

Effect of Fluorocarbon Based Water Repellent Finish on Cotton Handloom Fabrics

Monika¹, Prof. Ina Shasrti²

1. Research Scholar, Department of Design, Banasthali Vidyapith, Rajasthan

2. Dean, Department of Design, Banasthali Vidyapith, Rajasthan

Received: 15-11-2025, Accepted: 26-11-2025, Published: 31-12-2025

DOI: <https://doi.org/10.5281/zenodo.18108176>

ABSTRACT-In the present era of fashion awareness and modernization, consumers are also familiar with the quality for which they are paying. They want variety in clothing, so there is a need for balance among different properties like aesthetic, protective, and cultural for all types of clothing. In the recent market, customers have a wide range of fabrics/textiles available at different prices. Amongst a wide variety of textiles, performance-based textiles are the fastest growing area of the textile sector in the world's modern textile market. It includes a wide range of new developments in fibers, textile coating & technology. But on the other side, our traditional handloom sector is facing various problems like no new product range, variety is very limited, finished products are very limited, and no technical inputs are developed. In this study, an attempt has been made to add a water-repellent feature to handloom fabrics through current technology.

Keywords- Handloom Sector, Rural Development, Handloom Fabric, Water Repellent Finishes, Water Repellent Fabrics.

I. INTRODUCTION

The Handloom sector is the most significant cottage industry in India. The handloom sector plays a vital role in providing financial assets to the country as it is one of the most considerable employment-based activities after agriculture. The handloom sector can provide an evergreen ready market for agriculture as it permits experimentation, flexibility, and innovative designs, due to the use of agricultural products in raw materials. Almost 43.3 lakh people work on 23.77 lakh handlooms. These looms are spread in the domestic and non-intern units, out of which 20.66 lakhs are in villages and 3.11 in cities.

The weaving community consists of many people from different castes who have individual patterns and styles of weaving inherited from their ancestors. 7,016 million square meter handloom production was done during 2013-14, and 3,543 million square meter production was done during 2014-15. Nearly 15% of the total cloth production contribution comes from the handloom sector. India gets maximum export earnings through the handloom sector and

contributes 99% of hand-woven fabrics to the world. Skills are easily changed from one family to another and from one generation to another, but the major thing that attracts the most about handloom is its versatility. The Indian textile industry is well connected to this sector.

In the Textile sector, the power of the handloom is the unique designs that cannot be recreated by power looms such as the Paithani saree from Yeola, Maharashtra. The luxury products such as Chanderi saree of Madhya Pradesh, Patola saree of Gujrat and Bandhani products of Rajasthan, Himroo of Hyderabad, Khes of Punjab, Phenkek of Assam and Manipur, as well as the prints of Farrukhabad, Maheshwari saree of Madhya Pradesh and Banarasi Brocade of Silk are well recognized everywhere which are some of the major products produced by the handlooms sector.

Handloom fabric is a good solution to the uncertain climatic changes, and it is eco-friendly and can maintain the body and environment correlation. The production of Handloom fabric is done keeping the environment in mind. It is also a good green-tech case as it is readily available, particularly in rural areas, and requires less electricity.

Handloom fabric gives relief to the lower sections of society to eliminate poverty and unemployment. It has also become the ideology of self-reliance and self-sufficiency. It has become the intensive tool of the local weavers to make them economically strong. It became the symbol of the freedom fighters' attire led by Gandhi Ji.

As we Indians believe in Gandhian Theory, the Spinning Wheel or Charkha became not only a symbol of the revolution, but now is a symbol synonymous with self-reliance, perseverance, and determination. From then to now, the Charkha has initiated an upheaval and marked the path of progress for the Indian Spinning Industry.

As part of the National Handloom Celebration, the Indian Handloom brand was launched by the Honorable Prime Minister, Shri Narendra Modi, in Chennai on 7th August 2015. "Handloom brand" refers to the quality of handloom products in addition to raw materials, processing, adornment, weaving designing, and other parameters to get the trust of consumers.

Currently, the government also makes schemes and funds for the Indian handloom sector and encourages the people to pay equal respect to the handloom sector of the textile industry.

