (4%)
R407A : Mixture of R 32 (20%), R 125 (40%) and R 134a (40%)
R407B : Mixture of R 32 (10%), R 125 (70%) and R 134a (20%)
R410A : Mixture of R 32 (50%) and R 125 (50%)

C. Hydrocarbons

Propane (C3H8) : R 290
n-butane (C4H10) : R 600
iso-butane (C4H10) : R 600a

III. COMPUTATIONAL FLUID DYNAMICS

Computational Fluid Dynamics (CFD) is a set of numerical methods applied to obtain approximate solutions of problems of fluid dynamics and heat transfer. CFD is solving the equations of fluid flow and heat transfer problems.

There are two different approach-

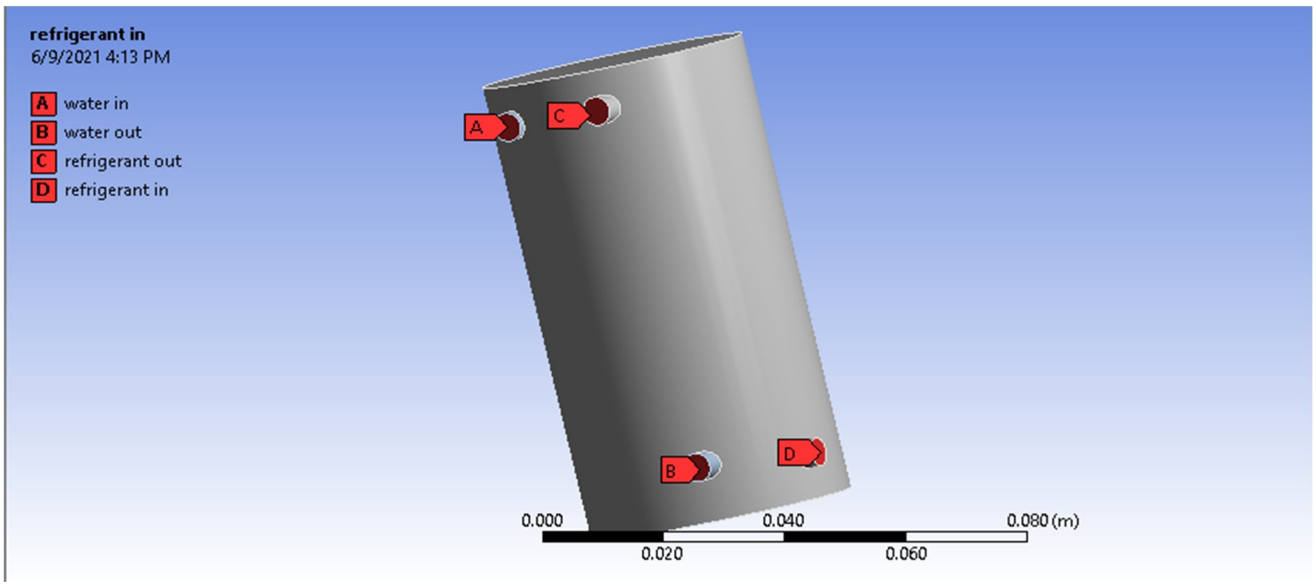
1) Write CFD code to solve a problem.
2) There are some commercial CFD software packages.

