

A Brief Study on How Winter Cloths Can Be Made Thin and Light

Md. Al-Amin

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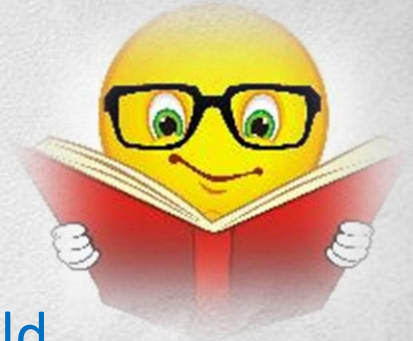
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Introduction

- There is no standard method for defining cold wave. Temperature extremes are generally determined based on local weather.
- In 2015 in USA, more than 800 people died from extreme cold exposure which is more than heat exposed death (Dec 17, 2016 The Washington Post)
- In Bangladesh, every year more than 1000 people die from cold weather-related illness or diseases.



Background



- A lot of research have been done on cold weather hazards but comparatively few on cold weather cloths in USA.
- Most researches on winter clothing have been done by people from Asian and European countries.
- Specially clothing parameters have been emphasized in research papers.

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Outline

- ❑ Key Factors of Controlling Temperature.
- ❑ Key Fabric Compositions.
- ❑ Innovative Research.



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Key factors of controlling temperature

- Static and Dynamic Motion.
- Clothing Insulation

- **Intrinsic clothing insulation:**

It is the resistance of heat from the skin to the clothing surface.

- **Total clothing insulation:**

It is the resistance of heat from the body surface to the environment and includes the air layer around the clothed body.



Key factors of controlling temperature

- **Thermal Conductivity:**

It is the property of a material to conduct heat.

- **Thermal Diffusion:**

It is the heat flow through the air in fabric structure. If the structure of the material sets is closed on both sides can limit the thermal diffusion.



Key factors of controlling temperature

- **Thermal Absorption:**

It is a surface property responsible for 'cool/warm' feelings.

- **Thermal Resistance:**

A strong relationship was observed between the value of thermal resistance of **material and their thickness**.



Key factors of controlling temperature

○ **Fabric Layer:**

- Multilayer fabric is more effective for thermal resistance than single layer fabric because of its property of entrapping air into it.
- Appropriate layer arrangement within a multilayer may change the heat and water vapor transfer and the condensation distribution.
- Both selection of materials and layer manipulation should be considered for the design of cold weather clothing.



Key Clothing Materials

- **Cotton & Wool**

- Much higher values of thermal absorption than the thermal insulation materials.
- Better warm feelings than others
- Greater heat conductors.

- **Polyester**

- Absorbs less moisture but insulates better.

- **Non woven**

- Lower thermal conductivity than the woven fabrics.

- **Insulating materials**

- Lowest thermal conductivity than any other materials.



Innovative Research

○ **Electro Spun Ultrafine Phase Change Fiber**

An advanced technique for generating ultrafine fibers and found to be almost similar in insulating properties like traditional fiberglass.

○ **Phase Change Material/Polymer (PCM)**

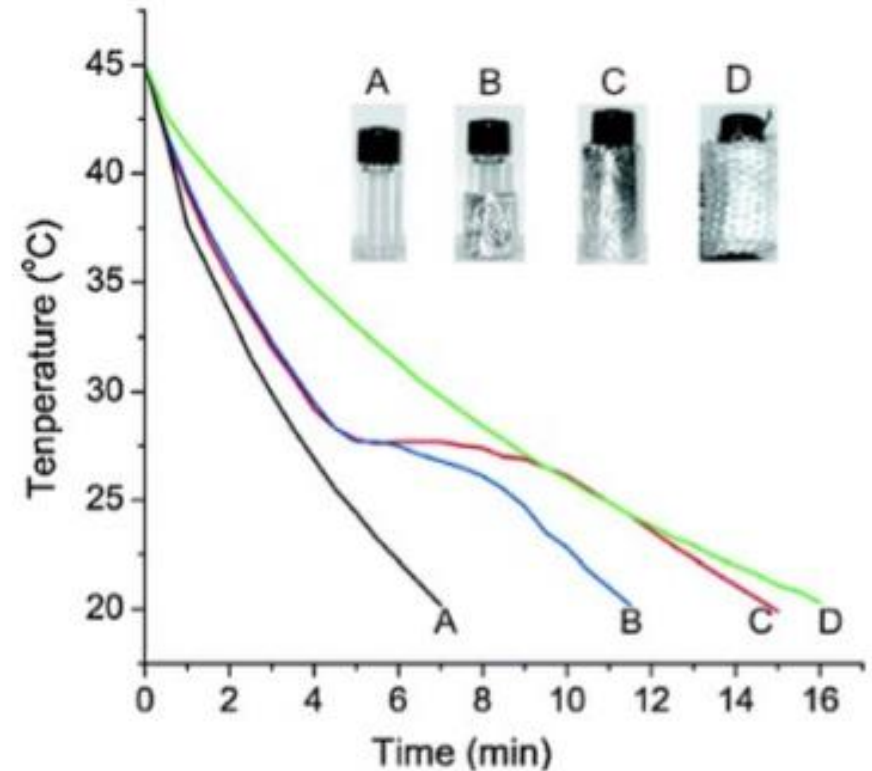
- The latent heat storage materials, commonly known as phase change materials (PCM).
- Capable of absorbing and releasing large quantities of latent heat.
- Required for cooling and heating applications in various research fields and industries.

○ **Induction Heatable Clothing/e-Textile**



A Research Experiment

1 cm³ of water at 60 °C was allowed to cool in a 4 °C .
Sample A - no insulation,
Sample B- half covered with the PCM nanofiber jacket,
Sample C - fully covered by the PCM nanofiber jacket.
Sample D - covered by a jacket of conventional fiberglass.



(Wu et al., 2018)



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Scopes and Implications

- Insulation value
- Layer manipulation
- Electro Spun Ultrafine Phase Change Fibers
- Phase Change Materials
- e-Textiles



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Questions?



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