Effect of using softener washing treatment on jeans fabrics

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Abstract

The present research work, using different softeners against water and air permeability resistance. In this work, three different concentrations for each of silicone & fatty acid softeners have been synthesized. Air permeability and water permeability are discussed by changing the amount of softener concentration. It was a great effort to figure out the optimal level of the softener that would have breathable permeability. The results show that if the amount of softener is increased, the permeability of the woven fabric decreases, which affects the different properties of the garment. Among these, silicone wash and fatty acids are the preferred methods of increasing the softness of the fabric. Softeners make the fabric soft, brilliant, greasy, brighter, and slippery and make it more elastic to produce a desirable property.

Keywords:

Silicone softener, Fatty acid softener, Fabric permeability.

الملخص

الراحة والجاذبية هما أهم مطلبين أساسيين في صناعة المنسوجات. تم تطبيق أنواع مختلفة من التشطيبات على القماش لتحقيق هذه الخصائص المرغوبة حيث يعمل البحث الحالي على استخدام مواد تطريه مختلفة ضد مقاومة نفاذية الماء والهواء. في هذا العمل، تم تصنيع ثلاثة تركيزات مختلفة لكل من مواد التطريه مثل السيليكون والأحماض الدهنية. تمت مناقشة نفاذية الهواء ونفاذية الماء عن طريق تغيير كمية تركيز مواد التطريه. لقد كان جهدًا قويا لمعرفة المستوى الأمثل لمواد التطريه الذي يمكن أن يكون أكثر نفاذية. تظهر النتائج أنه في حالة زيادة كمية مواد التطريه، تقل نفاذية القماش المنسوج، مما يؤثر على الخصائص المختلفة للملابس. من بين هذه الطرق، يعتبر غسل السيليكون والأحماض الدهنية من الطرق المفضلة لزيادة نعومة النسيج. تجعل مواد تطريه القماش ناعمًا ولامعًا ودهنيًا وأكثر إشراقًا وزلقًا وتجعله أكثر مرونة لإنتاج خاصيه مرغوب فيه.

الكلمات المفتاحية:

منعم السيليكون، مطهر الأحماض الدهنية، نفاذية النسيج.

1. Introduction

Denim (Jeans) may be the most considered style today and is cotton able to withstand wear, pressure, or damage; hard-wearing twill textile in which the weft is under two or more warp threads [1]. The fabrics of denim are woven with a coarse count, high thread density. It is usually used to make jeans, overalls, and other clothing. Whilst Denim was traditionally colored blue with indigo dye to make blue “jeans”. It is an icon and one of the most familiar products within the textile industry that attracts all age groups.

Fashion is today incomplete without Denim. Denim comes in all forms, looks and washes to match with every dress. The Dry-washing process is most popular for denim garments.

At present, the demand for denim apparel with faded look so increasing rapidly. Various types of washing have been used on denim apparel to give them a used look. Standard washing practices are Bleach wash, Enzyme wash, Garments/Normal wash, Bleach with Stonewash, Acid wash, Pigment wash etc. Among methods, the Bleach wash & Enzyme wash is very widely used in the washing industry.

Denim garment washing or denim washing is one of the most widely used finishing treatments with extensive usage due to its effects on appearance and comfort. Without washing, denim garments are being uncomfortable to wear due to their weaving and dyeing effects. It essentially needs a finishing treatment to make it softer, suppler and smooth, which enhance the wearer's comfort.

2. Terminology

Silicone is a characteristic or relating to a class or group of terms that refers to a class of artificial polymers based on a framework of occurring in turn repeatedly silicon and oxygen (Siloxane Bonds) with organic substituents attached to the silicon [2].

3. Conceptual Framework

3.1. The problem of research:

- The conceptual frameworks combining two different softeners might produce physical and mechanical effects during treatment processes.
- For organizing the research experience, the analytical approach should be used in monitoring and studying the concept of the rules of different types of softeners on fabric comfortability.

3.2. Research question

- To what extent could the techniques of fabric comfort characteristics depend on fabric properties such as smoothness of the fabric surface structure, air permeability, and wettability?

3.3. Research Goals

- To increase the soft handle of the fabric, silicon washing is one of the favorite techniques.
- In this work, the effect of silicone softeners on air permeability and wettability of fabric to be discussed by changing the amount of softener percentage.
- To find out the optimum level of silicon softener which will be feasible for air permeability and wettability of woven fabric for cotton yarn.

