Improvement of Dust Resistance Properties on The Surface of Jute Knitted Fabrics

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***Abstract*: Jute knitted fabric was produced in knitting lab and was treated with natural and synthetic dust resistance compounds of perchloroethylene, wax, and mixers of vinegar and olive oil at different temperatures with contact of dust to develop anti-dust characteristics on jute knitted fabrics. It was found that at 80ºC temperature, perchloro ethylene developed dust resistant property on jute knitted fabric whereas at 60ºC, wax treatment improved a dust resistant property and in natural treatment at room temperature, spray of vinegar+olive oil improved dust resistant property as well.**

***Keywords*: Jute, Knitted, Fabric, Dust Resistance, Perchloro Ethylene, Environment, Wax.**

I. INTRODUCTION

The quality of fabrics is determined by their relevance to the functions they are produced for. It is evaluated according to a set of criteria's which appropriate for each type of fabrics. A fabric testing is one of the most important methods for fabrics evaluation during or after production by using laboratory devices which are relevant to fabric properties (Mobark 2017). Knit fabrics are popular worldwide due to their excellent mechanical and comfort properties (David 1989). Jute, the lignocellulosic golden fibre of Bangladesh, is still the main cash crop and one of the major foreign exchange earners in the country providing livelihood of millions of farmers and industrial workers. It is an environment friendly, biodegradable and versatile bast fibre. For the environment friendly approach of jute product, the use of jute is increasing rapidly again throughout the whole world (Matković et al. 2014). Diversification of jute product is being considered the prime way to get back the golden days of jute. This is why; the use of dyed jute fabrics is increasing remarkably for producing value added jute products (Chowdhury et al. 2020). According to WHO, Dust is a small solid particles, conventionally taken as those particles below 75 μm in diameter, which settle out under their own weight but which may remain suspended for some time (WHO 1999). The world is now facing problems regarding environment pollution because of wide range of usages of synthetic materials. Knitted fabrics are known to possess excellent comfort properties as they not only allow for stretching and ease of movement, but they also have good handling characteristics for the body. They also possess high extensibility under low load, allowing comfortable fit on any part pulled. Furthermore they are also light weight and flexible (Li and Dai 2006). Knits are not typically very wind or water repellent of clothing comfort and wide product (Chowdhury et al. 2020, Blair 2007). The major constituents of jute are cellulosic materials making it an excellent candidate for knit fabric production (US Patent 1962, Chowdhury et al. 2020). The present research was introduced to develop a new technology for producing different designed jute knitted fabrics and develop dust resistant property on jute knitted fabrics. Therefore, the purpose of this study is to increase the use of diversified product of jute knitted fabric.

II. MATERIALS AND METHODS

Jute yarns were collected to make jute knitted fabric in knitting lab. All the chemicals in present study were reagent grade. The fabrics testing for the quality of fabrics and their capacity to resist dust was tested by the dust permeability.

Collection and Pretreatment of raw jute yarn 20kg of 8lbs/spyndle jute yarns has been collected from spinning department of mechanical processing division of Bangladesh Jute Research Institute (BJRI). Jute yarn treated with sodium hydro oxide, sodium silicate and other auxiliary chemicals to reduce the impurities, oil and wax. Then jute yarn is bleached with hydrogen peroxide to vanish the yellowish nature of yarn.

Dyeing and Knitting process Pretreated jute yarn then dyed with yarn dyeing machine with reactive red color at 60ºC temperature for developing color on jute yarn. Dyed jute yarn then transferred to knitting lab. Thenflat bed 3 gauge knitting machine was used to make jute knitted fabric with different design. Interlocking mechanism and one set jute yarn was used to produce jute knitted fabric.

Treatments: Three different treatments were followed in present study (**Fig. 1**), which were as follows:

(A) Perchloro ethylene treatment, Jute knitted fabric (4 pieces of 10g samples) was treated with perchloro ethylene at different temperatures. 1g perchloro ethylene was used for every sample. Then perchloro ethylene treated samples have been taken to close

contactof dust agent. At different temperature percholore ethylene treatment gave different value. At 80ºC perchloro ethylene developed dust resistant property on jute knitted fabric.

