

The Evaluation of Physical Property and Manufacturing Process of Functional Warp Knitted Fabrics with Variation of Weft

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Abstract

In recent years, the scientific progress has improved human life quality and changes the concepts of health and health care. It has been approved that the bamboo charcoal has various functions, including air cleaning, water purification, deodorization, far infrared radiation rate and anion amount. The bamboo charcoal fiber and bamboo charcoal yarn are applied extensively in the textile industry.

In this study, PET fiber was used as warp, and PET fiber, bamboo charcoal nylon fiber and stainless steel fiber employed as weft to weave three groups of warp knitted fabric. The variation of far infrared radiation rate, anion amount concentration, air permeability, water absorption, flexibility of these three groups of fabric were examined. The results indicate that the far infrared radiation rate of these three groups of fabric attained 0.8. The anion amount concentration of bamboo charcoal and bamboo charcoal / stainless steel warp knitted fabrics has reached 490-495. Finally, the air permeability of bamboo charcoal / stainless steel warp knitted fabrics achieved 281 cm³/s/cm².

Introduction

Today's high-stress lifestyle has resulted in a rising demand for health care and well-being products. The researchers and experts are devoted to develop and produce functional textile fibers such as bamboo charcoal and stainless steel fiber. Beside the aesthetic aspects of clothing, consumers pay also their attention to the air permeability, sweat absorbent and the touch of clothing materials. Due to the structure of needle loop, knitted fabrics possess a high stretch ability, and the slack structure of gray yarn used fit perfectly body curve and suitable for the movement. Different functional textile products have been developed [1-6]. Environment friendly, health care and functional materials have moved into the mainstream of clothing and textile. In fact, the features including anion amount, far infrared radiation rate, deodorization and porosity, have led to a widely use of charcoal and bamboo charcoal fiber in recent years [7-12].

Bamboo charcoal contains a lot of micropore and has a strong biodegradable ability (Charcoal per gram surface area of about 100-300 m²). It can absorb the chlorine in tap water, air, human body odor, sulfide, smoke smell, formaldehyde and benzene and other harmful substances, and then to purify the air, water purification and deodorization functions. Its micropore and honeycomb structure have humidity control function. When the ambient humidity is high, the bamboo charcoal can absorb water. While the surrounding gets dry, it can release water, and then adjust automatically the humidity balance in a body. The bamboo charcoal fiber contains of metal elements and carbides (CaC). Even a

minor change of temperature or pressure, while the bamboo charcoal is placed in water or air, the porous would release slowly anion amount, to activate the body metabolism and relieve the tension [13-14]. In this study, PET fiber, bamboo charcoal nylon fiber and stainless steel fiber were used and crochet machine was employed to weave warp knitted fabrics. The material is expected to process environment friendly, health care and functional features.

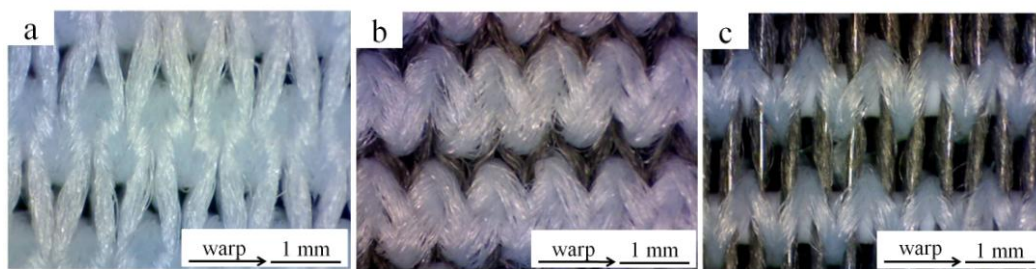
Experiment

Material

PET fiber: fibre fineness: 150 D, 48 f. (made by Far Eastern Co., Ltd.); bamboo charcoal nylon fiber: fibre fineness: 70 D, 36 f, bamboo charcoal content 3 %. (made by Hua Mao Co., Ltd.); stainless steel fiber: diameter: 0.08 mm. (made by Jin Ding Co., Ltd.); rubber thread, number 39. (made by Ta Yi Co., Ltd.)

