International Journal on Emerging Trends in Mechanical & Production Engineering
Vol. 3, Issue 1 - 2019

DOMESTIC REFRIGERATOR CONCEPT CREATION AND EVALUATION OF WASTE HEAT RECOVERY SYSTEM

ABHINAV KASHYAP[*], HARIMOHAN SHARMA[*], SAURABH KHANDELWAL[*]

ABSTRACT

To fortification of international surroundings, the major thing for fuel expenditure is to persuade the vitality. Hence, it is more important for significant process as well as to preserve the energy during the waste heat recuperation. “Product Design and thermal analysis (performance) of Waste Heat recovery system intended for domestic refrigerator utilizing Ansys workbench” is the major idea of this paper. From the condenser of refrigerator, the heat will be revealed and our paper will give an attempt by employing the waste heat. We can able to use the heat which is exposed from the condenser of refrigerator for both the process such as domestic as well as industrial intentions.

KEYWORDS*:* Ansys, Thermal, Waste Head.

INTRODUCTION

The vitality which is linked with the following factors of waste flows such as air, gases as well as liquids is referred as waste heat with the intention of leaving the surface of the network in addition to penetrate into the surroundings. Squander warm which is rejected from a procedure at a temperature enough high over the surrounding temperature allows the recuperation of vitality for some valuable purposes in a financial way. The basic nature of warmth isn't the sum yet its esteem. Squander warm recuperation and usage is the way toward catching and reusing waste warmth for valuable purposes. Not all waste warmth is for all intents and purposes recoverable.

The refrigeration apparatus will be weighted by food products such as domestic refrigerator, cheese ripening room, cold room, and insulated container and so on. There are two major things for the purpose of controlling the food feature, such as knowledge of air temperature as well as velocity profiles. In close proximity to the evaporator as well as some other walls are also significant for the knowledge of the width of thermal along with hydrodynamic surface coating. It may have the chance to cause health issues due to the material is very near to the evaporator wall freezing as well as proximity to some other walls too. The foods which are stored in a domestic refrigerator will have dissimilar forms, dimensions as well as volumes which are occupied while practicing. By using the above mentioned techniques, our main objective is to innovate a CFD model of domestic refrigerator which is used to envisage the temperature as well as velocity fields in freezer along with refrigerating sections, in addition to, the comparison as well as analysis also taken for the air flow and temperature distribution within the

[*]Department of Mechanical Engineering, APEX Institute of Engineering & Technology, Jaipur.
Correspondence E-mail Id: editor@eurekajournals.com

 ISSN: 2581-4486

freezer as well as refrigerating parts inside and outside the shelves.

THE PHYSICAL MODEL

To facilitate a domestic frost-free refrigerator, CFD simulation has been used. The air stream as well as temperature allocation will be analyzed in inside and outside shelves as well as freezer and refrigerating sections are modelled individually. Here 230 litres of domestic frost-free refrigerator will be regarded; hence, the evaporator will not be directly represented to the refrigerating sections. To cool as well as dehumidify at the same time, air is prepared to flow the evaporator firstly. After that, the cold as well as dry air will be carried into the sections. From the materials which are being refrigerated, the above mentioned cold air will take heat as well as wetness along with their environment; moreover, it becomes warm as well as humid in the mentioned procedure.

The evaporator will be streamed by air which is placed at the backend of the freezer anywhere it is cooled along with dehumidified. In this manner the fan blows the virus air into the cooler delta from which a segment streams into the cooler while the rest enters the refrigerating compartment. Here the cooler as well as refrigerating compartment is accepted as isolated units.

ASSUMPTIONS

- Among freezer as well as fresh food sections are eliminated in heat transfer.
- In isothermal walls, the condenser as well as evaporator coils will be determined due to isothermal phase variation processes linked along with these factors.
- At the inlet pipe, the temperature profiles along with uniform velocity will be considered.
- A relentless state case is being broke down. As a general rule there is a persistent on and off cycling for blower which conveys transient nature to the issue.
- In an unbalanced limitation, the refrigerator will be analyzed; moreover, two factors will not be considered such as effects of air leakage or else frosting and the linked mass transfer method.
- Within the refrigerating section, Boussinesq supposition will be used for the purpose of flow modelling which is governed through assorted convection.
- Also inside the refrigerator, radiation heat transfer will not be considered. No other walls are in direct contact along with the evaporator in the refrigerating compartment.
- The stream is thought to be laminar in both the compartments.
- Fluid stream is taken to be incompressible.

