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Sizing of Warp Yarn with a Different Concentration of Animal Fat and Acids and Determination of the Performance in Comparing with Conventional Sized Yarn

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ABSTRACT
This paper deals with Animal fat, which could effectively assess alternatives sizing materials than conventional sizing materials. Here, we have picked two yarn types; 1) Sized yarn and 2) Unsized yarn for the test. In sample preparation, we have treated 100gmunsized yarn with 500 ml fat solution each containing 10% HCL, 10% Glacial Acetic Acid, 10% Lactic acid and with only water. Handloom had been used to weave for both treated yarn samples. Then some physical and mechanical properties were tested to calculate weaving performance. After measuring the fabric weight we found that only water and fat solution treated samples weight showed higher GSM than other samples. Besides, higher tensile strength hadmeasured for conventionally treated samples. Approximately 30 – 50% less breaking strength was recorded for other samples for warp way directions, although only a little lower breaking strength had found in weft way directions. Again, higher abrasion resistances were observed for conventional fabric samples however HCL treated samples had prevailed least properties. Therefore costing of acid-fat treated samples are much lower than conventional sizing, besides desizing could be bypassed and single bath scouring and bleaching could be applicable.

Keywords: Animal fat, Sizing, GSM, Tensile strength, Abrasion.

1. Introduction

Now a day, Sizing warp yarns with starch coating is an important process considered as standard practice in the textile industry. The physical property of the yarn and on the performance of the yarn in the weaving operation lies on effective sizing process [1 – 3]. Fatty lubricants such as waxes and oils are applied to warp yarn to reduce friction, the yarn breakages and provide lubrication to the yarns in order to decrease the electro-static problems [4 – 7]. However, it requires desizing of all the chemicals which is known as desized process. Textile industry worldwide is facing considerable challenges due to concerns on price and availability of raw materials, increasing environmental restrictions and lack of technological breakthroughs that can reduce cost and/or develop new products [8 – 10]. Approximately, costing of Raw materials (66%), Size and Chemicals (4%), Production cost (8%), Worker wages and Salaries (8%), Interest on investment, loan, depreciation (7%), Overheads and administrative expenses (7%) is experienced this current year [11]. Considerable efforts are being made to find alternative approaches to explore the possibilities of reduced sizing and, preferably, size-less weaving (i.e., eliminating warp sizing) in the production of cotton fabrics [12].

In this article, a comprehensive effort on using animal fats mixing with different concentration of acids instead of conventional sizing materials was done. As animal fats and other acids can be removed totally in either single or double bath Scouring and Bleaching in a standard condition thus desizing process can be possible of bypassing.

After the finishing process, some of the physical and mechanical properties were tested and was compared with the conventional manufactured fabric.

2. Materials and methods

2.1. Materials

2.1.1. Yarn sample

For testing, sized and unsized warp yarn and weft yarn were collected from Sinha Textile Group whose count was 40/2Ne.

2.1.2. Size ingredients

Animal fat was used as sizing ingredients.

2.1.3. Chemicals

HCL (Azithromycin BP, CN HUB), Acetic Acid (MKCorporation, Dhaka), Lactic Acid, NaOH (TriveniInterchem Pvt. Ltd., China), H_2O_2 (Suvidhi Industries, India)

2.1.4. Warp yarn preparation

At first animal fat were collected and were melted by applying direct heat on it. Then 10% solution of mentioned acids was prepared separately. Three acids – water solution and only 10 ml water were mixed with the liquid animal fat containing 40 ml of liquid fat and prepared 4 different solutions of 50 ml individually.

2.1.5. Fabric samples

The following 5 types of fabric samples were weaved by using different chemical treated yarns:-

Sample – 1: Fabric constructed by using conventional sized yarn.