Method

In this study, PET fiber, bamboo charcoal nylon fiber and stainless steel fiber were used and crochet machine was employed to weave warp knitted fabrics. First group: top and bottom weft PET fiber and PET warp knitted fabrics (Fig. 1a). Second group: bamboo charcoal warp knitted fabrics (Fig. 1b). Third group: weft was twisted with bamboo charcoal and stainless steel warp to produce bamboo charcoal / stainless steel warp knitted fabrics (Fig. 1c). Three groups of warp knitted fabrics were conducted to far infrared radiation rate, anion amount, air permeability, water absorption and flexibility test.



Figures.1 (a) PET warp knitted fabrics; (b) Bamboo charcoal warp knitted fabrics; (c) Bamboo charcoal / stainless steel warp knitted fabrics.

Results and discussion

The far infrared radiation rate of PET warp knitted fabrics, bamboo charcoal warp knitted fabrics and bamboo charcoal / stainless steel warp knitted fabrics

The Fig. 2 presents that the far infrared radiation rate of these three groups of warp knitted fabrics are between 0.85-0.89. The difference among them is very small and the far infrared radiation rate attained 0.8, which signifies the efficacy of far infrared radiation.

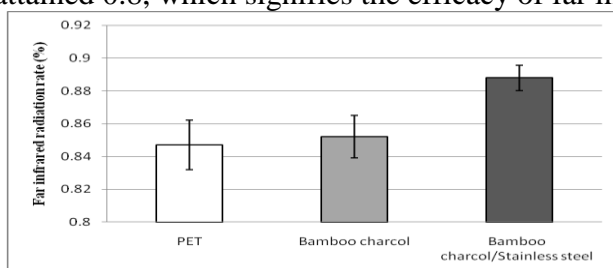


Figure. 2 Far infrared radiation rate of warp knitted fabrics with different weft (PET fiber, bamboo charcoal, bamboo charcoal / stainless steel). Warp: PET fiber, rubber thread; weft: bamboo charcoal nylon fiber, PET fiber, stainless steel fiber

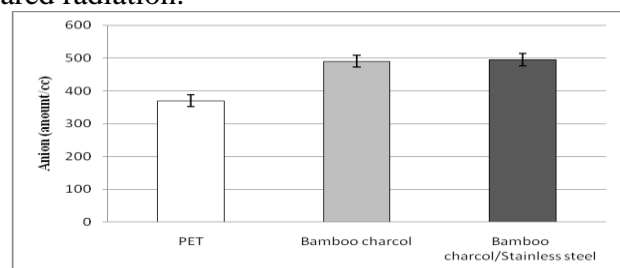


Figure. 3 Anion amount of warp knitted fabrics with different weft (PET fiber, bamboo charcoal, bamboo charcoal / stainless steel). Warp: PET fiber, rubber thread; weft: bamboo charcoal nylon fiber, PET fiber, stainless steel fiber

The anion amount of PET warp knitted fabrics, bamboo charcoal warp knitted fabrics and bamboo charcoal / stainless steel warp knitted fabrics

The results indicate that PET warp knitted fabrics consist of 370 anion amount, 490 for bamboo charcoal warp knitted fabrics and bamboo charcoal / stainless steel warp knitted fabrics up to 495 (Fig. 3). In fact, using bamboo charcoal nylon fiber as weft may result in a higher anion amount. While the metallic element and carbide attached to the powder of bamboo charcoal were stimulated by temperature, friction and pressure would cause ionizing radiation. The trigger would form anion amount. This will induce the warp knitted fabrics that consisted of bamboo charcoal to release anion amount. As a result, the warp knitted fabrics consisted of bamboo charcoal has a higher anion amount than PET warp knitted fabrics.

The air permeability of PET warp knitted fabrics, bamboo charcoal warp knitted fabrics and bamboo charcoal / stainless steel warp knitted fabrics

According to the Fig. 4, the air permeability of bamboo charcoal warp knitted fabrics is lower than PET warp knitted fabrics. This is because the fiber fineness of bamboo charcoal nylon fiber used in this research is 70 D, which is slimmer than PET fiber (150 D). Consequently, the knitted fabric made with this material has a higher density structure and that reduce the air permeability of bamboo charcoal warp knitted fabrics. The rigid feature of stainless steel fiber has resulted in the higher air permeability of bamboo charcoal / stainless steel warp knitted fabrics. The increase of porosity among fiber of bamboo charcoal / stainless steel warp knitted fabrics has resulted in a higher air permeability.

