International Journal of Research in Engineering and Innovation (IJREI)
journal home page: http://www.ijrei.com
ISSN (Online): 2456-6934

Optimum thermodynamic performances of an ejector vapour refrigeration system using HFO ecofriendly refrigerants

R. S. Mishra

Department of Mechanical Engineering, Delhi Technological University Delhi, India

Abstract

Ejector refrigeration technology is the one which can have utilized the waste heat to compress the refrigerant instead of compressor. Therefore, electrical energy was saved which can have employed to meet the other demand. The first law performance (coefficient of performance) and exergetic efficiency of ejector refrigeration system is evaluated by using energy-exergy principles. The numerical computation is carried out for the considered range of condenser temperature of 300K to 310K, evaporator temperature of 268K to 283K and generator temperature of 333K to 363K and the optimum (maximum) coefficient of performance (first law efficiency) of ejector coupled vapour compression refrigeration system using R12343ze(Z) while maximum exergetic efficiency (i.e. second law efficiency) was observed by using R-1225ye(Z). By increasing boiler temperature, the exergetic efficiency and compression ratio of the system is decreasing, however the first law efficiency is increasing. Similarly increasing condenser temperature, the first law efficiency and entrainment ratio of the system is decreasing, however by increasing evaporator temperature, the exergetic efficiency, entrainment ratio and compression ratio of the system is decreasing and the first law efficiency(COP) and exergy destruction ratio are increasing.

Keywords: Thermodynamic analysis, SCO2 cycle, intercooling, ORC, waste heat recovery

1. Introduction

The throttling device in a refrigeration system usually assists two purposes. First as due to the liquid refrigerant was expanded from the condenser pressure to the evaporator pressure. The other one is the control function which may include the supply of the liquid to the evaporator at the rate at which it is evaporated. Therefore, the irreversibility associated with throttling is major issue in vapour compression refrigeration cycle. different ways different ways to reduce throttling losses in the refrigeration cycles due to internal irreversibilities . However, by using ejector as expansion device by changing the throttling valve in the conventional vapour compression refrigeration system is a hopeful alternative to reduce the throttling losses or the expansion irreversibility in the refrigeration system due to its modest structure, simple manufacturing, not any of moving parts, lower cost and little maintenance requirements, the use of two- phase ejector has become an important cycle modification recently. The ejector reduces the compressor work by raising the suction pressure to a level higher than that of which in turn improves COP of the system. It also enables to reduce size of the evaporator.

2. Ejector Refrigeration System

Ejectors are widely used in different applications such as refrigeration, propulsion, evacuation and aerospace. They used a pressurized flow as a object stream to entrain a force flow. The thermodynamic performance of an ejector as an expansion device relatively than the conventional expansion valve or capillary tube in the vapour compression system is experimentally analyzed. The main object of the incorporating an ejector into vapour compression cycle is to improve the first law efficiency(COP) by reducing the throttling loss associated with the expansion device. Several studies on thermodynamic performances are described as follow:

Kornhouser [1990,] performed the thermodynamic analysis on the ejector expansion refrigeration cycle to investigate thermodynamic performance improvement on vapour

Corresponding author: R.S. Mishra
Email Address: hod.mechanical.rsm@dtu.ac.in
https://doi.org/10.36037/IJREI.2020.4406

compression refrigeration system (VCRC) by using eight refrigerants (such as R11, R12, R113, R114, R500, R502, R22 and R717) and found that the R502 refrigerant has given the highest coefficient of performance improvement and the COP improvement using R12 was 21% over the basic cycle. Similarly, Domanski [1995] carried out the theoretical COP computation of the ejector-expansion refrigeration cycle and found that there was considerable sensitiveness to the ejector efficiency on thermodynamic first law performance. Nakagawa and Takeuchi [1998] used longer length of the divergent part of the motive nozzle and concluding that the longer divergent part provides a longer period of time for the two-phase flow to achieve equilibrium and found higher motive nozzle efficiency in the system. Yari and Siriousazar [2007] worked on performance of transcritical CO2 refrigeration cycle with ejector expansion using the second law of thermodynamics and found 24.8%improvement in optimum second law efficiency as compared to conventional system and 16% as compared to internal heat exchanger refrigeration system.