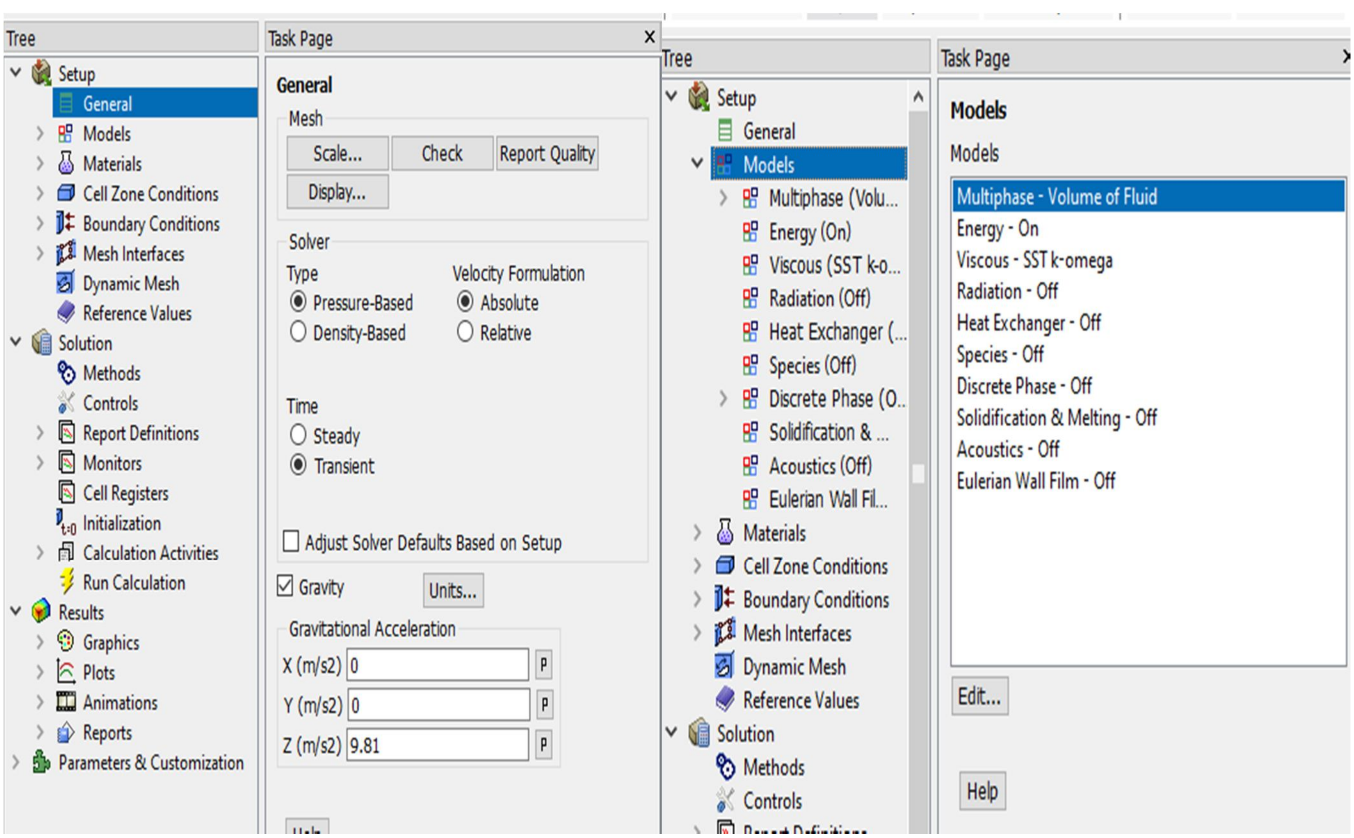
All codes contain three main elements:

