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EFFECT OF FLUOROCARBON BASED WATER REPELLENT FINISHES ON PERFORMANCE OF DURRIES

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ABSTRACT

The effect of two types of water repellent chemicals on cotton, cotton: polyester and wool: jute durries has been reported in this paper. To evaluate the performance of water repellent finishes, Cotton100%, Cotton 75%: Polyester25% and Wool 67%: Jute33% durries were treated with two types of fluorocarbon-based water repellent finishes at different concentrations, 20 gpl, 40 gpl, and 60 gpl. The levels of water repellency of the fabrics were assessed by AATCC Test Method 22-2017(spray rating test method). The durability of finishes against washing was also studied. The results showed that water repellent properties of the cotton, cotton polyester, and wool jute durries depend upon on the type of water repellent finish and its concentration.

KEYWORDS: *Water Repellency, Fluorocarbon Based Finish, Durries, Concentration, Abrasion Resistance, Weight*

INTRODUCTION

Durries have become the styling item in today's age. Apart from the utility to cover the premise, today durries give a chance to add a decorative touch to the surroundings.

In the present time consumer taste regarding durrie has changed so there is a need to provide the consuming public with durries that have special properties. The textile industry has been called upon to find various techniques which will impart many desired properties including water repellency. Today in textile industries many types of water repellant finishes are available to increase the water repellency of the fabric. Finishes related to water repellency can maintain the fresh appearance of the fabric. Durries that repel water from the surface are more easily cleaned, not wet easily and repel soil & dry dirt particles as well as water-based stains.

Finishes that repel water, oil and dry dirt are important for clothing, home textiles, and technical textiles. Durries are basically used as a floor covering so they get soiled easily. A survey of consumers to determine their buying preference showed that they want durries with water repellency properties. The present study is in this direction.

Water repellency is achieved using different products. Fluorocarbon based repellents provide the best performance among all the repellents. These consist of perfluorinated carbon chains with a polymer backbone with perfluoro groups as its side chain. Kasturiya, N. and Bhargava, G.S. (2003).Some existing fluorochemicals are made with C8 carbon in the polymer backbone chains which after using a certain time can release perfluorooctanesulfonate (PFOS) and perfluorooctanoic acid (PFOA) and other toxic and hazardous materials. Hence, C6 based fluorocarbons were

introduced to minimize the toxicity, though their repellency, as well as longevity, is less than C8 based ones. They provide the lowest surface energies to the fiber surface, which can improve oil repellent ability also.

Two types of water repellant agents were used in this study. The first group of water repellant finishing agent is a dispersion of fluorine compounds, namely fluorocarbon (FC). The final polymer, when applied to a fiber, should from a structure that presents a dense CF3 outer surface for maximum repellency. The length of the perfluorinated side chains should be about 6 carbons. These are Eco- friendly fluorocarbon liquid based on C6 chemistry for durable water and oil repellant finish on textiles.

The second group of water repellant finishing agent is fluorocarbon with isocyanate booster and the length of the perfluorinated side chains should be about 6 carbons. These fluorocarbons are free from Free of Perfluorooctanoic (PFOA), Perfluorooctane sulfonic acid (PFOS), and Alkylphenolethoxylate (APEO).

Various researches are done on floor covering are based on studying existing practices of *durrie* weaving and designing, there is a dearth of the research on the application of finishes on durries, especially the features like the finishing which will enhance the value and functional utility of the durries. The purpose of this study was to investigate the effect of water repellant finishing agents on the properties of durrie.

Materials and Methods

Materials

Fabrics

Three Commercially Available Durries Were Used in this Study. These Durries Were Purchased From Balajiart, Lawan, District Dossa. Following Durries Were Selected:

- Cotton100%
- Cotton 75% :Polyester 25%
- Jute 67% : Wool 33%

Table 1: Construction Parameters of the Durries

Name of the Durries	Yarn Count (Ne)		Thread Density		GSM (gm/sq mt)	Thickness (mm)
	Warp Yarn	Weft Yarn	Ends/ Inch	Picks /Inch		
100% Cotton	1.69	21.38	19	22	1026.7	2.20
Cotton 75% : Polyester 25%	1.63	15.44	16	17	1488.2	2.65
Jute 67% : Wool 33%	0.86	0.54	10	11	1220	3.74

Cotton yarn of 6 ply in the warp direction and 22 parallel single yarns in each pick were used in 100% cotton durries. Cotton yarn of 6 ply in the warp direction and 36 parallel yarns of 2ply filament in each pick were used in Cotton/Polyester *durrie*s. In Wool/Jute *durrie*s, jute yarn of 2 ply in the warp direction and 3 ply wool yarn made of 2 parallel yarns in weft direction were used.

