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ANALYZING THE IMPROVEMENT IN EFFICIENCY OF A REFRIGERATOR USING DIFFUSER

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ABSTRACT In this paper we discussed about the improvement in efficiency of a domestic refrigerator using diffuser by connecting it in the compressor outlet. Here refrigerant, 134a is used to operate the cycle. Diffuser angle is taken as 10o,11o,13o .initially Coefficient Of Performance was calculated without the diffuser and after that diffuser is connected with the refrigerator and the Coefficient Of Performance was calculated. Here the parameters like the temperature and pressure are considered. After calculating the coefficient of performance the cop with diffuser is compared with the cop without the diffuser and the results are tabulated. Here the power consumed by the refrigerator will be reduced for the same refrigeration effect. The result of this analysis cop was increased from 2.52 to2.59.

KEYWORDS : diffuser, coefficient of performance, angle

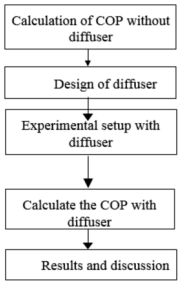
I.INTRODUCTION

apour Compression Refrigeration system consists of four components namely Compressor, Condenser, Expansion valve, Evaporator. The main principle of the refrigerator is to absorb the heat from the evaporator and dissipated in the atmosphere with the help of applying some workdone. Heat always flows from the higher temperature object or surrounding to the lower temperature object or surroundings. Now a days in modern refrigerators the waste water which is created during defrostation is evaporated using the compressor's heat.

In this refrigeration process, the diffuser is used between the compressor outlet and the inlet of the condenser, here high pressure refrigerant flows into the diffuser. According to the principle of the diffuser, the refrigerant which is given as the input to the diffuser will have less pressure when compared to the pressure of the refrigerant which is carried out in the outlet in the diffuser. So this diffuser creates the high pressure drop in the expansion valve so more cooling effect is created for the same amount of current consumption so more coefficient of performance can be obtained.

In this refrigeration system, R134a is used because it is the common mostly used refrigerant among the refrigerators and also it is very economical and non flammable. When other refrigerants are used in this setup its flammable property will cause defects in the diffuser so for this purpose refrigerant R134a is used.

II.METHODOLOGY



III.EXPERIMENTAL SETUP

Initially diffuser should be designed for the setup. By calculating the parameters like the inlet pressure, outlet pressure, angle of the diffuser, length of the diffuser, inlet diameter of diffuser, outlet diameter of a diffuser.

IV.DESIGNING OF DIFFUSER

The angle of the diffuser is taken as 10o,11o 13o,as per the old journals which are taken for reference[5] they state that the efficiency of the diffuser will be maximum around 11o to 15o. so here the diffuser is designed for about 10o,11o 13o.

So, the diffuser is designed using the following formula,

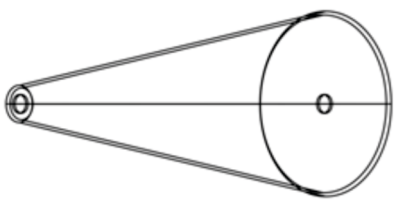
$$L = \frac{(d2-d1)/2}{\tan\theta}$$

length of the diffuser can be calculated using the above formula,

$$L = \frac{(60-12)/2}{\tan 11}$$

L = 125mm.

By using modeling software the model of the diffuser is designed,



(DIFFUSER IS MODELED USING AUTOCAD)

FABRICATION OF DIFFUSER

Here the metal used for the fabrication of diffuser was copper which is found in the tubes of the condenser, brazing process involved in joining of the diffuser in the pipes of the compressor and the condenser as stated in figure 1. No

welding process is done because copper will not withstand the heat which is produced by the welding process,

Fig.1 brazing process for diffuser

Fig.2.brazing process attaching copper tube

Fig.3. experimental setup with diffuser

Finally the diffuser is fixed along the domestic refrigerator as shown in figure 3. Here the inlet is diffuser is connected to the exit or delivery of the compressor and the condenser inlet is connected to the delivery of the diffuser.

III.WORKING OF DIFFUSER

As stated earlier, diffuser is connected in the passage of the refrigeration stream here refrigerant having high velocity is passed through the diffuser this is done by the help of the compressor. And the diffuser helps the compressor by boosting the pressure of the incoming refrigerant inside the diffuser there by reducing compressor's work. So the overall efficiency of the refrigeration system is increased.

