



Overview of Discharge Printing Techniques on Denim Fabric

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Discharge printing: is a type of printing in which the ink is applied to a previously colored cloth, often known as the 'ground' shade. The dyes used for the ground shade must be carefully chosen such that when a proper print paste is applied, the dyed cloth is permanently decolored locally, resulting in a 'white' discharge patterning look. Discharge printing produces vivid, opaque graphics on dark textiles while maintaining a delicate feel. The patterns on the cloth are created by the chemical degradation of the original dye in the printed sections in the discharge technique. With these factors in mind, the current study attempted to optimize the discharge printing recipe by adjusting the dye and discharging agent concentrations. of dye and discharging agent, for denim cotton fabric dyed with eco-friendly reactive dye and to assess the physical and color fastness properties of printed samples.

Keywords: Textile; Denim; Discharge Printing; Indigo Dye; Natural Dyes, Extraction.

Introduction

Dyeing and printing fabrics

Dyeing and printing fabrics are extremely old crafts that, in current times, have benefited much from science and have been shared in the technological revolution. The ancient Indians used printing as a technique of adornment, and it was later adopted by the Europeans.

Egyptians can be divided into groups based on their approaches and styles. Textile printing is a type of printing that is done on textiles the method of putting color to cloth in a predetermined pattern or design It's possible. dyeing procedure that is considered a specialist. The primary goal of printing is to think things out.

Then apply dye to a precisely defined region on the cloth, leaving the rest of the fabric alone The cloth was mostly unaffected. Color is applied in the form

of a solution in dyeing, Printing, on the other hand, uses color in the printing process. [1-4]

Jeans were originally advertised and sold as workwear, with a focus on durability and usefulness. When customers found and valued jeans as everyday wear, they became fashionable, and new techniques were created to improve and personalize denim items. Garment washing is the term used to describe these methods. All of these methods entail the use of rotating drum machines to process garments.

Denim Fabrics

Denim is more than just a cotton fabric [2, 5-7]. The majority of people confuse denim and jeans. Those are two very distinct things. The cloth that is used to produce jeans is known as denim. In the preceding explanation, we also defined denim. Denim fabric is used to make jeans, which is a sort of clothing. Jeans are considered casual clothing and are worn by both men and women outside of work. In this essay, I'll go

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over the process of making denim and jeans individually.

Denim is a hard-wearing cotton twill fabric, traditionally woven with an indigo-dyed warp and white filling yarns. Denim jeans manufacturing involves the same classical principles which have been followed since its creation, but technological advances have transformed it into a highly fashionable material. [8, 9]

Cotton Fiber

Cotton is widely utilized in the production of denim jeans, where fiber quality and staple length are critical. Cotton can be combined with lycra, polyester, lyocell, wool, flax, hemp, and other materials to create unique forms of denim. Even though several of these fibers are currently being used in denim, it is quite unlikely that they will ever totally replace cotton.

The cotton fiber needs to undergo a series of operations to be spun into yarns. Most of the cotton processing techniques for denim manufacture have not changed over the years. Unlike the weft, the production of warp yarn needs special attention, as it can influence the final quality of denim.

Manufacturing of Denim Fabric: Unlike many other varieties of cloth (which are woven in one area and dyed in another), denim is woven and dyed in the same spot. In most cases, cotton is utilized in denim fabric production, while indigo dyes are used for denim fabric coloring. We will go through each step in detail in this article. First, a denim fabric production flow chart is presented.

