การศึกษาเปรียบเทียบการดูดซึมน้ำของผ้าทอพื้นเมืองที่ผลิตจากเส้นใยไผ่ ฝ้าย ไหม เพื่อการพัฒนาเชิงพาณิชย์

The Compartive Study of Water Absorption from Local Bamboo, Cotton and Silk Fibres in Commercial Textile

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บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์เพื่อพัฒนาสิ่งทอไทย โดยการวัดอัตราการซึมน้ำจากผ้าทอของชุมชน ในการใช้เส้นใยไผ่ทอร่วมกับฝ้ายและไหมด้วยวิธีการทดสอบการแช่น้ำ การทดสอบความอิ่มตัว การทดสอบการหยดน้ำ โดยการพิจารณาการดูดซึมน้ำจากกระบวนการเหล่านี้ การทดสอบการหยดน้ำโดย เครื่อง Monsant Crease Recovery Tester: Model MR-7P จากศูนย์ทดสอบสิ่งทอ/สถาบันสิ่งทอไทย กระทรวงอุตสาหกรรม จะถูกนำมาประยุกต์ใช้ซึ่งเป็นไปตามมาตรฐานสากลของ American Association of Textile Chemists and Colorists (AATCC) TM 79: 2007 (ปัจจุบันมาตรฐาน AATCC มี 3 ฉบับ ได้แก่ รุ่น AATCC TM 79 ฉบับปี 2000, 2007 และ 2010) ในการทดสอบนั้น ได้มีการเตรียมตัวอย่างทดสอบอยู่ 3 ตัวอย่าง ประกอบด้วย ไผ่เส้นยืน พุ่งด้วยไหม 50:50 ไผ่เส้นยืน พุ่งด้วยไผ่ 50:50 และไผ่เส้นยืน พุ่งด้วยฝ้าย 50:50 ผลการศึกษาพบว่า การดูดซึมน้ำของไผ่เส้นยืน พุ่งด้วยฝ้าย 50:50 มีค่าสูงที่สุด) ประมาณ 17.02 วินาที (เมื่อเปรียบเทียบกับไผ่เส้นยืน พุ่งด้วยไหม 50:50)ประมาณ 60+ วินาที (และไผ่เส้นยืน พุ่งด้วยไผ่ 50:50) ประมาณ 29.98 วินาที นอกจากนี้ เมื่อพิจารณาทางด้านเศรษฐศาสตร์ ค่าใช้จ่ายต้นทุนวัสดุของไผ่เส้นยืน พุ่งด้วยฝ้าย 50:50 (ประมาณ 50 บาทต่อตารางเมตร) มีราคาถูกกว่าไผ่เส้นยืน พุ่งด้วยไหม 50:50 (ประมาณ 80 บาทต่อตารางเมตร) และมีราคาเท่ากับไผ่เส้นยืน พุ่งด้วยไหม 50:50 (ประมาณ 5๐ บาทต่อตารางเมตร) ดังนั้น ไผ่เส้นยืน พุ่งด้วยฝ้าย 50:50 เหมาะที่จะนำไปใช้เป็นเสื้อผ้าหรือเครื่องนุ่งห่มที่ผู้ส่วมใส่มีความต้องการมากสำหรับการดูดซึมน้ำหรือเหงื่อ เช่น เสื้อกีฬา ผ้าขนหนู ผ้าเช็ดตัว ผ้าเช็ดมือ ผ้าเช็ดโต๊ะ ผ้าเช็ดจาน ชุดชายหาด เสื้อคลุมอาบน้ำ เสื้ออบซาวน่า รองเท้าแตะ เสื้อผ้าเด็ก หรือผลิตภัณฑ์สุขอนามัยสำหรับเด็ก เป็นต้น เมื่อพิจารณาถึงไผ่เส้นยืน พุ่งด้วยไหม 50:50 แม้ว่าการดูดซึมน้ำค่อนข้างมากประมาณ 60+ วินาที แต่ทว่าถ้าหากผู้สวมใส่จะพิจารณาปัจจัยบางประการ ได้แก่ ค่อนข้างแห้งได้อย่างรวดเร็ว ช่วยเพิ่มความสะดวกสบาย รักษาความนุ่มนวลตามธรรมชาติ และระบายอากาศ ไผ่เส้นยืนพุ่งด้วยฝ้าย 50:50 สมควรเป็นผ้าที่ดีที่สุดสำหรับการใช้งานตามที่กล่าวมา