Deng et al. [2007] carried out analysis on a transcritical CO_2 ejector expansion refrigeration cycle that uses an ejector as the main expansion device in its place of an expansion valve and determined thermal performances for the given working conditions, and found 18.6% improvement in the ejector COP which was maximum as compared to the internal heat exchanger system and also 22% improvement as compared to the conventional refrigeration system.

Table-1: Input data used in ejector refrigeration system

Description of Data	Values
In Cooling Load of ejector refrigeration system (Q_{eva})	4.75 "kW"
Boiler temperature ejector refrigeration ($T\__{boiler}$)	333[K]
Condenser temperature of ejector refrigeration (T_{Cond})	303[K]
Evaporator temp of ejector refrigeration (T_eva)	273[K]
Ambient temperature (T_o)	300[K]
Refrigerants used in ejector refrigeration system	Ecofriendly ultra-low GWP
(Length / Diameter} ratio of constant area mixing chamber(L/D) of ejector	10
Diameter of primary nozzle throat (D_throat)metre	(0.5/1000)
Diameter of mixing chamber(D_m) metre	(1.4/1000)
Exit diameter of primary nozzle (D_p) metre	(0.8/1000)
Diffuser angle(theta	3°
Diffuser Length (L_d) metre	(112/1000)
Area Ratio	7.84

Nehdi et al. [2007] carried out the simulation work on the performance of the vapour compression cycle using ejector as an expander and it has been found that the geometric parameters of the ejector design have significant effects on the system performance and also found the maximum COP for optimum geometric area ratio around 10 for the given operating conditions of evaporator temperature, 5ºC and condenser temperature, 40 ºC. Yari, M. [2008] conducted exergetic analysis of the vapour compression refrigeration cycle using ejector as an expander and calculated the effects of evaporating temperature and condensing temperature on the COP, second law efficiency and exergy destruction in various component, and also concluded that the COP and second law efficiency of the ejector-compression is to be 16% greater than that for the vapour compression system and total exergy destruction of the vapour compression system is to be about 24 % higher than that for the ejector-compression cycle. On the performance improvement, J Sarkar [2009] carried out the research using three natural refrigerants viz., ammonia, propane and isobutene and determined that maximum performance improvement using ejector can be achieved using isobutane, however lowest performance improvement is given by ammonia. J Sarkar [2010] carried out detailed thermal analysis of two-phase ejectors and their applications in vapour compression refrigeration and heat pump systems and established theory on characteristics of both subcritical and trans-critical vapor compression systems with various cycle configurations.

3. Results and Discussion

Following input data have been used for numerical computations is shown in table-1. Table-2(a) shows the variation of first law (COP) performance of ejector refrigeration system boiler temperature with different ecofriendly refrigerants and it is found that R1243zf gives best first law performance slightly higher than using R1234ze(E) and lowest is using HFO-1336mzz(Z). As increasing boiler temperature, the first law efficiency is increasing rapidly. Table-2(b) shows the variation of second law (exergetic) performance of ejector refrigeration system boiler temperature with different ecofriendly refrigerants and it is found that R1225ye(Z) gives best exergetic performance slightly higher than using R1224yd(Z) and lowest is using HFO-1233zd(E). As increasing boiler temperature, the exergetic efficiency is decreasing rapidly. Table-2(c) shows the variation of exergy destruction ratio (EDR) of ejector refrigeration system boiler temperature with different ecofriendly refrigerants and it is found that R1225ye(Z) gives highest EDR and lowest is using R1224yd(Z). As increasing boiler temperature, exergy destruction ratio is increasing. Table-2(d) shows the variation of compression ratio of ejector refrigeration system boiler temperature with different ecofriendly refrigerants and it is found that HFO1336mzz(Z) gives highest EDR and lowest is using R1243zf. As increasing boiler temperature, the compression ratio is decreasing rapidly. Similarly, entrainment ratio of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants does not affect with variation of boiler temperature.

