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Influence of water quantity in Wet Processing of Terry towel Fabric

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Abstract
The objective of this effort is to find out the outcome of water quantity in wet processing of towel fabric. In this work the material: liquor (M:L) 1:4, 1:5, 1:6 and 1:7 have been used respectively for the wet processing of the equal amount of towel fabric and the quality parameters e.g.: color fastness to wash, rubbing, perspiration, wicking performance, and absorption time etc. which are assessed. All the results are good at liquor ratio 1:5 and comparable with other results of M: L. If the use of liquor ratio is 1:5, and then it can be saved water in addition to get a good result of dyed terry towel fabric. These will assist to save water in the dyeing section.

Keywords: Terry towel, Water quantity, Quality parameters

1. Introduction

Terry towels are textile products, which are prepared with loop piles on one or both the sides generally, cover up the whole outer surface and subjected to alter fashions and the market is constantly demanding to the consumers in terms of softness and absorbency. The manufacture of terry fabrics is a multifaceted procedure and is only possible on specially equipped weaving machines. Three yarn systems are fed in the terry loom compared to the two system types of traditional weaving. The two warps are processed simultaneously. The loops of the terry fabric can be handled with the warp ends that have been loosely tensioned on the surface by terry towel weaving technique. Unwound independently, warped onto two different section beams, and proportioned separately are ground warps and pile warps. In drafting and denting, ground and pile warps are passed by ground and pile drop wires, through specific terry reeds with double teeth, and through the eyes of the heald wire of the heald frames or harnesses. The ground warp beam and the pile warp beam are the two beams that supply warps to the loom. The pile warp beam has less tension than the ground warp beam. As a result, the pile warp beams produce higher length of warps than does the ground warp formation. The towel's pile is crucial to both its ability to absorb water and other qualities. The desired quality, weight, and other factors determine the loop length. Better quality yarn, such as combed, compact, carded, and zero-twisted yarns, is used by manufacturers. To achieve improved absorbency and lint properties, piles are made from a variety of high-value fibers, including premium cotton varieties like suvin, giza, pima, bamboo, and modal, among others. For ground yarns, often coarser counts are employed, such as open end (OE) and 2-ply yarns [1-8].

However, the wet processing of terry towel is typically done in a soft-flow winch dyeing machine. The weight of the dry material is being dyed to the required amount of water in the exhaust dye bath. For instance, a liquor ratio of 1:5 means that 5 liters of water and 1 kg of fiber are dyed. Although a high liquor ratio

improves dyeing uniformity, it has detrimental effects on the environment and the production costs, as well as the increasing carbon emissions. Throughout the entire textile production process, water is employed extensively. For textile substrates from water baths, almost all colors, particularly chemicals, and finishing chemicals, are helpful. Additionally, the majority of cloth preparation procedures, such as desizing, scouring, bleaching, and mercerizing, use aqueous systems.

2. Bangladesh Terry Towel sector overview

In Bangladesh several types of terry towel are produced such as Bath Terry Towel, Bath Robe, Terry Hooded Towel, Terry Kitchen Towel, Terry Bib, Terry Bath Mat, Institutional Terry Towel etc. Figure 1 shows the total Terry towel (Harmonized System or HS code 5802) exported from Bangladesh from 2002-2003 to 2020-2021 fiscal years.

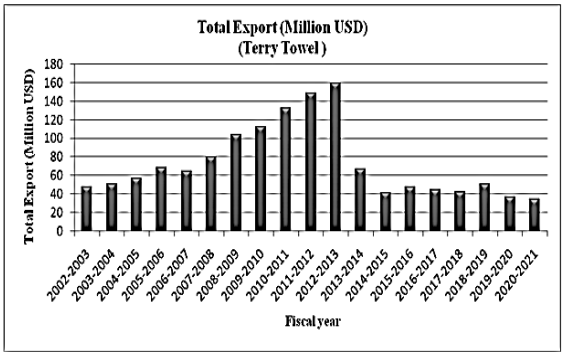

Figure 1. Terry towel (Harmonized System or HS code 5802) export from Bangladesh 2002-2021 fiscal year. [Data Source Export Promotion Bureau]

3. Experimental

Color fastness to wash, rubbing, perspiration (acid and alkali) and wicking performance and absorption time were determined by ISO 105 C06:2010, ISO 105 X12:2016, ISO 105 E04:2013 and III-SOP- INH- TM- 4 and EN 14697 Annex B methods respectively

4. Results and Discussion

4.1 Water consumption in different process:

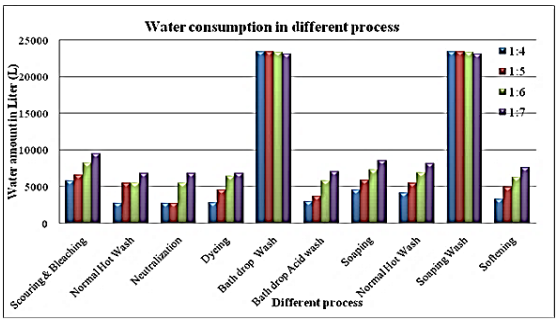

Figure 2. The water consumption in various steps of wet processing of terry towel.

Figure 2 shows the water consumption in different steps of wet processing of terry towel in different M:L ratio such as 1:4, 1:5, 1:6 and 1:7. It is seen that the maximum amount of water is used during the wash after the bath drop wash and soaping. The amount of water is used during these two processes are about 20000 to 25000 liters. The other processes such as scouring and bleaching, normal hot wash, neutralization, dyeing, bath drop acid wash, soaping, normal hot wash and softening the amount of using water range is 5000 to 10000 liters used in bulk dyeing of terry towel.

