Name of Scholar   :   SUNEEL KUMAR KALLA

Name of Supervisor: Prof. (Dr) J.A.Usmani

Name of Co-Supervisor: Dr. B.B. Arora (DTU)

Department: Department of Mechanical Engineering,

                                         Jamia Millia Islamia, New Delhi.

Title of the Study: Thermoeconomic Analysis of Refrigeration System

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Abstract

The objective of this study is to identify the better alternative refrigerant for HCFC R22 on the basis of coefficient of performance and exergetic efficiency with no or minimum changes in the components of the window air conditioning system.

A system model is prepared on the basis of energy and exergy analysis of vapour compression refrigeration cycle used in a window air conditioning system. This model is implemented in comparing the thermodynamic performances of the alternative refrigerants R438A and M1 through simulation with the help of CYCLE D from NIST. The performance parameters compared are coefficient of performance, exergy destruction and exergetic efficiency. Total Equivalent Warming Impact (TEWI) factor was also utilized to assess the refrigerants.

The results obtained through simulation are validated with the results obtained by performing experiments on the air conditioning test rig which is fabricated for this purpose. After validation of simulation results, parametric investigation is performed to study the effect of different system variables on the performance parameters.

The results show that the energy as well as exergy efficiency of both the refrigerants are lesser than that of R22. However, as compared to M1, R438A is energy efficient and environment-friendly alternative to replace R22 air conditioners.

The simulation results obtained were in the range of $\pm$10 % that of the experimental results.

Further, the parametric investigation revealed that heat exchanger effectiveness has no significant effect on coefficient of performance of the air conditioning system. Also, in two stage vapour compression cycle, maximum COP is achieved at an optimum intermediate pressure which differs for each refrigerant.