Dyeing and Water Repellent Finishing of Thai Rice Straw Blended Fabric for Home Textile Products

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Abstract

The objectives of the research were to study dyeing process of Thai rice straw blended fabric, to study water repellent finishing of Thai rice straw blended fabric, to test physical properties of Thai rice straw blended fabric and to design and produce home textile products. The main material used was Thai rice straw blended fabric using blended yarn as 12% rice straw, 23% rayon and 65% polyesters. No. 20 used for a weft yarn. The warp yarn was 100% polyester yarn, number 150 D/2 and jacquard structure. The development of dyeing was laboratory experiments from Distar company limited. After that, the dying processes were undertaken by Thailand textile institute. The dying processes used were reactive and disperse. Water Repellent finishing was Starguard FCS. Testing of physical properties before and after finishing according to ASTM ISO and AATCC standards and the designing and producing of prototype products. The results showed that pink and blue followed the spring and summer fashion trend in 2018 of Thailand Institute of Fashion Research: in FASH. The result of the decoration of Thai rice straw blended fabric with water repellent finishing found that before finishing was not water resistant, and after finishing was resistant to level 5.5. The White fabric with the maximum width of fabric is 138.90 centimeters. After finishing the water repellent found that the blue fabric was resistant to tearing, the weft yarn and the warp yarn was the highest 93.75: 83.55 Newton. After finishing the water repellent found that all fabrics have color fastness to wash level 4.5. The prototype products of home textile products designed and sewed for 1 collection which were hats, cushions, mat pads, coasters and tissue boxes. The satisfaction results for the prototyped products had found that the water repellent finishing has the highest satisfaction, equal to 4.94. The fabric, color skin, touching and water repellent finishing were the highest satisfactions in all aspects.

Keywords: Dyeing, Water repellent, Physical property, Thai rice straw, Home textile

1. Introduction

Thailand is predominantly an agricultural country (Agriculture statistics of Thailand, 2018). From the report of the Research and Development Institute of Kasetsart University, it was found that the amount of 6.3 million tons of rice straw each year is left over from harvesting. The benefits of straw are abundant, ranging from animal feed, handicraft to renewable energy. At present, the community enterprise has brought rice straw to be used as handicrafts such as rice paper, rice straw bags, rice straw, rice straw mat etc. In addition, there are also straw briquette businesses, which most customers were the owner of the farm, whether it was cattle, goats or sheep, which has a briquette between 12-15 Thai Baht and the selling price between 30-35 Thai Baht (Komkhaotuathai, 2017).

In 2015, the researchers conducted a research project on "The Development of Blended Fiber with Thai Rice Straw for Textile and Clothing Industry". The results of the boiling separation test showed that the rice straw fiber Pathumthani 1, boiled with sodium hydroxide 20% for 60 minutes, in hot water 100-110 °C of temperature was suitable fiber for being blended with polyesters fibers and rayon fibers. The research found that the right blended ratio for the yarns was 12% rice straw fiber, 23% rayon fiber and 65% polyester fiber (Jatuphatwarodom, 2017).

From the above details, the researcher interested in bringing the remaining fabric dying according to fashion trends in 2018, decorated with water reflectors for home products, the physical properties of rice straw woven fabrics, and taking the fabric to design the prototyped home products. The research results will be useful to the Thai textile industry. The results will also lead to further development in commercial area



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according to utility innovative textile from rice straw that can be blended with synthetic fibers or other natural fibers based on the benefits of use. Making a good property suitable for the production of fabric to be used as a home product resulted in reducing rice straw, which was the remaining material from rice cultivation each year and helped to reduce the burning of rice straw that causes pollution which causes global warming.

2. Objectives

- 1. To study of dyeing processes of Thai rice straw blended fabric
- 2. To test of water repellent finishing of Thai rice straw blended fabric
- 3. To test of physical properties of Thai rice straw blended fabric
- 4. To design and produce of home textile products

3. Materials and Methods

3.1 Materials

3.1.1 The main materials were 120 meters of Thai rice straw blended fabric which was left from the research project "The Development of Home Textile Product from Thai Rice Straw Fiber by the Environmental Friendly Technology" in 2015. Thai rice straw blended fabric were blended yarn, 12% rice straw, 23% rayon and 65% polyesters. No. 20 used for the weft yarn. The warp yarn were 100% polyester yarn, number 150 D/2 and jacquard structure. The dyeing colors used were reactive and disperse. Water repellent finishing was Starguard FCS.

3.1.2 The equipments were dyeing tools, physical properties test tools, laboratory experiments of Distar company limited, Thailand Textile Institute, and Textile and clothing department of Faculty of Home Economics Technology, Rajamagala University of Technology.