Denim Fabric

Denim fabrics made entirely of cotton would be extremely robust and long-lasting. Blue denim is traditionally a warp-faced cotton fabric with a 3 x 1 twill weave, with the warp dyed a solid color and the weft left un-dyed. After dyeing, the appearance and quality of the Denim Fabric will increase, however the procedure varies from plant to plant. The denim production technique is mostly dictated by the dyeing procedure. [10]

The dyeing for Denim Fabric happens at the sizing stage. Generally, there are two most popular methods of dyeing Denim Fabric. They are:

1. Rope Dyeing
2. Sheet Dyeing

Flow Chart of Denim Production Process

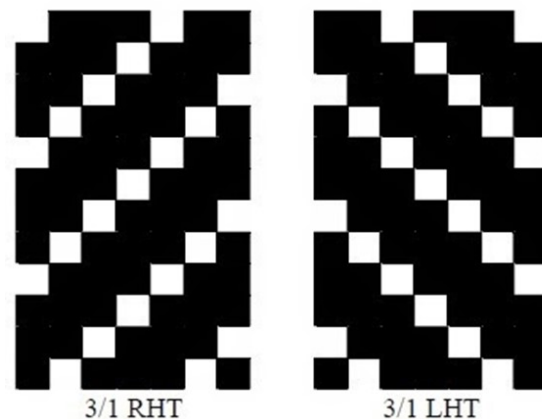
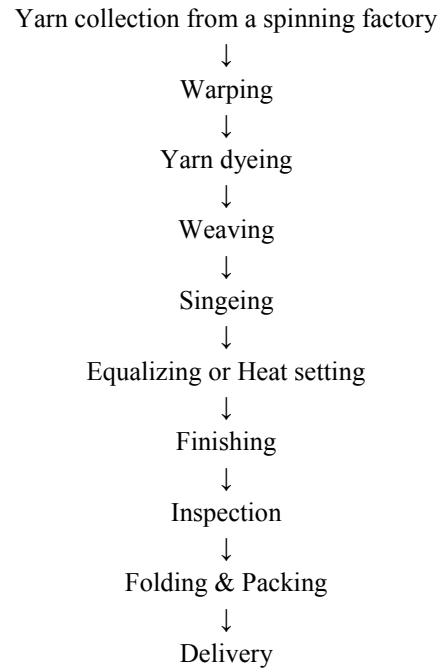


Figure 1: weave denim structure

3.



Figure 2: Rope Dyeing

Slasher dyeing involves pre-treatment of denim yarns in the form of a warp sheet in early compartments, followed by multi dip/nip indigo dyeing; the process is completed after washing, drying, **sizing**, and final drying. Because the warp sheet is instantly processed and then transported to the weaving department for conversion to fabric,(5-12)

Sheet Dyeing Process

This method avoids a few of the rope dyeing's intermediary steps. After being treated with chemicals like caustic and washing soda and squeezing off the excess water, the yarn sheet is permitted to pass through Dyeing Troughs for oxidation and color development. After dyeing, the dyed yarn is rinsed two or three times with fresh water and squeezed before being passed through six drying cylinders. The colored yarn is sent through the starching apparatus, where it is sized. The sized warp beam after sizing

moves on to weaving Brushing, singeing, washing, impregnation for dressing, and drying are some of the finishing techniques used on woven Denim Fabrics after weaving. Brushing and singeing should remove impurities and aid to smooth out the fabric's surface. Dressing controls the fabric's hand and stiffness, whereas compressive shrinking controls its dimensional stability.

Even today, denim fabric that hasn't been dyed indigo isn't considered authentic. Denim makers used Natural Indigo Dye, which was expensive and gave a natural finish when Denim Fabric first entered the fashion market. Even though Synthetic Indigo Dye has progressively overtaken Natural Indigo Dye, some disorganized producers prefer the latter and charge a premium by labeling their products "Natural Dye Used." (4)

Woven and knitted denim fabric property

- 1) Knitted denim fabric show greater spirality compared to woven denim.
- 2) Good washing fastness for knitted fabric because reactive dye forms a covalent connection with the fiber rather than a coating like indigo dye in denim fabric, woven denim fabric dyed with indigo dye has moderate washing fastness compared to knitted denim.
- 3) GSM of knitted denim fabric is higher as compared to woven denim. GSM of denim woven fabric is low because after washing some size ingredients in the sizing were removed during sizing.