Sample – 2: Fabric constructed by using 10% HCL and Fat treated solution

Sample – 3: Fabric constructed by using 10% Acetic Acid and fat treated solution

Sample – 4: Fabric constructed by using 10% Lactic Acid and Fat treated solution

Sample – 5: Fabric constructed by using only fat and water treated solution

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2.2. Methods

2.2.1. Methods of sizing with animal fat and acid

The warp yarn (unsized) (For Samples 2 – 5) were passed through the chemical solution separately and treated for 3-5mins. And passed through the squeezer to squeezed the excess fat and chemical liquor. Then passed through a heating chamber to melt the fat from the yarn surface for 1-2 min and again passed through the squeezer to remove the excess fat to make yarn dry. Finally, these treated yarns were prepared for weaving and were sent to the handloom as fabric were constructed by handloom due to lack of loom facilities.

2.2.2. Desizing (sample 1)

For this, the conventional industrial methods were followed to remove the size materials.

2.2.3. Double bath scouring and bleaching (sample 1 – 5)

Double Bath Scouring and Bleaching were done by using 20 g/L NaOH and 1 g/L H_2O_2 at a M:L = 1:20. Here temperature was 90℃ and run time was 20 min.

2.2.4. Determination fabric weight

According to ASTM D3776 / (2013) standard fabric weight was measured. [13]

2.2.4. Determination of tensile strength

According to the ASTM D5034 standards fabric tensile strength was measured. [14]

2.2.5. Determination of abrasion resistance

According to the ASTM D3511 standard fabric abrasion property was tested. [15]

3. Results and discussion

3.1. Effects of sizing on fabric weight

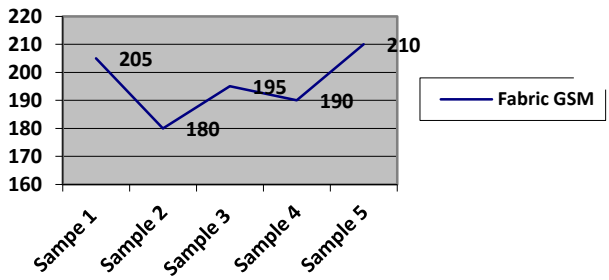

Fig.1 Different sizing effects on Fabric Weight

It is clearly has seen that fabric weight varies for all the tested fabric samples. Lower fabric weight was observed when warp yarns were treated HCL acid and the higher impact was recorded for only fat treated samples.

3.2. Effects on the tensile strength of the fabric.

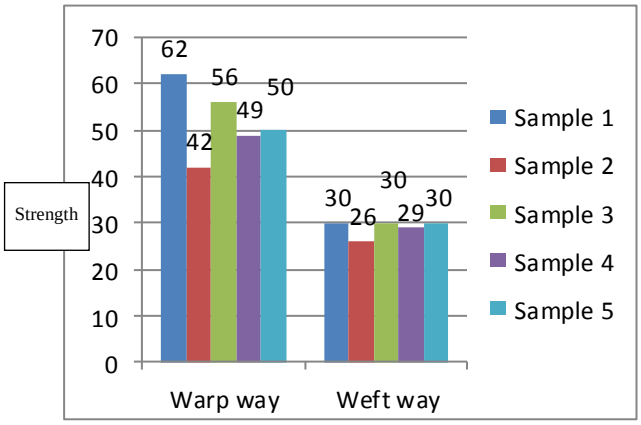

Fig.2 Effects of Tensile Strength on different Samples

Higher strength was found (both warp way (62 kg) and weft way (30 kg)) for conventional fabric samples. All the others breaking strength were observed lower than the conventional methods. Approximately 30 – 50% less breaking strength was recorded for warp way, however, only a little less breaking strength was observed in weft way.