3.4. The Research Limits

The commercial Jeans Fabric (100% Cotton, twill 2/2 woven) on the market has been used.

3.5. Research hypotheses

- Silicone softeners make the fabric softer, brighter, slippery, and more elastic to produce a desirable handle
- The application of softeners has a significant effect on air permeability and wettability with respect to untreated fabrics.

4. Previous work

Rahman (2018.) [3] & Sisodia et al, (2019) [4] & Parmar et al. (2017) [5] explained that Silicone softener improves the sample to give a silky soft hand, excellent lubricity, increase recovery, tear strength, abrasion resistance etc. Silicone softeners are more expensive than fatty softeners. It shows exceptional durability and temperature stability, and Silicones are the most versatile polymer known.

Xiao et al. (2011) [6] reported that clothing comfort indicated by the Fabric smoothness-roughness had been considered one of the principal factors. Whilst it is a significant factor for nowadays consumer decisions. The fabric surface friction behavior is directly proportional to Fabric smoothness behavior. The static and dynamic friction as Subjective fabric hand assessment is influenced by the cloth surface and the fingers; Bhuvana et al. (2006) [7] indicated that the human finger is a delicate instrument equipped for distinguishing slight contrasts in the frictional conduct of fabric. Das et al. (2005) [8] reported that the results of hand tests are communicated in abstract terms (e.g., clingy, oily, soft, sleek, harsh, scratchy, sheer, sticky, and waxy) contingent on the feeling of touch. So, it is imperative to evaluate texture erosion quantitatively.

Choudhury et al. (2012) [9] showed that Stiffness drape coefficient values as drape testers are used to test fabrics in terms of bending length. Choudhury studied the effect of softeners on softness and established that the bending length decreased with increased softener concentration, indicating a reduction in fabric stiffness. Chattopadhyay and his colleague (2010) [10] found that silicone softener treatment on fabrics decreased the bending length, which was indicative of enhanced material quality.

Parveenzadeh et al. (2005) [11] explained that the processing of textiles to accomplish a specific hand is one of the most of central importance parts of finishing. Softeners improve the hand, smoothness, elasticity, and antistatic and soil release properties of textiles. The mechanism of cotton softening is well established. Igarashi and his colleague (2019) [12] & Turner et al. (2019) [13] reported that among many textile qualities factors, smoothness is a significant property.

Bereck et al. (2001) [14] Silicone softeners can impart enhanced softness, higher flexibility and more elasticity, substantial drape characteristics, increased pliability and more excellent smoothness than other soft finishes. Schindler et al. (2004) [15] added that their additional advantages include non-foaming aspects, lesser yellowing effect, higher fiber substantively and hydrophobic nature. The broad applicability and suitability of these materials are outstanding. The properties include lubricating property, mechanical stability, chemical stability and translucent appearance [16]. Based on their emulsion droplet size, silicone softeners are classified into three groups: nano, micro-and macro-emulsions [17]. Their particle sizes are macro, 150–300 nm; micro, below 40 nm; and nano, less than 10 nm [18]. The smaller-sized silicone softeners show better performance and improved softness to a remarkable extent due to deep penetration and lubrication at the fiber level [19, 20].

Javadi et al. (2013) [21] & Moyinul and his colleague (2015) [22] emphasized that Silicone oil is the most essential and common chemical in textile processing. Silicone softeners mostly used to get better softness properties on textile fabric. It improves the abrasion resistance of materials, mobility of fibers, tears strength of fabrics, soiling resistance and static protection.

It also decreases yarn and fabric tensile strength by reducing fiber cohesion, reduces sewing thread breakage, pilling and flammability [1,2]. Softener can be classified by (a) Cationic softener, (b) Anionic softener, (c) Nonionic softener, (d) Amphoteric softener and (e) Silicone softener.

Every textile softener is applied in the form of an aqueous dispersion or emulsion. Schindler and Hauser (2004) [23] have differentiated between the different types of silicone softeners as Polydimethylsiloxane, Epoxy functional silicone softeners, Amino functional silicone softeners, Cationic silicone softeners, Hydrophilic silicone softeners etc. Tomasino (2000) [24] explained that According to particle size, there are three types of commercially available modified

Polysiloxanes silicone softeners: macro, micro and nano silicone emulsions. The handle effects with softness depend not only on the chemical character but also on their position in the textile. If the softener is attached mainly on the outside of the yarns, it is the primary effect of the character of the chemical as felt; moist, dry, fatty, oily, smooth, rubbery etc. However, suppose the softener can penetrate the yarn between the individual fibers. In that case, a secondary handle effect is obtained: so-called “inner softness” produced by the reduction in friction between the individual fibers.