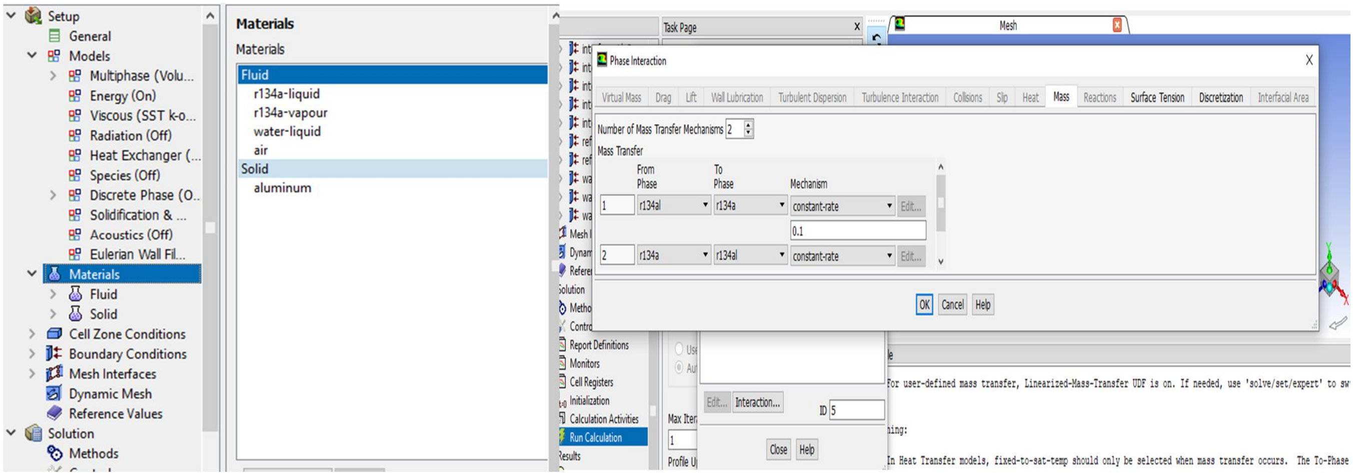
a) *Pre-processor:* It creates Geometry and Mesh.
b) *Solver:* It is used to solve the fluid flow equations .
c) *Post-Processor:* The simulation can be analyzed in this step.

In ANSYS WORKBENCH, Design Modeler & Meshing works as a pre-processor, FLUENT is the Solver, and CFD-post is the post- processor.There are three basic methods to solve a problem in CFD. They are the Finite difference method, the Finite element method and the Spectral methods. Finite Volume Method is a special case of the Finite Difference method. It is a very popular method.

