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Intelligent PCM Composite for Enhancing the Thermoregulated Properties of Different Cotton/Polyester Fabric Constructions

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Abstract

COTTON and polyester, which comes in a range of textile, yarn, and fiber forms, are the most widely used textile materials. This depends on the qualities of both materials and how they will be used. This research aims to enhance the thermal heat profiles for the blend fabrics from both materials when treated with phase change material, giving different fabrics construction with the same weight the ability to change their thermal state over a wide range and be used for thermal protection for a variety of purposes, regardless of ambient temperatures (PCM). Different cotton/polyester fabric constructions were simply treated with Octadecane as (PCM material) loaded on alginic stearate to develop PCM composite treatment materials. The characteristics of the fabrics were determined after treatment with the KES thermal conductivity system and Differential Scanning Calorimetry (DSC), and their physicomechanical properties were also examined. PCM composites may be used to coat different cotton/polyester fabric constructions, and the coated version outperforms the uncovered counterpart in terms of performance. Examining the characteristics of uncovered and covered fabrics, it was also discovered that these treatments enhanced the mechanical and physical features but had no impact on the permeability to air and water vapor.

Keywords: Thermal profile, Phase Change Material (PCM), and Octadecane.

Introduction

Temperature, precipitation, wind, and other environmental factors can all fluctuate naturally over the course of several decades. Our planet has alternately been warmer and colder for millions of years. Today, however, human activity is causing rapid warming, mostly as a result of the burning of fossil fuels, which releases greenhouse gas emissions. A blanket-like effect caused by rising greenhouse gas emissions from human activities traps the sun's heat and causes temperatures to rise. Carbon dioxide and methane are two examples of greenhouse gas emissions that are contributing to climate change. These are produced by burning fossil fuels like coal or gasoline, which are used to power vehicles or heat buildings. Carbon dioxide can also be released during forest and land clearing. Garbage landfills are yet another.**[1]**

Due to a temperature gradient or differential, energy can be transferred from one system to another in the form of heat. Heat is a vector quantity that flows with a negative temperature in a downward direction. Gradient. Due to a temperature difference, thermal energy will be transferred across a medium, which could be either a solid or a fluid. **[2]**. Any heated material will continue to gain heat as its temperature rises. Reverse cooling allows heat that was contained in the substance to escape into the surrounding air. During the cooling process, the material's temperature steadily drops **[3]**.

Phase change materials, a novel kind of insulation material, have entered the market since the late 1980s (PCMs). They can enhance textiles' thermal properties when included in them. The ability to temporarily store energy—at either high or low temperatures for use in the future is a characteristic of PCM materials. It changes from

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one physical state to another to make a distinction. The thermal energy that can be retained by changing a material's phase while maintaining a constant temperature is known as latent heat. Phase change materials are thought to be the ideal material for insulating the human body's heat because of their thermal qualities. the potential to prolong the wearer's time in his thermal comfort zone. Therefore, a product should help with localized thermal regulation if it has a thermal window between 19°C (the vasoconstriction temperature) and 37°C. Going from one state to another, such as from a solid to a liquid, is referred to as a "phase change." Standard phase change materials (PCM) typically consist of a polymer or carrier that has been loaded with a thermally conductive substance. **[4-13]**

Therefore, the goal of this work is to achieve thermal stability by covering different cotton/polyester fabric constructions [having the same warp yarn (polyester) and same weft yarn (cotton with the same density) and the difference only in weaving construction] with a PCM composite material that has been produced to have the potential to alter phase states, giving cotton/polyester fibers a unique and novel feature. Cotton and polyester fibers exhibit excellent thermal stability after PCM treatment throughout a variety of ambient temperatures.

Because of this, it is better suited for usage in sandwich panels and cushioning with a variety of thermal uses for insulation and stability.

When combined in a microcapsule, heat energy will be stored and released, keeping the mixture's temperature in the range of 30-34°C, which is quite cosy for the body. Wax compounds known as phase change materials, such as octadecane, have the unusual ability to absorb and expel heat energy without changing the temperature.