Water Repellent Finishing Agents

Two types of water repellent finishes were used

- The Resiguard Owr was supplied byResil chemicals Pvt Ltd, Banglore.
- Ruco- Guard Afr6 (C6 fluorocarbon booster's resin) was obtained from RudlofAtulChemicals Ltd, Gujrat. It is free of Perfluorooctanoic(PFOA), Perfluorooctane sulfonic acid(PFOS), and Alkylphenolethoxylate (APEO).

METHOD

Application of Water Repellant Finishes on Durries

Pure and blended *durrie*s were treated with two different water repellant chemicals at three different concentrations (20gpl,40gpl, and 60gpl). The recipe and process parameters were adopted as recommended by the supplier.

These finishes were applied on *durrie* samples by a pad-dry-cure method with the help of squeezing roller type laboratory padding mangle with speed of 20 rotations per minute and 2 kg/cm² padding pressure. Laboratory oven of S.K Equipment was used for drying and curing. Padding picks up varied for different *durrie*s i.e. 80% to 100% for Cotton *durrie*s, 50% to 80% for Cotton/Polyester *durrie*s and for Wool/Jute *durrie*s 100% to 130% wet pick up was obtained. Drying at 120°C and curing at 160°C to 170°C was done.

Finishes were applied individually with different concentrations to study the effect of each finish on the 100% cotton, cotton/polyester, and wool/jute *durrie*s. The *durrie* samples were immersed in the finish solution for 30 minutes to achieve better impregnation. Then the *durrie*s samples were passed between the two rollers of padding mangle to squeeze out excess solution and to force liquor inside the material, and then *durrie* samples were dried and then cured at elevated temperatures. The material liquor ratio was taken 1:10.

Determination of Water Repellency: Spray Test (AATCC Test Method 22-2017)

Water sprayed against the taut surface of fabric under controlled conditions produces a wetted pattern. The size of the wetted pattern, which depends on the relative repellency of the fabric, is compared with standard photographs with water repellency ratings of zero (0), 50, 70, 80, 90 and 100. A rating of zero (0) is assigned if the fabric's surface is completely wetted by water, whereas a rating of 100 corresponds to no wetting of water on the surface of the fabric. Three test specimens 180.0 × 180.0 mm were conditioned at 65 ± 5% relative humidity and 21 ± 2°C (70 ± 4°F) for a minimum of 4 hours before testing water repellency.

Study of Durability of Finishes

The durability of water repellant finishes was tested after 3, 5 and 10 washes. Wash Procedure III of AATCC (130-2015) was followed. After giving predetermined wash cycles, the water repellency of *durrie*s was again determined.

Determination of Weight and Abrasion Resistance of *Durrie*s

Weight/Unit area (IS 1964: 2001) of *durrie*s was calculated in gm/ sq. mt. Abrasion resistance of *durrie*s was determined by Schopper Abrasion Wear Test (GMW3283). Percent weight loss was calculated after abrading with silicon carbide paper for 2000 cycles.

Data Analysis and Interpretation

Water Repellency of Unfinished and Finished Durries

Table 2: Effect of Finishes on Water Repellency of Durries

Rating of Water Repellency					
Type of Durries	Type of Finish	Concentration			
		0 gpl	20 gpl	40 gpl	60 gpl
Cotton 100%	WA	50	80	90	100
	WB	50	70	80	90
Cotton75% : Polyester 25%	WA	0	70	90	100
	WB	0	50	70	90
Jute 67% : Wool 33%	WA	50	70	90	100
	WB	50	70	90	100