FREEZER COMPARTMENT

The dimensions of freezer section will be given in table 1. By using the inner inlet port, the cold air will penetrate into the section. From the interior inlet port, some section of air will come out and it goes into the section over the shelf as well as enduring air penetrates in a straight into the region under the shelf by using the gap among the back wall as well as shelf. At -18°C, temperature will be supervised in freezer section.

REFRIGERATING COMPARTMENT

At the top of the section, inlets will be placed. The frosty air in the wake of getting in to the front channel streams downwards as well as goes up against the chiller divider along with in the long run re-circles inside the compartment. This air in the wake of returning from the chiller blends with the air blown through the back gulf port. The blended air plunges because of lightness circles through the racks lastly exits through the entryway racks.

 ISSN: 2581-4486

Table 1.Dimensions of model freezer compartment

Content	Dimensions
Height	370 mm
Weight	410 newton
Depth	400 mm

Table 2.Dimensions of model refrigerating compartment

Content	Dimensions
Height	811 mm
Weight	410 newton
Depth	510 mm

To eradicate heat from interior spaces or else materials, we implemented an air conditioning / refrigeration method as well as it will be discarded to the exterior air. In air, the heat elimination will occurrence in a straight line, in several conventional air source parts, or else to circulate water by commencing with a cooling tower. In the exterior cooling water, the heat will be eliminated by the flow of water. Heating water will be the finest as well as mainly obvious form of heat recuperation.

HOW MUCH HEAT IS AVAILABLE?

To know the available heat which is to be recuperation, we use heat recovery creates a sense for an application prior to its decision. From the space along with heat of compression, we can able to know the entire heat which is obtained. Furthermore, to recovery the heat, there are 4 regions such as,

1. The condenser
2. Superheat in the discharge gas
3. Compressor jacket or oil coolers &
4. Totally enclosed water-cooled motors.