There are several techniques to integrate the encapsulated PCM with melted When finishing fibers, yarn, or fabrics, there are several ways to use polymer fiber, including a) microcapsules, where PCM microcapsules are firmly anchored inside the fiber structure during the spinning process, b) padding by matrix coating, where PCM microcapsules are embedded in a coating material like acrylic, polyurethane, etc., and c) printing by foam dispersion, where microcapsules are combined with a water-blown polyurethane foam mix.

Blending is the process of combining two or more fiber masses so that the finished product has characteristics that are typical of the average of the parts. Combining several fiber types is a frequent technique to improve the practicality and aesthetics of a cloth. The particular benefit of yarns made of both natural and synthetic fibers is that they successfully integrate the advantages of both, such as comfort in use and ease of maintenance. These advantages also enable the production of a greater variety of goods, strengthening the marketing advantage. **[4]**

In the textile industry, blends of polyester and cotton (P/C) account for 58.45% of the global market. These blends are well-known for their appealing visual value and user-friendly functionality. By combining these two fibers to perfection, the limitations of each are suitably balanced. The P/C mixes, however, present some difficulties for the dyer because cotton is hydrophilic and polyester is hydrophobic, necessitating the use of chemically distinct classes of dyes to color them. **[4]**

Polyester cotton is a blended fabric made of both artificial polyester and natural cotton. As it combines the advantages of the two textiles, the blend is ideal for apparel. Thus, the fabric maintains the coolness and lightness of cotton while giving strength and durability from polyester. This blend typically feels pleasant because it combines polyester's no-iron crispness with the natural softness and moisture absorption of cotton. **[4]**

The goal of this study is to provide cotton/polyester textiles with distinctive and novel properties of thermal stability by coating them with PCM composite materials that can change phase states. The cotton/polyester textiles show excellent thermal resilience with a variety of ambient temperatures after PCM treatment. They are therefore more suited for a range of thermal applications that need stability and isolation.

Experimental

Materials and Methods

Chemicals

Sodium alginate medium molecular weight was purchased from Fluka. Stearic acid, sodium lauryl sulfate, dichloromethane (DCM), dicyclohexyl carbodiimide (DCC), potassium carbonate (K_2CO_3), and octadecane were purchased from Sigma-Aldrich.

Fabric Manufactured

Textile machine specification

The textiles were given the following machine requirements at the Faculty of Applied Arts, Helwan University:

Machine type= Smit
country of manufacture= Italia
manufacturing year=2008
Machine width= 190 cm (comb width)
machine speed= 300 strokes/minute
Weft thread passage= Using elastic tapes (rapier)
Selector (meat selection) = 8-fingered

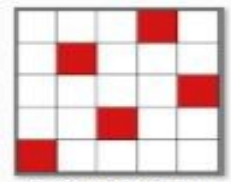
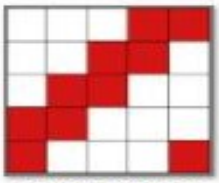
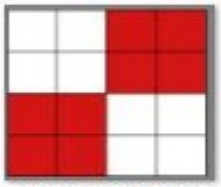
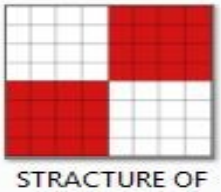
Jacquard specification

Jacquard devise type= Electronic stubli jacquard
Jacquard strength=3072 Shankle
The number of design hooks=2560 Shankle
The number of iterations=4 iterations
The number of networks iterations=35.5 cm
Canvas width without brace=142 cm
Network construction method= parcel
Poison wicking number=72 wick/cm
used comb= comb(8×9)
warp number=150\1 Quilted denier polyester
stamen colors= One color is dammed white

Fabric specification

The following specifications, are given in **Table 1**, were produced for four distinct cotton/polyester fabric constructions at the Faculty of Applied Arts, Helwan University:

Table 1: cotton/polyester fabric construction

Fabric	Code	Construction	Weft density per cm	Weft No	Weight(m^2)
Warp: Polyester Weft: Cotton	AC1	Atlas 5 weft  STRACTURE OF A1 SAMPLE (SATEEN 5)	23	30/2 dyne	220.7
Warp: Polyester Weft: Cotton	AC2	2/3 Twill  STRACTURE OF A2 SAMPLE (TWILL 2-3)	23	30/2 dyne	220.7
Warp: Polyester Weft: Cotton	AC3	2/2 thread in both directions (Basket)  STRACTURE OF A3 SAMPLE (BASKET 2-2)	23	30/2 dyne	220.7
Warp: Polyester Weft: Cotton	AC4	4/4 thread in both directions (Basket)  STRACTURE OF A4 SAMPLE (BASKET 4-4)	23	30/2 dyne	220.7

