

# Comparative Studies of Natural Rubber Latex on Different Fabrics

Rekha Maan

Department of Fashion Technology, B.P.S Mahila University, Khanpur Kalan (Sonepat), Haryana, India

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## ABSTRACT

Waterproof fabrics are playing a vital role in modern technical textiles due to more technological advancement in modern research and its manufacturing processes are one of the important technological introductions in modern industry. Waterproofing fabric has to be treated with chemicals to give them a property which makes them water resistant. The properties of a Waterproof fabric depend on the type of polymer used and its expression, the quality of the textile substrate, and the coating method employed. The focus of the present study is to determine the optimal combination of hydrophobic components in coating material to obtain the properties of water proofness and comfort ability to wearer. Natural rubber latex was used in various combinations to coat the fabric. To coat the fabric, a steel ruler was used. The project involves the study of natural rubber latex coating on textiles. This fictionalization of textiles by natural rubber latex can be used in textile and apparel industry as well as in technical uses of water proof fabrics. Little research was done to investigate the application of natural rubber latex for water proof textiles along with comfort properties. In this research study, Three types of plain woven fabrics 100% cotton ,polyester and polyester/cotton were chosen to developing water proof fabric by apply natural rubber latex finish . To investigate the effects of waterproof finish on treated woven fabric measured the levels of water repellency accordance to spray test method (ISO 4920-2012) and Hydrostatic test method measured the levels of waterproof-

**Keywords:** Woven Fabric, Waterproof Finish, Natural Rubber Latex

**Aim:** - The aim of the present study was to develop the water-proof finish for textile by using natural rubber latex. To achieve the goal, some experiments were carried out

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## 1. INTRODUCTION

Water repellent coated fabrics are now in an important place in technical textiles and its manufacturing processes are one of the important technological introductions in modern industry. The properties of a coated fabric depend on the type of polymer used and its expression, the quality of the textile substrate, and the coating method employed. The usage of coated textiles for protective clothing, shelters, covers, liquid containers, etc., dates back to ancientness. [1--2] The present research focus on NR Latex rubber has been used as a water repellent agent to make water repellent textile fabric because NR Latex have good repellent properties against water droplet.[3-4]

Natural rubber, also called India rubber or caoutchouc, as initially produced, consists of polymers of the organic compound isoprene, with minor impurities of other organic compounds, plus water. Malaysia and Indonesia are two of the leading rubber producers. Forms of polyisoprene that are used as natural rubbers are classified as elastomers.[5-6] Currently, rubber is harvested mainly in the form of the latex from the rubber tree or others. The latex is a sticky, milky colloid drawn off by making incisions in the bark and collecting the fluid in vessels in a process called "tapping". The latex then is refined into rubber ready for commercial processing. In major areas, latex is allowed to coagulate in the collection cup. The coagulated lumps are collected and processed into dry forms for marketing. [7-8] The focus of the present study is to determine the optimal combination of hydrophobic components in coating material to obtain the properties of water repellent and comfort ability to wearer. Natural rubber latex was used in various combinations to coat the fabric. To coat the fabric, a steel ruler was used. The project involves the study of natural rubber latex coating on textiles. Natural rubber is used extensively in many applications and products, either alone or in combination with other

materials. In most of its useful forms, it has a large stretch ratio and high resilience, and is extremely waterproof. The present study also deals with the broadcasting of locally available natural rubber latex for water proof properties. Present research on water repellent finish will be effective and useful for water repellent textile clothing, which will have been providing protection against hitting of high pressure of water penetration and repel the water, it will be useful in rainy seasons. [9, 14]

## 2. OBJECTIVES

1. To study the potential of above mentioned essential natural rubber latex and chemicals for their water proof activity.
2. To study of testing before coating and after coating in different stages.
3. Testing of coated and control fabric for effectiveness of its waterproof properties using goniometry and spray tests.
4. To study the natural rubber latex and chemical constituents and no. of coat that is responsible for repellency effect.
5. To evaluate the effectiveness of coated samples at different steps of selected.
6. To study the comparative water proof efficacy of coated fabrics with knife coating and padding mangle method.
7. To check the durability of natural rubber latex coated fabrics after washing.

## 3. MATERIALS AND METHODS

**Selection of fabric:** 100% cotton, polyester and pc blend fabrics, sourced from the local market of Sonipat (Haryana). These have been selected after market survey by keeping in mind approximate same weight and construction parameter.

**Table 1: fabric specification**

Samples	Average of GSM	EPI	PPI	Warp count(Ne)	Weft count (Ne)
Cotton	76 gm	88	58	42	43.1
Polyester	84 gm	118	54	66.2	26.5
P /C blend	70 gm	114	58	68.2	36.1

### Recipe Preparation

**Formulation of recipe coating:** For Formulation of NR latex water proof compound coating for textile Compounding Ingredients, NR latex (rubber), PVA, curing agent, accelerator, activator are require.