Table-2(a): Variation with Generator (Boiler) temperature with first law thermodynamic performances of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants

T_{Boiler} (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
333	0.4843	0.4833	0.4398	0.4522	0.4476	0.4298	0.4888
338	0.5838	0.5827	0.5292	0.5449	0.5404	0.5073	0.5991
343	0.6799	0.6792	0.6126	0.6338	0.6274	0.5827	0.7050
348	0.7909	0.7903	0.6951	0.7228	0.7141	0.6563	0.8094
353	0.8626	0.8620	0.7773	0.8034	0.7936	0.7286	0.9069
358	0.9475	0.9471	0.8524	0.8836	0.8727	0.7999	1.001
363	1.040	1.01	0.9269	0.9587	0.9518	0.8613	1.085

Table- 2 (b): Variation with Generator (Boiler) temperature with second law (exergetic) thermodynamic performances of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants

T_{Boiler} (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
333	0.3489	0.3479	0.3541	0.3730	0.330	0.3475	0.3347
338	0.3471	0.3461	0.3520	0.3712	0.3278	0.3451	0.3331
343	0.3453	0.3444	0.3498	0.3695	0.3257	0.3427	0.3315
348	0.3436	0.3427	0.3478	0.3679	0.3237	0.3403	0.3302
353	0.3424	0.3416	0.3457	0.3665	0.3217	0.3380	0.3291
358	0.3415	0.3406	0.3438	0.3652	0.3198	0.3357	0.3282
363	0.3407	0.3399	0.3419	0.3641	0.3179	0.3335	0.3278

Table- 2(c): Variation with Generator (Boiler) temperature with exergy destruction ratio (EDR) of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants

T_{Boiler} (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
333	1.870	1.874	1.824	1.681	2.301	1.878	1.988
338	1.884	1.889	1.841	1.694	2.060	1.898	2.002
343	1.90	1.903	1.859	1.706	2.070	1.918	2.016
348	1.914	1.918	1.876	1.718	2.089	1.938	2.029
353	1.923	1.927	1.892	1.729	2.108	1.959	2.039
358	1.932	1.936	1.909	1.739	2.127	1.979	2.047
363	1.940	1.942	1.925	1.747	2.145	1.999	2.061

Table- 2(d): Variation with Generator (Boiler) temperature with compression ratio of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants

T_{Boiler} (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
333	1.811	1.813	2.056	1.981	1.910	2.591	1.685
338	1.768	1.77	2.003	1.935	1.861	2.104	1.627
343	1.731	1.733	1.956	1.894	1.816	2.054	1.593
348	1.690	1.693	1.914	1.857	1.776	2.01	1.563
353	1.667	1.670	1.875	1.825	1.739	1.970	1.537
358	1.641	1.644	1.841	1.796	1.706	1.933	1.514
363	1.653	1.626	1.809	1.770	1.676	1.90	1.495

Table-3(a) shows the variation of first law (COP) performance of ejector refrigeration system condenser temperature with different ecofriendly refrigerants and it is found that R1243zf gives best first law performance slightly higher than using R1234ze(E) and lowest is using HFO-1336mzz(Z). As increasing condenser temperature, first law efficiency (COP) is decreasing rapidly.

Table-3 (b) shows the variation of second law (exergetic) performance of ejector refrigeration system condenser temperature with different ecofriendly refrigerants and it is found that R1225ye(Z) gives best exergetic performance slightly higher than using R1224yd(Z) and lowest is using HFO-1233zd(E). As increasing condenser temperature, the exergetic efficiency is increasing rapidly.

Table-3 (c) shows the variation of exergy destruction ratio (EDR) of ejector refrigeration system condenser temperature with different ecofriendly refrigerants and it is found that R1225ye(Z) gives highest EDR and lowest is using R1224yd(Z). As increasing condenser temperature, exergy destruction ratio is decreasing.

Table-3 (d) shows the variation of entrainment ratio of ejector refrigeration system condenser temperature with different ecofriendly refrigerants and it is found that HFO1336mzz(Z) gives highest EDR and lowest is using R1243zf. As increasing condenser temperature, the entrainment ratio is decreasing rapidly. Similarly, compression ratio does not affect with variation of condenser temperature.