Method

Synthesis of anhydrous fatty acids

According to the process previously described by Hassabo and Mohamed, anhydrous fatty acids were created. [12] In a nutshell, 10 ml of stearic acid is dissolved in 2 ml of dichloro methane, thoroughly mixed, and then put in an ice bath with argon gas. The precipitated portion will be removed through the filtration procedure, and the solvent will be evaporated to give us the anhydride [14, 15]. Next, dissolve 5 ml of dicyclohexylcarbamide in dichloromethane, add the mixture, and stir in an ice bath for two hours.

Synthesis of alginic acid ester

According to a modified approach previously described by Hassabo and Mohamed, an alginic acid ester was made. [12] In a nutshell, 10 g of alginic acid and 10 g of anhydride are combined, thoroughly ground, and heated for 15 to 25 minutes at 160 °C before being allowed to cool at ambient temperature. The pH is then brought to a neutral state, the ester produced is dissolved in water, and the object is then washed with the resultant chloroform. Dialyzing the final mixture in deionized water for a day was followed by two days of lyophilization [14, 15].

Synthesis of PCM composite based on alginic/fatty acid ester

Alginic acid ester is mixed with paraffin compounds (n-octadecane) at a molar ratio of 2:1 polymer to paraffin at a temperature of 110°C for 14 hours to create PCM compounds.

Fabric treatment

The following is how the therapy mixture was made: A 10% (w/w) compound of alginic, stearic, and octadecane was dissolved in 100 ml of hot water (80 C) with 2 g/l of tween 80 added as a surfactant. A homogenizer was used to homogenize the solution for 15 minutes at a speed of 20000 rpm. The fabrics were then treated using the pad-dry-cure procedure by being submerged in the treated bath for 15 minutes at 80°C, squeezed with 100% wet pickup, and then dried in an air oven for 5 minutes at 100°C.

Measurements and Analysis

Fourier Transform Infrared Spectroscopy (FT-IR) analysis was utilized to evaluate the phase change materials and their composite to analyze the chemical alterations and interaction phases. Based on the FTIR spectrometer model (JASCO FT-IR-6100), the FTIR spectrum was measured using the ATR technique, and the spectral range of 4000-400 $cm^{-1}$was recorded.

The differential scanning calorimeter analysis was carried out using a DSC 131 Evo (SETARAM Inc., France) device. the standards were used to calibrate the instrument (Mercury, Indium, Tin, Lead, Zinc, and Aluminium). The purge gases employed were nitrous oxide and helium. The test was set up to include a heating zone with a temperature range of 25 to 100°C and a heating rate of 10°C per minute. The samples were weighed using 120 ul of the aluminum crucible.

The duration index (DI) ($J/cm^3/K$) is a term used to characterize a material and the temperature at which it is designed to work. To assess the length of a PCM during a phase transition at a constant temperature, use Equation 1.**[16]**.

$$DI = \Delta H \rho / \Delta T \qquad \text{(Eq. 1)}$$

Where H is the enthalpy of the PCM change of state, PCM is the density, T is the temperature difference between the temperature of interest and the measured temperature, and (ambient, or body temperature).

Equation 1 acts as a gauge to ascertain the length of a PCM during a phase transition at a fixed temperature; Equation 2 links the textile material on which the PCM is placed to the total resistance to dry heat transfer (R), which is the insulation value of clothing systems.

$$R = (\Delta T \times A)/H, \qquad \text{(Eq. 2)}$$

Where; A: Areal Material; T = TF - TR (Material's Front and Rear) (Material's Front and Rear's Front and Rear's Temperature Difference); and Heat Flow (H). "clo" (m2.°C/W), where 1 clo = 0.155 m2.°C/W (zero (0) clo corresponds to a person wearing a normal business suit and one (1) clo corresponds to a person wearing a nude body, is the unit for garment insulation developed from the research of hygienic comfort.**[17-19]**.