(B) Wax treatment, Jute knitted fabric (4 pieces of 10g samples) was treated with liquid wax and stabilizer at different temperatures.

(C) Natural chemical treatment, A mixture of water, vinegar and olive oil was used to make a spray and was applied on jute knitted fabric (4 pieces of 10g samples) at room temperature.

*Jute knitted fabric treated with Perchloro ethylene***,** Raw jute yarn was treated with soda and other auxiliary chemical (bicarbonate, lissapol) at 80ºC temperature for 30min to remove the yellowish nature of raw jute, other impurities where the reaction composition was- Na_2CO_3, 150g/L; Lissapol, 50g/L; Soda, 150g/L; M:L, 1:10. Acetic acid (200ml) was used to wash the squaring jute yarn to remove auxillary chemicals. Bleaching was done with H_20_2 and auxillary chemicals (silicate) at 70ºC temperature about 30 minutes, where the reaction composition was- H_20_2, 300ml; Silicate, 100gm/L; Lissapol, 50gm/L; M:L =1:10; Temparature 70ºC; Soda=150gm/l. Dyeing process was done with reactive dye at 90ºC temperature about 45min. In this process bleached jute yarn was dyed in red color (200g). Other chemicals used were- NaOH, 100g; NaCl, 300g. Cool dyeing was then done at pH 7.5 for 45 min. Dyed yarn then tranfered to weaving Department to creel and make yarn package. 3-gaugeflat bed jute knitting machine was used to knit jute knitted fabric. In this process dyed jute yarn was converted to knit fabric with plain design. Intelocking mechanism and one set jute yarn was used in this process **(Fig. 2)**. Jute knit fabric was then treated with perchloro ethylene. In this process knit fabric was cut into 10g sample and make contact with dust; the sample was treated perchloro ethylene to measure the effect of dust resistance for this treatment (**Fig 3**).

Jute knitted fabric treated with liquid wax, Jute knitted sample was undergone treatment with liquid wax at different temperatures. It showed great changed at 60ºC temperature **(Fig. 4)**.

III. RESULTS AND DISCUSSION

Treatment of jute knitted fabric with perchloro ethylene, with liquid wax and with natural compound was shown in Table 1 to 3, respectively. Knitting is considered to be the second most frequently used fabric construction method (Felczak et al. 2015, Alamac American Knits 2004). Shogofurov et al. (2021) showed the physical and mechanical properties of knitted mixed knitted fabrics. Changes in tissue structure, positive effect on the air permeability, toughness, elongation and abrasion resistance properties of knitted fabric strengthen the shape retention of knitted fabric. It was revealed that perchloro ethylene has direct impact on jute knitted fabric to produce dust resistant character on fabric surface at 80ºC temperature. In liquid wax treatment at 60ºC temperature liquid wax coated jute knitted surface created a layer to distract dust from fabric surface which was dust resistance property. For natural compound mix treatment at room temperature combination of water, vinegar and olive oil made the jute surface less affectionate to dust. The jute knit fabrics were found to be better than traditional knit fabrics and can be dust resistance with the treatment of liquid wax, which is acceptable. the quality of fabrics depends on their liability to retain dust on their surface or pores and on other qualities as well. Thus this unique property can be used as a replacement for synthetic and cotton fibre with jute. The production of knitted fabrics from polyacrylonitrile yarn on the basis of rubber, glad, openwork fabrics allows obtaining knitted products with high hygienic and shape-retaining properties, toughness and beautiful appearance. The technological performance of the newly created knitted fabrics has been studied and they are recommended for top knit products. Further research is needed to complete satisfaction result more experiment needed where nonwoven and knitted fabrics should be investigated for the property of expelling dust.

IV. CONCLUSION

The reflectance increment of the fabric was a similar to lowering the light-absorbing tendency. Attainment of flame resistance property provided an additional feature to retain the quality from the fire flame. The cotton fabric could be considered for value addition purpose in protective clothing as well as modern fabric processing (Sela et al, 2020). Jute knitted fabric can replace the synthetic fabrics and reduce the environment pollution for its bio friendly nature (Gulati et al. 2022). By increasing the usages of diversified jute knitted products, Bangladesh can save the environment from pollution. Environment awareness is a priority program in our country. Therefore, environment friendly jute knitted fabric can play huge role to replace the demand of cotton knitted fabric and can help the environment to make free from pollution. This dust resistant knitted jute fabric can be used for improving market potentiality for its dust resistant and different design. Dust resistant knitted fabric can also be served as an environment friendly product.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this paper.