Begum (2012) [25] This study examines the effect of macro, micro and nano-sized particles of silicone emulsion softeners of different quantities on physical and colorimetric properties of blue and red colored single jersey fabrics by experimental analysis. Therefore, three other sized particles of silicone provide excellent absorbency, higher color yield, minimum shade change and good soft handle to both colored fabrics, but nano silicone emulsion reduces the wet rubbing fastness.

Macro silicone emulsion provides excellent softness, acceptable shade change, increased color yield, good absorbency and improves wet rubbing fastness. On the other hand, micro silicone emulsion provides sufficient wet rubbing, soft handle, acceptable shade change, increased colour yield and good absorbency to both colored fabrics.

Chowdhury (2018) [26], the study demonstrated that the changes in functional properties of both

woven and knit cotton fabrics were determined to evaluate the performance of different special finishes. He used100% cotton fabrics treated with different types of finishing chemicals at various formulations. Özgüney (2008) [27] comfort and attractiveness are the most significant prerequisites of knitted fabric manufacturing. To attain these desired properties, different types of finishing applied on knitted fabric.

Among these, silicon washing is one of the favorite’s techniques to increase the soft handle of the fabric. Silicone softeners make fabric smoother, brighter, and slippery and more elastic to produce a desirable handle. In this work, the effect of silicone softeners on air permeability and drape of the fabric discussed by changing the amount of softener percentage. From the results, it is clear that if the amount of silicon softener percentage increases, then the air permeability of knitted fabric decreases and drape co-efficient increases which influence the various properties of garments. Pratihar et al. (2013) [28] reported that the application of softeners has a significant effect on air permeability and drape concerning untreated fabrics.

5. Purposes of Garments Washing:

In today's trend, Denim has achieved much predilection for different ages as blue jeans. as stated to the fashionable denim garments, subjected to many different functions washing techniques to obtain a worn, vintage look with different effects like hand sand, whiskers, 3D, destroy etc. on the other hand to produce a fading effect is the main target of denim washing without simulating the main body fabrics and patchiness, seam puckering, crinkles, hairiness, softened-hand feel, de-pilling, stabilized dimensions etc., is carried out to create a wash look appearance. After washing the garments, create a new look that seems like the unique touch of fashion.

- By technique of washing, a faded/old look, color or tinted effect is established in the garments, which also seem the best touch of garments.
- It also produces a different outlook.
- Washing technique creates new fashion such as tagging, grinding, destroy, Whiskering, permanent wrinkle, P.P spray, hand crapping, 3D etc. Which also seems the best touch of garments.
- The primary and essential function of washing is to change the size materials; thus, the garment becomes size free and becomes soft hand feel.
- When these soft garments are touched, then it seems to the best touch of garments.
- For attraction of customers/Buyer by different types of fashionable washing and market developments.

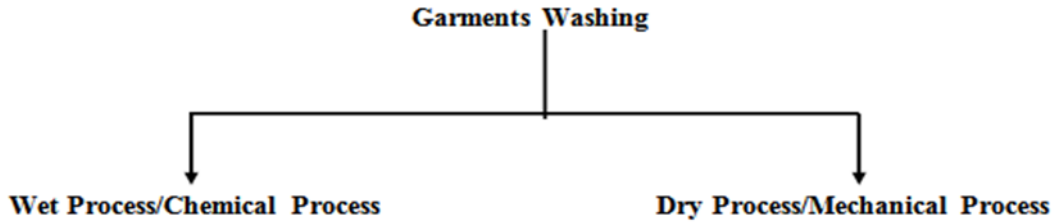
6. Characteristics of Denim Fabric:

- Warp yarns are colored (usually with indigo, vat, blue or Sulphur black).
- Structure: right hand or left-hand twill, i.e., z/s-twill of 2/1 or 3/1 construction.
- Usually made of cotton yarns of coarser count (7s, 10s, 14s, 16s, etc.).
- Coarser cloth (weight lies between 6-14 oz./sq. yds.) and used for pant and warm jackets.
- It is for long-wearing.
- It is robust and durable.

6.1. Classification of Denim treatments:

6.2. Denim washing:

Denim washing produces effects like colour fading with or without patchiness, crinkles, seam puckering, hairiness, de-piling, softened-hand feel, stabilized dimensions etc.