Knitted denim gives a good performance compared to woven denim with a low manufacturing cost. [11]

| Fabric name | Yarn count | Dye color | Shrinkage % | | Spirality | Color fastness to rubbing | | Color fastness to washing | Gsm | | oz/yd ² | |
|-------------|-------------------|---------------|-------------|-----|-----------|---------------------------|-----|---------------------------|-------------|------------|--------------------|------------|
| | | | L/W | B/W | | Dry | wet | | Before wash | After wash | Before wash | After wash |
| Knit denim | 24/1 ne lycra 40d | Reactive blue | -5% | -5% | 2.2% | 4-5 | 4 | 4 | 263 | 270 | 7.76 | 7.96 |
| Tuck denim | 24/1 nelycra 40d | Reactive blue | -5% | -5% | 2% | 4-5 | 3-4 | 4 | 284 | 290 | 8.38 | 8.56 |

Figure 3: Test result of knitted denim

Fabrics used in denim

Indigo denim is made by dyeing the warp threads with indigo and utilizing white threads for the weft. As a result, most blue jeans have a pale blue inside and are virtually white on the right side with the fabric facing the twist.

Denim Stretch: To give the fabric some flexibility, denim is stretched using spandex or another elastic component. Skinny jeans are frequently paired with stretch jeans.

Wrinkled denim: This sort of denim has been given a wrinkled appearance.

Acid Washed Denim: This denim has been marbled by treating it with chlorine and pumice stone.

Raw denim: Raw denim, also known as dry denim, is a fabric that has not been washed after it has been made.

This type of denim has not been washed or treated. Generally, it is worn for six months to a year without washing to ensure that it forms on the wearer's body. Fans of raw denim often put their jeans in the fridge overnight to kill microbes and bacteria.

Brushed Denim: Most types of denim have been disinfected, which is the washing process that resulted in modern denim fabric. While cleansed jeans are softer, they are less durable and are not as customizable as raw jeans.

Stretch denim: With this type of denim, cotton is mixed with spandex or a similar material. The resulting fabric is more stretchy than regular denim, so it is commonly used in figure-fit applications such as skinny jeans.

Stretch Denim Fabric

a) Stretch knit fabric, weft knit

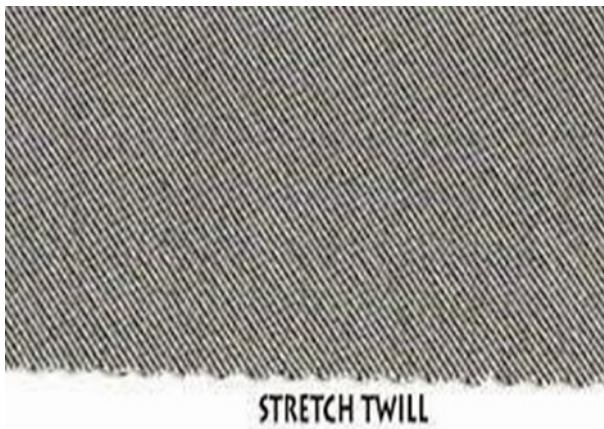


Figure 4: Shape: TR Stretch Denim Fabric

b) Colored Denim Fabric

Composition: 90% Cotton + 10% Spandex, multicolored yarn dyed



Figure 5: Lin: colored denim 5. Denim

c) Slub: Slub is used to manufacture this type of denim.



Figure 6: Denim Slope Fabrics

d) Terry Denim Fabric



Figure 7: Terry denim

e) Jacquard Denim Fabrics



Figure 8: jacquard denim

f) denim flower pattern:



Figure 9: flower pattern denim

g) Denim Style Flaw:



Figure 10: fig: denim flaw pattern

h) Snake pattern denim fabric:



Figure 11: snake pattern denim

i) Satin Denim Fabric:



Figure 12 satin denim fabric

j) Recycled Denim:



Figure 13: Recycled denim

k) Poly/Cotton Blend Weft TR Denim:



Figure 14: Poly/Cotton Blend Weft TR Denim Fabric

l) Coated Denim Fabric:



Figure 15: Coated Denim

Denim Dyeing Process with Indigo Dyes

Indigo Dye

Indigo, a low-quality dye, is often used in denim dyeing because it gives the fabric its distinctive blue hue. While the dye's low fastness is advantageous for generating a distressed look, it causes substantial effluent issues throughout the dyeing process and afterward in denim garment washing. Synthetic indigo has mostly replaced natural indigo, which appears to be more sustainable; nonetheless, bio-synthesis of indigo would be sustainable. A comparison of optimal natural indigo powder collected from plants and optimized synthetic indigo manufacturing reveals that natural indigo production is not always more ecologically friendly than synthetic indigo production.

