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Helmet Cooling Ways and Methods

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A B S T R A C T

The helmet is used for the safety of bike riders. It is also used by cyclists, workers, soldiers, and many others. They wear helmets for a long period causing an obstacle in heat dissipation through the head. This percolation of heat in the helmet causes physiological and psychological discomfort. A survey of different methods for improving comfort in the helmet is done and a discussion over some methods and scope of improvement is done in this paper.

Keywords: Helmet cooling, PCM, Peltier effect cooling, Air conditioning of helmet

1. Introduction

The helmet used by bike riders and cyclists has a layer of foam in the inner cavity to protect them from any sudden damage to the head. As riders use helmets for a certain time but have to focus on dynamic conditions on road. Better focus and concentration need a good mental and physical comfort level, which might get deteriorate because of increasing temperature in the helmet due to lack of ventilation. It also obstructs the heat flow because of the plastic or fiber body which is a bad conductor of heat. The helmet body doesn't allow heat to escape from the helmet through a small vent is provided on it.

2. Methodology

A tremendous amount of research is going on this problem statement which needs an economical, reliable solution for maintaining heat in the helmet under comfort limit. This problem is managed by wearing a piece of cloth under a helmet which soaks sweat, but not a solution as it is not a remedy.

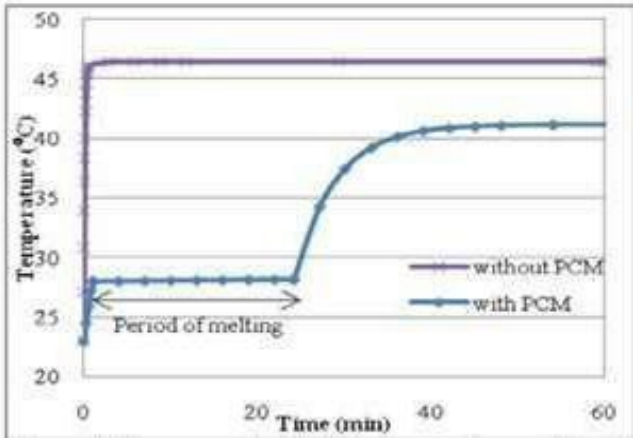

Fig. 1 - Temperature vs Time with and without PCM [1]

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During winter helmet wearing is still not that uncomfortable as it is in summer. Especially in India temperature starts rising from the month end of February till the middle of June. The temperature ranges from 38℃ to 45℃ and at some places, it reaches 48℃ also. Whereas some researchers show that when the ambient condition is 38℃ the temperature inside the helmet reaches 38℃ in a further 20min. (farookhnia, 2012) In this research article use of phase change material (PCM) is done by varying the thickness of the cooling pad filled with PCM. This cooling pad acts as a heat sink and controls the temperature of the helmet cavity under the limit. The cooling pad was filled with CaCl2.6H2O.

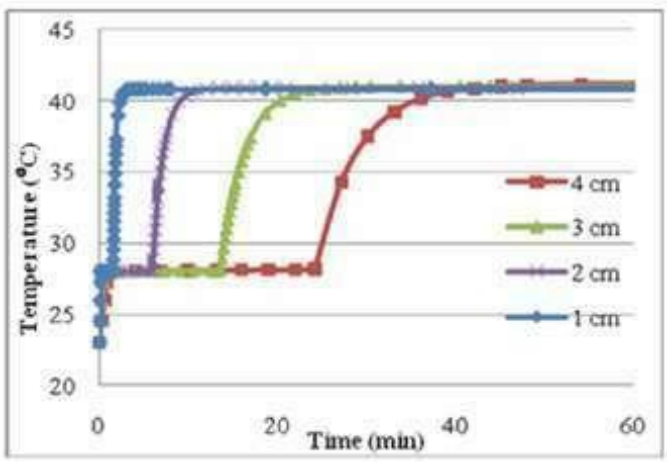

Fig. 2 - Temperature vs Time graph with variable thickness of cooling pad [1]

The property table of CaCl2.6H2O, used by researchers is mentioned below.

Table 1 – Property table of PCM

Description	Value
Melting point	28°C
Latent heat	188340 (J/kg)
Specific Heat Capacity (Solid Phase)	1430.5 J/kg°C
Specific Heat Capacity (Liquid Phase)	2312.6 J/kg°C
Thermal Conductivity (Solid Phase)	1.09 W/m°C
Thermal Conductivity (Liqulid Phase)	0.54 W/m°C
Density (Solid Phase)	1710 kg/m3
Density (Liquid Phase)	1500 kg/m3

The results were quite satisfying as it maintains thermal comfort under the helmet for a long time but the limitation was observed by them is PCM needs to be charged in a cycle of discharged too.

The use of the Peltier effect was also experimented for solving the same problem of the helmet. The use of the Peltier effect provides the mode of power generation which is utilized for adding features to the helmet which results in safety, prevention, and need. Use of the Peltier effect is done to optimize the heat gradient. To implement this mentioned effect inside the helmet project uses the principle of the Peltier effect which states that "whenever two dissimilar metals are joined to form two junctions and electricity is passed through it, heat is absorbed at one junction while heat is r eleased at the other junction". In this project, they have used the cold junction to make the helmet cool during hot summers and the hot junction can be used to make the helmet warm in cool winters (Animesh,2019). This use of the Peltier effect results in the air-conditioned helmet for the rider. The extra features that were added to this helmet model are SOS, GPS, mobile charging. All these features including air conditioning were done by harnessing low-grade energy from the helmet is converted it to high potential energy by using a boost converter to recharge a 12V rechargeable battery and to run all the features of a comfortable helmet.

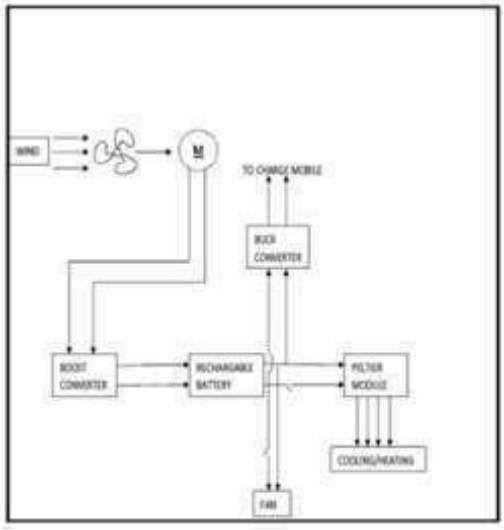

Fig. 3 - Circuit diagram for Peltier effect helmet cooling [2]

The experiment resulted in a cooling of 4.3℃ in 4 min and was able to maintain the temperature at 28℃ with a cooling rate of 1.075℃/min.Chelliah.et al used simulation method by preparing a model in solid works and simulating it in CFD. As a heat sink PCM is used which wrapped in Aluminium foil. Glauber salt is used as a PCM in this experiment. Amount of PCM used is 0.02kg which is having latent heat capacity as 251000j/kg. In the experiment set up when 0.02kg of Glauber salt is used as heat sink was capable of absorbing heat of 5020 joules. This gives an exact amount for a second to 1.121 joules. This is 1.121 joules of heat per second has the ability to maintain temperature in the helmet for 1.24 hrs while driving with temperature approximated to 30℃. (Chelliah,2015)

3. Conclusions

A better source of maintaining thermal comfort in helmet while driving is using PCM but the limitation of using PCM is its limited heat capacity.

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