3.3. Effects on the abrasion resistance of the fabric.

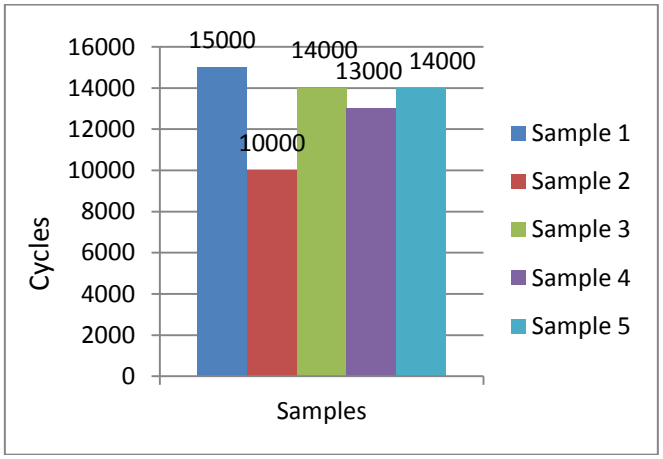

Fig.3 Effects of Cycles on Abrasion Resistance of different Samples

Conventional fabric samples did not break up to 15,000 cycles whereas HCL treated samples breaks when cycles were more than 10,000. Besides samples 3 and samples 5 breaks more than 14,000 cycles and samples 4 breaks after 13,000 cycles.

3.4. Cost analysis

Total liquid = acid (10 ml) + water (40 ml) = 50 ml; this could size approximately 10-15 kg of warp yarn that can

weave around 10 yards of plain fabric on the natural construction on loom.

3.4.1. Sizing cost

Cost while HCL-fat sizing

Price of HCL = $2.5/L

10 ml HCL price = 2.5 cents that could treat minimum 10 yards of fabric.

So, cost of 1 yards fabric size with HCL = 0.25 cent/yards

Cost while Acetic acid (CH_3COOH) -fat sizing

Price of Acetic Acid = $ 4.5/L

10 ml Acetic Acid price = 4.5 cents that could treat minimum 10 yards of fabric.

So, cost of 1 yards fabric size with Acetic Acid = 0.45 cent/yards

Cost while Lactic Acid ($CH_3CH(OH)CO_2H$) -fat sizing

Price of Lactic Acid = $ 5 /L

10 ml Lactic Acid price = 5 cents that could treat minimum 10 yards of fabric.

So, cost of 1 yards fabric size with Lactic Acid = 0.50 cent/yards

Cost of animal fat

Price of Animal fat = $0.5 /kg

Price of 20 gm fat = 1 cent (as 20 gm fat was added to 50 ml solution)

20 gm fat is used to size warp yarn which could approximately weave 10 yards plain fabric.

So, cost of fat for 1 yards of fabric sizing = 1/10 = 0.1 cent

3.4.2. Single bath scouring and bleaching cost

M:L = 1: 20

Cost of H_2O_2 for bleaching 1 yards of treated sample

Price of H_2O_2 = $3.2 / kg (required 1gm/L)

So, 1 gm price = 0.32 cent

Wt. of 1 yards fabric = 200 gm (approximately)

So water requires = 0.200 x 20 = 4 Litre water

So, for 1 yards fabric bleaching, H_2O_2 needs = 0.32 x 4 = 1.28 cent

Cost of NaOH for bleaching 1 yard of the treated sample

Price of NaOH = $0.58 /kg

Price of 20 gmNaOH = 1.165 x 4 = 4.64 cent

So, for 1 yd fabric bleach needs NaOH = 4.64 cent

So, total scouring and bleaching cost = 1.28 + 4.64 cent/yards

= 5.92 cent / yards

Total cost calculation

Total cost of each sample treatment = Sizing cost + Fat cost + Scouring & bleach cost

For HCL-fat treated sample cost = 0.25 + 0.1 + 5.92 cent/yards = 6.27 cent/yards

For CH3COOH-fat treated sample cost = 0.45 + 0.1 + 5.92 cent/yards = 6.47 cent/yards

For $CH_3CH(OH)CO_2H$-fat treated sample cost = 0.50 + 0.1 + 5.92 cent/yards = 6.52 cent/yards

Only fat treated sample cost = 0.1 + 5.92 = 6.02 cent/yards

And conventional sample cost = 14 cent/yards(data collected from factory)