IV. BOUNDARY CONDITIONS AND SETUP CONDITIONS

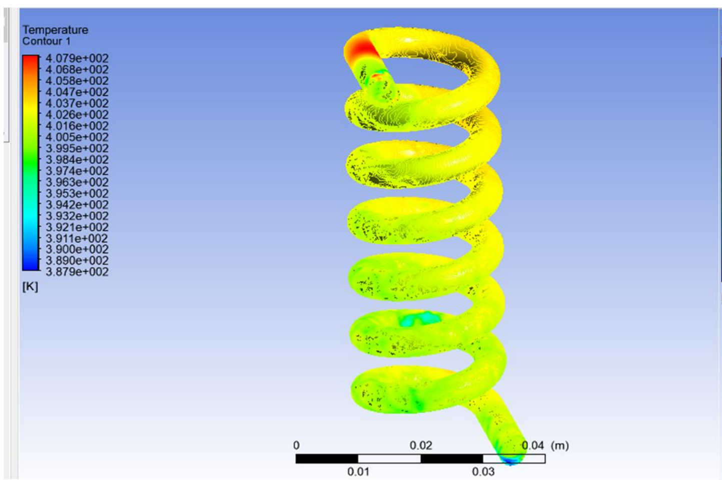




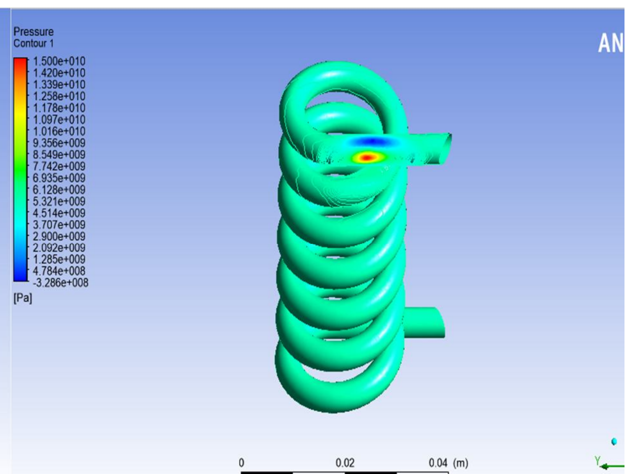


V. RESULTS

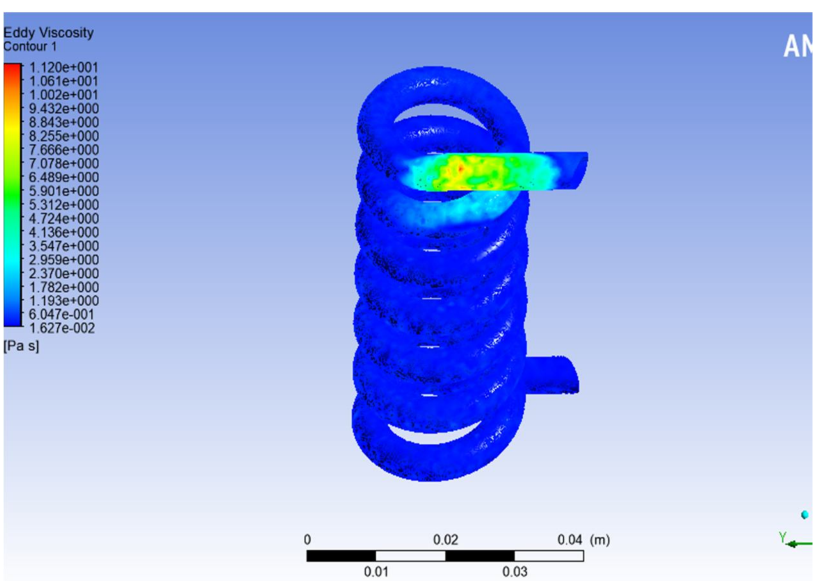
A. R134A



a)Temp. impact on fin of r-134a

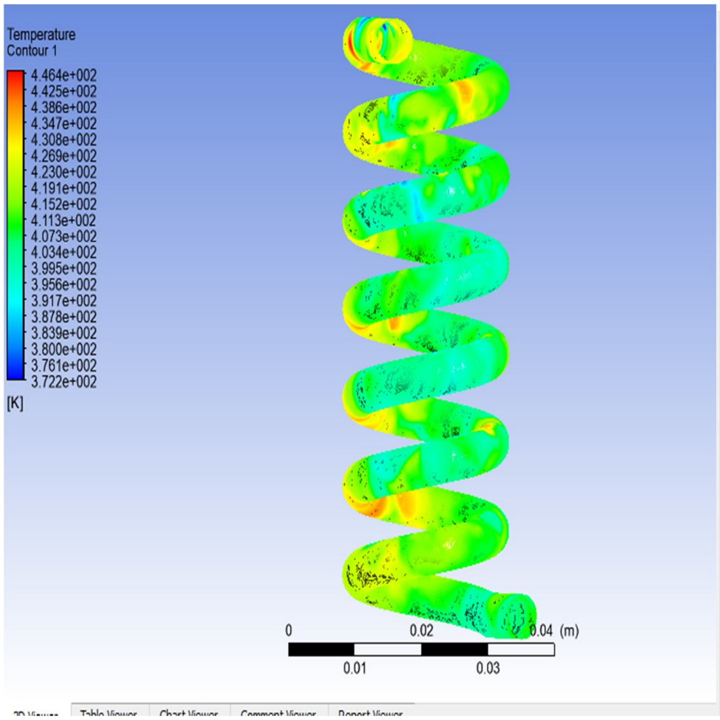


b)pressure impact on fin of r-134a

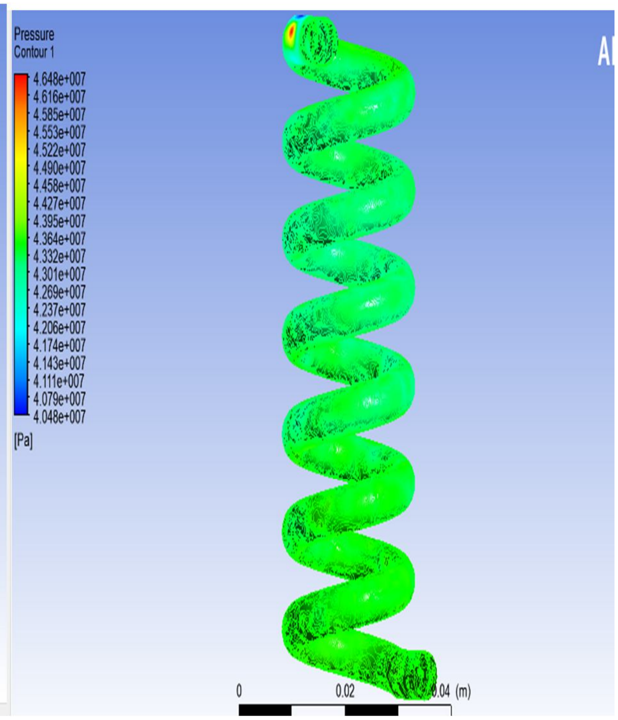


c)eddy viscosity impact on fin of r-134a

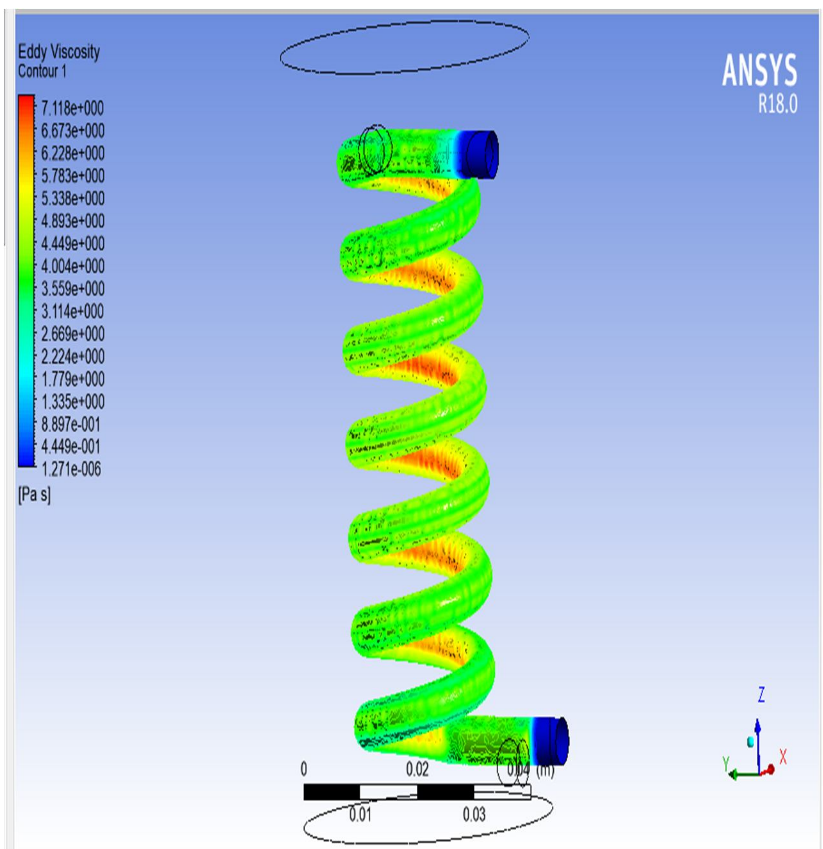
B. R22a



a) Temp. imact on fin of r-22



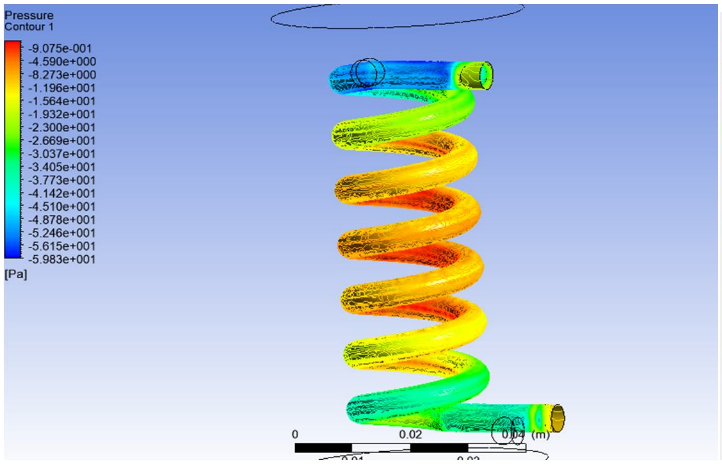
b) pressure impact on fin of r-22



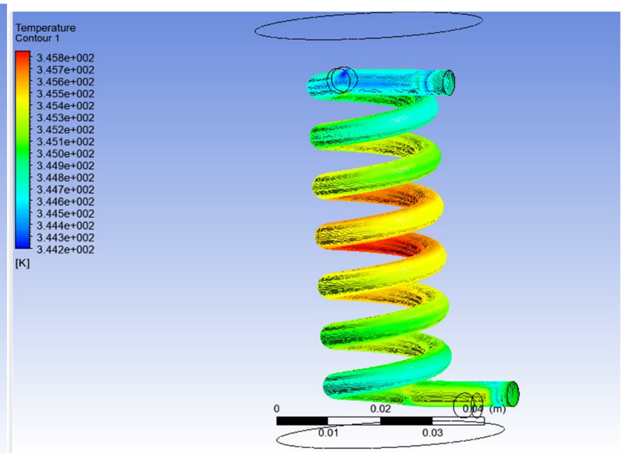
c)Eddy viscosity impact on fin of r-22

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

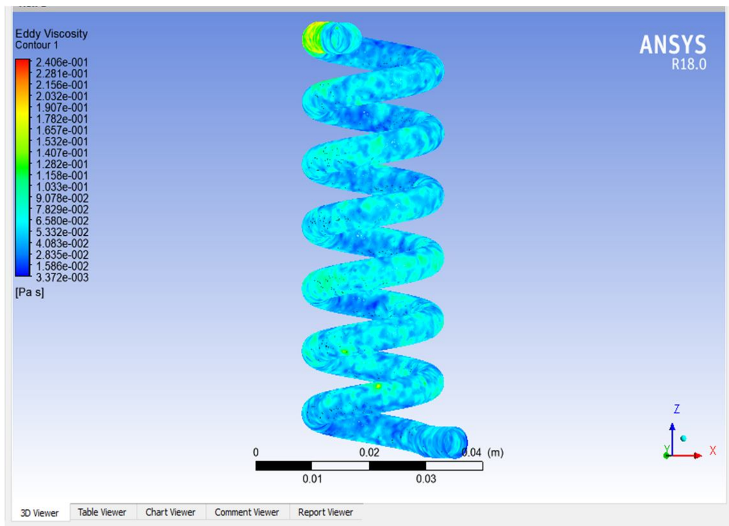
