

# Study and Fabrication of Dual Refrigerator: A Review

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**Abstract** According to the first and second laws of thermodynamics, it's also an unavoidable byproduct of appliances like air conditioners and fridges. "The first law states that energy is neither created nor destroyed," says Buongiorno. "If one joule of energy goes into a machine that operates steadily, one joule of energy must come out." Refrigerators and air conditioners take in electricity to extract heat from orange juice and ice cream and sweltering living rooms, and that's where the Second Law comes into play: The energy expelled in the form of waste heat has a lower utility than the original energy source. "The sum of the heat extracted plus the work that went into the cooling process is discharged in the form of waste heat, and there must be a temperature difference between the machine and the ambient air in order to drive that heat out." So, here in our project we will use the waste heat to heat the foods etc and cooling compartment will be used for cooling water etc. This invention relates to a refrigeration unit and more particularly refers to a new and improved dual temperature refrigerator.

**Keywords** Dual Refrigeration; Condensation; Evaporation; Energy saving; Parameters optimization.

## Introduction

According to the first and second laws of thermodynamics, it's also an unavoidable by-product of appliances like air conditioners and fridges. "The first law states that energy is neither created nor

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This invention relates to a refrigeration unit and more particularly refers to a new and improved dual temperature refrigerator.

Refrigerator has become an essential commodity rather than need. Very few of us are aware about the fact that lot of heat is wasted to ambient by the condenser of refrigerator. If this energy can be utilized effectively then it will be an added advantage of commodity our project aims towards the same goal.

Refrigerator in simple language is removal of heat from the place where it is objectionable and dissipation of heat to the place where it is not objectionable. The working process of the refrigerator is explained as below.

**Compressor** The compressor is the heart of the refrigerator. The input power that is electricity is used to run the compressor. The compressor compresses the refrigerant(R-12 or R-134A) which is in the gaseous form to increase its pressure and temperature. The capacity(tons) of the refrigerator decides the power input to the compressor.

**Condenser** The main purpose of condenser is to transfer the heat generated in refrigerant during the compression process. The temperature of the refrigerant entering in condenser is about 40<sup>0</sup>-60<sup>0</sup>c depending input power of compressor. The atmospheric temperature is about 25<sup>0</sup>-30<sup>0</sup>c. Due to such large temperature difference heat transfer takes place from condenser to atmosphere. That means this heat is wasted to atmosphere.

**Expansion tube /valve** A capillary tube (small bore copper tube) is used to reduce pressure of refrigerant from condenser to evaporator pressure.

**Evaporator** This part is placed at the freezer compartment. The working is same as the condenser. The refrigerant boiling in the evaporator tubes takes

latent heat from surrounding and in turn cools the space.

### Literature Review

#### Literature Survey on dual refrigerator concept:

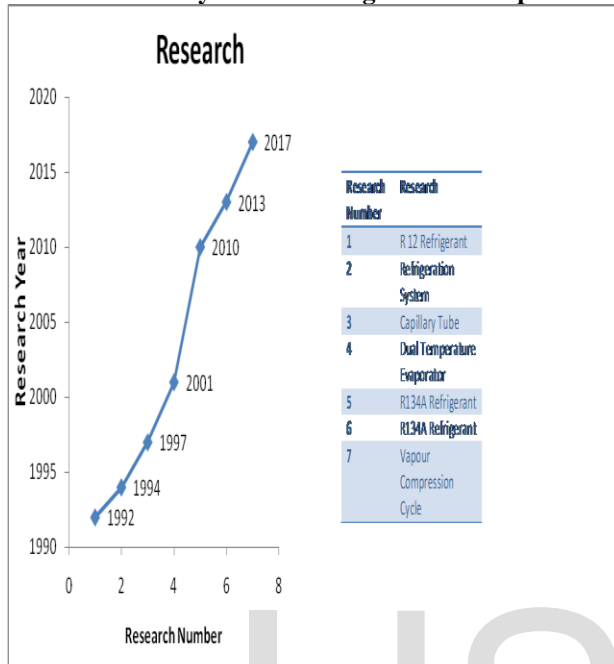


Fig.1: Graphical Presentation of review papers

J. K. Park et al [1] did the dual controlled refrigeration system is devised to enhance the energy efficiency and basic performance of an indirect cooling household refrigerator/freezer. In order to alternately serve the fresh food and freezer compartment with a conventional simple refrigeration cycle, two capillary tubes and on/off valves are adopted. S. Kelman et al [2] experimentally analyzed on performance advantages of a dual-temperature evaporator refrigerator system over a conventional design. Through extensive use of computer aided. Modeling, it is demonstrated that energy savings of at least 8-10% can be achieved. H. Ge et al [3] analyzed the A prototype refrigerator/freezer was fitted with a single evaporator, ducted so it could serve both compartments in a sequential manner. The experimental results confirmed earlier simulation analyses, which predicted that achieving maximum energy savings (approx. 15%) would require a two-speed compressor having a high/low speed ratio of 5.T. Uribe et al [4] experimental analyzed It showed that cycle periods as long as 10-25 seconds should be able to produce COP's comparable to those achievable with variable speed compressors. This project builds on those results and aims to develop ways of designing heat exchangers and other components to fully capitalize on this technology.