6.3. Dry Process

1. Regular wash/ garments wash/ rinse wash
2. Hand Brush/Hand Scraping

3. Pigment wash
4. Whiskering
5. Caustic wash
6. PP Spray/PP Sponge
7. Silicon wash and fatty acid
8. Destroy
9. Stone-wash
10. Crinkle
11. Enzyme wash
12. 3D
13. Stone Enzyme wash
14. Tagging
15. Acid wash
16. Sand Blasting
17. Bleach wash
18. Tinting wash Overall Whiskering

7. The function of Chemicals Used in Washing:

7.1. Desizing:

Desizing is utilized to remove mainly starches, waxes, fats, pectin's, minerals & Indigo dye from denim, twills, poplin &canvass fabrics etc.

Softener (Cationic, nonionic):

- It is to make the garments soft.
- It also provides excellent lubricating properties.

7.2. Wet Process:

- It is a fundamental step but the most crucial step of washing.
- This process removes impurities, starch & stains during the handling of fabric.
- Methods of Removing Sizes from Denim Jeans
- Washing with High Alkaline agents (i.e., Soda ash)
- Washing with High Acidic agents (i.e., Acetic acid)
- Washing with Oxidative chemicals (i.e., Hydrogen Peroxide)

7.3. Binder:

- Binder is a film former consisting of various polymer.
- The polymer contains a reactive group & it forms a crosslink during curing.

Silicone and Fatty acid play a very crucial role in textile finishing. The essential requirements like increasing hydrophobicity, softness, whiteness, fastness could be served by applying the appropriate softener. Concerning different properties on different fabric softener has been synthesized.

In the textile industries, silicones and Fatty acid are used in all fiber processes during production or directly on the finished fabric goods. Silicones are applied from different delivery

systems to provide various benefits like lubrication, softening, foam control or hydrophobic coatings [29].

Hasani and his colleague (2013) [30] have evaluated the surface roughness of weft knitted fabrics by analysing the signals obtained from image processing using the 600-dpi resolution scanner and MATLAB software.

8. Classification of main components of softeners [31]

The main components of softeners are long-chain fatty acid (saturated or unsaturated) derivatives and organosilicon.

8.1. Fatty acid softeners

This type of softener is usually a type of surfactant, which is used earlier. The primary synthetic materials are stearic acid, oleic acid and other long-chain fatty acids or esters, or polyethene prepared by introducing water-soluble groups or emulsifying stampede agents. The handle is generally thick. After finishing with this kind of softener.

8.2. Silicone softener

It is usually synthesized from octamethylcyclosiloxane. Octamethylcyclotetrasiloxane, also called D_4, is an organosilicon compound with the formula four and is a colorless viscous liquid. It is a common Cyclomethycaine. Many types of products enhanced, such as methyl silicone oil, hydroxyl silicone oil, hydrogen-containing epoxy modified silicone oil, silicone oil, amino silicone oil, etc. The softness and mellowness of the fabric treated with this kind of softener are significantly improved.

8.3. The mixture of fatty acids and organosilicon.

Fatty acid laxatives have the advantages of simple composition, low price, and total grip, but they are usually not smooth enough. Silicone laxatives can improve the softness of fabrics, so manufacturers often add 10-50% silicone to fatty acid laxatives. The fabric undergoes a pretreatment process as a base point to obtain materials free from external impurities. To achieve smooth and hassle-free results in the subsequent process such as dyeing, printing and finishing systems that ultimately perform well-known concepts known as processing and producing "right the first time, every time and at the right time".

8.4. Megasoft BBK

Cationic silicone softener.

- It gives an excellent soft hand feel and resilient with a light oiliness for all kinds of fabrics
- Zero impact on the fabric colour.

8.5. Daysoft NAT 60

Cationic fatty acid is a concentrated softener for soft handle cotton finishing and its blends.

- Pleasantly soft and smooth handle
- Applicable for padding procedures
- No bad influence on fastness properties of dyeing
- Low tendency of yellowing under usual drying conditions (130 – 140 °C).

9. Experimental work

9.1. Materials and Methods

Jeans Fabric (100% Cotton, twill 2/2 woven) have been used. The weight per/unit area of Denim is Light Weight as such 4.5 oz. /sq. yd. (150 gm/m2) produced by Mahalla Kupra Messer weaving &spinning has been used in the present research, the number of picks 24/ ends 40 /cm. Denim's Hue/Tone & colour is the fabric was pretreated by desizing, singing, scouring, bleaching in the mill, using standard recipes (Table I).