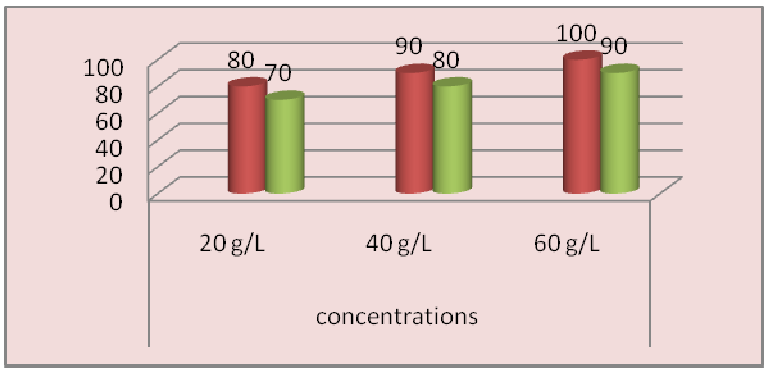

Figure 1: Water Repellent Rating of Cotton Durries

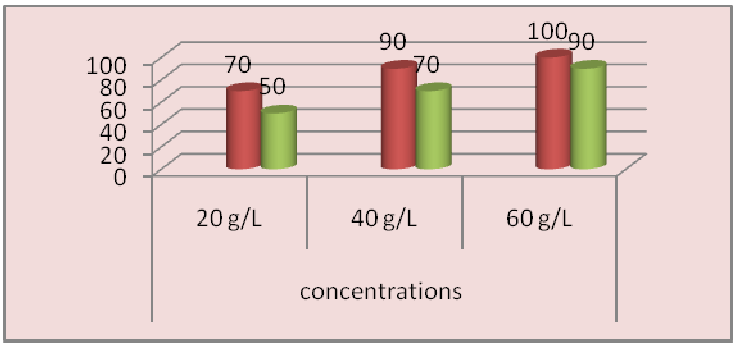

Figure 2: Water Repellent Rating of Cotton: Polyester Durries

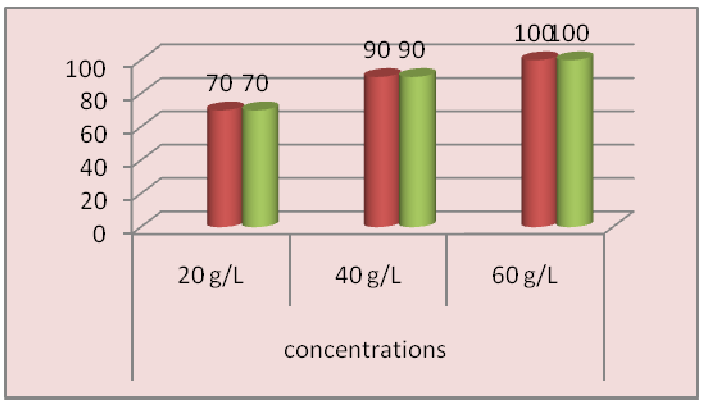

Figure 3: Water Repellent Rating of Wool: Jute Durries

Data presented in Table 2 and Figures 1,2 &3 shows that unfinished cotton 100% and Jute 67%: Wool 33% *durrie*s have water repellency rating of 50 while Cotton75%: Polyester 25% *durrie* have water repellency rating of 0. Thus unfinished cotton: polyester *durrie* show no water repellency compared to cotton and jute: wool *durrie*s. This difference may be due to the difference in their construction parameters. Polyester has very good wicking properties. Water moves along the surface of the fiber.

It is clear that the application of finishes improved water repellency of all the *durrie*s. As the concentration of finishes was increased gradually from 20 gpl to 60 gpl, water repellency of *durrie*s increased continuously. This trend was similar in case of both the finishes, WA (RESIGUARD OWR) and WB(RUCO- GUARD AFR6).

It is also found that finish A performed better than finish B i.e. finish A imparted higher water repellency to cotton and cotton: polyester *durrie*s than finish B. However, in case of jute: wool *durrie*, same water repellency rating was observed with finish A and finish B.

Two way ANOVA was applied to find out the significance of the differnce of water repellency among a different concentration of finishes and among different fabrics. The difference in water repellency of different concentration of finish A was found significant (F= 22323, p = 0.0). Similarly, the difference in repellency of different *durrie*s treated with finish A was found significant (F= 543, p=0.0). Interaction between concentration and fabric is also found significant (F= 473, p=0.0). Thus both the factors have affected water repellency in case of finish A.

Two way ANOVA calculated in case of finish B also shows the significant effect of concentration of finish B on water repellency (F= 29627,p=0.0). Likewise, the effect of different type of *durrie*s on water repellency is also found significant (F= 9326, p=0.0). Interaction between these two factors is significant (F= 1190, p=0.0). Thus both the factors have affected water repellency in case of finish B.

Durability of Water Repellents

A product receives it desirable end-use qualities through an application of textile finishes. These chemicals improve or facilitate change on the surface characteristics of the fiber, in accordance with the application that is desirable. The durability of finishes is also important in consideration to the serviceability of treated *durrie*s. To provide the best serviceability of treated *durrie*s the finishing agents should be long lasting with the product at least for few laundering cycles. The durability of treated *durrie*s was evaluated to find out the performance of finishes agents towards the laundering process. As 60 gpl concentration of both the finishes provided the best result, the durability of *durrie*s finished with 60 gpl concentration of each finish was checked.

Table 3: Durability of Water Repellent Finishes

Name of Durries	Type of Finish	Rating of Water Repellency			
		0 Wash	3 Washes	5 Washes	10 Washes
Cotton 100%	WA	100	80	70	50
	WB	90	80	70	50
Cotton75%: Polyester 25%	WA	100	80	70	50
	WB	90	80	50	50
Jute 67%: Wool 33%	WA	100	80	70	50
	WB	100	80	70	50

WA- RESIGUARD OWR, WB- RUCO- GUARD AFR6

Table 3 shows the durability of water repellant finishes, WA (fluorocarbon C6) and WB (Fluorocarbon with boosters). It is evident that the durability of finishes gradually decreases as the number of washes increases due to repellant chemical washed off from *durrie*s surfaces during the washing. *Durrie*s are not washed frequently. However, the durability of finishes can be improved if *durrie*s are dry cleaned instead of regular machine washing.