#### Literature Survey on Refrigerants used:

D. M. Staley et al. [5] experimentally analyzed this paper develops a steady-state system design model for a standard 18 ft3 refrigerator/freezer. Models for the compressor, condenser, evaporator, and suction line interchanger are considered. Experimental data for both R12 and R134a are used as a basis to calibrate the models and as a basis of comparison of model validity for different Refrigerants. K. J. Porter et al [6] experimentally analyzed this report describes a refrigerator/freezer system model which can run in either design or simulation mode. The results of the model are compared with data taken from a refrigerator/freezer system operating under a very wide range of conditions. M. P. Goodson et al [7] experimentally analyzed that, the development of a refrigerator/freezer model (RFSIM) that is capable of running in either design mode (user-specified superheat and sub cooling) or full simulation mode. The primary purpose was to build on the foundation of an earlier version of the model, to make it refrigerant-independent, and to compare it to experimental data. P. R. Srichai et al [8] studied a refrigerator's energy efficiency could be increased by reducing the condenser fan speed when operating at low ambient temperatures. The decrease in fan speed causes a re-distribution of charge from the condenser to the evaporator resulting in a reduction in evaporator superheat and an overall increase in evaporator capacity.

#### Literature Survey on optimization techniques used:

T. Kulkarni et al [9] studied that examined design issues of microchannel evaporators associated with the flow maldistribution caused due to header pressure gradient. The effects of mass flow maldistribution on microchannel heat exchanger were quantified by using a single port simulation model. B. P. Rasmussen et al. [10] this thesis details the efforts to develop a dynamic model of a transcritical vapor compression system suitable for multivariable control design purposes. The modeling approach is described and the developed models are validated with experimental data. The models are nonlinear, independent of fluid type, and based on first principles. S. Jain et al. [11] at off-design conditions, the compressor is either cycled or a variable speed drive enables the compressor to run at a speed that matches the load. However, cycling can incur efficiency losses as large as 10-20% of total compressor power. B. P. Rasmussen et al [12] Analysis of the linearized models and empirical models created using system identification techniques suggest that lower order models are adequate for the prediction of dominant system dynamics. M.H.Kim et al [13] studied simple semi-empirical model for small rolling-piston-type rotary compressors using the most potential alternative refrigerants R-410A

and R-407C including R-22 has been developed based on thermodynamic principles and large data sets from the compressor calorimeter test.

T. Kulkarni [14] experimentally analyzed The basic purpose of the compressor sub-model in a larger system model is to provide the refrigerant mass flow rate, power consumption and discharge states of the compressor using some given information. The usual input data are compressor geometry (displacement and clearance volume), compressor speed, suction pressure and temperature, discharge pressure, and ambient temperature. D. W. Gerlach et al [15] considers only serial connection where the refrigerant flows through the fresh food evaporator and then through the freezer evaporator without a pressure drop between the evaporators. The prototype tested had insufficient compressor power and a higher cabinet thermal conductance than designed.

X. Liu et al [16] describes the integration of component subroutines into system simulation models for air conditioners and refrigerators. The modular approach is illustrated by describing its application to a dual-evaporator refrigerator simulation. Chetan Papade et al [17] studied the performance of a vapour compression refrigeration system with and without a Matrix Heat Exchanger. The concept of analytical study of vapour compression refrigeration system using matrix heat-exchanger carried out to improve the coefficient of performance of system. Akshay Kashyap et al [18] used advanced condenser design to improve condensation of refrigerant and modification done in the evaporator section by adding thermoelectric cooler which reduces the load on compressor and simultaneously achieve cooling effect and reduce the net power consumption during period of cycle and enhance the net COP of the refrigerator. Won Jae Yoon et al [19] studied a two circuit cycle with parallel evaporators for a domestic refrigerator freezer (RF) shows energy saving potential comparing with conventional cycle with single loop or several evaporators because of low compression ration and pressure drop in evaporator in fresh food compartments (R) -Operation. Md. Nawaz Khan et al [20] explains the comparative performance analysis of vapour compression refrigeration system with four different refrigerants R12, R134a, R407 and R717. The effects of the main parameters of performance analysis such as refrigerant type, mass flow rate and condenser discharge temperature also investigated for various configuration. Jitendra Kumar Verma et al [21] reviewed available alternative refrigerants and their physical and chemical properties have been done. Selection of efficient, eco-friendly and safe refrigerant for future has been attempted in this paper through discussions.

A. Baskaran et al [22] studied performance analysis on a vapour compression refrigeration system with

various eco-friendly refrigerants of HFC152a, HFC32, HC290, HC1270, HC600a and RE170 were done and their results were compared with R134a as possible alternative replacement.

Y. Liu et al [23] describes the complete process of testing capillary tube-suction line heat exchangers. And presents preliminary data for non-adiabatic flow of R-134a in the capillary tube, as well as the comparison between the experimental data and simulation results. C. E. Mullen et al [24] developed Component submodels for a room air conditioner computer simulation and validated using data from a 1.5-ton room air conditioner. The room air conditioner was tested over an extremely wide range: both indoor and outdoor temperatures varied from 67 to 115 F. C. M. Korte et al [25] experimentally investigated effects of condensation on the air-side performance of plate-fin-tube heat exchangers x by conducting experiments under dry conditions and then repeating these experiments under condensing conditions. Sensible air-side heat transfer coefficients and friction factors are reported and compared for these cases.

## CONCLUSION

This eco-friendly concept is utilizing waste heat to heat the food and cooling compartment will be used for cooling water. This invention relates to a refrigeration unit and more particularly refers to a new and improved dual temperature refrigerator.

## FUTURE SCOPE

The refrigeration related company can introduce this project and make a new benchmark in the field also this can be a new type of product in the market. There star ratings can be considerably improved because it is based on energy saving.

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