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

Md. Al-Amin[1]

[1]Affiliation not available

December 27, 2023

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

Md. Al-Amin

HDFS 8813: Seminar in HDFS

Mississippi State University

MISSISSIPPI STATE
U N I V E R S I T Y™

School of Human Sciences
Fashion Design and Merchandising

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
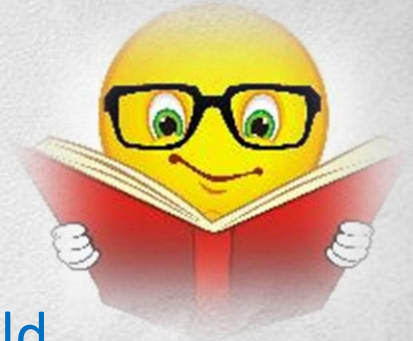
o A lot of research have been done on cold weather hazards but comparatively few on cold weather cloths in USA.

o Most researches on winter clothing have been done by people from Asian and European countries.

o Specially clothing parameters have been emphasized in research papers.

Outline

❑Key Factors of Controlling Temperature.

❑Key Fabric Compositions.

❑Innovative Research.

Key factors of controlling temperature

o Static and Dynamic Motion.

o 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

o **Thermal Conductivity**:

It is the property of a material to conduct heat.

o **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

o **Thermal Absorption**:

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

o **Thermal Resistance:**

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

Key factors of controlling temperature

o **Fabric Layer:**

➤ Multilayer fabric is more effective for thermal resistance then 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

o **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.

o **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.

o **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.
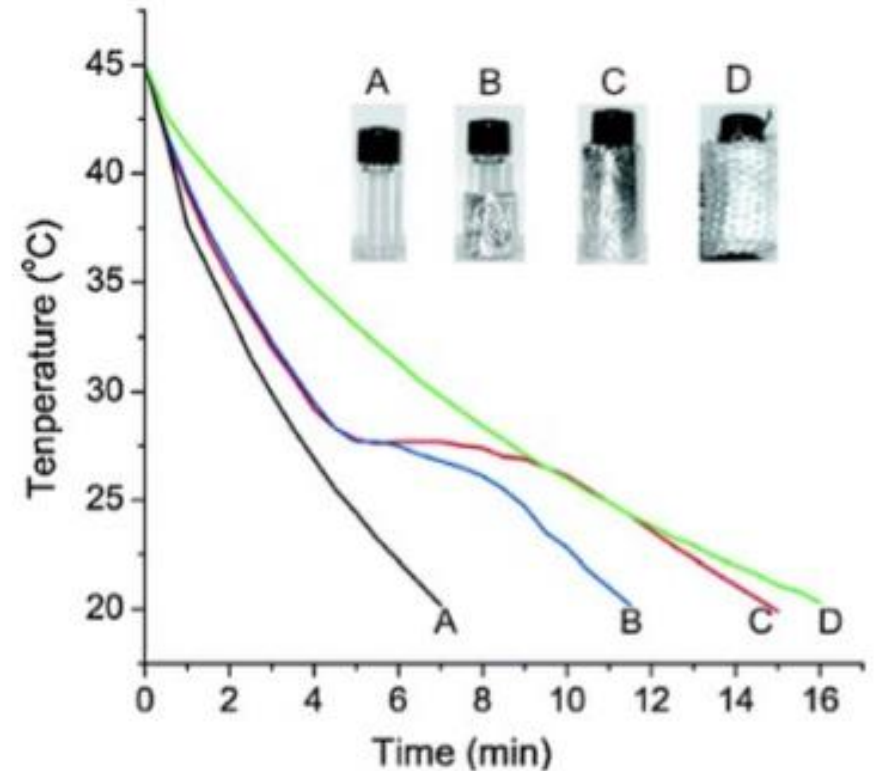
(Wu et al., 2018)

Scopes and Implications

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

References

1. Nelson, C. N. & Henry, W. N. (2000). Static and dynamic insulation values for cold weather protecting clothing. In *Performance of protective clothing: Issues and priorities for the 21st century. 7*, (pp. 233-247). *West Conshohocken, PA:* American society for testing and materials.
2. Huang J. (2006), Thermal parameters for assessing thermal properties of clothing. *Journal of thermal biology*, *31*, 461-466. doi: 10.1016/j.jtherbio.2006.03.001
3. Matusiak, M. (2006). Investigation of the thermal insulation properties of multilayer textiles. *Fibres & textiles in eastern Europe*, 14 (5), 98-102.
4. Crespy, D. & Rossi, R. M. (2007). Temperature-responsive polymers with LCST in the physiological range and their applications in textiles. *Polymer international*, 1461-1468. doi: 10.1002/pi
5. Wu, H. & Fan, J. (2007). Study of heat and moisture transfer within multi-layer clothing assemblies consisting of different types of battings. *International journal of thermal sciences, 47*, 641-647. doi: 10.1016/j.ijthermalsci.2007.04.008
6. Kwon, J. & Choi, J. (2012). The relationship between environmental temperature and clothing insulation across a year. *International journal of biometeorology, 56*, 887-893. doi: 10.1007/s00484-011-0493-7
7. Noyan, E. C. B., Onder, E., Sarier,N. & Arat, R. (2018). Development of heat storing poly(acrylonitrile) nanofibers by coaxial electrospinning. Thermochimica acta, 662, 135-148. doi.org/10.1016/j.tca.2018.02.008
8. Wu, Y., Chen, C., Jia, Y., Wu, J., Huang, Y. & Wang, L. (2018). Review on electrospun ultrafine phase change fibers (PCFs) for thermal energy storage. Applied energy, 210, 167-181. doi.org/10.1016/j.apenergy.2017.10.117
9. Matusiak, M. & Sybilska, W. (2016). Thermal resistance of fabrics vs. thermal insulation of clothing made of the fabrics, *The Journal of The Textile Institute*, 107, 842-848, doi: 10.1080/00405000.2015.1061789
10. https://patents.google.com/patent/US7816632B2/en
11. Ashraful Alam, M., Al-Amin, M., & Islam, A. (2023). A Critical Review on Synthesis and Sensing: Implications of Carbon Nanotube Development for Future Technologies. *International Journal of Innovative Science and Research Technology*, 8(9). DOI: 10.5281/ZENODO.8409143
12. Al-Amin, M., Hossain, T., & Islam, J. (2021). The Technology Development and Management of Smart Manufacturing System: A Review On Theoretical and Technological Perspectives. *European scientific Journal.* 170-193.
13. Al-Amin, M. (2020). *A comparative study of mechanical performance characteristics between treated and untreated ham nets*. Mississippi State University.
14. Budhathoki-Uprety, J., Chen, Y., Drago, J., Godthi, N., & Sultana, N. (2020, November). Polymer Functionalized Nanocarbons for Biomedical Applications. In *Electrochemical Society Meeting Abstracts prime2020* (No. 67, pp. 3411-3411). The Electrochemical Society, Inc..
15. Sultana, N., Dewey, H., & Budhathoki-Uprety, J. (2023, May). Development of Optical Nanosensors for pH Measurements in Model Biofluids. In *243rd ECS Meeting with the 18th International Symposium on Solid Oxide Fuel Cells (SOFC-XVIII)*. ECS.

Thank You

Questions?

MISSISSIPPI STATE
UNIVERSITY™

School of Human Sciences
Fashion Design and Merchandising