3.2 Methods

3.2.1 To study of dyeing process of Thai rice straw blended fabric.

3.2.1.1 Preparation of fabric dyeing.

This research used the fashion trend, the Thailand Fashion Research Institute (inFASH) of spring and summer 2018, using the name as "The Age of Earthquakes. SPRING / SUMMER 2018 " by choosing pink (Sachet Pink 15-2216 TPX) and blue (Eventide 16-3919 TPX) for making home textile products (Color trends 2018, 2017).

Preparation process of the dyeing was undertaken in the laboratory of Distar company limited. After that, the dyeing lots had been done in Thailand Textile Institute. The mixture of pink was 0.032% Dianix Brilliant Red SF, 0.072% Levafix Brilliant Red CA, 0.032% common salt, and 10 g per 1 liter of water. The mixture of blue was Dianix Yellow Brown XF2 0.0085%, Dianix Red XF2 0.0066%, Dianix Blue XF2 0.0580%, Sera Con P-NR 2.0 g per 1 liter of Remazol Yellow SAM 0.0037%, Remazol Red SAM 0.0120%, Remazol Blue SAM 0.0310%, common salt, 22 g per 1 liter of water, and 2.8 g of soda ash per 1 liter of water.

3.2.1.2 Fabric dyeing

1) Polyester dyeing process.

The dyeing substrate was Sera Gal P-LP, 1.0 g per 1 liter of water. Sera Quest C-PX 0.5 g per 1 liter of water. Sodium acetate 0.5 g per 1 liter of water. Adjusting pH to 4.5 with Acetic acid. Each color was mixed together using the dyeing temperature at 40 °C to 130 °C at 30 minutes of dyeing.

2) Rice straw dyeing Process.

Rice straw was the same cellulose fiber as cotton fiber. Therefore, the dyeing of rice straw uses the same dyeing process. Researchers used Sera Quest M-PP, 0.5 g. per 1 liter of water. Sera Lube M-CF, 0.5 g. per 1 liter of water. Mix each color with soda ash and caustic soda at 60 $^{\circ}$ C.

3.2.2 To test of water repellent finishing of Thai rice straw blended fabric.

Blue and pink dyed fabrics were used to decorate water reflections with the following details:



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3.2.2.1 Water preparation was calculated from the weight of the fabric combined with the minimum water in the machine (minimum value was 25 liters), including fabric weight 14.18 kg when combined with minimum of 25 liters of water, which was 14.18 + 25 = 39.18 ≈ 30 liters (approximately).

3.2.2.2 Chemical formula 1 Proguard BT-FL, 50 g per liter. The result was the amount prepared by using 50 * 30 = 1500 g or 1.50 kg. Mix the chemical formula 1 into 30 liters of water in the preparation basin. Spin the chemicals together. Adjust the pH value at 4-5 and pour the mixture into the rolling machine. Bring the fabric to the machine for the finishing process by using the drying temperature at 150 ° C, running speed of 3 meters per minute (the fabric will pass drying for 2 minutes)

3.2.3 To test of physical properties of Thai rice straw blended fabric.

Testing before and after as the following: there were the length and width testing of the fabric according to ASTM D3774. Fabric weight was tested according to ASTM D3776. Tensile strength was tested using ASTM D 5034: 2009. Tearing strength was tested by ASTM D 1424: 2009. Pilling resistance was tested according to ISO 12945-1: 2000 (E) and the color fastness was tested according to AATCC61 standard.

3.2.4 To design and produce of home textile products

Design and sewing of home textile products, including of 1 collection as; hats, cushions, plate mats, coasters and tissue boxes. And then bring all products to explore consumer satisfaction. The statistics used was percentage, mean and standard deviation.

4. Results and Discussion

4.1 Results of the dyeing processes of Thai rice straw blended fabric with water repellent finishing

The results show that figure 1: pink and blue were the colors according to 2018 fashion trends of Thailand Institute of Fashion Research in spring and summer 2018.



Figure 1 Pink and blue of 2018 fashion trends

4.2 Results of the water repellent finishing of Thai rice straw blended fabric

Before having water repellent finishing, the liquid could penetrate through the fabric. After the finishing liquid could not penetrate the fabric. All fabrics were decorated with water repellent finishing as show in Figure 2



Figure2 Examples of fabrics with water repellent finishing



4.3 Results of physical properties testing Thai rice straw blended fabric with water repellent finishing

Table 1 The results of before and after the tensile strength testing of Thai rice straw blended fabric with water repellent finishing (Unit: Newton)

Color	Befo	ore	After		
	Warp	Weft	Warp	Weft	
1. White	1091.83	409.97	0	0	
2. Pink	1127.96	458.72	1114.82	440.96	
3. Blue	1100.50	459.33	1149.49	462.32	

Table 1, the results before and after the tensile strength of Thai rice straw blended fabric with water repellent finishing found that after the water repellency finishing, the warp and the weft of the blue fabric was stronger than the pink one. 1149.49: 462.32 Newton.