C. R-744



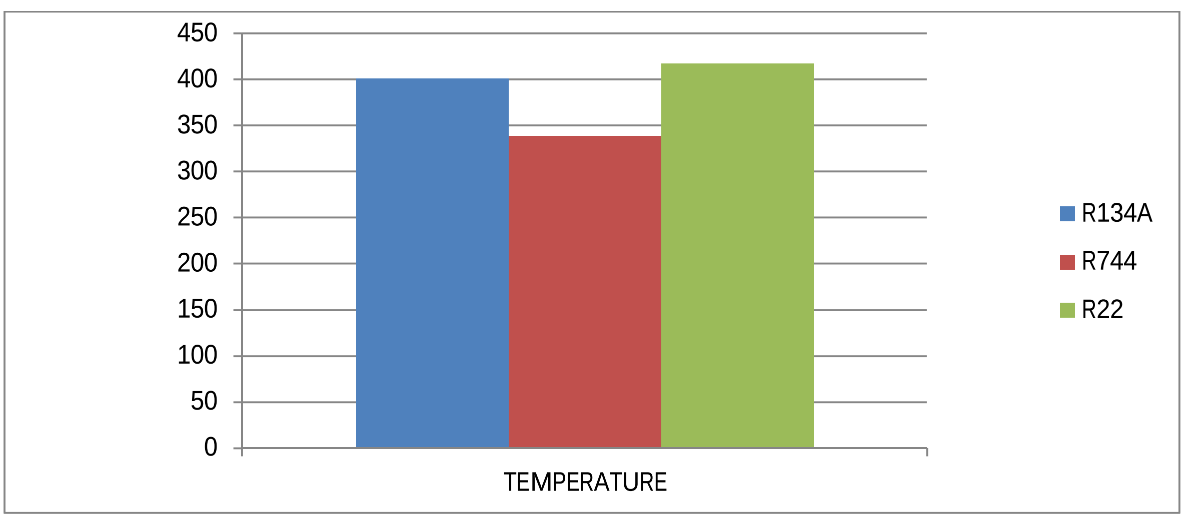
a)Temp. impact on fin of r-744



b)pressure impact on fin of r-744



c)eddy viscosity on impact on fin of r-744

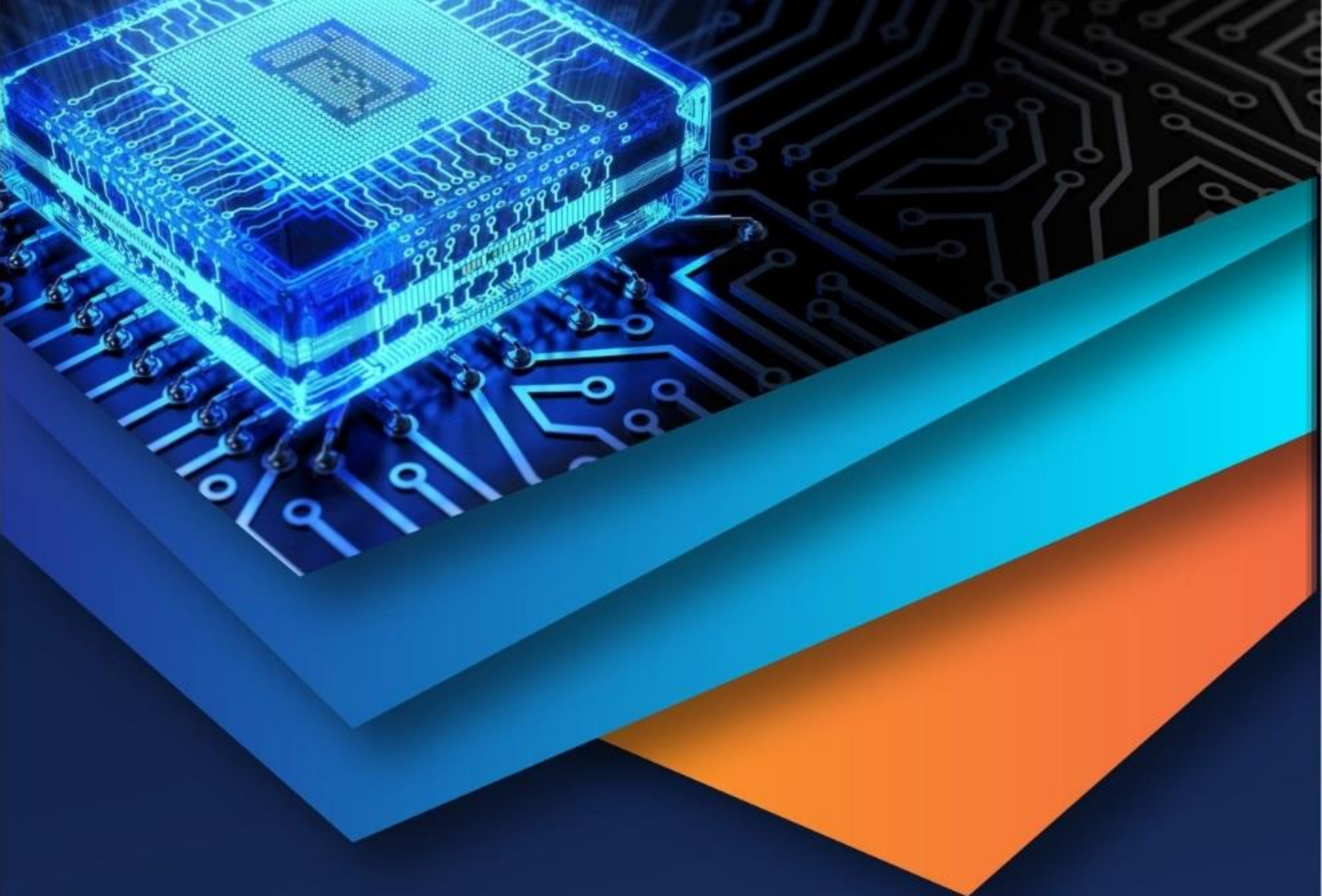


VI. CONCLUSION

It is concluded that by observing the temperature and pressure variations among these three refrigerants R-134a have better performance than the R-22 also R-134a have zero ozone depletion potential and less global warming potential compare to R-22. The Metal particle of Al2O3 present in R-134a makes the refrigerant inefficient because of heated immediately. On other side R-744 which is made by recycling of CO2 from atmosphere does not have any CFCs and also not hazardous to atmosphere also is very efficient