คำสำคัญ: การดูดซึมน้ำ, ผ้าทอพื้นเมือง, เส้นใยไผ่, ฝ้าย, ไหม, ทดสอบการหยดน้ำ

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Abstract

The aim of this research was to develop Thai textile products by comparing water absorption of bamboo, cotton and silk fibres local textile. Using water absorption as an indicator by drop test of 7-Station Monsant Crease Recovery Tester: Model MR-7P was applied and followed by American Association of Textile Chemists and Colorists (AATCC) TM 79: 2007. The results showed the rate of water absorption of warp bamboo fibres with weft cotton fibres 50:50 is the highest (17.02 sec), warp bamboo fibres with weft silk fibres 50:50 (29.98 sec) and warp 100% bamboo fibres (60+ sec) respectively. In economical profile, the cost of the warp bamboo fibres with weft cotton fibres 50:50 (50 Baht/m^2) is cheaper than the warp bamboo fibres with weft silk fibres 50:50 (80 Baht/m^2) and as same as the warp 100% bamboo fibres (50 Baht/m^2). Therefore warp bamboo fibres with weft cotton fibres 50:50 is suitable to apply in any clothing and garment with more comfortable in water absorption such as sport wears, any towels, dishcloths, washcloths, beachwear, bathrobes, home textile products, sauna dressing-gowns, headgears, slippers, children's clothes, hygiene products for babies, etc. Even through the rate of water absorption of the warp bamboo fibres with weft bamboo silk 50:50 is so high (60+ sec) but the wearers, require some factors including drying quickly, maximizing the comfort, retaining its natural softness and maintaining its ventilation. Therefore warp bamboo fibres with weft cotton fibres (50:50) is the most suitable application.

Keywords: water absorption, local textile, bamboo fibres, cotton fibres, silk fibres, drop test

Introduction

Absorption properties are determined by the fabric's structure and geometrical characteristics, such as porosity, thickness, pile density, handle etc. as well as by finishing procedures like washing, softening etc. Water absorption defines the amount of water the fabric can absorb, which is an important property of any textile (Karahan & Eren, 2006). The behavior of textile in contact with liquid plays an important role in determining clothing performance and in maintaining body comfort (Das et al., 2007). In textile form, bamboo retains many of the properties it has as a plant. Bamboo is highly water absorbent, able to take up three times its weight in water (Lipp-Symonowicz et al., 2011; Wallace, 2005). In bamboo fabric, this translates to an excellent wicking ability that will pull moisture away from the skin so that it can evaporate. For this reason, clothing made of bamboo fiber is often worn next to the skin. It also explains why bamboo is the flavored choice of nappy makers and children wear manufacturers. The heterogeneity of pore size, shape and orientation affects the penetration of liquid into the yarn structure and, hence, its liquid retention properties, as exhibited by textured filament yarns (Nyoni & Brook, 2006). The water absorption properties were analyzed with respect to warp density, weft density, pile height, and the type of yarns used for producing them. It was found that an increase in weft density, warp density or pile height

causes an increase in static water absorption, but the pile height had the most significant effect. The percentage of water absorption is the lowest for open-end yarn, and the highest for two-ply ring carded yarn. The higher twist values used in the production of open-end yarns are thought to make water penetration inside open-end yarns more difficult. It was concluded that the percentage of water absorption decreases with increasing warp and weft densities, whereas it increases with an increase in pile height because of the increased pile warp yarn surface area. Xu, et al., (2007) investigated the thermal and structural differences among chemical bamboo fiber, Tencel (regenerated cellulose made from the eucalyptus tree's wood pulp), and conventional viscose fibers. The pertinent finding are that chemical bamboo fibers suggest good water retention power due to the many voids in their cross section and chemical bamboo fibers and conventional viscose fibers possess better ability of absorbing and releasing water than Tencel. Because the cross-section of bamboo fiber is filled with various micro-gaps and micro-holes, bamboo cloth has much better moisture absorption. Bamboo cloth can absorb and evaporate human sweat in a split second. For improving and developing Thai textile, researcher also studied the water absorption of bamboo fibres for northeast community for optimizing development and application of bamboo fibre including warp bamboo fibres with weft silk fibres 50:50, warp 100% bamboo fibres and warp bamboo fibres with weft cotton fibres 50:50 using 7-Station Monsant Crease Recovery Tester: Model MR-7P as follow as AATCC TM 79: 2007 at textile testing center/Thailand textile institute, ministry of industry.