Table- 3 *(a): Variation with condenser temperature with second law (exergetic) performance of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants*

T_{Cond} (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
300	0.5664	0.6521	0.590	0.6116	0.6029	0.5707	0.5652
303	0.4833	0.4833	0.4398	0.4522	0.4476	0.4298	0.4888
305	0.3969	0.3946	0.360	0.3679	0.3654	0.3545	0.3966
306	0.3557	0.3557	0.3246	0.3308	0.3291	0.3211	0.3562
308	0.2668	0.2865	0.2616	0.2647	0.2644	0.2614	0.2846
309	0.2257	0.2557	0.2333	0.2352	0.2354	0.2346	0.2527
310	0.2050	0.227	0.2070	0.2076	0.2084	0.2095	0.2231

*Table-*3 *(b): Variation with condenser temperature with second law (exergetic) performance of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants*

T_{Cond} (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
300	0.3461	0.3462	0.3524	0.3709	0.3286	0.3459	0.3333
303	0.3479	0.3479	0.3541	0.3730	0.330	0.3475	0.3347
305	0.3490	0.3490	0.3553	0.3744	0.3309	0.3486	0.3357
306	0.3496	0.3496	0.3559	0.3752	0.3314	0.3492	0.3362
308	0.3508	0.3508	0.3572	0.3766	0.3323	0.3504	0.3372
309	0.3514	0.3514	0.3578	0.3774	0.3328	0.3510	0.3377
310	0.3520	0.3520	0.3584	0.3782	0.3333	0.3516	0.3383

Table- 3*(c): Variation of condenser temperature with exergy destruction ratio (EDR) of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants*

T_{Cond} (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
300	1.886	1.888	1.838	1.671	2.043	1.891	2.0
303	1.870	1.874	1.824	1.667	2.031	1.878	1.988
305	1.859	1.865	1.814	1.666	2.022	1.868	1.979
306	1.854	1.860	1.810	1.665	2.018	1.864	1.974
308	1.846	1.851	1.80	1.664	2.009	1.854	1.965
309	1.841	1.846	1.795	1.650	2.005	1.849	1.961
310	1.835	1.841	1.790	1.644	2.0	1.844	1.956

Table- 3 *(d): Variation of condenser temperature with entrainment ratio of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants*

T_{Cond} (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
300	3.514	2.433	2.86	2.445	2.913	3.240	2.316
303	3.420	2.657	3.171	2.671	3.236	3.634	2.517
305	3.148	2.815	3.392	2.831	3.465	3.917	2.659
306	2.892	2.896	3.507	2.913	3.584	4.075	2.732
308	2.653	3.065	3.747	3.083	3.833	4.374	2.882
309	3.514	3.152	3.871	3.17	3.962	4.535	2.959
310	3.421	3.24	3.998	3.260	4.092	4.701	3.038

Table-4(a) shows the variation of first law (COP) performance of ejector refrigeration system evaporator temperature with different ecofriendly refrigerants and it is found that R1243zf gives best first law performance slightly higher than using R1234ze(E) and lowest is using HFO-1336mzz(Z). As increasing evaporator temperature, the first law efficiency(COP) is increasing.

Table-4 (b) shows the variation of second law (exergetic) performance of ejector refrigeration system boiler temperature with different ecofriendly refrigerants and it is found that R1225ye(Z) gives best exergetic performance slightly higher than using R1224yd(Z) and lowest is using HFO-1233zd(E). As increasing evaporator temperature, the exergetic efficiency is decreasing rapidly. Table-4(c) shows the variation of exergy destruction ratio (EDR) of ejector refrigeration system condenser temperature with different ecofriendly refrigerants and it is found that R1225ye(Z) gives highest EDR and lowest is using R1224yd(Z). As increasing evaporator temperature, exergy destruction ratio is increasing. Table-4(d) shows the variation of entrainment ratio of ejector refrigeration system boiler temperature with different ecofriendly refrigerants and it is found that HFO1336mzz(Z) gives highest entrainment ratio and lowest is using R1243zf. As increasing evaporator temperature, the entrainment ratio is decreasing rapidly. Table-4(e) shows the variation of compression ratio of ejector refrigeration system evaporator temperature with different ecofriendly refrigerants and it is found that HFO1336mzz(Z) gives highest compression and lowest is using R1243zf. As increasing evaporator temperature, the compression ratio is decreasing rapidly.