But at present handloom fabrics are not so much utilized by people because of many reasons such as no new products, no new designs, and no technical inputs have been developed. The varieties are very limited. Moreover, aged old products seem too trivial to be used by the new generation due to the changes in culture and trends. This is the biggest factor that has kept the young generation away from manufacturing and using Handloom fabrics. The major factor is the lack of quality of the finished product. Even the price of the product is too high as compared to its competition from other fabrics. The color of the clothes fades very rapidly, as they are not user-friendly. These are the factors (color, design, variety, and trend) that have kept the customers away from using Handloom fabrics. Another issue is the marketing of handloom fabrics which should be taken on a professional basis rather than on a sentimental basis.

In the era of modernization and mechanisms where the water repellent fabrics are manufactured over the Power Loom, here the researcher has tried to make the handloom-based water repellent fabric. As discussed above the handloom is one of the major employment-giving sectors. In this study an attempt has been made to add water-repellent features through padding drying and curing methods. Because only power loom and mill-based water-repellent fabric or products are available in the present.

Water repellent textiles create a water droplet bead on its surface before moving off. Water-repellent textiles are only helpful in medium rainfall. Individual fibers are covered with water-repellent compounds instead of making a layer over the fabric surface. There have been both the stable & the unstable finishes chosen on the textiles intended for the end-use. Wax, animal fat & vegetable oils were the first finishing materials used for water-repellent clothing.

II. MECHANISM OF REPELLENCY

A hydrophobic film forms on the fiber substance when textile water repellents are applied. The film's structure is characterized by a saturated hydrocarbon or fluorocarbon chain that is attached and aligned on the fiber surface by a reactive or polar group. The structure of fabric is an important factor in water repellency. The fabric used for treating water must be absorbent and free of surface active agents, alkalis, and excess acids.

Water repellency is achieved by water-repellent finishes by reducing the free energy on fiber surfaces. Fiber surfaces that don't interact with liquids are called low-energy surfaces. The critical surface energy or surface tension must

be less than the surface tension of the liquid (internal cohesive interaction) that is repelled. Various water repellent treatments are available to obtain water repellency, such as paraffin emulsions, chemical reactions of repellent material with the fiber surface such as fatty acid resins, and to make a repellent film on the fiber surface, and these are silicone and fluorocarbon-based products.

III. TYPES OF WATER REPELLENTS

3.1 Fluorocarbon based repellents-

Oil and water repellency is provided by fluorocarbon-based repellents. Synthesis of fluorocarbons involves the incorporation of perfluoroalkyl groups into acrylic or urethane monomers. They can be polymerized to create fabric finishes. The perfluoroalkyl group was produced by electrochemical fluorination earlier, but nowadays they are produced through polymerization. When the final polymer is put on a fiber surface, it creates a structure that has a dense outer surface that provides maximum repellency. Perfluorinated side chains have an average length of 8-10 carbons. Fluorocarbon-containing products are applied using the pad-dry-cure method. The crystalline structures are created by heat treatment, which results in the orientation of the side chains. It is essential to achieve optimal repellency. The orientation of this chain is disrupted by washing and drying cleaning, which can lead to decreased finish performance. Ironing, pressing, and tumble drying are all heat treatments that can revitalize the orientation.

3.2 Paraffin repellent-

Animal and vegetable waxes are mixtures of esters of fatty alcohols and fatty acids. When waxes such as beeswax, carnauba wax, and paraffin wax are applied to textile materials through an emulsion, they impart a soft and supple texture to the materials. Cotton and rayon fabrics can be softened and finished by using stabilized paraffin wax emulsions, which are available. They are advertised as uniform, smooth, and white emulsions, which produce stable emulsions when diluted with water. The diluted emulsions are stable against alkali and hard water salts. The nature of these emulsions is anionic. When used alone, they are compatible with starches, glue, gelatin, gums, and other ingredients, and the wax emulsions give the fabrics a soft and supple feel. Using a padded method, they are applied and dried without washing. This finish is not durable enough for laundering and dry cleaning.

Its low air and vapour permeability limits the usage of paraffin-based repellents.

