ISSN:0971-1260
Vol-22-Issue-4-October-December-2019

A Study of Design and human comfort on Thermoelectric Cooling Helmet

[1]Shaleen Sharma, Shaleens7@gmail.com
[2]Sumit Sharma, Sumit260793@gmail.com

Abstract

A new cooling helmet which is cooled by thermo-electric refrigeration with combination of Peltier plate, heat sink, forced fan, battery. Thus, achieves cooling effect on human head. The considering human comfort, human thermoregulatory system. Test conducted on Greater Noida highway, India shows considerable good result. A motorcycle helmet is a type of helmet (protective headgear) used by motorcycle riders. The primary goal of a motorcycle helmet is motorcycle safety - to protect the rider's head during impact, thus preventing or reducing head injury and saving the rider's life. Some helmets provide additional conveniences, such as ventilation, face shields, ear protection, intercom etc.

Key words: motorcycle, thermoregulatory, helmets etc.

Introduction

The origins of the crash helmet date back to the Brook lands race track in early 1914 .where the medical officer, a Dr Eric Gardner, noticed he was seeing a motor cyclist with head injuries about every 2 weeks. He got a Mr. Moss of Bethnal Green to make canvas and shellac helmets stiff enough to stand a heavy blow and smooth enough to glance off any projections it encountered. He presented the design to the Auto-Cycle Union where it was initially condemned, but they later converted to the idea and made them compulsory for the 1914 Isle of Man TT races, although there was resistance from riders. Gardner took 94 of these helmets with him to the Isle of Man, and one rider who hit a gate with a glancing blow was saved by the helmet. Dr Gardner received a letter later from the Isle of Man medical officer stating that after the T.T. they normally had "several interesting concussion cases" but that in 1914 there was none. Carpenter observed that motorcycle rider feel that their helmet interior reaches 130°F during hot days. He dispelled this myth by actually measuring the temperature which indicated that the interior quickly rises to body temperature 98.6°F and can edge to 100°F.

Moreover, today's demand is not only safety but safety cum comfort.

Reasons for not wearing helmet

Most of the people vehemently against wearing helmets while riding motorcycle in India because of following reason:

1) Young adult don't think that it is cool to wear a helmet.

ISSN:0971-1260
Vol-22-Issue-4-October-December-2019

2) Main reason that people feel discomfort while wearing a helmet because of hotness occur inside helmet in summer day's
3) When travelling short distance, motorcyclists feel that they are less likely to have a crash but many accidents occur at short distance.
4) Young adult worry that if they wear helmet they will mocked by their peers.
5) It is often cited that helmets mess up one's hair & especially may not fit properly over women's hair style. It is obvious many of us choose 'hair style' over 'helmet'

TYPES OF REFRIGERATION SYSTEM:

- Vortex tube refrigeration system.
- Pulse tube refrigeration system
- Peltier plate.

Designs of helmet in Auto CAD

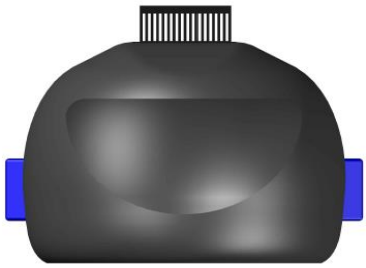

Fig: - (front view of helmet)

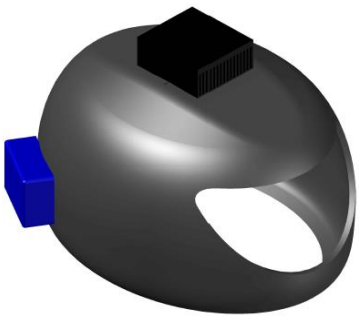

Fig: - Isometric view of helmet**.**

ISSN:0971-1260
Vol-22-Issue-4-October-December-2019

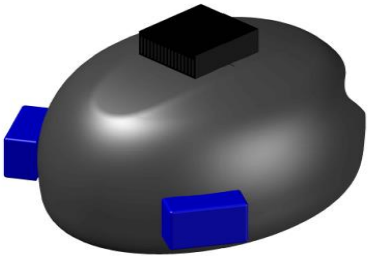

Fig: -back view of helmet.

HUMAN COMFORT

Thermal comfort is defined as that condition of mind which expresses satisfaction with thermal environment. Thermal comfort may vary from person to person. Sometimes it is called neutral condition.

Shows that at neutral condition the temperature should be:

Skin temperature, T_{skin} =33.7^0 c

Core temperature, T_{core} =36.8^{0}c

Human body is warm blooded .it is like a heat engine as it also takes some chemical energy in terms of fuel and converts part of fuel into work and rest part into heat .

What is metabolism?

The process of conversion of chemical energy contained in food in to the heat and working is called metabolism.

What do you mean by metabolic rate?

The rate at which the chemical energy is converted in to heat and work is called metabolic rate.

What the need to understand the metabolic rate for making a refrigeration system

When we discuss air conditioning system we need to know metabolic rate because finally we shall see that whatever energy human body consumes in the form of food is ultimately rejected in the form of heat, once it is rejected from the body it becomes load or it becomes a cooing load on air refrigeration system.