Measurements of thermal conductivity and Q-max (warm/cold sensation). Textile samples. Three fabric samples from each fabric type were acquired, one before and one after treatment, and each sample was said to have a quick-drying property. The samples were utilized exactly as supplied, and **Table 1** summarises the fabric information. Before evaluating the fast dry's thermal properties. They underwent ASTM D1776-compliant conditioning.

The capacity of cloth to transport heat is referred to as thermal conductivity. According to the KES-F7 standard, thermal conductivity was measured in this investigation. The following equation may be used to calculate a fabric's thermal conductivity: [20]

$$k = \frac{W \times D}{A \times \Delta T}$$

Where a = area of heat plate = 25 cm^2; k = thermal conductivity (W/cm.°C); W = heat flow (W); D = average thickness of samples; and T = temperature differential (heat plate temperature (30°C) - cooling base temperature (20°C) = 10°C. For SI unit conversion (W/mk): k x 10^2 equals KSI (W/mk).

Q-max Evaluation (warm/cold sensation). The coldness and warmth feeling that impact how skin feels when it touches a surface is indicated by the Q-max index. The amount of heat that is lost from the skin to the cloth determines it.

Tensile strength and elongation at break are conducted on a tensile strength apparatus type FMCW 500 (Veb Thuringer Industrie Werk Rauenstein 11/2612 Germany) at 25°C and 65 % relative humidity according to the ASTM Test Method D5035-2011. **[21]** The dry crease recovery angle (CRA) was measured according to AATCC Test Method 66 – 2014. **[22]** Fabric roughness was measured using Surface Roughness measuring instrument SE 1700 using ASTM Test Method D 7127 – 13. **[23]** Stiffness was performed using the cantilever apparatus according to ASTM test method D 1388-14e1. **[24]** Air permeability (AP) was evaluated according to ATSM (D 737-96). [25] Water vapor permeability (WVP) was evaluated according to ATSM (E96/E96M − 16). [26]

Results and discussion

Characterization of synthesized composite

FT-IR analysis

Alginate stearate was identified via FT-IR. The IR spectra of alginate, stearic acid anhydride, and alginate stearate are shown in Figure 1. Peaks at 2932 cm^{-1} may be seen in the FT-IR spectra of alginate and are connected to -CH stretching peaks. Another peak, at 1357 cm^{-1}, was discovered to be a CH2 peak. Additionally, Figure 1 validated the chemical alteration of alginate by adding a stearic acid anhydride. Here are several instances when FT-IR spectra for stearate of alginate demonstrate chemical alteration: O-H = 3438 cm^{-1}, C-H = 2915 and 2842 cm^{-1}, C=O = 1694 cm^{-1} (fatty acid ester), C-O = 1204 and 1147 cm^{-1}, COO = 1627 cm^{-1} and COO = 1433 cm^{-1}, and C-O = 1747 cm^{-1} (methyl ester).

DSC Analysis

The DSC results for synthetic composite materials made with and without Octadecane composite, alginate, stearic acid, and Octadecane (PCM material) are shown in **Table 2**. (PCM). **Table 2** clearly shows that the latent heat of the hosting materials increases when alginate is added to the completed composite form. When the biopolymer interacted with stearic acid, the melting point likewise decreased, and it did so again once Octadecane was introduced. Phase compliance with the final melting temperature.

The DI values of the composite made from octadecane suggest that it can be organized to protect the body from changes in external temperature, according to the data in **Table 2**.

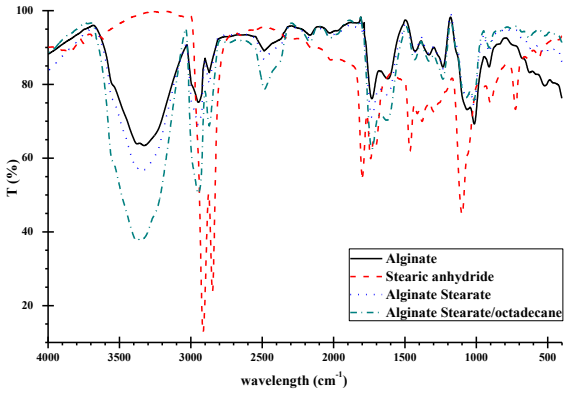


Figure 1: FT-IR spectra of hosting materials with/without Octadecane

Table 2: DSC results for hosting materials from the second heating with or without octadecane