Scope and Limitation

1.Studied the water absorption of bamboo fibres for northeast community for optimizing development and application of Thai textile.

2.There were 6 main study cases including Ban Lhong Pra Du, Moo 1, Sub-District Huay Talhang, Nakhon Ratchasima, Ban Ta Ma, Moo 1, Chum Saeng Sub-district, Satuek District, Buriram, Ban Somphon Rat, Moo 10, Nong Sano Sub-District, Buntharik District, Ubon Ratchathani, Ban Kokjan, Moo 2, Kokjan Sub-district, Uhumporn Phisai District, Sisaket and Ban Khaen Koet, Moo 14 and Ban Khok Sung, Moo 8, Chumphonburi Sub-district, Chumphonburi District, Surin, Thailand.

3.There were 3 main samples of fabrics including warp bamboo fibres with weft silk fibres 50:50, warp 100% bamboo fibres and warp bamboo fibres with weft cotton fibres 50:50.

4.There are various test methods used for the evaluation of liquid absorption, such as the aqueous immersion test, the saturation value test, the drop test, etc. (Wei et al., 2003). By the way, the drop test of 7-Station Monsant Crease Recovery Tester: Model MR-7P was applied as follow as AATCC TM 79: 2007 (The completeness and uniformity of textile processing as well as the suitability of a fabric for a particular use is dependent upon

its ability and propensity to take up water. The test is based on the amount of time it takes for a drop of water to disappear from surface of a specimen by being absorbed into the material) at textile testing center/Thailand textile institute, ministry of industry. Calculate the water absorption of individual specimens using values read directly from the test instrument in SI units.

5.Three methods of determining the number of threads per centimeter are included, any of which may be used, the choice depending on the character of the fabric. The principles are as follows:

- Method A: A section of fabric of dimension specified is dissected and the number of threads counted. The treads that are to be counted are preferably short, 1 or 2 cm being suitable.

- Method B: the number of threads visible within the aperture of a defined counting glass is determined.

- Method C: the number of threads per centimetre of the fabric is determined with the aid of a traversing thread counter.

- So, the samples were prepared as ISO 7211/2: 1984, Method C for determination of warp and weft threads used in fabrics per unit length at textile testing center/Thailand textile institute, ministry of industry and their costs were collected and analyzed from northeast community is presented in table 1.

Table 1: Characteristics of each sample for testing air permeability following ISO 7211/2: 1984

Type	Wrap bamboo fibres with weft silk fibres 50:50	warp 100% bamboo fibres	Warp bamboo fibres with weft cotton fibres 50:50
Warp fibres @in^2	57	57	58
Weft fibres @in^2	71	61	27
Total of fibres @in^2	128	118	85

6. The costs of each fabric were collected from northeast community including Ban Lhong Pra Du, Moo 1, Sub-District Huay Talhang, Nakhon Ratchasima, Ban Ta Ma, Moo 1, Chum Saeng Sub-district, Satuek District, Buriram, Ban Somphon Rat, Moo 10, Nong Sano Sub-District, Buntharik District, Ubon Ratchathani, Ban Kokjan, Moo 2, Kokjan Sub-district, Uhumporn Phisai District, Sisaket and Ban Khaen Koet, Moo 14 and Ban Khok Sung, Moo 8, Chumphonburi Sub-district, Chumphonburi District, Surin, Thailand as follow as table 2.