**Recipe:**

**Solution 1:** 80 ml latex + PVA Solution + 2gm sulphur (string for 1 hr.)

**Note: (PVA solution prepared 1 day before)**

**Solution 2:** 50ml water + 2gm MBT + 2gm Sulphur + 2gm steric acid + 2gm zinc oxide (20 mint string by mechanical stirrer)

**Solution 1+ solution 2 mix to each other and stirred for 4 hours.**

Applying on fabric → Curing

**Optimized final Recipe:**

**Table 2: NR latex compounding with additives [15-18]**

Formulation of NR latex compound Compounding Ingredients	Weight parts per hundred parts of rubber (phr)
NR late (rubber)	80
PVA	20
Curing agent (Sulphur)	2 gm.
Accelerator (mercapto banzo thio urea )	2gm.
Accelerator activator (steric acid + zinc oxide)	2gm.
(sodium carbonate)	2 gm.

**Test Methods:** Various kinds of tests were performed to judge the waterproof and mechanical properties of the coated fabric, which are as below:

1. Tensile Test
2. Tearing test method
3. Thickness Test
4. Crease Recovery
5. Stiffness Test
6. Drop test method
7. GSM (Gram per square meter)
8. Spray Test Method
9. Hydrostatic test method.

#### 4. RESULT AND DISCUSSION

In this present research study results are mentioned and discussed. Therefore all the relevant finding of results has been discussed in following section.

**Tensile Strength:** Experimental results of Tensile strength (TS) and elongation at break(EB) were measured by digital tensile strength tester, model: CAP500KGF, according to ASTM D 5034. The results are given in the Table:

**Table 3: Tensile strength (TS) of 3 type of fabric cotton polyester, PC blend (before coating and after coating) in warp and weft direction.**

Fabric type	Before coating (BC)				After coating(AC)			
	Warp		Weft		Warp		Weft	
	Elongation In inch (EB)	Load kg (TS)	Elongation In inch (EB)	Load Kg (TS)	Elongation In inch (EB)	Load Kg (TS)	Elongation In inch (EB)	Load kg (TS)
Cotton	1.3	19	1.40	18	1.25	22.2	1.30	22
Polyester	1.9	21	2.0	20	1.7	26.5	1.9	23
P/C Blend	1.8	20.3	2.0	20	1.5	20.9	1.8	20.7

**Tensile strength analysis:** It was observed that, Tensile strength has been increased of cotton, polyester and P/C blend fabric after applying the natural rubber latex coating, it means NR Latex coating increased the strength of the textile substrate cotton, polyester and P/C blend fabric due to effective absorbency of NR Latex content polyester and P/C Blend , and it provides a good tensile strength to fabrics.

**Tearing strength:** Tearing strength test was performed in accordance with ASTM D 751 to evaluate the uneven tearing behavior of the NR coated fabric. Table shows the results of tear strength.

**Table 4: Tearing strength (TS) of 3 type of fabric cotton polyester, PC blend (before coating and after coating) in warp and weft direction**

Tearing strength(TS)				
Fabric type	Before coating		After coating	
	Warp	Weft	Warp	Weft
Cotton	1.472kg	1.44kg	1.842 kg	1.542kg
Polyester	2.9kg	1.452kg	3.42kg	1.65kg
P/C Blend	3.07kg	1.593kg	3.52kg	1.842kg

**Tearing strength analysis :** It was observed that, tearing strength has been increased of cotton ,polyester and p/c blend fabric after applying the natural rubber latex coating ,it means NR Latex coating increased the tearing strength of the textile substrate cotton, polyester and P/C blend fabric and it makes the good tearing strength fabrics.

**Thickness test:** Thickness of cotton , polyester and p/c blend has been increased after applying Natural rubber latex , Thickness of fabrics increased values are described below:-

**Table 5: Thickness of 3 type of fabric cotton polyester, PC blend (before coating and after coating).**

Fabric type	Before coating	After coating
Cotton	0.21	0.26
Polyester	0.16	0.19
P/C Blend	0.17	0.21

**Thickness analysis:** It was observed that thickness has been increased of cotton, polyester and p/c blend fabric after applying the natural rubber latex coating ,it means NR Latex coating increased the thickness of the textile substrate cotton, polyester and P/C blend fabric .

**Crease recovery:**

**Table 6: crease recovery of 3 type of fabric cotton polyester, PC blends (before coating and after coating) in warp and weft direction.**

Crease recovery				
Fabric type	Before coating		After coating	
	Warp	Weft	Warp	Weft
Cotton	96	96	105	107
Polyester	112	117	128	132
P/C Blend	109	112	120	123

**Crease recovery analysis**

It was observed that, crease recovery angle of cotton, polyester and p/c blend fabric has been increased after applying the natural rubber latex coating , it means NR Latex coating increased the crease recovery of the textile substrate cotton, polyester and P/C blend fabric and it enhance the crease recovery angle of the fabrics.