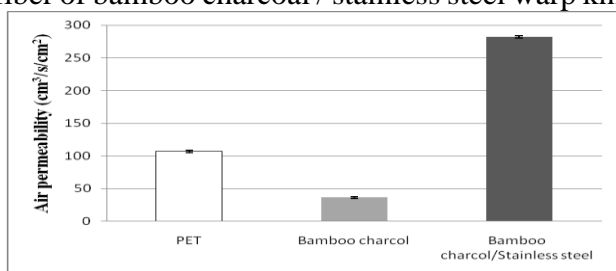


Figure. 4 Air permeability of warp knitted fabrics with different weft (PET fiber, bamboo charcoal, bamboo charcoal / stainless steel). Warp: PET fiber, rubber thread; weft: bamboo charcoal nylon fiber, PET fiber, stainless steel fiber

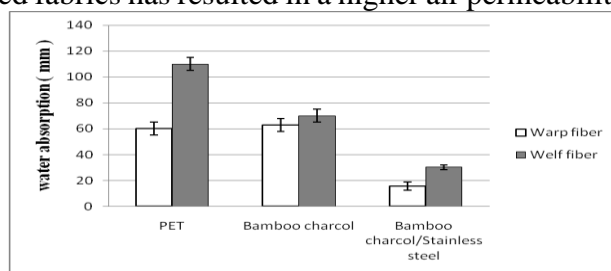


Figure. 5 Water absorption of warp knitted fabrics with different weft (PET fiber, bamboo charcoal, bamboo charcoal / stainless steel). Warp: PET fiber, rubber thread; weft: bamboo charcoal nylon fiber, PET fiber, stainless steel fiber

The water absorption of PET warp knitted fabrics, bamboo charcoal warp knitted fabrics and bamboo charcoal / stainless steel warp knitted fabrics

The Fig. 5 shows that the reduction of water absorption was related to the change of weft to bamboo charcoal nylon fiber. Although nylon fiber has a higher hydrophilic than PET fiber and the adjunction of bamboo charcoal powder in nylon fiber has reduced the overall water absorption of bamboo charcoal nylon fiber. The stainless steel fiber has a low hydrophilic characteristic and that made the warp knitted fabrics consisted of stainless steel fiber has a lowest water absorption. The water absorption height of Warp is lower than weft. Little difference in water absorption between the warp made of PET fiber and rubber thread. The lower water absorption of bamboo charcoal / stainless steel was because of the not hydrophilic aspect of stainless steel.

The flexibility of PET warp knitted fabrics, bamboo charcoal warp knitted fabrics and bamboo charcoal / stainless steel warp knitted fabrics

The Fig. 6 indicates that the flexibility of knitted fabrics reduce relate to the type of weft, from high to low is bamboo charcoal / stainless steel, bamboo charcoal, PET. The flexibility of knitted fabrics, shorter distance and lower value mean higher flexibility. The result shows that the PET warp knitted fabrics has best flexibility, following by bamboo charcoal warp knitted fabrics and bamboo charcoal /

stainless steel warp knitted fabrics is the lowest. The reason is because that the adjunction of stainless steel fiber increases the weight of fabric.

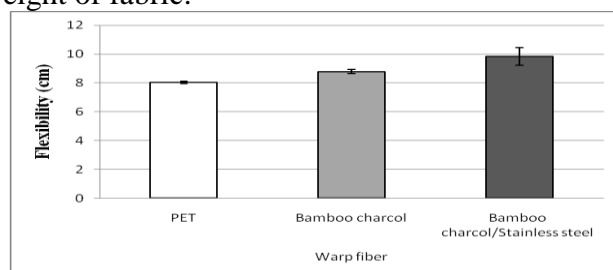


Figure. 6 Flexibility of warp knitted fabrics with different weft (PET fiber, bamboo charcoal, bamboo charcoal / stainless steel). Warp: PET fiber, rubber thread; weft: bamboo charcoal nylon fiber, PET fiber, stainless steel fiber

Conclusion

This research examines the physical property and manufacturing process of functional warp knitted fabrics. The result reveals that the far infrared radiation rate of three groups of fabric attained 0.8 and their functional effects have been approved. In terms of anion amount, bamboo charcoal and bamboo charcoal / stainless steel warp knitted fabrics is 490-495. Concerning the air permeability, bamboo charcoal / stainless steel warp knitted fabrics has the best air permeability which is $281 \text{ cm}^3/\text{s}/\text{cm}^2$. Finally, about the water absorption and flexibility, because of the warp of PET fiber and rubber thread, there was no significant change in water absorption. The weft of warp knitted fabrics has higher water absorption and their flexibility are 110 mm and 8 cm.

Acknowledgement

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