Table 2: The costs of each fabric studied

Type	Wrap bamboo fibres with weft silk fibres 50:50	warp 100% bamboo fibres	Warp bamboo fibres with weft cotton fibres 50:50
Cost @Baht/m^2	80	50	50

Testing procedure and experiment

Absorbency is one of several factors that influence textile processing such as fabric preparation, dyeing and the application of finishes. Often interchanged with the term wettability, the absorbency characteristics of a fabric can influence the uniformity and completeness of bleaching and dyeing by the ability to take in water into the fiber, yarn or fabric construction. The suitability of a fabric for a particular use, as in the case of gauze or toweling, is also dependent upon a fabric's ability and propensity to take up water. The absorbency of yarns or textile fabrics can be also determined by this test method. The AATCC Test Method 79**,** absorbency of textiles**,** developed in 1954 by AATCC committee RA34; jurisdiction transferred to committee RA63 in 2003. The test method is for the determination of the water absorbency of yarns, fabrics and garments. It can be used on textiles of any fiber content or construction, including woven, knit and nonwoven. This test measures a fabrics propensity to take up water as follow:

1.Conduct the test in the standard atmosphere.

2.Sample (18×18 cm) is placed in an embroidery hoop (a 15 cm or more diameters) with all creases out of it, so that the surface is free of wrinkle but without distorting the structure of the material.

3.A burette dispenses a drop of distilled water at 21±3°C onto the surface of the fabric from a distance of 9.5 mm below the burette.

4.Time is recorded until the water drop absorbs completely. When the wetting time exceeds 60 seconds, 60+ seconds also should be recorded.

Conclusion and Discussion of experiment

After applying the 7-Station Monsant Crease Recovery Tester: Model MR-7P following AATCC TM 79: 2007 at textile testing center/Thailand textile institute, ministry of industry, the results were also satisfactorily and presented in table 3.

Table 3: Water absorption of each sample

Type	Water absorption (sec)
Warp bamboo fibres with weft silk fibres 50:50	60+
warp 100% bamboo fibres	29.98
Warp bamboo fibres with weft cotton fibres 50:50	17.02

1.The water absorption of warp bamboo fibres with weft cotton fibres 50:50 is the highest (17.02 sec) comparing with warp bamboo fibres with weft silk fibres 50:50 (60+ sec) and warp 100% bamboo fibres (29.98 sec). In economic considerations, the cost of the warp bamboo fibres with weft cotton fibres 50:50 (50 Baht/m^2) is cheaper than the warp bamboo fibres with weft silk fibres 50:50 (80 Baht/m^2) and as same as the warp 100% bamboo fibres (50 Baht/m^2). So, the warp bamboo fibres with weft cotton fibres 50:50 is suitable to apply to be any clothing and garment with the demand for more comfortable of water absorption such as sport wears, any towels (bath towels, bath sheets, hand towels, kitchen towels), dishcloths,

washcloths, beachwear, bathrobes, home textile products, sauna dressing- gowns, headgears, slippers, children's clothes, hygiene products for babies, etc because it allows the body to breathe as the fabric absorbs the sweat away from the body. By the way, there are still many detail of bamboo fibre used to produce yarn and cloth that also affect to the cost. So, we should determine their properties with their price for optimizing selection the best one (Figure 1).