3.3 Silicone water repellents-

The use of silicone-based products as water repellents leads to an increase in durability. The primary ingredients are Silanol, Silane, and a catalyst like tin Doctorate. The

catalyst is responsible for enabling moderate condensation conditions and promoting the orientation of the silicon film on the fiber. Water repellency of fabrics is influenced by the outward-oriented methyl group. During the drying of the treated fabric, the Silanol and Silane components can react to form a three-dimensional cross-linked sheath around the fiber. The fabric is fully repellent after completing this process after a day of storage. These repellents offer a high level of water repellency at a low concentration, have a soft feel, improve shape retention, and enhance appearance. Increased pilling, seam slippage, decreased repellency when applied in excessive amounts, moderate durability when laundered and dry cleaned, and no oil and soil repellency are some of the disadvantages of this finish.

3.4 Stearic acid-melamine repellents-

These repellents are created by the reaction of stearic acid and formaldehyde with melamine, which is another type of water repellent. The hydrophobic nature of stearic acid groups results in water repellency. The primary objective of stearic acid melamine repellents is to enhance the durability of treated fabrics for laundering and full-hand washing. Stearic acid and melamine repellents have disadvantages such as a decrease in fabric tear strength and abrasion resistance, changes in fabric color, and formaldehyde release.

IV. OBJECTIVES

- To develop water-repellent fabrics through handloom with basic weaves.
- To develop water-repellent fabric for upholstery and home furnishing products through handloom.

V. MATERIAL AND METHODS

For water-repellent finishes, the fabric must be dense enough to give positive results. Therefore, in this study the researcher has tried to develop some samples through handloom with basic weaves because commercially available handloom fabrics were not found dense. 2/20 cotton yarn was selected for fabric construction. The all samples were made with a frame shuttle loom. According to stockport system, 48 number reed was used for dense fabric; generally, handloom weavers use 36 number reed for 2/20 count yarn. All samples were developed with four heald shafts and the drafting process was done for only a single time. Plain, twill regular warp rib and matt weaves were used for fabric formation. These are distinct textile weaving methods. Construction details of samples-

| S.No. | Weave | Yarn Count | | EPI | PPI | GSM |
|-------|-------|------------|------|-----|-----|--------|
| | | Warp | Weft | | | |
| 1. | Plain | 2/20 | 2/20 | 48 | 46 | 234gm |
| 2. | Twill | 2/20 | 2/20 | 48 | 50 | 242 gm |
| 3. | Rib | 2/20 | 2/20 | 48 | 54 | 238 gm |
| 4. | Matt | 2/20 | 2/20 | 48 | 56 | 247 gm |

| | | | |
|---|---|---|---|
| | x | | x |
| x | | x | |
| | x | | x |
| x | | x | |

Plain

| | | | |
|---|---|---|---|
| | | | x |
| | | x | |
| | x | | |
| x | | | |

Twill

| | | | |
|---|---|---|---|
| | x | | x |
| | x | | x |
| x | | x | |
| x | | x | |

Rib

| | | | |
|---|---|---|---|
| | | x | x |
| | | x | x |
| x | x | | |
| x | x | | |

Matt

Sample 1 - It was constructed through plain weave with 2/20 ne white cotton yarn. Plain weave is the simplest, with each weft thread alternating over and under each warp thread, creating a crisscross pattern.

Sample 2 - Sample was constructed by 1x3 twill weave. The 2/20ne white colour cotton yarn was used for warp and double plies of grey and navy blue 2/20 ne were inserted together in weft. Twill weave, on the other hand, features a diagonal pattern formed by the weft threads going over multiple warp threads, then under a few, creating a diagonal line.

Sample 3 - The sample was developed through cotton yarns with red and white coloured stripe patterns through warp rib weave. 2/20 white beached yarn was used for warp and double plies of red and white 2/20 ne were inserted together in weft to make fabric dense. Rib weave is a variation of a plain weave that creates raised lines and 'rib' in either the warp or weft direction.

Sample 4 - The sample was constructed through regular matt weave 4x4 with white cotton 2/20 yarns in warp and weft directions. Matt weave is also known as basket weave, its characterized by squares on both sides.