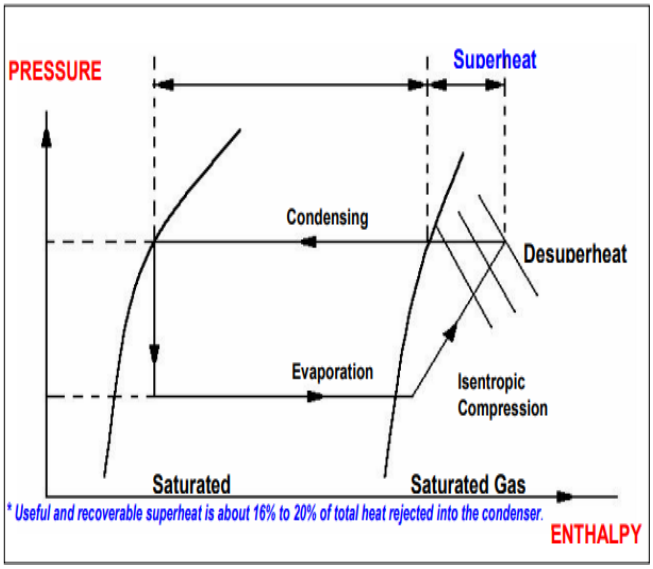

Figure 1.Typical Refrigeration cycle

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SIMULATION AND RESULTS

GEOMETRY

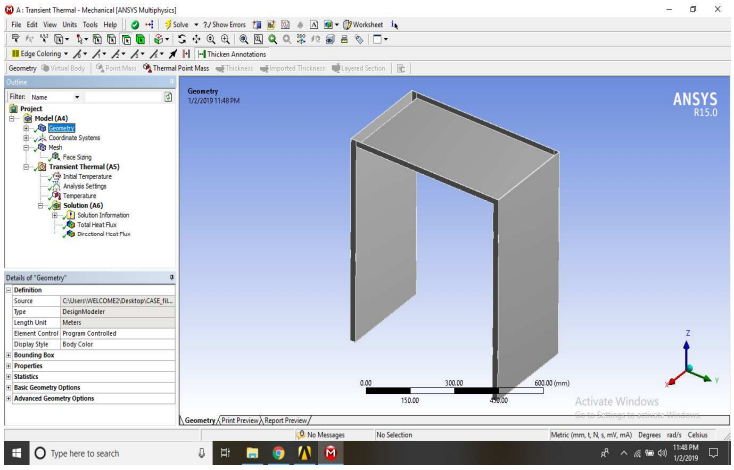

Figure 2.The geometry view of the model

MESH VIEW

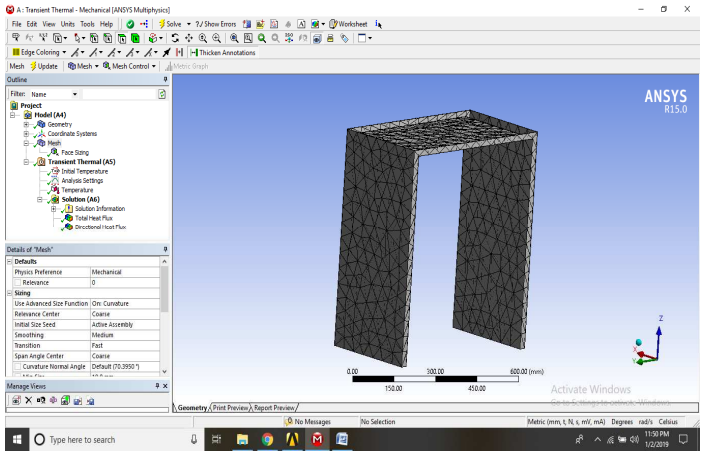

Figure 3.Mesh View of the model

TRANSIENT THERMAL (AS) FOR TOTAL HEAT FLUX

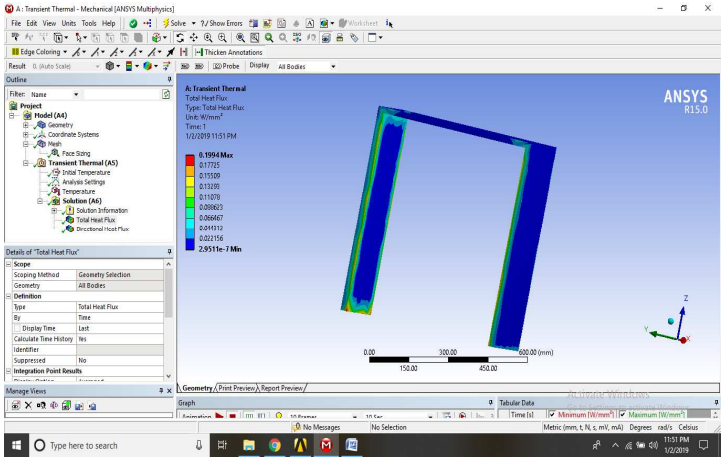

Figure 4.Transient Thermal view for total heat flux

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TYPE – Total Heat Flux UNIT – W/mm^2

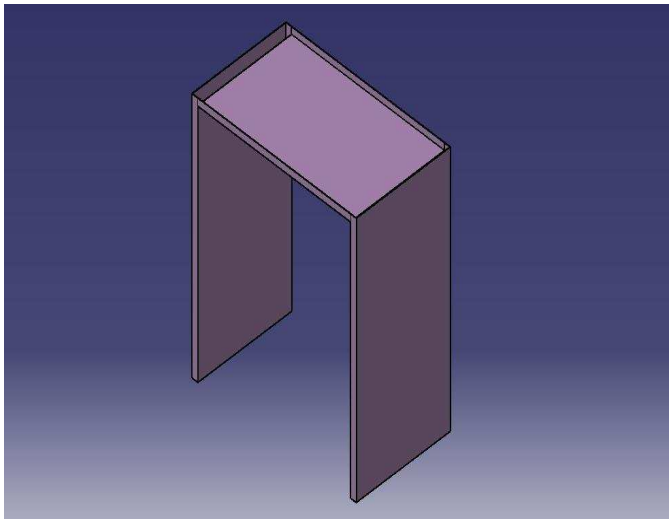

Figure 5.Ansys Result(I)

PROBLEM FORMULATION AND PROPOSED SOLUTION

First to sketch the case dimensions in CATIA V5 and create a solid part of case using SHELL and EXTRUSION commands. SAVE in project folder Open ANSYS WORKBENCH 15:

1. In ANSYS WORKBENCH 15 various analysis options available on right side . Now we are going to do thermal analysis. So choose the transient thermal analysis.
   - Double click on trasient thermal analysis.
   - mini toolbar shown on white space
2. To assign the material on the material data. For our analysis we choose the material as STEEL.
3. And next double click on the GEOMETRY on the mini toolbar.