Table- 4(a): Variation of evaporator temperature with thermodynamic performances of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants ecofriendly refrigerants

$T_{\_Eva}$ (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
263	0.2831	0.2728	0.2411	0.2506	0.2420	0.2405	0.2794
268	0.3621	0.3617	0.3255	0.3350	0.3314	0.3194	0.3692
273	0.5433	0.4833	0.4398	0.4592	0.4476	0.4298	0.4888
278	0.7008	0.608	0.6071	0.6194	0.6246	0.5884	0.6556
283	1.095	1.09	0.8797	0.8889	0.9052	0.8540	0.9115

Table- 4 (b): Variation of evaporator temperature with thermodynamic exergetic performances of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants ecofriendly refrigerants

$T_{\_Eva}$ (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
263	0.4399	0.4394	0.4461	0.4665	0.4191	0.4393	0.4243
268	0.3975	0.3969	0.4035	0.4233	0.3776	0.3967	0.3826
273	0.3485	0.3479	0.3541	0.3730	0.330	0.3475	0.3347
278	0.2786	0.2711	0.2965	0.3137	0.2748	0.2902	0.2191
283	0.2240	0.2173	0.2282	0.2428	0.2102	0.2228	0.2138

Table- 4 (c): Variation of evaporator temperature with thermodynamic exergy destruction ratio of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants ecofriendly refrigerants

$T_{\_Eva}$ (K)	*R1234ze(Z)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
263	1.270	1.276	1.242	1.144	1.386	1.276	1.357
268	1.514	1.520	1.479	1.362	1.648	1.521	1.613
273	1.868	1.874	1.824	1.687	2.031	1.878	1.988
278	2.595	2.689	2.372	2.188	2.639	2.446	2.583
283	3.476	3.602	3.382	3.119	3.757	3.489	3.676

Table- 4(d): Variation of evaporator temperature with entrainment ratio of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants ecofriendly refrigerants

$T_{\_Eva}$ (K)	*R1234ze(Z*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
263	3.891	3.895	4.997	3.921	5.146	6.067	3.607
268	3.20	3.204	3.96	3.223	4.059	4.667	3.002
273	2.652	2.657	3.171	2.671	3.236	3.634	2.517
278	2.140	2.145	2.563	2.231	2.604	2.861	2.126
283	1.866	1.87	2.09	1.876	2.116	2.276	1.807

Table- 4(e): Variation of evaporator temperature with compression ratio of ejector fitted vapour compression refrigeration system using ecofriendly refrigerants ecofriendly refrigerants

$T_{\_Eva}$ (K)	*R1234ze(D)*	*R1234ze(E)*	*R1224yd(Z)*	*R1225ye(Z)*	*R1233zd(E)*	*HFO1336mzz(Z)*	*R1243zf*
263	1.688	1.688	1.911	1.837	1.775	2.003	1.545
268	1.744	1.744	1.980	1.906	1.840	2.078	1.602
273	1.813	1.813	2.056	1.982	1.910	2.159	1.665
278	1.903	1.686	2.138	2.062	1.987	2.249	1.732
283	1.970	1.732	2.229	2.151	2.070	2.347	1.807

4. Conclusions

Following conclusions were drawn from this investigation.

- Optimum (maximum) coefficient of performance (first law efficiency) of ejector coupled vapour compression refrigeration system using R1234ze(Z) while maximum exergetic efficiency (i.e. second law efficiency) was observed by using R-1225ye(Z).
- As increasing boiler temperature, the first law efficiency is increasing and the exergetic efficiency is decreasing rapidly. Similarly, exergy destruction ratio is also increasing as boiler temperature is increasing
- By using R1225ye(Z) in the ejector refrigeration system, the highest EDR was observed and lowest by using R1224yd(Z).