The reduction process in indigo dyeing is currently causing concern. Sodium hydrosulfite's usage as a reducing agent has been linked to several environmental concerns. Better fixation using commercially available pre-reduced indigo needs fewer chemicals and resulting in a lower effluent burden. Organic reducing agents, biological reduction, electrochemical reduction, and catalytic hydrogenation of indigo have all been investigated as alternative reducing systems.

Indigo Dyeing

The ability to achieve wash down effects on multiple washing without losing the color's freshness is a unique quality of indigo-colored denim. Indigo dyeing is an important part of the denim production process, and the warp yarns are colored using either rope or slasher dyeing processes. The use of reducing agents and the large volume of effluents are key concerns in dyeing, and quality control includes monitoring dye bath parameters such as pH, sodium hydrosulfite, and leuco indigo concentration, as well as the dye bath temperature. The pH is critical since it regulates the amount of ring dyeing, and the immersion period and some dips are also vital.

In terms of sustainability, denim production today faces an eco-efficiency problem. Several attempts have been made to develop unique 'green' denim dyeing procedures that are more efficient, quick, inexpensive, and simple to use. The loop dyeing technique, in which the yarns are colored in a single bath with one squeezing unit after passing through the pretreatment boxes, is one of the results.



Figure 16: Indigo dye and dyeing (Photo: Getty Images)

Non-indigo Dyes

Non-indigo dyes, such as sulfur dyes, are increasingly frequently employed in denim warp dyeing, providing vibrant hues and a more environmentally friendly alternative to indigo dyeing. This dyeing is more efficient because of their stronger affinity for cotton, and current procedures can cut water usage even more. Dyeing equipment, which was designed specifically for indigo dyeing, is being modified to accommodate the application of various colors. Because it is frequently blended with other types of dyes in the same application process, or overdyed with them, the fraction of 100% indigo-dyed denim warp is quite tiny nowadays. Sulfur dyes are widely used for bottoming and topping of indigo for reducing the overall cost.

Natural dyes

Natural dyes are pigments or colorants derived from plants, invertebrates, or minerals. The group of natural pigments is plant pigments of plant roots, berries, bark, leaves, wood, and other organic sources such as fungi and lichens.

Natural dyes have significant limitations in terms of colorfastness and shade brilliance when applied alone. They provide brilliant and rapid colors when used with metallic mordants. As a consequence, rather than requiring unsustainable technology to produce colors, mild chemistry may be used to get almost identical effects. Our country's great biodiversity has supplied us with lots of raw resources, but a long-term relationship between cultivation, collecting, and utilization must be established

Because of rising environmental consciousness, the use of non-toxic and eco-friendly natural dyes on textiles has become a subject of great importance to avoid some dangerous synthetic dyes. Due to the specific advantages and limitations of both natural and synthetic dyes, the use of natural dyes for the coloration of textiles has largely been limited to craftsmen, small-scale dyers, and printers, as well as small-scale exporters and producers in the large scale sector for general textiles. Dealing with the manufacturing and selling of high-value eco-friendly textiles. We believe that this research will help to satisfy the aforesaid benefits of natural dyes. (16)

Methods

Preparation of Natural Dye

Natural dyes are gathered in the form of hard particles. Then, using a grinder, it is ground into powder. Then, using a blender, it is turned into a paste with hot water. Finally, make a natural dye stock solution. For instance, a 10% stock solution. Preparation of a Date-Based Natural Reducing Agent The first date is gathered from the market. Then separate the seeds, husk, and other parts of the date. To make one liter of reducing agent, around 200 grams of date is placed in a pot and mixed with an electric balance. Heat is increased to a boiling point and then cooled to 300°C. Following that, filter the liquid and put it in a suitable jar with a flap.