A new window is opened with a GUI. In this GEOMETRY mode we can import our case.

FILE import select catpart file.

After import close the window

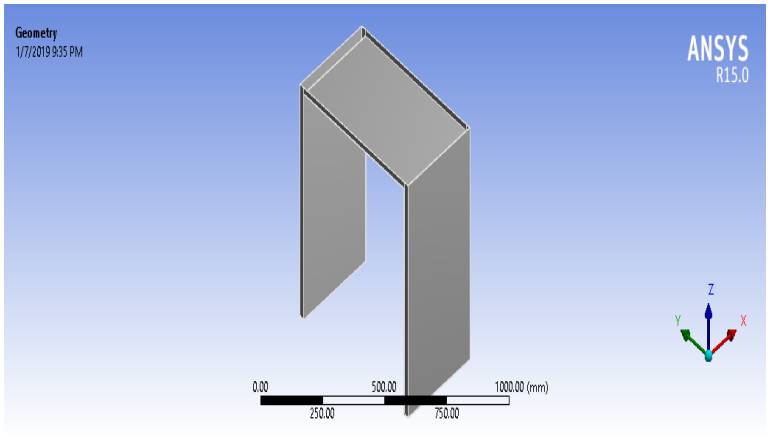

Figure 6.Ansys Result(II)

Hereafter Click the MODEL on Toolbar. Window is opened with an imported model .to mesh the model by clicking MESH on tree located on right side.

 ISSN: 2581-4486

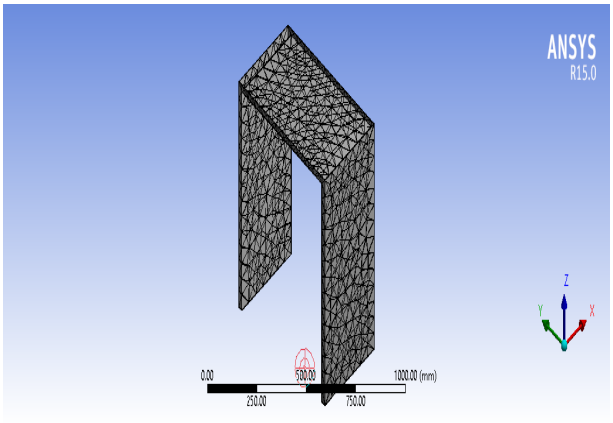

Figure 7.Ansys Result(III)

Finally we can apply the temperature on both sides of wall about 50.6 degree celcius by clicking TEMPERATURE sub tree of TRANSIENT THERMAL on tree located on right side.

RESULT

Model (A4) > Transient Thermal (A5) > Solution (A6) > Solution Information > Temperature - Global Maximum.

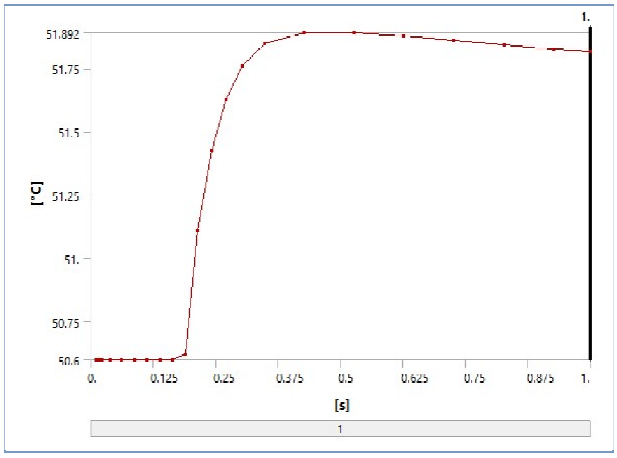

Figure 8.Graph of Transit Thermal (A4)

Model (A4) > Transient Thermal (A5) > Solution (A6) > Solution Information > Temperature - Global Minimum.