refrigerant. R-744 has zero ODP, lowest GWP, non-toxic, and higher refrigerant performance than other refrigerants.

REFERENCES

[1] Dalkilic AS and Wongwises S 2010 Int. Commun. Heat Mass Transf.37 1340
[2] Harby K 2017 Renew. Sustain. Energy Rev. 73 1247.
[3] Pearson SF.Natural refrigerants for heat pumps. IEA Heat Pump Center Newsletter 2004; 20:13–16.
[4] Saleh B, Wendland M. Screening of pure fluids as alternative refrigerants. International Journal of Refrigeration 2006; 29: 260–269.
[5] YoonSH, ChoES, HwangYW, KimMS, MinK, KimY. Characteristics of evaporative heat transfer and pressure drop of carbon dioxide and correlation development. International Journal of Refrigeration 2004; 27 pages 111–119.
[6] Neksa P.CO2 heat pump systems. International Journal of Refrigeration 2002; 25:421 pages–427.
[7] Hesse U, Kruse H. Alternatives for CFC's and HCFC 22 based on CO 2. IIF-IIR Commission B1/B2: Ghent, Belgium, 1993 pages 317–325.
[8] Suneel K Kalla , B B Arora ,Performance analysis of R22 and its substitutes in air conditioners, Journal of Thermal Engineering, Vol. 4, No. 1, pp. 1724-1736, January, 2018
[9] Heleno Pontes Antunes, Experimental comparison of a cascade refrigeration system operating with R744/R134a and R744/R404A, 16th International Refrigeration and Air Conditioning Conference at Purdue, July 11-14, 2016 page 1.
[10] Bandarra Filho, Enio Pedone, "Experimental comparison of a cascade refrigeration system operating with R744/R134a and R744/R404a." (2016). International Refrigeration and Air Conditioning Conference. Paper 1785.
[11] Aziz, Izzudin and A K Mainil, Performance comparison of a refrigerator system using R134a and hydrocarbon refrigerant (HCR134a) with different expansion devices, 1st Nommensen International Conference on Technology and Engineering IOP Publishing , (2017)
[12] Kruse, H. and Suess, J., "Research on the Behavior of Refrigeration Compressors Using CO2 as the Refrigerant" (1996). International Compressor Engineering Conference. Paper 1110.



10.22214/IJRASET

INDEX COPERNICUS 45.98

ISRA JIF IMPACT FACTOR: 7.129

SJIFactor TOGETHER WE REACH THE GOAL IMPACT FACTOR: 7.429

ISI

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY