DEVELOPMENT OF THERMO REGULATED FABRIC USING PHASE CHANGE MATERIAL - A CRITICAL REVIEW

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ABSTRACT

Phase change materials changes its phase from state to state like solid, liquid or gas. Most commonly used PCM is Polyethylene Glycol (PEG). Phase Change Materials depends on phase change temperature, amount of energy absorb/release and amount of phase change material encapsulated. Phase Change Materials can be microencapsulated using physical or chemical method and then coated to fabric. Fabric coating with PCM can be done by pad-dry cure method. PCM coated fabric can withstand temperature when compared to uncoated fabric. Using PCM in cotton fabric can improve its thermal properties when compared to pure cotton fabric.

Keyword: *Phase Change Materials, Microencapsulation, Pad – Dry cure method, Thermo regulation*

1.Introduction

Phase Change Materials can change its phase from state to state, when heat absorbed it changes phase from solid to liquid. When heat released to maintain temperature, phase changes from liquid to solid. Example: Ski-man moving towards hill, body temperature raises to 33C so phase changes from solid to liquid, because of heat absorbed in fabric. When he/she reached top, body temperature drops below 33C so phase changes from liquid to solid, because heat released from fabric to body to maintain temperature. N-paraffin waxes with melting temperature of 36-18C, such as heptadecane, hexadecane and octadecane. PCM coated fabric in outdoor clothing reduce thickness and weight. Some PCM has low thermal conductivity, to improve paraffin wax metallic fillers, metal matrix structure and several methods are used. PCM in outer layer cloth will not reach skin temperature. PCM closet to the body will remain close to skin temperature and remain in liquid state. PCM on outer layer, get cold and solidify and it continues until PCM change from liquid to solid. Microencapsulation process by which solid,liquid,gas material ingredients packed within a secondary material for purpose of shielding the active ingredient from environment. Size of the material is one micron (one thousand of mm). It can separate incompatible component, conversion of liquids to free-flowing solids, masking of odor/taste/activity of encapsulated material.

2. BENEFITS OF THERMO REGULATED FABRIC USING PCM:

1. Phase Change Materials maintain body temperature.

2. Phase Change Materials is compatible with hot and cold weather.

3. Phase Change Materials can mask odor and activity of encap material.

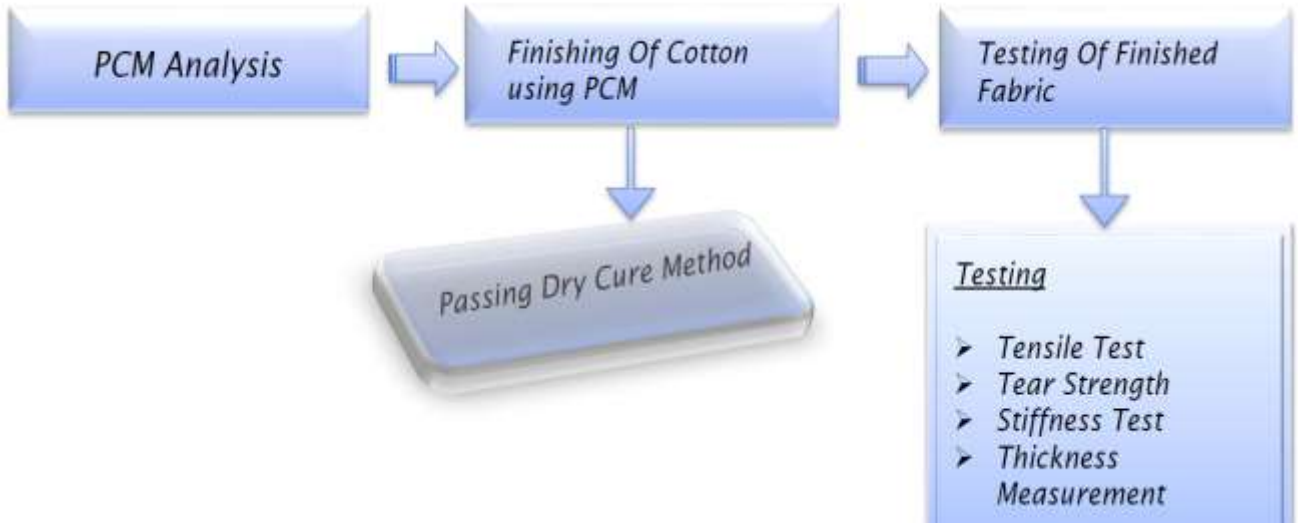
2.1 OBJECTIVES:

- *To characterize the PCM in terms of phase change temperature to understand the semi-solid density phase transition phenomenon.*
- *To develop thermo regulated breathable smart fabric i.e., "thermally smart fabric" by coating and fixing the 'thermo sensitive polymer' onto the 100% cotton fabric.*
- *To characterize the cross linking of the polymer with the fabric by FTIR spectra analysis method.*
- *To study the effect of finishing treatment on the general surface and performance characteristics of the fabric.*
- *To empirically analysis the cost performance of the developed fabric.*
- *To conduct wear trials of a developed fabric.*

2.2 PAD-DRY CURE PROCESS:

1. The process is accomplished by padding fabric through a dye chemical solution of the three components to a wet pickup of about 75%, drying at moderate temperature, and curing at an elevated temperature.
2. Drying is a mass transfer process consisting of the removal of water or another solvent by evaporation from a solid, semi-solid or liquid.
3. Curing is a process during which a chemical reaction or physical action takes place, resulting in a harder, tougher, or more stable linkage or substance.

3. METHODLOGY:



4. MATERIALS:

We have used 100% cotton fabric with 30^{s},40^{s} count for pcm microencapsulating. Pad-dry cure machine was used for this project.

5. EXPERIMENT:

Using 100% cotton fabric, medium count range [30^{s}/40^{s}]. PCM was microencapsulated. Encapsulation is capturing small amounts of phase change materials in sheet materials, so that phase change materials are permanently enclosed and protected. Used to produce vest,snowsuit,blankets,dwets etc., which perform of changing aggregation form solid to liquid within certain temperature and to reduce extreme variation in temperature. Pad-Dry cure process is accomplished by padding fabric through a dye chemical solution of the three components to a wet pickup of about 75%, drying at moderate temperature, and curing at an elevated temperature. Curing is a process during which a chemical reaction or physical action takes place, resulting in a harder, tougher, or more stable linkage or substance. Finally, Various testing was done to compare the plain cotton fabric and pcm microencapsulated cotton fabric.

6. RESULT AND CONCLUSION:

This paper proposes the Phase Change Material's micro encapsulation and how it has been coated in the fabric. The use of Phase Change Material in textile coating helps to maintain body temperature swing which can withstand (+) or (–) room temperature.

Thermo properties of the fabric can be increased and maintained by pad dry cure method, which is cost effective and simple process used for fixing and curing and it can be designed to be dynamic and actively responsive for some special end use fields.

Micro encapsules performed their function effectively under both heating and cooling conditions, and endothermic and exothermic phase transitions took place within the intervals coinciding with those of PCMs.

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