Preparation of Natural Reducing Agent from Apple

To begin, take one apple from the market and slice it into little pieces using a knife. A 200-gram apple may

be used to make one liter of a natural reducing agent. One apple is placed in a saucepan with one liter of regular water. The temperature was elevated to 100°C for around 30 minutes. Following that, filter the liquid and put it in a suitable jar with a flap.

Preparation of Natural Reducing Agent from Banana

The banana is first collected from the market and cut into little pieces using a knife. A 200-gram banana may be used to make one liter of a natural reducing agent. One banana is placed in a saucepan with one liter of regular water. The temperature was elevated to 100°C for around 30 minutes. Following that, filter the liquid and put it in a suitable jar with a flap. Calcium Hydroxide (Lime) must be ground into a powder and mixed with hot water to produce a paste. After that, filter the water and store it in an appropriate container.

Dyeing Procedure with Natural Indigo Dyes by Using Natural Reducing Agent (Date)

Recipe:1

- Natural dye: 10 gm/ l
- Natural reducing agent (Date): 200 ml/ l
- Ca (OH) 2: 15 gm/ l
- Reducing Temperature: 80°C
- Dyeing Temperature: 30°C
- Time: 30 minutes

Process

To begin, make a solution of natural dyes, natural reducing agents, and calcium hydroxide that meets all of the requirements. The solution is then placed in a dyeing bath and heated to 800 degrees Celsius. The color of the well-reduced solution changes to a greenish-yellowish hue. The solution is then cooled to 300 degrees Celsius. After that, the cloth is placed in a dye solution at 300°C for 30 minutes. After that, oxidation takes around 10 minutes with tap water. From yellowish, the colored sample transforms into blue. After that, the drying is done in an electric oven.

(Recipe)2

- Natural dye: 10 gm/ l
- Natural reducing agent (Apple): 200 ml/ l
- Ca (OH)2: 15 gm/ l
- Reducing Temperature: 80°C
- Dyeing Temperature: 30°C
- Time: 30 minutes

Oxidation is done by tap water for 5-10 minutes until the yellowish shade is diminished.

(Recipe)3

- Natural dye: 10 gm/ l
- Natural reducing agent (Banana): 200 ml/ l
- Ca (OH)₂: 155 gm/ l
- Reducing Temperature: 80°C
- Dyeing Temperature: 30°C
- Time: 30 minutes

Oxidation is done by tap water for 5-10 minutes until the yellowish shade is diminished. (15)

Chemistry of Indigo

Today you will be synthesizing indigo using the Baeyer-Drewson reaction, which is an Aldol Condensation reaction shown in Figure 2.2. This is the method developed by J. F. W. Adolph von Baeyer in 1880 to produce the first synthetic indigo. This reaction works well for small-scale reactions and is not used today in the industry for producing large quantities of indigo.

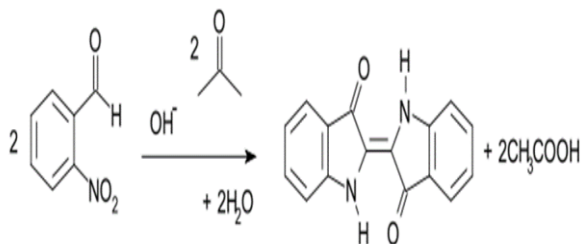


Figure 17: The Baeyer-Drewson reaction of 2-nitrobenzaldehyde with acetone in basic conditions to produce indigo.

- Indigo is not soluble in water, so to dye cloth, the indigo needs to be made into a water-soluble form. Therefore, indigo is called a vat dye. In this experiment, the insoluble indigo dye is synthesized and then reduced with sodium hydrosulfite (sodium dithionite), as shown in the following Figure, to the water-soluble leuco-indigo (sometimes called indigo white). When the clear yellow leuco-indigo solution comes into contact with air it oxidizes back to the insoluble blue indigo compound.