Effect of Finishes on Selected Properties of Durries

Change in weight and abrasion resistance was assessed after application of finishes to find out the extent of modification in these properties.

Table 4: Weight of Unfinished and Finished *Durrie*s

Type of Durries	Type of Finish	Weight per Unit Area (gm/sqmt)			
		0 gpl	20 gpl	40gpl	60 gpl
Cotton 100%	WA	1026.7	1053.4	1137.07	1146.63
	WB	1026.7	1096.43	1117.43	1128.5
Cotton75%: Polyester 25%	WA	1488.2	1516	1526.1	1582.36
	WB	1488.2	1599.33	1602.63	1625.13
Jute 67%: Wool 33%	WA	1220	1353	1364.03	1371.8
	WB	1220	1364.53	1374.136	1422.3

WA- RESIGUARD OWR, WB-RUCO- GUARD AFR6

It is evident from Table 4 that after the application of finishes on *durrie*s, the weight of the treated *durrie*s has increased. The reason behind an increase in weight of the *durrie*s is coating of the surface of the *durrie*s with a chemical which has covered up pores of the *durrie*s. Therefore, the water is not allowed to penetrate into the *durrie*s.Weight of *durrie*s increases gradually after increasing the conc. of both the water repellent finishes, from 20 gpl to 60 gpl**.** It is observed that an **i**ncrease in weight of *durrie*s is slightly more when finish B was applied. This may due to higher add on of finish or presence of a thicker layer of finish B on *durrie*s.

The table also reveals that the weight of wool/ jute *durrie*s highest and that of 100% cotton *durrie* is lowest. Fabric weight varies according to construction parameters. As fine yarns have been used in cotton *durrie*, it is lighter in weight compared to jute: wool *durrie* in which thicker yarns have been used.

Table 5: Effect of Finishes on Abrasion Resistance of Durries

Type of *Durries*	Type of Finish	Percent Weight Loss			
		0 Gpl	20 Gpl	40gpl	60 Gpl
Cotton 100%	WA	0.937	0.885	0.785	0.712
	WB	0.937	0.788	0.682	0.646
Cotton75% : Polyester 25%	WA	0.179	0.331	0.287	0.286
	WB	0.179	0.296	0.276	0.267
Jute 67% : Wool 33%	WA	1.702	1.67	1.407	1.301
	WB	1.702	1.41	1.388	1.323

Table 5 shows the abrasion resistance of untreated and *durrie*s treated with different finishes. Cotton: polyester *durrie* shows the best abrasion resistance. *Durrie*s made of 100% Cotton shows good abrasion resistance whereas wool/jute *durrie*s show poor/low abrasion resistance. According to Booth (1976), the abrasion resistance of tough fiber is higher than that of weak fibers. Presence of polyester finer in cotton: polyester *durrie* improved its abrasion resistance. Jute fibers are brittle so abraded easily.

The Schopper test (also known as the Frank Hauser abrasion test) was carried out. *Durrie*s were abraded for 2000 cycles and no thread breakage has been seen in all three *durrie*s and only broken fiber ends poking out of the *durrie* surfaces are observed. Concentrations of finish also affect the abrasion resistance of *durrie*s. Improvement in abrasion resistance was observed on increasing the concentration of both the finishes. Thus the reason for the improvement in abrasion resistance is the presence of finish on *durrie*s. Finishes have made a layer or coating on the surface of *durrie*, thus abrasion resistance has increased. Abrasion resistance of *durrie*s is slightly better in case of finish B as percent weight loss is less. The reason may be the presence of a thicker layer of the finish B on *durrie*s, which is supported by more weight after application of finish B. (Table3).

CONCLUSIONS

In this study, the effect of different concentrations of two water repellant finishes on Cotton, Cotton/Polyester and Wool/Jute *durrie*s were investigated. AATCC Test Method 22-2017 Spray test results that the repellant finishes and their concentrations range significantly influence water repellency of all three *durrie*s. Changing or increasing conc. from 20 gpl to 60 gpl, gives gradually increased water repellency in *durrie*s. Comparatively better results were obtained with WA finish than WB finish. The durability of water repellant finishes was tested after 3, 5 and 10 washes. The durability of finishes gradually decreases as the number of washes increases due to repellant chemical washing off from surfaces of *durrie*s during the various laundering cycles. Increase in weight of *durrie*s was found. Abrasion resistance of *durrie*s improved after application of finishes.

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