Thermal efficiency of human body:

ISSN:0971-1260
Vol-22-Issue-4-October-December-2019

Similar to a heat engine, one can defined thermal efficiency of a human being as the ratio of "useful work output to the energy input". The thermal efficiency of human being can vary from 0% to as high as 15-20% for a short duration. NOTE- For most of the calculation we considered thermal efficiency of human being as "0".Irrespective of work output , a living human being(body) continuously generate heat at a rate varying from "100 w to as high as 2000 w" continuous heat generation is essential as the temperature of the body has to be maintained within narrow range . The body temperature must be maintained within narrow range to avoid discomfort and within somewhat wider range, to avid danger from cold and hot stress at neutral condition the temperature should be. Skin temp, skin=33.7^0 c core temp, core=36.8^0c all other temperature, the body will feel discomfort or it may become lethal.

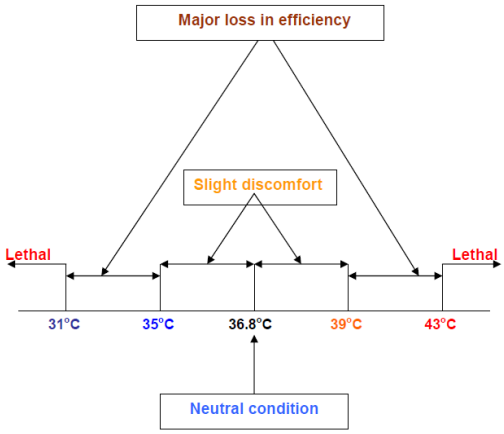

Fig :- human comfort or discomfort at different temperature.

When the temperature is lower than 35 and higher than 39 then people suffer major loss in efficiency. It becomes lethal when temperature falls below 31c or rise above 43c.

The heat generation rate(Qgen) is given by the formulae

$$Qgen = M(I - \eta) \approx M$$

Where,

Q_{gen} = heat generated in w/m^2

Assuming for calculation purpose η =0

The metabolic rate depends on the activity, it is measured in the unit called "met".

CALCULATIONS:

ASSUMPTIONS:

ISSN:0971-1260
Vol-22-Issue-4-October-December-2019

Assumptions required to be taken for calculation.

1. For calculation process the human body is considered to be a cylinder.
2. It is assumed that uniform heat is generated.
3. It is also assumed that uniform heat is dissipated.

The surface area over which the heat dissipation takes place is given by DU BOIS equation.

$$A_{du} = 0.202\ m^{0.425}\ h^{0.725}\ldots\ldots(1)$$

Where m = mass in kg, H= height in metre.

MACHINING DONE ON HELMET:

We have mainly used a twist drilling machine for our project.

Drill operation: Drilling is the process of producing cylindrical hole in the work piece.

Twist drill: A drill having deep helical grooves extending from a point to the smooth portion of the shrank

Steps involved:

1. **To fix Peltier plate:**
   a. Drill four holes in X- direction and four holes in Y- direction.
   b. Now use filing to remove extra material so that our Peltier plate can be fixed in that cut portion.

Fig: fix Peltier plate

ISSN:0971-1260
Vol-22-Issue-4-October-December-2019

2. To fix the fan with cooling chamber :

We drill a hole using a twist drill having a hole using a twist drill having the following dimensions.

DAIMETER = 3mm

No. of holes = 4 mm

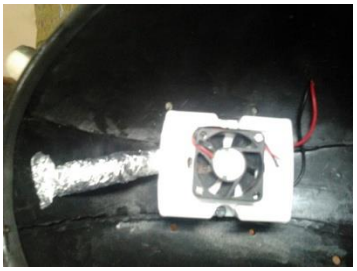

Fig:- fix the fan with cooling chamber

3. For fixing the pipe on the front side of the helmet

a. We drill a hole using twist drill of diameter 12.5mm and no. of holes is single.

4. To fix the two batteries at the back side of helmet :

a. We drill a hole using twist drill having diameter 4mm and no. of holes 4

Fig:- fix the two batteries at the back side of helmet

5. To fix the heat sink at the top of the helmet we drill 4 holes using twist drill.

No. of holes =4

Diameter =4mm

ISSN:0971-1260
Vol-22-Issue-4-October-December-2019

Conclusion

The prototyping of a cooling system based on thermoelectricity for a motorcyclist helmet has been done. The targeted cooling performance is achieved and future improvements will be carried out to enhance the cooling performance of the design. This will include the use of higher power thermoelectric. This can be a very effective solution mainly for the people living in high temperature zones.

Reference

[1] Carpenter, B., 1987. Heads, Helmets and Heat.

[2] Bill, C., 2009. Zeus ZS-806 Helmet Review.

[3] Tan, F.L. and S.C. Fok, 2006. Cooling of helmet with phase change material. Journal of Applied Thermal

[4] Engineering, 26: 2067-2072

[5] A Carpenter, B., 1987. Heads, Helmets and Heat. Road dissipate the heat. Rider Magazine.

[6] Bill, C., 2009. Zeus ZS-806 Helmet Retrieved October 2, 2009.

[7] Buist, R.J. and G.D. Streitwieser, 1988. The Thermoelectrically cooled helmet. Proceedings of the 17

[8] International Thermoelectric Conference, Arlington, TX, USA, pp: 88-94.

[9] Prange, M., 2003. Presentation at the Review of Pediatric Head and Neck Injury Conference held at the

[10] Childern's Hospital of Philadelphia, Philadelphia, PA.

[11] Johnson, D.A. and J. Bierschenk, 2005. Latest developments in thermoelectrically enhanced heat sinks.

[12] Electronics Cooling.. Retrieved March 8, 2009.