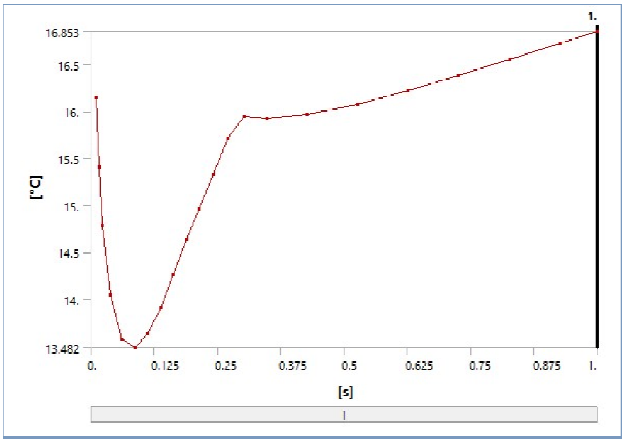

Figure 9.Graph of Transit Thermal (A4)

 ISSN: 2581-4486

CONCLUSION AND FUTURE WORK

It is concluded that our proposed system performs much better and based on the six parts in the proposed system we can easily achieve the detection for the mining industry. Here, we are solved the problems which occur in the previous research. The block diagram shows the variation and specification units of the developed system. We can easily find the absorption level of the harmful gases, to remove the helmet and to identify the period of helmet is on the miner's head by using the helmet IR sensor.

REFERENCES

[1]. G. E. Stinson, C. J. Stuman, D. J. Warburton, " A dairy refrigeration heat recovery unit and its effects on refrigeration operation" , J. agric. Engng Res. (1987) 36, 275-285.

[2]. Milind V. Rane, Madhukar S. Tandale, "Benefits of superheat recovery on chillers case study for a hotel installation", International Congress of Refrigeration 2003, Washington, D.C.

[3]. S. C. Walawade, B.R Barve, P. R. Kulkarni, "Design and Development of Waste Heat Recovery System for Domestic Refrigerator", IOSR Journal of Mechanical and Civil Engineering, ISSN: 2278-1684, PP: 28-32.

[4]. F.N.Yu, K.T.Chan, "Improved condenser design and condenser-fan operation for air-cooled chillers", Applied Energy, Vol.83 (2006) 628-648.

[5]. Alexander Cohr Pachai Johnson Controls Building Efficiency "Energy consumption and heat recovery of refrigeration systemin modern Arena".

[6]. G. E. Stinson, C. J. Stuman, D. J. Warburton, "A dairy refrigeration heat recovery unit and its effects on refrigeration operation" , J. agric. Engng Res. (1987) 36, 275-285.

[7]. Milind V. Rane, Madhukar S. Tandale, "Benefits of superheat recovery on chillers case study for a hotelinstallation", International Congress of Refrigeration 2003, Washington, D.C.

[8]. S. C. Walawade, B.R Barve, P. R. Kulkarni, "Design and Development of Waste Heat Recovery System for Domestic Refrigerator", IOSR Journal of Mechanical and Civil Engineering, ISSN: 2278-1684, PP: 28-32.

[9]. F.N.Yu, K.T.Chan, "Improved condenser design and condenser-fan operation for air-cooled chillers", Applied Energy, Vol.83 (2006) 628-648.

[10]. Alexander Cohr PachaiJohnson Controls Building Efficiency "Energy consumption and heat recovery of refrigeration system in modern Arena" E Transactions on Communications 61(2), 769-780 (2013) Cross Ref Google Scholar.

[11]. Cortella G, Manzan M, Comini G, CFD simulation of refrigerated display cabinets" International Journal of Refrigeration, 24, 2001.

[12]. Ding G, Zhang C, Lu Z, Dynamic simulation of natural convection bypass two circuit cycle refrigerator-freezer, Applied Thermal Engineering, 24, 2004, 1312-1320.

[13]. Guo-Liang Ding, Hong-Tao Qiao, Zhi-Li Lu, Ways to improve thermal uniformity inside a refrigerator, Applied Thermal Engineering, 24, 2004, 1827-1840.

[14]. Jaramillo J, Rigola J, Perez-Segarra CD and Oliet C, Numerical study of air inside refrigerating compartment of frost-free domestic refrigerators, International Journal of Refrigeration, 37, 2000.

 ISSN: 2581-4486