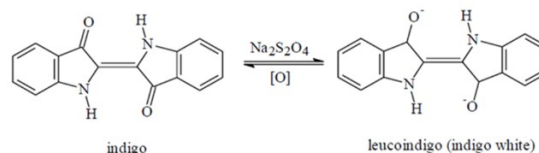


Figure 18: The reaction showing the conversion of the insoluble blue indigo dye to the clear yellow, water-soluble leuco-indigo or indigo white

Method-1 (Natural Indigo Dyeing Process by Using Sodium Dithionite)

Indigo stock solution – Depending on the quantity you want to make soluble (reduced form).

Example: To reduce 10g of indigo

Prepare two pots as follows:

Pot A:

Prepare a solution depending on the quantity to reduce

Weight Indigo: 10g

Pour in a jar with a lid of 200 ml

Add Alcohol (ethanol): 8-10g (methylated spirits may be used) homogenize until getting a consistent paste.

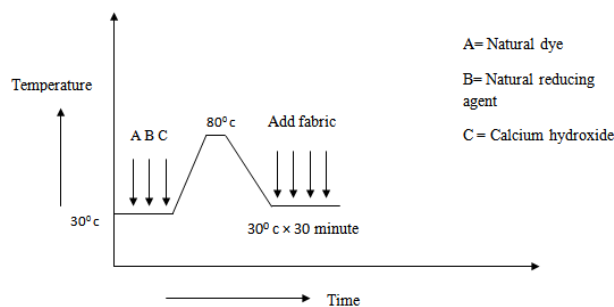
Pot B:

Weight Water – heat up to 50°C (»120°F) 120 g

Add Sodium carbonate, and then mix 10g

Add Sodium hydrosulfite 10g (10)

The diagram of the total pretreatment and dyeing process was as below

**Discharge Printing**

When printing by removal, the materials are first dyed with special dyes, and then they are printed. Design after that on those backgrounds with a paste that contains materials. A chemical that reacts with the pigment in the background, and this reaction. The double removes or whitens the color in the painted area and replaces it. The desired color is in the previous place, and the spaces may be descended to remain white. One of its advantages is that it has light or white colors on top. Wallpapers are dyed with medium or deep pigments without problems.

Matching the design to the background, this technique is suitable for the production of screen machines. The design is small and separate or spaced out so that it is difficult to print terrestrial direct method.

Advantages of Discharge Printing

1. Large areas of ground color are possible.
2. Delicate colors and intricate patterns possible on deep ground color, excellent depth, and clarity possible.
3. Very cool technique that removes the dye from the shirt.
4. Little to no feeling of the print on the shirt.
5. Vibrant colors.
6. The best way to print on dark shirts with non-traditional inks.
7. Something different from screen-printing "norms".
8. Still able to do a great amount of detail.
9. We offer discharge printing at no additional charge. It's often cheaper than traditional ink.
10. Higher production cost but long-lasting unique styles.

Disadvantages of Discharge Printing

There are certain drawbacks to this method of printing. The reducing agent used is determined by the fabric being printed and the backdrop colors. Because the background dyes must be simple to discharge, they are usually azo-based hues. Dyes with certain structural features, on the other hand, discharge more freely than others. Monoazo dispersion dyes based on azobenzene are the easiest to discharge in general.

Other disadvantages are

1. It is an expensive process.
2. Two-stage application involved in dyeing or padding and discharge printing.
3. Limited choice of ground and motif colors.
4. Requires rigid process care that any default will lead to damages.
5. Some sizes may discharge better than others.
6. Can be hard to use for photographic style or process printing.
7. Only works on natural fibers, like cotton, so 50/50 can't be used.
8. Not all shirt colors will discharge (royal blue never works well, for example).
9. Process can be quirky.

What is Discharging Agents?