- By increasing boiler temperature, the compression ratio is of the system is decreasing rapidly.
- The entrainment Ratio of ejector vapour refrigeration system using ecofriendly refrigerants does not affect with variation of boiler temperature.
- R1234ze(Z) gives best first law performance slightly higher than using R1234ze(E) and lowest is using HFO-1336mzz(Z). while maximum exergetic efficiency (i.e. second law efficiency) was observed by using R-1225ye(Z). slightly higher than using R1224yd(Z) and lowest is using HFO-1233zd(E)
- As increasing condenser temperature, first law efficiency (COP) is decreasing and the exergetic efficiency is increasing rapidly.
- In the ejector refrigeration system, the ecofriendly R1225ye(Z) gives highest EDR and lowest is using R1224yd(Z). As increasing condenser temperature, exergy destruction ratio is decreasing.
- By using ecofriendly HFO1336mzz(Z) in the ejector refrigeration system, highest EDR was observed while lowest EDR is found by using R1234ze(Z).
- As increasing condenser temperature, the entrainment ratio is decreasing rapidly. Similarly, compression ratio does not affect with variation of condenser temperature. However maximum entrainment ratio of ejector coupled vapour compression refrigeration system was observed by using HFO-1336mzz(Z) and minimum by using R1234zf.
- As increasing evaporator temperature, the first law efficiency(COP) and exergy destruction ratio are increasing and the exergetic efficiency is decreasing.
- Ecofriendly R1243zf gives best first law performance slightly higher than using R1234ze(E) and lowest is using HFO-1336mzz(Z). R1225ye(Z) gives best exergetic performance slightly higher than using R1224yd(Z) and lowest is using HFO-1233zd(E).
- R1225ye(Z) gives highest EDR and lowest is using R1224yd(Z).
- HFO1336mzz(Z) gives highest entrainment ratio and lowest is using R1243zf. As increasing evaporator temperature, the entrainment ratio is decreasing.
- HFO1336mzz(Z) gives highest compression and lowest is using R1234ze(Z). As increasing evaporator temperature, the compression ratio is decreasing.

References

[1] A.A Kornhauser [1990] the use of an ejector as a refrigerant expander, proceedings of the USN/ IIR- Purdue refrigeration conference, page-10-19.

[2] Domanski, P. A. Theoretical evaluation of vapor compression cycle with a liquid-line/suction-line heat exchanger, economizer, and ejector. Nistir-5606, National Institute of Standards and Technology, March 1995

[3] Nakagawa, M., Takeuchi, H. Performance of two-phase ejector in refrigeration cycle. In Proceedings of the 3rd International Conference on Multiphase flow, Lyon, France, 8-12 June 1998, pp. 1–8.

[4] M Yari, M Sirousazar, [2007]: Performance analysis of the ejector-vapour compression refrigeration cycle, Institute of Mechanical Engineers, https://doi.org/10.1243/09576509JPE484

[5] Deng, J.-Q., Jiang, P.-X., Lu, T., Lu, W. Particular characteristics of transcritical CO_2 refrigeration cycle with an ejector. Appl. Therm. Eng., 2007, 27, 381–388.

[6] E. Nehdi, et.al.,[2007], performance analysis of the vapour compression cycle using ejector as an expander, International journal of Energy Research,31(4),364-375.

[7] Yari, M. 'Exergetic analysis of the vapour compression refrigeration cycle using ejector as an expander', Int. J. Exergy, (2008) Vol. 5, No. 3, pp.326–340.

[8] J. Sarkar, "Performance characteristics of natural refrigerants based ejector expansion refrigeration cycles," Proceedings of the IMechE, Part A: Journal of Power and Energy 2009,223, pp. 543–50.

[9] J, Sarkar et.al. [2010]: Geometric parameter optimization of ejector-expansion refrigeration cycle with natural refrigerants, International Journal of Energy Research, 34(1),84-94.

[10] J Sarkar "Ejector enhanced vapor compression refrigeration and heat pump systems—A review" Elsevier Renewable and Sustainable Energy Reviews16(2012)6647–6659.

Cite this article as: R.S. Mishra, Optimum thermodynamic performances of an ejector vapour refrigeration system using HFO ecofriendly refrigerants, International Journal of Research in Engineering and Innovation Vol-4, Issue-4 (2020), 218-223. *https://doi.org/10.36037/IJREI.2020.4406*.