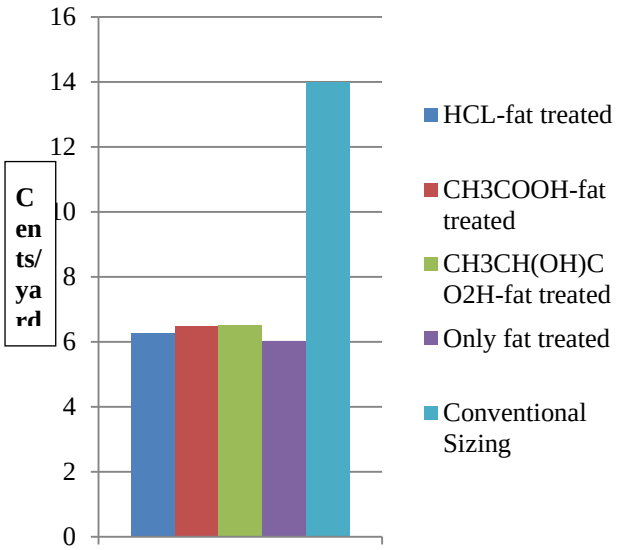

Fig.4 Cost comparison of different sizing processes

From the above cost analysis and through meticulous observation some conclusion can be mentioned as such for every case fat treated samples sizing and scouring and bleaching cost is much lower than the conventional. Therefore, a single bath scouring and bleaching have a possibility where desizing is not mandatory for fat treated samples. On the other hand for the industrial process, it is must have desizing process, scouring, bleaching process individually. Finally acid- fat treated samples are more convenient than conventional.

Conclusion

Sizing and desizing process are the two most important processes to follow in the textile industry. Both processes are important as without better sizing best weavability cannot be achieved and at the same time without proper desizing it is not effective on the further processing. Due to the higher costing and time consuming it has already become necessary to find an alternative to this. In this research work, we tried to show that animal fat could be a better alternative as it can be further removed completely in the process of scouring and bleaching which could save money and time significantly. Though the required or sufficient properties were not found, hence it needs some further work which could establish it as a suitable alternative method of fabric processing.

REFERENCES

[1] 'Balcb and Paine. *Production 0/ starch/rom sweet potatoes. Ind. Eng. Chem.* 23,1205 (1931) .

[2] Weber, Shaw, and O'Leary. Quality of Sweet· Potato Starch for Beater Sizing of Paper. Misc. Pub. BS 150 (June 1935). .

[3] Schreiber, Geib, and Moore. *Con8istency a/potato starch size.*BS J. Research 11, 765 (1933), RP623.

[4] Lord, P.R.; Mohamed, M.H., (1982). Weaving: Conversion of Yarn to Fabric.Woodhead Publishing, Cambridge.

[5] Goswami, B.C.; Anandjiwala, R.D.; Hall, D.M., (2004). Textile Sizing. Marcel Dekker Inc, Auburn.

[6] Strauss, M.D. and Petty, D.A. "Towards the Perfect Warp" *Textile Asia*, May1 1987, pp.47 50.

[7] Hall, M. "Pros and Cons of Wax for Sizing" Textile Slashing Short Course Proceedings, Auburn, Alabama 1985

[8] Wikipedia, (2012). Distillers grain. shttp://en.wikipedia.org/wiki/Distillers_grain.

[9] Pimentel, D., (2003). Ethanol fuels: Energy balance, economics, and environmental impacts are negative. Natural Resources Research 12(2), 127–134.

[10] http://www.ethanolrfa.org/pages/industry-resources-coproducts

[11] 11. On May 7, 2015 / Blog posts, PRODUCTION & PRODUCT DEVELOPMENT / sourcegarment.com

[12] Sawhney, A. P. S., Dumitras, P.G., Sachinvala, N.D, Calamari, T.A., Bologa, M.K., and Singh, K.V. Research Approaches for reducing or eliminating warp sizing in modern high-speed weaving. American Association of Textile Chemists and Colorists (AATCC), September 2005.

[13] ASTM D3776 / (2013), Standard Test Methods for Mass per Unit Area (Weight) of Fabric, American Society for Testing and Materials, West Conshohocken, PA, USA.

[14] ASTM D5034 (2013), Standard Test Method for Breaking strength of fabric, Constant Load of Elongation (CRE), Grab Test, ASTM International, West Conshohocken, PA, 2013, www.astm.org

[15] ASTM D3511 / D3511M-13, Standard Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Brush Pilling Tester, ASTM International, West Conshohocken, PA, 2013, www.astm.org