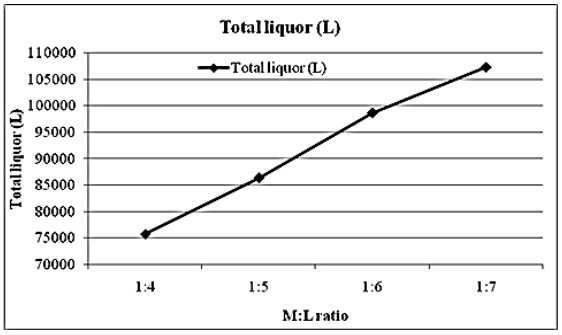

Figure 3. comparison of total liquor with the M:L ratio during wet processing of terry towel

4.2 Comparison on total liquor

Figure 3 shows that the amount of water in liters is increasing with the

increment of M:L ratio. It is observed that if the amount of water is more used in different steps in different ratio, the total amount of using water during the whole wet process is also increased. The graph shows the highest amount of liquor is used in M:L ratio 1:7 and the lowest amount is used at 1:4.

4.3 Color Fastness to Wash

Table 1 shows the grey scale rating of color change and the staining on the multifiber fabric in different M:L ratio. It reveals that the results are almost similar. The color change rating is 4 which indicate good and the staining on the fibers such as di-acetate, cotton, nylon, polyester, acrylic and wool fiber in multifiber fabric is 4-5 indicate very good results.

Table 1. The color fastness to wash at different liquor ratio.

Liquor Ratio	Color Change	Staining on					
		Di-acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1:4	4	4-5	4-5	4-5	4-5	4-5	4-5
1:5	4	4-5	4	4-5	4-5	4-5	4
1:6	4	4-5	4-5	4-5	4-5	4-5	4-5
1:7	4	4-5	4-5	4-5	4-5	4-5	4-5

4.4 Color Fastness to Rubbing:

Table 2 illustrates the grey scale rating of dry and wet rubbing fastness results of reactive dyed towel fabric in different M:L ratio such as 1:4, 1:5, 1:6 and 1:7. It reveals that the results are almost similar. The results of both dry and wet rubbing rating result is 4-5 which indicates very good.

Table 2. The color fastness to rubbing at different liquor ratio.

Liquor Ratio	Grades	
	Dry Rub	Wet Rub
1:4	4-5	4-5
1:5	4-5	4-5
1:6	4-5	4-5
1:7	4-5	4-5

4.5 Color Fastness to Perspiration: (Acid and Alkali)

Table 3 demonstrates the grey scale rating of color fastness to perspiration results of reactive dyed towel fabric in different M:L ratio such as 1:4, 1:5, 1:6 and 1:7. It reveals that the results are almost similar. The color change rating is 4 which indicates good and the staining results for all fibers of multifiber fabric is 4-5 which indicates very good results.

Table 3. The color fastness to perspiration at different liquor ratio.

Liquor Ratio	Color Change	Staining on					
		Di-acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1:4	4	4-5	4-5	4-5	4-5	4-5	4-5
1:5	4	4-5	4-5	4-5	4-5	4-5	4-5
1:6	4	4-5	4-5	4-5	4-5	4-5	4-5
1:7	4	4-5	4-5	4-5	4-5	4-5	4-5

4.6 Wicking performance and absorption Time

Table 4 shows the results of wicking performance along the length and width in millimeter (mm) and absorption time in seconds (S) before and after wash of the reactive dyed towel fabric in different M:L ratio such as 1:4, 1:5, 1:6 and 1:7. The wicking was 31 mm and 45 mm lengthwise, 30 mm and 43 mm widthwise in addition to absorption time was 5 and 3 seconds respectively before and after wash of the 1:4 M:L ratio dyed towel fabric. Similarly, the wicking was 38 mm and 44 mm lengthwise, 35 mm and 44 mm widthwise in addition to absorption time was 6 and 3 seconds respectively before and after wash of the 1:5 M:L ratio dyed towel fabric. Likewise, the wicking was 33 mm and 45 mm lengthwise, 30 mm and 43 mm widthwise in addition to absorption time was 7 and 3 seconds respectively before and after wash of the 1:6 M:L ratio dyed towel fabric. As well as, the wicking

was 31 mm and 46 mm lengthwise, 30 mm and 45 mm widthwise in addition to absorption time was 7 and 3 seconds respectively before and after wash of the 1:7 M:L ratio dyed towel fabric. It is seen that in all cases, the wicking length is increased and the absorption time is decreased after wash of the reactive dyed towel fabric samples.

Table 4. The wicking performance and absorption tie at different liquor ratio.

Liquor ratio	Wicking Performance				Absorption time (S)	
	Before wash		After wash		Before wash	After wash
	Length (mm)	Width (mm)	Length (mm)	Width (mm)		
1:4	31	30	45	43	5	3
1:5	38	35	44	44	6	3
1:6	33	30	45	43	7	3
1:7	31	30	46	45	7	3

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Conclusion

From the above discussion, it can be mentioned that if we compare the quality parameters of the dyed towel fabrics which are dyed with different water ratio of the equal amount of towel fabric are almost similar, hence the increment of m:l during different steps of wet processing is not an wise decision. From all the results, we can say that all the results are good at liquor ratio 1:5. If we use liquor ratio 1:5, then we can save water as well as get a good result from dyed fabric. These will help in our service sector to save water in dyeing section.

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