VI. SELECTION OF WATER REPELLENT FINISH

For the application of finish, a commercially available fluorocarbon-based finishing agent was used on all fabric samples. The initial procedure was to wash fabric samples with detergent to eliminate any impurities and then dry them. The finishing chemical was weighed with an electrical balance according to 40 and 60 gpl and a solution was prepared. To maintain a pH level of 5, acetic acid was added to prepared solution. Finishing was applied on all samples through the padding mangle lab instrument. Finish was done through padding, drying and curing method. The curing process was done at 160 °C for 1-1.5 minutes. After curing, the samples were tested with a water-repellent spray tester.

VII. RESULT AND DISCUSSION

According to the AATCC spray test rating chart, untreated fabrics show 0 rating complete wetting of whole upper and lower surfaces. After coating with commercially available fluorocarbon solution, fabrics show 70-100 spray test rating. Plain, rib and matt fabrics showed 100 ratings as a positive result when samples were tested, but twill weave (1x3) was shown 60-70 ratings because the structure of twill weave held very long floats, so pores of fabric were not blocked through coating material properly. Water will not penetrate through the coated fabric and will not absorb moisture very quickly. The coated fabric can be utilised in upholstery home furnishing products. After water-repellent coating, fabric will not get dirty quickly; fabric also maintains hygiene; hence, there will be no need to wash frequently.

VIII. CONCLUSION

Handloom is representing the tradition, culture and skills of artisans. The Indian handloom sector generates employment opportunities, especially for rural artisans, including women artisans. The product diversification is necessary in the handloom sector. People will also prefer the handloom fabric in their regular life if new products are made with new designs and technology according to trends and tests of the people. Nowadays people are performing some functional properties in home furnishing products with their aesthetic sense. So, an experiment was conducted and its result was positive, which led to the conclusion that handloom fabric can become water-repellent if the fabric is densely woven. Plain, rib and matt weave can be used to make the fabric dense. The reed should also be selected keeping in mind that the pores in the fabric should be less so that they can be blocked through water-repellent finish.

REFERENCES

- [1]. Devi, C. V. (2014). Handlooms for livelihood in North-eastern region: Problems and prospects. *Journal of Rural Development*, 32(4), 427-438.
- [2]. Tanzaava, J., Das, B.K. & Malswmtlunga, V. (2022). MARKETING FOR THE SUSTENANCE OF HANDLOOM IN INDIA: A STUDY. *Zeichen Journal*, 8(1), Page No :194, ISSN No: 0932-4747
- [3]. Rao, K. R. M., & Kumar, K. K. (2018) A Study of Quality of Work Life of Weavers under Integrated Handloom Cluster Development Scheme (IHCDS). Volume II, Issue II, February 2018|ISSN 2454-6186
- [4]. Sree Vyshnavi, P.V. & Nair, (2017). HANDLOOM SECTOR IN INDIA: A LITERATURE REVIEW OF GOVERNMENT REPORTS. *International Research Journal of Management and Commerce*. 564. 418-438.
- [5]. Sakthivel, S., Zaid Hamza, A., & Kiruthika, S. D. (2013, October). Application of waterproof breathable fabrics, describing the basic principles and techniques involved in designing waterproof breathability fabrics.
- [6]. Vethandamoorthy, D., Mandawala, E., & Bandara, W. (2019) Development of Silicone Based Water-Resistant, Chemical Resistant Moisture Absorbent and Non-Ignitable Fabric. *WHAT EVERYBODY OUGHT TO KNOW ABOUT WATERPROOF AND WATER- REPELLENT FABRICS*. (2018, August 3). https://www.reddit.com/r/camotrek/comments/94c441/what_everybody_ought_to_know_about_waterproof_and/ (Accessed on 11/11/2025)

- [8]. Williams, J. T. (2017). Waterproof and Water Repellent Textiles and Clothing (The Textile Institute Book Series) (1st ed.). Woodhead Publishing.
- [9]. Taylor, J.T. (2002) Cotton weaving and design, Abhishek Publication, Chandigarh-1
- [10]. Tegmeyer, J. (2015). Woven Fabrics (Illustrated ed.). Clanrye international.