IV.CALCULATION OF COP

Table 1 : pressure at various points of refrigerator

Pressure	Without diffuser	With diffuser		
P1	0.70	10o	11o	13°
		0.70	0.70	0.70
P2	11.90	11.90	12.05	11.98
P3	11.90	11.90	11.90	11.90
P4	0.45	0.45	0.45	0.45

P1 - COMPRESSOR INLET
P2 - CONDENSER INLET
P3 – CONDENSER OUTLET
P4 – EVAPORATOR INLET

Compressor work = h_2-h_1
= 511-438
= 73kj/kg

Refrigeration effect = h_1-h_4
= 438-254
= 184 kj/kg

Diffuser work = h_2-h_2`
= 513- 511
= 2kj/kg

Reduction in compressor work = (h_2-h_1)-(h_2`-h_2)
= 73-2
= 71kj/kg

COP_1 = refrigeration effect / compressor work
= 184 / 73
= 2.52

COP_2 = refrigeration effect / reduction in compressor work
= 184 / 71
= 2.59

Table 2 : cop of the refrigerator

Divergence angle		Cop
Without diffuser	2.52	
	10°	2.52
With diffuser	11°	2.59
	13°	2.55

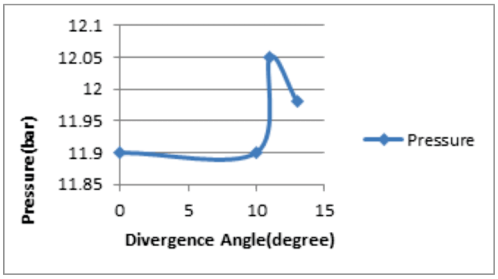


Fig.4. comparison of pressure and divergence angle

Figure 4 represents the result of the diffuser's divergence angle on pressure. Here the pressure is maximum at the 11o which is followed by the 13°.

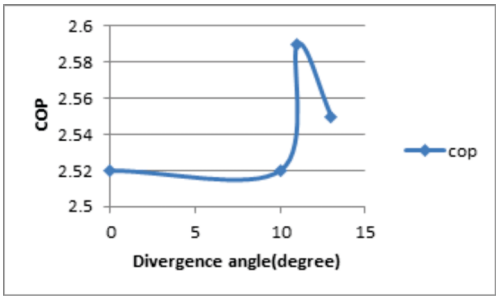


Fig.5. comparison of cop and divergence angle

Figure 5 represents the effect of divergence angle on coefficient of performance of the refrigerator. here maximum cop is obtained at the angle 11o followed by 13°.

$$\text{percentage of increase in c.o.p} = \frac{\text{system with diffuser} - \text{system without diffuser}}{\text{system without diffuser}} \times 100$$

$$= \frac{2.59-2.52}{2.52} \times 100$$

$$= 2.77\ \%$$

III.CONCLUSION

Various differs of various divergence angle are designed for the experimental setup and the coefficient of performance for various divergence angle of various differs are calculated. Here divergence angle are taken as 10o,11o,13°.

Here, diffuser of divergence angle 11o has maximum coefficient of performance output than the other two diffuser of angle 10o,13°.

REFERENCES

[1] Ponna Sasikumar, "COP improvement of VCR system (R-600a) by using diffuser as a secondary compressor and varying the condenser fins space" International journal of advanced engineering research and technology, vol.5,Issue 11, 2017.

[2] Debabrata Panda, "Experimental analysis on the effect of condenser diameter on the performance of a simple vapor compression refrigeration system" International journal of engineering studies and technical approach, vol.2, Issue.4, pp.178-184, 2016.

[3] Adityaswaroop, "To improve COP of a refrigerant using diffuser", International journal of advance research in science and engineering, vol.6, issue 5, pp. 91-101, 2017.

[4] R.T.Saudagar,"Experimental analysis of vapour compression refrigeration system with diffuser at condenser inlet", International journal of engineering and advanced technology,vol.2, issue 4, pp. 182-186, 2013.

[5] G.Naga raju,"Enhancement of COP of vapour compression refrigeration system by using diffusers", International journal of recent technology and engineering, vol.8,pp.6123-6129, 2019.

[6] Ankit dwivedi, "Performance enhancement of simple vapour absorption system using loop heat pipes", International journal for research in applied science and engineering technology, vol.6,issue 1,pp.865-873, 2018.

[7] Nurul Seraj, "Enhancement of coefficient of performance of vapour compression refrigeration system using diffuser at inlet of condenser, International journal for research in applied science and engineering, vol.5, pp.172-178, 2017.

[8] Panneerselvam, "Performance analysis of vapour compression refrigeration system with mechanical sub cooling", International journal of innovative technology and exploring engineering, vol.8,pp.1061-1064, 2019.

[9] Chetan kumar, "Enhancement of coefficient of performance by analysis of flow through vapour compression refrigeration cycle using CFD" International advanced research journal in science, Engineering and Technology, vol.2, Issue 6,pp.66-72, 2015.

[10] Prabal Roy, "Improvement od Efficiency of air refrigeration system by lowering the inlet temperature od air", International journal of engineering trends and technology,vol.5,pp.25-29, 2018.

[11] Rahul chauhan, "Study of VCR and enhancement in cop", International journal for scientific research and development,vol.5, pp.214-217, 2018.

[12] Shoyab hussan , "Improve the cop of vapour compression cycle with change in Evaporator and Condenser pressure", International journal of scientific and engineering research, vol.6, pp.199-202, 2015.

[13 Anjappa,"Enhancement of COP of vapour compression Refrigeration cycle using CFD", International research journal of Engineering and Technology, vol.7,pp.304-313, 2020

[14] Dabas, "Performance characteristics of vapour compression refrigeration System using transient conditions", International Journal of advancement in technology, vol.2,pp.584-593,2011.