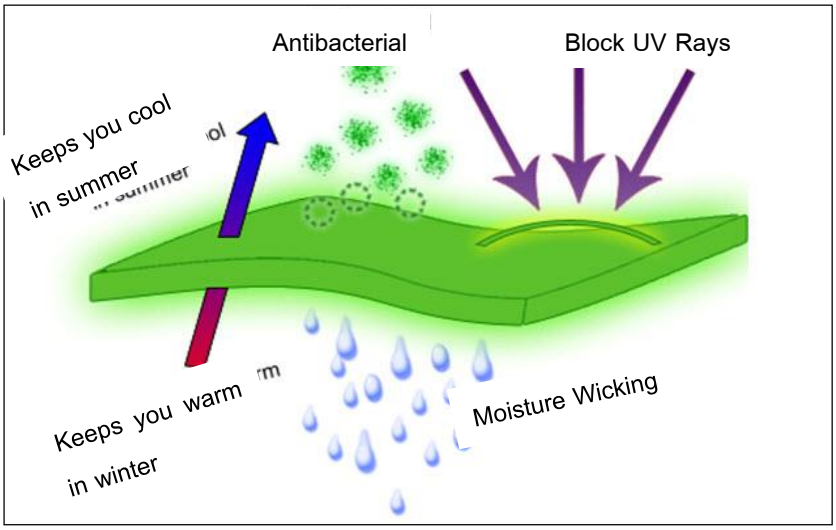

Figure 1: Bamboo textile's properties

2.Chen et al., (2007: 785-787) reported that the reason for the high antibacterial property of bamboo fabric was that it rapidly absorbs and evaporates water due to its structure, and that bacteria cannot survive in such a dry environment. It is also a reason for supporting the warp bamboo fibres with weft cotton fibres 50:50 should be applied to be sock or undergarments. In Poland shops we can find a lot of products made by local manufacturers, amongst which there are various kinds of underwear including special medical socks with an antibinding structure designed for diabetics and people with blood circulation problems in the legs (JJW, 2010, Online).

3.Figure 2-3 present some products made by bamboo fibres of northeast community including Ban Lhong Pra Du, Moo 1, Sub-District Huay Talhang, Nakhon Ratchasima, Ban Ta Ma, Moo 1, Chum Saeng Sub-district, Satuek District, Buriram, Ban Somphon Rat, Moo 10, Nong Sano Sub-District, Buntharik District, Ubon Ratchathani, Ban Kokjan, Moo 2, Kokjan Sub-district, Uhumporn Phisai District, Sisaket and Ban Khaen Koet, Moo 14 and Ban Khok Sung, Moo 8, Chumphonburi Sub-district, Chumphon-buri District, Surin, Thailand.

Figure 2: Any towels made by bamboo fibres with cotton fibres

Figure 3: Cloths made by bamboo fibres with cotton fibres

4.Bamboo clothing is an excellent fabric choice and it has many benefits and advantages over traditional cotton. Bamboo fabric is softer than cotton with a texture similar to silk. It is also quick to absorb moisture, therefore keeping you dry and odor free. Pure bamboo clothes can dry twice as fast as cotton clothes. Bamboo clothes can be worn all year round as they keep you cool in summer and warm in winter.

5.Bamboo textiles have many fantastic properties that combined make this a truely amazing fabric. It is breathable and cool, has a nice lustre; extremely soft; fast water absorption performance; and anti-bacterial as follow as figure 4 (Wannajun et al., 2011; Erdumlu & Ozipek, 2008; Karahan et al., 2006). So, it should be promoted and developed in order to support the marketing of textiles both of community and national.

6.Bamboo fibers are quickly emerging now in the fashion world. The fabric woven with bamboo yarn is light, almost translucent and softer than cotton (Amanda & Untao, 2001). It has a natural sheen that feels like silk or cashmere but has the advantage of being machine-washable. Bamboo fibres take up colour well when dyed. Some bamboo fabrics also have fantastic drape. The varieties of fabrics that can be made from bamboo fibre are numerous including hand wovens, terrycloths, jerseys, fleece and velour. Bamboo fabric is also not widely known, but considering these benefits, there is a considerable and growing market for bamboo fabric products (Li., 2004). Therefore, it has attracted many workers interest (Tong et al., 2005).

7.The environmental benefits of bamboo clothing are an added benefit. Bamboo plants are very quick growing and do not require fertilizers or pesticides for a successful crop. They also require very little water and they can survive drought conditions as well as flooding. Bamboo is a sustainable

and renewable resource as the bamboo plant is self-replenishing (new shoots are continuously growing, ready to replace the old ones).

8.Bamboo products are biodegradable and some companies have a utilization program that allows consumers to return a worn-out product and buy another at a lower price, which is a very good policy for encouraging others to do the same (Wojciechowska & Włochowicz, 2010).

Another benefit of bamboo is that it releases a significant amount of oxygen into the atmosphere, more so than trees. Planting bamboo can help reduce the level of carbon dioxide in the air as well as reducing soil erosion. The complex root system of bamboo plants makes them an excellent choice for planting in high erosion areas such as riverbanks and areas subject to mud slides. They are also suitable for planting in areas which have suffered significant soil degradation and deforestation (BambooClothes, 2014: (Online)).

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