**Bending length**

**Table 7: bending length of 3 type of fabric cotton polyester, PC blend (before coating and after coating) in warp and weft direction.**

Bending length				
Fabric type	Before coating		After coating	
	Warp	Weft	warp	Weft

Cotton	1.93	1.12	1.96	1.15
Polyester	2.2	2.05	2.5	2.10
PC Blend	2.0	2.2	2.2	2.8

**Bending length analysis:** It was observed that, bending length of cotton, polyester and p/c blend fabric has been increased after applying the natural rubber latex coating ,it means NR Latex coating increased the bending length of the textile substrate cotton, polyester and P/C blend fabric and it enhance the bending length of the fabrics.

**Drop penetration test:**

**Table 8: drop penetration test of 3 type of fabric cotton polyester, PC blend (before coating and after coating).**

Fabric type	Absorption time	
	Before coating	After coating
Cotton	5 sec.	Not absorb till 5 min.
Polyester	24sec.	Not absorb till 5min.
P/C Blend	20sec.	Not absorb till 5 min.

**Drop penetration analysis:** It was observed that, drop penetration in cotton, polyester and p/c blend fabric has been increased after applying the natural rubber latex coating, it means NR Latex coating increased the water repelling properties of the textile substrate cotton, polyester and P/C blend fabric and it makes the water repellent fabric.

**GSM (Gram per square meter)**

**Table 9: Graphical values of GSM (Gram per square meter) of 3 type of fabric cotton polyester, PC blend (before coating and after coating).**

Fabric type	GSM	
	Before coating	After coating
Cotton	76	139
Polyester	84	122
P/C Blend	70	138

**GSM Analysis:** It was observed that GSM of cotton, polyester and p/c blend fabric has been increased after applying the natural rubber latex coating, it means NR Latex coating increased the GSM of the textile substrate cotton, polyester and P/C blend fabric.

**Spray test:** Determination or resistant to surface wetting (spray test) ISO 4920-2012.

**Table 10: Resistant to surface wetting spray test before coating and after coating.**

Fabric type	Spray Test	
	Before coating	After coating
Cotton	0	5
Polyester	1	5
P/C Blend	0	5

- 0- Complete Wetting of the Entire Face Of The Specimen.
- 1- Complete Wetting of the Entire Specimen Face Beyond The Spray Points.
- 2- Partial Wetting of the Specimen Face Beyond The Spray Points.
- 3- Wetting of Specimen Face at Spray Points.
- 4- Slight Random Sticking or Wetting of the specimen.
- 5- No Sticking or Wetting of the Specimen face.

**Effect of NR Latex on fabric evaluated by spray test:** Before applying NR Latex coating absorbency properties or rating in these three types of fabric cotton and P/C Blend was 0, that showing the Complete Wetting of the Entire Face of the specimen, And before coating Polyester absorbency rating was 1, that showing the Complete Wetting of the Entire Specimen Face beyond the Spray Points, but after applying coating, it repel the water droplet and repelling rating has been observed 5, that showing the No Sticking or Wetting of the Specimen Face.

**Hydrostatic test method:** This test method measures the resistance of a fabric to the penetration of water under hydrostatic pressure according to AATCC TM 127-2017 test method. It measured the water resistant with the help hydrostatic pressure.

**Table 11: Resistant to surface wetting hydrostatic test method test before coating and after coating.**

Fabric type	Hydrostatic Test method
	Hydrostatic pressure in cm
Cotton	65
Polyester	65
P/C Blend	65
Result >	Resultant fabrics cotton, polyester, and P/C Blend has been repelled the water . Note :If hydrostatic pressure above 45 cm ,means resultant fabric will be water repellent.

**Effect of NR Latex on fabric evaluated by hydrostatic test method:** Before applying NR Latex coating absorbency rating properties in these three types of fabric cotton, and P/C Blend was 0, that showing the Complete Wetting of the Entire Face of the specimen, but after applying coating, it repel the water droplet and repelling rating is 5, that showing the No Sticking or Wetting of the Specimen Face.

### CONCLUSION

- In this study, an attempt has been made to evaluate the role of rubber plants and chemicals for their repellent against water. Compared with earlier reports, our results also reveal that the experimental of rubber coating were effective to control water penetration inside the fabric surface.

- From these results, it can be concluded that vulcanization of natural rubber latex excellent repellent activity against water. The results reported in this study open the possibility for further investigations of the efficacy of repellent property of natural product of Natural rubber latex and also provide safer alternatives for modern deadly poisonous synthetic chemicals.
- Hence, chemicals used in the study alone or in combinations with NR Latex , those followed from other water repellent finishes for textile , could be used for the preparation of water proof products. Such formulations could help in reducing the harmful effects of water repellents.
- In this study , obtained effective water repellency properties due to effective absorbency of NR Latex coating on textile substrate and as well as it enhance the mechanical properties of fabrics such as tensile strength, tearing strength ,GSM, bending length, crease recovery etc.
- And ultimately Achievements from this research study a very thin layered of natural rubber latex coating on cotton, polyester and P/C blend fabric in a cost effective manner that Improved the water resistance and mechanical properties of the coated fabric as well as enhance other properties of fabric such as ,Removal of hairiness of fabrics, Substantial, reduction in abrasion loss of fabrics, Good drape property of fabrics, Improvement in mechanical properties (tensile strength, tear strength) ,Removal of foul smell of rubber .

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