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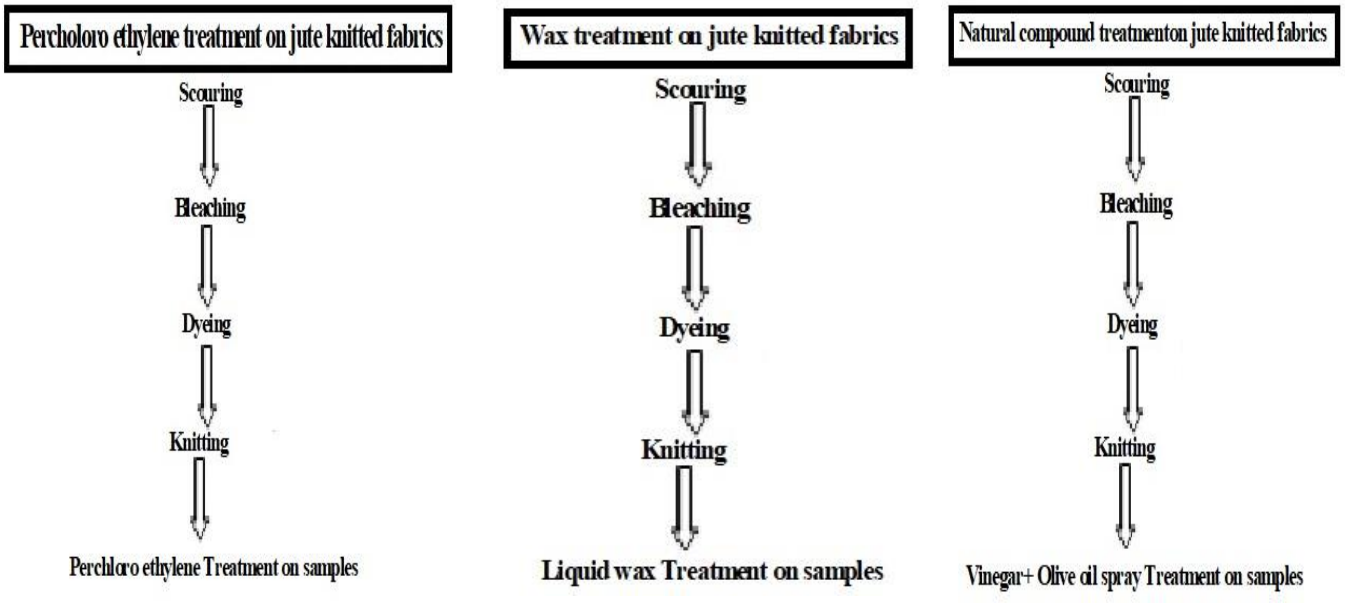


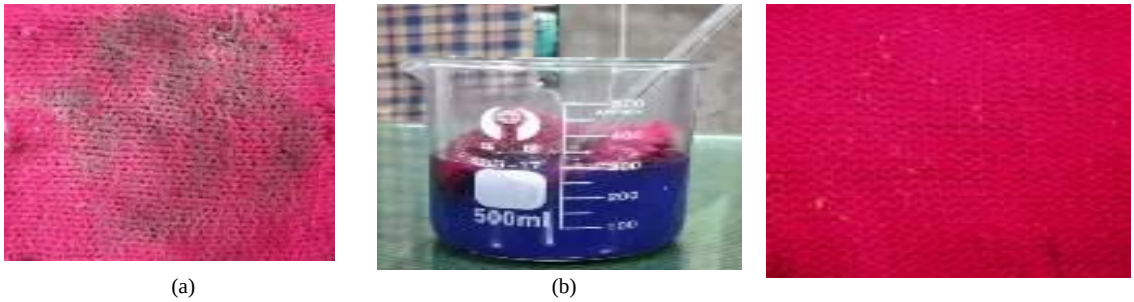
(a) (b) (c)

Figure 1: Treatments- (a) Perchloro ethylene treatment, (b) Wax treatment, (c) Natural chemical treatment.