A stripping chemical called sodium hyposulfite is used to remove colors from cloth that has been vat-dyed or printed. The most important method of discharge is minimization. This basic procedure may be altered and customized to create discharges from a variety of colors and fabrics. The terms "reducing agent" and "discharging agent" are used interchangeably by several printers. The most often used reducing agents are formaldehyde sulphonylates. Because of the chemical's stability, very few sulphonylate losses occur during the printing and before steaming. Sodium formaldehyde sulphonylate is used. (CI Reducing Agent 2, also known as Formosul or Rongalite C) dates back to 1905, when it was realized that procedures based on this reducing agent had several benefits.

Coloration Indigo the on Permanganate Potassium of Effect

Treating jeans fabrics with potassium permanganate to remove dyes Indigo

Discharge Screen Printing

-. Advantages of Discharge Screen Printing

1. A very cool technique for removing dye from shirts.
 2. There is little to no sense of the shirt's pattern.
 3. Colors that pop
 4. The most effective technique to use non-traditional inks to print on dark clothing
 5. Screen printing isn't the only option."norms"
 6. Able to complete a lot of work in a short amount of time
 7. We provide free discharge printing.
- there is an extra fee In fact, it's frequently less expensive than standard Discharge Screen Positives ink Printing

Treating jeans fabrics with potassium permanganate to remove dyes Indigo

The Discharge Style Printing Process on Cotton Fabric is conducted in the following order: In discharge printing, a pre-dyed fabric is printed with a paste containing a reducing (discharge) agent and a dye (the illuminating color) that is resistant to reduction. The base shade is simultaneously removed and replaced by the 'illuminating' color in the printed areas. Intricate designs, usually on starkly contrasting backgrounds, with outstanding clarity, sharpness, and fit have become the hallmark of this style, which can only be produced with much effort if at all, by

employing direct printing procedures. The discharge style printing technique on cotton is carried out in the following order Denim Discharge Printing with Potassium Permanganate as an Oxidative Agent

Effects of cellulase enzymes on denim:

1. In fading the desired effect is wash down look on the garment making the seams, hems, and pockets more prominent.
2. Other than look color contrast commonly known, the salt pepper effect is also one of the effects produced by fading. A faded garment with acid cellulase enzymes gives less color contrast as compared to a garment washed with neutral cellulase enzymes.

One of the best-known applications of enzymes today is bio-stoning or bio-stone washing, an alternative to stone washing on denim and other garments to give fading or vintage look. Cellulase enzymes can be used in place of pumice stones and achieve less damage to the fabric, machinery, and the environment.

Conflicts of interest

There are no conflicts to declare

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نظرة عامة على تقنيات الطباعة بالازالة على أقمشة الدينيم

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الهدف من هذه الدراسة هو معرفة ما إذا كان يمكن إزالة الصبغات النيلية: استخدام مكونات أمنة باستخدام عامل اختزال طبيعي التمر والموز والتفاح مسؤول عن ازاله اللون من ارضيه ملونه مسبقا مثل يمكن استخدام الاختزال أو الأكسدة لتحقيق ذلك على منسوجات الجينز. تم تصنيع الأقمشة المناسبة لهذا الاستخدام باستخدام مجموعة ، تم توضيح تأثير استخدام مادة المعالجة (برمنجنات البوتاسيوم (KMnO4) كعامل مؤكسد في طباعة الازاله الدينيم.و أكثر عوامل الاختزال استخدامًا هي كبريتات الفورمالديهايد. استقرار هذه المركبات يحدث فقط خسائر محدودة من السلفوكسيولات أثناء الطباعة وقبل التبخير. تم إنشاء استخدام سلفوكسيولات فورمالديهايد الصوديوم (CI Reducing Agent 2 ، الذي يباع باسم Formosul أو Rongalite C) منذ عام ١٩٥٥ ، عندما تم التعرف على أن الطرق القائمة على عامل الاختزال هذا توفر العديد من المزايا. تحسين تركيز Rangelit C لتحضير معجون طباعة الازالة باستخدام Rongalite C كعامل ازالة

الكلمات الدالة: المنسوجات – الدينيم – الطباعة بالازالة -استخلاص الصبغات الطبيعية