Hosting materials	T_o (°C)	Tp (°C)	□H (J/g)	DI * (J/cm^3.K)
Alginate [37]	251.1	288.32	43.24	
Stearic acid [27]	65.2	69.7	166.52	
Octadecane [13]	29.3	33.4	241.44	
Alginic Stearate	30.14	36.11	57.92	6.75
Alginic/ Stearate/Octadecane	32.67	42.69	188.57	34.84
Duration index: based on ΔT from melt point to body temperature (37ΔC) and average density of 0.8 g/cm^3				
T_o: Onset Temperature, T_p: Keeping Temperature, **ΔH**: Enthalpy				

Characterization of treated fabrics

Differential scanning calorimetric (DSC)

Heat is lost to the environment via convection, radiation, and skin evaporation. **Table 3** displays the DSC findings of cotton/polyester fabric treated with alginate/stearic acid and octadecane. It has been discovered that covered fabrics in these composites impart the thermo-regulating property (Blank) and the latent heat that sweat creates, in contrast to exposed fabrics. The most important function of textiles in terms of thermal protection is to maintain a microclimate close to the skin to support the need for thermoregulatory behavior on any surface [27]. The existing insulating characteristic of the structure can give an increased warm thermal capacity while preserving

comfortability when textile apparel is paired with PCM material.

To increase the thermal insulator capabilities and minimize temperature variations, different cotton/polyester fabric constructions were wrapped in PCM composite material. Using PCM materials is a feasible method to store and release heat while altering the ambient temperature.[9, 12, 28, 29].

Alginate/Stearic gives more latent heat to uncoated cotton/polyester. According to estimates of the total resistance to dry heat transfer, cotton/polyester fabrics coated with Alginate/Stearic acid/Octadecane composite are more pleasant than those that are untreated. Finally, it can be said that cotton/polyester fabrics can be coated with PCM composites and that the covered fabrics outperform their uncovered counterparts in terms of performance.

Thermal Conductivity Measurement

The thermal conductivity of variably fabricated cotton/polyester fabrics is shown in **Table 4**. The thermal conductivities of AC1, AC2, AC3, and AC4 are essentially identical, with AC4 having a significantly greater thermal conductivity than the other three. The highest thermal conductivity for AC1 is 0.047. The weaving characteristics of the fabric may explain this. Given that all produced textiles have the same weight and density, the thickness of a fabric is the sole fabric property that affects its ability to transfer heat. That influence is clear from the data in **Table 4**.

Heat conductivity reportedly decreases with increasing textile thickness increases [30-32]. Additionally, a fabric's porosity is the main factor that affects how well it conducts heat. More air may be trapped in larger pores, making them better heat insulators. The fabric with more pores hence often has better heat conductivity. Air is trapped inside the gaps of a looser structure in a thicker cloth. As a result of its greater thermal insulation, the thicker fabric has a lower heat conductivity.

The greater the thermal conductivity rating, the better the fabric's ability to conduct heat. AC1 and AC2 both had the highest thermal conductivity, whilst AC4 had the lowest. This demonstrates that while AC4 items were not the best choice, those with AC1, AC2, and AC3 had the quickest drying qualities.

Q-max Evaluation (warmth or coldness). A higher Q-max number denotes a colder first contact experience, according to the machine's ability to directly detect Q-max. The Q-max values for the four samples (AC1, AC2, AC3, and AC4) are 0.134, 0.125, 0.119, and 0.082, respectively. As can be seen, a Qmax value for AC1, AC2, and AC3 performed better in terms of warmth/cold feelings, which may be attributed to the properties of their fabrics.

According to the data in **Table 4**, the Q-max of a cloth increases with fabric thickness. Due to its considerable thickness, the fabric may have a tightly packed structure with several wales or courses per inch. A fabric may have a smooth surface that improves the cloth's ability to contact the skin. Because of this, body heat may readily transfer to the surrounding air, making it appear cooler when touched.

Additionally, the fabrics were treated with prepared PCM. Materials containing polymers are essential for reducing fabric thickness because they produce a thin layer on the fabric's surface, lowering the fabric's thickness and thermal insulation. However, all treated textiles now have higher thermal insulation qualities since prepared materials can retain temperature.