(a) (b) (c)

(d) (e)

Figure 2: Different stages of yarn processing- (a) Scouring of jute yarn, (b) washing of scoured jute yarn, (c) Bleaching of jute yarn, (d) Creeling and coning, (e) Dyed jute yarn knitting.



(a) (b) (c)

Figure 3: Jute knitted fabric treated with perchloro ethylene- (a) Before treatment of Jute knitted fabric contacted with perchloro ethylene, (b) Jute knitted fabric treated with perchloro ethylene, (c) After treatment of Jute knitted fabric with perchloro ethylene.

(a) (b) (c)

Figure 4: Jute knitted fabric treated with perchloro liquid wax- (a) Before treatment of Jute knitted fabric contacted with perchloro liquid wax, (b) Jute knitted fabric treated with perchloro liquid wax, (c) After treatment of Jute knitted fabric with perchloro liquid wax.

Table 1: Treatments of jute knitted fabric with perchloro ethylene.

Fabric weight	Treatments	Temperature	M:L ratio	Contact material	Remarks
10g	Per chloro ethylene, 1g+ Lissapol, 0.1mg+ H_2O_2, 0.5 mg+ Na_2CO_3, 0.5mg	Room temperature	1:10	Dust	No changed
	Per chloro ethylene, 1g+ Lissapol, 0.1mg+ H_2O_2 , 0.5 mg+ Na_2CO_3, 0.5mg	60°C	1:10	Dust	Mild changed
10g	Per chloro ethylene, 1g+ Lissapol, 0.1mg+H_2O_2, 0.5 mg+Na_2CO_3, 0.5mg	80°C	1:10	Dust	Changed
	Per chloro ethylene, 1g+ Lissapol, 0.1mg+H_2O_2, 0.5 mg+Na_2CO_3, 0.5mg	90°C	1:10	Dust	No changed

Table 2: Treatment of jute knitted fabric with Liquid wax.

Fabric weight	Treatments	Temperature	M:L ratio	Contact material	Remarks
10g	Liquid wax, 5g+stablizer, 1mg+ H_2O_2, 0.5 mg+Lissapol, 0.1mg+ Na_2CO_3, 0.5mg	Room temperature	1:5	Dust	No changed
10g	Liquid wax, 5g+stablizer, 1mg+ Lissapol, 0.1mg+ H_2O_2 , 0.5 mg+ Na_2CO_3, 0.5mg	60°C	1:5	Dust	changed
10g	Liquid wax, 5g+stablizer, 1mg+Lissapol, 0.1mg+H_2O_2, 0.5 mg+ Na_2CO_3, 0.5mg	80°C	1:5	Dust	No changed
10g	Liquid wax, 1g+stablizer, 1mg+Lissapol, 0.1mg+H_2O_2, 0.5 mg+ Na_2CO_3, 0.5mg	90°C	1:5	Dust	No changed

Table 3: Treatment of jute knitted fabric with Natural Compound.

Fabric weight	Treatments	Temperature	M:L ratio	Contact material	Remarks
10g	2cup H_2O +1 cup vinegar+2 tablespoon Olive oil+H_2O_2, 0.5 mg+ Na_2CO_3, 0.5mg	Room temperature	1:10	Dust	Changed
10g	2cup H_2O +1 cup vinegar+ 2 tablespoon Olive oil+ Lissapol, 0.1mg+H_2O_2, 0.5 mg+Na_2CO_3, 0.5mg	60°C	1:10	Dust	Mild changed
10g	2cup H_2O+1 cup vinegar+ 2 tablespoon Olive oil+Lissapol, 0.1mg+H_2O_2, 0.5 mg+Na_2CO_3, 0.5mg	80°C	1:10	Dust	No changed
10g	2cup H_2O+1 cup vinegar+2 tablespoon Olive oil+Lissapol, 0.1mg+H_2O_2, 0.5 mg+Na_2CO_3, 0.5mg	90°C	1:10	Dust	No changed