9.2. Softener Treatment fabric.

Samples were given softening treatments in the Mahalla Kupra company plant. This study used two types of softeners: according to standard May/June 2020 Vol. 7, No. 3 | 14 AATCC Journal of Research DOI: 10.14504/ajr.7.3.3 Accepted [32]: 11/06/2019 modified polysiloxane microemulsion at various concentrations (2, 4, and 6 g/L). Using a standard recipe (5–5.5 pH, 75% wet pickup at 30–35 °C, a drying temperature of 110 °C and a curing temperature of 150 °C for 40 s) recommended by the softener supplier. A total of 10 samples were prepared using these softeners. Sample details and the concentration of individual softeners used are
given in table (1). Fabric Sample Analysis; the samples were tested for various physical properties, including mass (IS 1964), EPI/PPI (IS 1963).

The twill weave (used in Denim) fabric is constructed by interlacing warp and filling yarns in a progressive alternation that creates a diagonal effect on the face, or right side, of the fabric a surface of diagonal parallel ridges. In some twill weave fabrics, the oblique effect may also be seen clearly on the backside of the fabric. Due to Denim's right-hand twill construction, one colour predominates on the fabric surface. the Denim fabric used in this experimental work is the production, Messer spinning &weaving Mahalla Kupra company constructed in 2/1 left-handed twill (The simplest twill weave is either 1/2 or 2/1 twill (Three Leaf Twill), 20 weft/20 warp count,

9.3. Fabric Sample Analysis

According to the contemporary fashion designs and fashion brands and as far as the clothes has become not, concerned with tensile strength, elongation or resistance to abrasion. Fashion of jeans, the brand counts the likes of Gigi Hadid, Jeanne Damas, Kaia Gerber, and Alessandra Ambrosio as shown in fig (1,2) [33].

Fig (1)

Fig (2)

The present research was dealing with air and water permeability.

Standard Test Method for Air Permeability of Textile Fabrics, ASTM D737 – 18.

The specimen is loaded to the test area of the instrument employing an automatic holder. The Air permeability tester equipped with a vacuum pump to draw air through an automatic interchangeable test head with a circular opening. The pre-selected test pressure is automatically maintained, and the air permeability of the test specimen is digitally displayed in the pre-selected unit of measure on the touch panel. After the test, the holder is released, and the vacuum pump will be shut off.

The samples were tested for various physical properties, including mass, air and water permeability at mahalla Kupra (miser spinning and weaving cop.) Laboratory fabric testing reported in table (1).

Table (1)

Fatty acid		silicon		Weight g/l,	Sample number
Water permeability/ Second	Air permeability m3/hr./m2	Water permeability /second	Air permeability m3/hr./m2		
60	156	60	156	0	0
8	١٤٤	8	140	2	1
5	83.5	11	80	4	2
4	79	14	72	6	3

It is evident from the table (1); that if the amount of softener is increased, then air permeability of fabric will decrease as shown in fig (3). As more amount of softening fabric, the fabric will be less absorbent as well. It will create a problem of comfortably of garments. Less air can pass through the fabric; thus, the wearer will feel uncomfortable. For example, it could be said that a lesser air permeability when it has more softener. When a 2 gm /L softener is applied, the fabric air permeability is 140cc/cm2/sec. It is gradually seen that four up to 6 gm/L silicon provides lesser air permeability of cc/cm/sec 8%, 48% and 60% consequently. The same result gained whenever the amount of fatty acid increased the prevention of air permeability follows the pattern of 7.6 %, 46.5 % and 49.4 % accordingly. Therefore, the garment will be uncomfortable, where it will be less permeable.

