Thermodynamic Analysis of Multi Evaporator Vapour Compression Refrigeration System with Individual Compressor Using Mixed Refrigerant and Comparison with Pure Refrigerant

A Major Thesis Submitted in Partial Fulfilment of the requirements for the award of the degree of

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CANDIDATE'S DECLARATION

I hereby declare that the work which being presented in the major thesis entitled "**Thermodynamic Analysis of Multi Evaporator Vapour Compression Refrigeration System with Individual Compressor using Mixed Refrigerant and Comparison with Pure Refrigerant**" in the partial fulfilment for the award of the degree of Master of Technology in "THERMAL ENGINEERING" submitted to Delhi Technological University (Formerly Delhi College of Engineering), is an authentic record of my own work carried out under the supervision of Dr. Akhilesh Arora and Prof. P.K. Jain, Department of Mechanical Engineering, Delhi Technological University (Formerly Delhi College of Engineering). I have not submitted the matter of this dissertation for the award of any other Degree or Diploma or any other purpose what so ever. I confirm that I have read and understood 'Plagiarism policy of DTU'. I have not committed plagiarism when completing the attached piece of work, similarity found after checking is 10% which is below the permitted limit of 20%.

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CERTIFICATE

This is to certify that the above statement made by ABHISHEK VERMA is true to the best of my knowledge and belief.

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ABSTRACT

Thermodynamic analysis is carried out which is based on the energy and exergy analysis of multi evaporator refrigeration system with individual compressor and multiple expansion devices using flash chamber at different temperatures of both evaporator and condenser for R12, R134a, R436a (0.52R290 / 0.48R600a) and R436b (0.56R290 / 0.44R600a). The properties of blend refrigerant (R290/R600a) are calculated using Refprop and a computational model is developed using engineering equation solver. The present work has been carried out for food freezing plant (fishes, fruits, vegetables) which works on multi evaporator vapour compression refrigeration system for evaporator-1 in the range of -30^{0}C to -15^{0}C, evaporator-2 in the range of -6^{0}C to 10^{0}C and the condenser in the range of 25^{0}C to 44^0 C. Performance parameters (total work input for the system, the coefficient of performance (COP), exergy destruction (ED) for whole system, exergy destruction ratio (EDR), exergetic efficiency) are calculated over these ranges of temperature and compared all these refrigerants.

After the performance evaluation of the system for different refrigerants, it is found that R436b (0.56R290 / 0.44R600a) has the highest COP and Exergetic Efficiency, it has also the least Total Work Input for the system and Exergy Destruction.

Now it is concluded that R436b is the best among all other refrigerants which are used for the system, and it has zero GWP. Thus it is recommended that it can be used for the replacement of R134a in the household refrigerator and food freezing plant.

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NOMENCLATURE

COP	Coefficient of Performance (non-dimensional)
ED	Exergy Destruction (kW)
EDR	Exergy Destruction Ratio (non-dimensional)
Eta or η	Efficiency (non-dimensional)
h	Specific Enthalpy (kJ / kg)
m	Mass flow rate (kg / s)
P	Pressure (kPa)
Q	Refrigerant capacity (kW)
s	Specific Entropy (kJ / kg-K)
T	Temperature (^{0}C)
TR	Tonne of Refrigeration
W	Specific Work (kJ/kg)

Subscript/Superscript

c1	Compressor-1
c2	Compressor-2
cond or c	Condenser
e1	Evaporator-1
e2	Evaporator-2
ex	Exergetic
flash	Flash tank
o	Dead state
r1	Refrigerated space at low temperature (evaporator-1)
r2	Refrigerated space at high temperature (evaporator-2)
t1	Expansion device-1
t2	Expansion device-2