The initial touch feeling provided by Q-max is essential since it causes a cooling sensation when in contact with human skin. In this investigation, it was discovered that treated polyester fabrics all had a cooler touch feel and are thus superior to untreated ones for apparel.

Table 3: DSC, Duration index, and Total Resistance results of covered cotton/polyester fabrics with PCM composite material (Alginate/Stearic acid/Octadecane composite)

Sample description		**T_o (℃)**	**Tp (℃)**	ΔH (J/g)	**DI * (J/cm^3K)**	**R ** (clo)**
AC1	Uncovered/ Blank	36.59	36.73	1.037	0.31	0.300
	Treated	33.08	37.58	82.350	16.81	0.009
AC2	Uncovered/ Blank	35.35	35.48	1.001	0.48	0.264
	Treated	33.90	38.51	84.388	21.77	0.008
AC3	Uncovered/ Blank	35.14	35.28	0.996	0.43	0.281
	Treated	30.79	34.97	76.643	9.87	0.009
AC4	Uncovered/ Blank	33.41	33.58	1.230	0.27	0.068
	Treated	36.15	40.69	119.856	112.42	0.004
	* **Duration index:** based on ΔT from melt point to keeping temperature and average density of 0.8 g/cm^3					
	**R: Total Resistance to Dry Heat Transfer					
	To: Onset Temperature, **Tp**: Keeping Temperature, **ΔH**: Enthalpy					

Table 4: Thermal conductivity for different cotton/polyester samples before and after treatment

		Thickness (cm)	Q_{max}	Heat flow (W)	Thermal conductivity
AC1	Blank	0.059	0.136	2.63	0.062
	After treatment	0.067	0.134	2.4	0.065
AC2	blank	0.057	0.122	2.24	0.051
	after treatment	0.069	0.125	2.18	0.060
AC3	blank	0.057	0.103	2.37	0.053
	after treatment	0.063	0.119	2.33	0.058
AC4	blank	0.071	0.053	0.71	0.019
	after treatment	0.098	0.082	1.21	0.047

Evaluation of comfortability

The air permeability of various textile textiles has a significant impact on how well they operate. In particular, materials used in clothing, parachutes, vacuum cleaners, airbags, and industrial filters are taken into consideration. The cloth's air permeability is significantly influenced by its weight and structure (thickness and porosity).

Fabrics are woven by interlacing threads of warp and weft. The warp runs the length of the fabric, and the weft (or filling) covers its breadth. The warp yarns are maintained apart from one another. As a result, the warp is constructed from a variety of various threads that are put into the loom. On the other hand, the weft yarn is usually weaved into the fabric one length at a time [33]

The weft and warp threads of the cloth are separated by gaps. The void volume of a textile fabric has a considerable impact on a variety of consumer and commercial purposes, including garment comfort, flammability, thermal insulation efficiency, barrier fabric performance, and the accuracy of filter media [34]

The void volume in woven textile fabrics is what makes them permeable to air. The air permeability of a textile is determined by the rate at which air moves through it when there is a pressure differential between the two fabric surfaces [35]. As the required pressure differential, 10 mm of water is needed [36, 37]

Some of the factors that determine a fabric's capacity to breathe include the number of warp and weft yarns per centimeter (or inch), the degree of twist in the yarns, the size of the yarns, and the kind of yarn structure [38]. Therefore, it will be challenging to build a more complex theory that specifies how the air permeability of all fabric qualities is connected. [39]

The findings show that both the investigated parameters dropped after treatment but remained within acceptable limits. **Figure 2** shows the air permeability and water vapor permeability of treated and untreated textiles. Which demonstrates that the treatment had no impact on the comfort of the cloth.

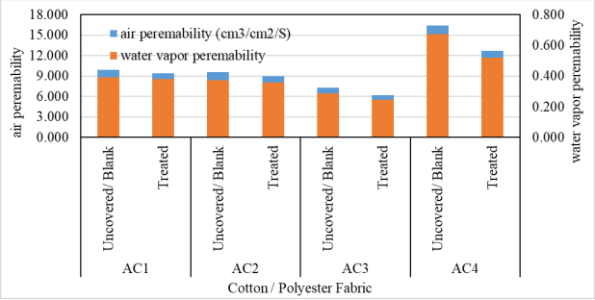


Figure 2: air permeability and water vapor permeability of treated and untreated cotton/polyester fabrics

Mechanical and physical performance

The tensile strength, elongation at break, roughness, and crease recovery angle of cotton/polyester textiles in the warp and weft directions were examined before and after being treated with PCM composite material. **Table 5** displays the results. As was demonstrated, the diverse fabric architectures have a positive influence on textiles.