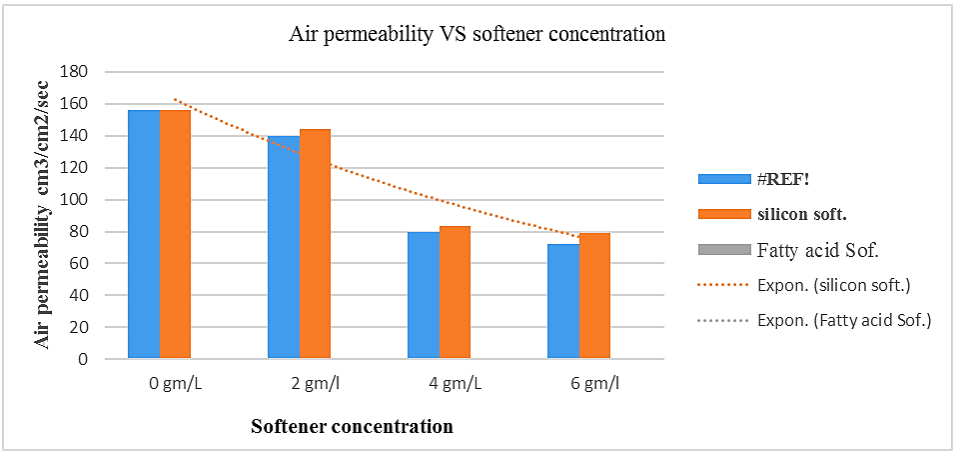


Figure-3: Air permeability after applying different amount of silicon Softener and Fatty Acid.

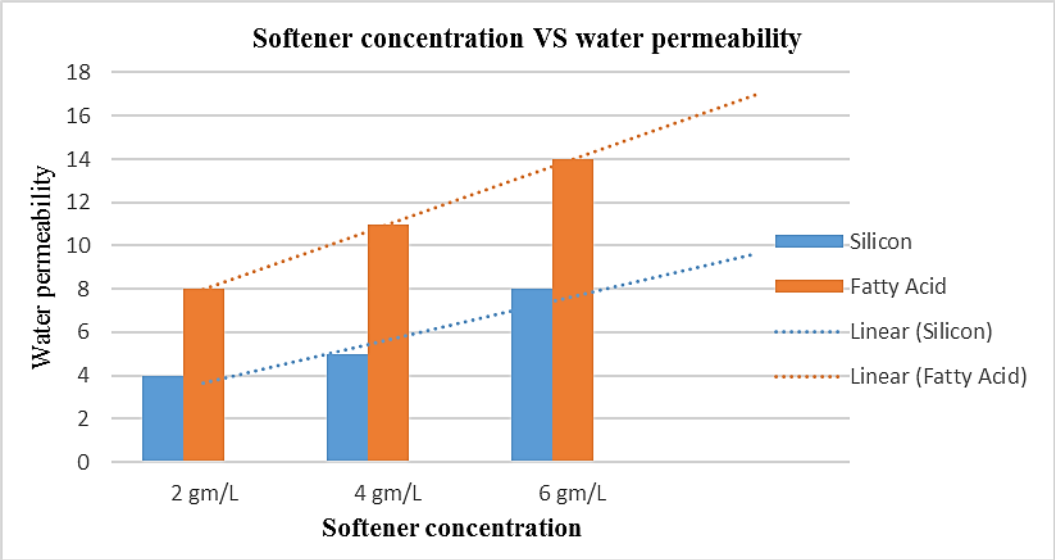


Figure-4: water permeability after applying different amount of silicon Softener and Fatty Acid.

10. Effect on Absorbency

In addition to soft feeling, softener finishing, in general, imparts water repellent property to the textiles. Such water repellency property is provided by methyl groups which are oriented and attached to the fiber surface by silicone or fatty acids links. Therefore, the absorbency of different samples with different concentrated softeners was determined by immersing the sample in the 50cc surface of the sample. The time taken by the immersed samples by the fabric was reported. Lesser time taken by the water to get absorbed by the fabric indicates better absorbency. Table (1) and fig (4) show the effect of silicone and fatty acid softener on the water absorbency of the samples. It is evident from the results that the fabric with more softener will indicate water repellent compared to its conventional standard sample. On the other hand, silicon showed less time than a fatty acid. It could be said that silicon is recommended over fatty acid as a softener.

11. Conclusion

By using the indicated amount of softener, it will be possible to make the garments more human friendly. It will create a soft handle on finished garments. On the other hand, softeners increase the weight of the fabric. So, drape ability will also increase for this reason. The increasing amount of drape is not better for garments. If the garments are made from these fabrics, as mentioned above, they will feel more comfortable and relaxed. It will enhance their performance in their respective working field also. While the increased use of softener provides more drape on garments. Cotton can become embrittled during preparation (scouring and bleaching) because natural oils and waxes are removed. Finishing with softeners can overwhelm this deficiency and promote the original suppleness. No fabric reaches the customer's hand without finishing treatment. This finishing depends on the end-use of the fabrics. This study shows the complexity of the fabric assessment that there are various finishes, but softening finishes are amidst the most influential textile chemical finishing for the Denim industry. It is

essential to invest in further research and development. Every industry sector should now produce products that are the best in terms of quality and price.
Further studies should narrow this range to correctly identify the contribution of other factors like fibres, softener concentration, etc.

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