Table 2	The results of before an	nd after tearin	g strength t	testing of	Thai rice strav	v blended	fabric with	water	repellent
finishing	g (Unit: Newton)			-					_

Color	Bet	fore	After		
	Warp	Weft	Warp	Weft	
1. White	80.61	75.55	0.00	0.00	
2. Pink	58.06	33.15	84.14	74.51	
3. Blue	58.64	42.36	93.75	83.55	

Table 2, the results of before and after the tearing strength testing of Thai rice straw blended fabric with water repellent finishing found that blue fabric was resistant to tearing, the warp and the most the weft was 93.75:83.55 Newton. In conclusion, after water repellent finishing, all colors were stronger than before finishing.

Table 3 The results of before and after fabric	weights, fabric width, pilling a	nd color fastness testing of Thai rice straw
blended fabric with water repellent finishing		

Color -	Fabric	Fabric weight		Fabric width		Pilling		Color fastness	
	Before	After	Before	After	Before	After	Before	After	
1. White	182.58	0	139.70	138.90	4.00	0	4.5	4.5	
2. Pink	259.21	250.23	120.40	126.90	4.00	3-4	4.5	4.5	
3. Blue	244.26	234.01	125.60	126.90	4.00	3-4	4.5	4.5	

Table 3, the results of before and after fabric weights, fabric width, pilling and color fastness testing of Thai rice straw blended fabric with water repellent finishing found that the weight of the fabric after the decoration of the water was less weight than before finishing (White: 182.58, pink: 259.21:250.23 and blue: 244.26:234.01 g per square meter). This is the result from dyeing and water repellent finishing causing weight gain. White fabric's width was less than before water repellent finishing. Dyeing and water repellent finishing made shrinkage. As well as the study on the "Effect of Dyeing and Finishing



Parameters on Cotton Knitted Two Thread Fleece Fabric and 1x1 Rib Fabric" research which was found that the shrinkage has occurred both length wise and width wise (Siddiquee et al., 2016). Pink and blue after finishing were bigger than before. (Pink: 120.40:126.90 and blue: 125.60:126.90 centimeter) Before finishing, both of the fabrics was level 4, and after finishing, pink fabric and blue fabric were level 3-4 of pilling resistance. Before and after the water repellency fabric found that all fabrics were level 4-5 color fastness. Therefore, it was durable for washing.

4.4 The results of designing and producing of home textile products

The pink and blue fabrics were used to decorate water repellent finishing. And then used to design and make products in home textile products. The home textile products were designed and sewed to 1 collection which were hats, cushions, mat pads, coasters and tissue boxes as shown in figure 3.



Figure 3 Examples of home textile products

Consumer satisfaction towards home products according to hats and cushions' fabrics, skin colors, designs and water repellent finishing. All subjects have high level of satisfaction. Water repellent finishing was the highest satisfaction at 4.94. The mat plate regarding its texture, skin color, touch, design and water repellent finishing has high level of satisfaction. The highest satisfaction was on water repellent finishing at 4.86. The coaster regarding the fabric was skin color, design, and water repellent finishing. Water repellent finishing was the highest satisfaction at 4.90. And the tissue box regarding the texture, skin color, touch, design and water repellent finishing, the highest satisfaction score was color at 4.88.

5. Conclusion

The pink and blue were the colors according to 2018 fashion trends of Thailand Institute of Fashion Research in spring and summer 2018. The testing results in before and after the tensile strength of Thai rice straw blended fabric with water repellent finishing found that after finishing, the warp and the weft of the blue fabric was stronger than the pink fabric. 1149.49: 462.32 Newton. The tearing strength of the fabrics with the finishing had found that the blue fabric was resistant to tearing, the warp, and the most the weft was 93.75:83.55 Newton.

Fabric weights, fabric width, pilling and wash ability testing of the fabrics with the finishing found that the weight of the fabric after the finishing was less weight than before. (White: 182.58, pink: 259.21:250.23 and blue: 244.26:234.01 g per square meter) White fabric's width was less than before with water repellent finishing. Pink and blue sizes after finishing was bigger than before (Pink: 120.40:126.90 and blue: 125.60:126.90 centimeter). Before finishing, both of fabric was level 4, and after finishing, pink fabric and blue fabric were level 3-4 of pilling resistance. Before and after the water repellency, the fabric had found that all fabrics were level 4-5 of wash ability. The prototyped product was 1 collection including, hats, cushions, mat pads, coasters and tissue boxes. Researchers also recommended the continuation of this particular research for example, not only test water repellent finishing and having product development with Thai rice straw, but also further studies on the other kinds of fibers like Thai sugarcane, pineapple etc. By having more researches regarding Thai natural fibers, it would help agricultural stakeholders to rise up profitability, and also level up the Thailand textile industry.

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