Table 5 shows how differences in fabric structures lead to changes in the physicomechanical properties of textile materials. While only slightly improving the crease recovery angle and fabric roughness, the treatment dramatically increased the tensile strength and elongation at the break. This shows that the alginic/stearic polymer material used as the hosting polymer was extensively absorbed into the textile fabrics' microstructure, resulting in a thin coating layer on the fabric's surface that was responsible for the observed alterations. [40-43]

The covalent chemical connection, which also led to the creation of an intensive network with a high degree of crosslinking, was most likely the root cause of the significant increase in the crease recovery angle.

Table 5: Mechanical and physical properties of treated and untreated cotton/polyester fabrics

Sample description		Tensile strength (kgf)	Elongation at a break (%)	young's modulus (kgf/mm^2)	roughness	CRA
AC1	Uncovered/ Blank	53.58	34.7	34.26	17.11	113
	Treated	54.51	44.0	37.10	17.25	124
AC2	Uncovered/ Blank	61.75	28.0	60.37	17.31	115
	Treated	67.92	44.7	37.52	17.42	129
AC3	Uncovered/ Blank	54.51	44.0	37.10	17.25	110
	Treated	57.92	44.7	37.52	17.42	126
AC4	Uncovered/ Blank	53.26	50.0	40.29	17.34	115
	Treated	60.29	48.0	36.73	17.22	128

Conclusion

Following the KES-F7 standard, this study examined the thermal conductivity, Q-max characteristics, and heat storage capacity of four distinct polyester constructions treated with synthesized alginate, stearic, and octadecane as PCM composites. It was discovered that various products displayed various advantages. Because of its excellent heat transfer properties, thermal conductivity analysis, mechanical characteristics, and capacity to store and release heat contribute to thermal, air, and water vapor comfortability for people. Q-max results revealed that all examined cotton/polyester fabrics were the best option in terms of warm/cold feelings.

Conflict of interest

The authors declare that there is no conflict of interest

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مركب PCM ذكي لتعزيز الخصائص المنظمة حرارياً لتركيبات منسوجات القطن / البوليستر المختلفة

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المستخلص: الأقطان والبوليستر ، اللذان يأتيان في مجموعة من المنسوجات والغزل والألياف ، هما أكثر مواد النسيج استخدامًا. هذا يعتمد على نوعية كل من المواد وكيف سيتم استخدامها. يهدف هذا البحث إلى تحسين الملامح الحرارية الحرارية للأقمشة الممزوجة من كلا المادتين عند معالجتها بمواد متغيرة الطور ، مما يمنح بنية مختلفة من الأقمشة بنفس الوزن القدرة على تغيير حالتها الحرارية على نطاق واسع واستخدامها للحماية الحرارية من أجل أغراض متنوعة ، بغض النظر عن درجات الحرارة المحيطة (PCM). تمت معالجة تركيبات الأقمشة القطنية / البوليستر المختلفة ببساطة باستخدام Octadecane كمادة (مادة PCM) محملة على ستيرات الألجينية لتطوير مواد المعالجة المركبة PCM. تم تحديد خصائص الأقمشة بعد معالجتها بنظام التوصيل الحراري KES و قياس المسح التفاضلي (DSC) ، كما تم فحص خصائصها الفيزيائية الميكانيكية. يمكن استخدام مركبات PCM لطلاء تركيبات نسيج قطنية / بوليستر مختلفة ، ويتفوق الإصدار المطلي على نظيره المكشوف من حيث الأداء. عند فحص خصائص الأقمشة المكشوفة والمغطاة ، تم اكتشاف أن هذه العلاجات عززت الميزات الميكانيكية والفيزيائية ولكن لم يكن لها تأثير على نفاذية الهواء وبخار الماء..

الكلمات المفتاحية: التعريف الحراري ، مادة تغيير الطور (PCM) ، والأوكتاديكان.