Abstract

The study focused on developing an eco-friendly discharge printing paste for dyed cotton fabrics at suitable concentration and pH combined with a neutral thickener was conducted at Federal University of Agriculture, Abeokuta. The study involved controlling the flow and concentration of bleaches, a process that led to irregular prints and fabric tear. Five household bleaches with known percentage concentration of sodium hypochlorite - Bleach-A: 0.36% (3.56 g/dm3); Bleach-B: 3.5% (34.00g/dm3); Bleach-C: 1.15% (11.48g/dm3); Bleach-D: 4.29% (42.92g/dm3) and Bleach-E: 0.06% (0.57g/dm3) were used for the study. A neutral thickener was developed to control the flow of bleach by combining different amounts of modified starch (4.5, 5.0, 5.5, and 6.0g) and water (125 ml) to achieve a variety of consistency at 20°C. The produced thickener was then combined with varying volumes (15, 25, 35) of 4.29% hypochlorite bleach (pH =11.4), to create a discharge paste. Lastly, five coloured cotton textiles (black, brown, navy-blue, purple, and army-green) were used to test the developed discharge paste using screen printing. The outcome demonstrated that purple and black colours were difficult to discharge. The neutral thickener containing modified starch (6.0g), water (125 ml) mixed with 35 ml of 4.29% hypochlorite bleach to create discharge paste, produced right consistency for a printing paste and had a pH of 9.66. The pH test results, indicated that it was safe to use on cotton fabrics. In conclusion, the discharged paste (6.0g of modified starch, 125 ml water, and 35 ml 4.3% hypochlorite bleach) produced regular, repeating designs on cotton fabrics that were dyed without causing damage to the fabric.

Key word: Discharge, Printing, Dyed, Cotton, Fabrics, Bleaches
natural and synthetic fabric surfaces, colours are worked up imaginatively and applied artistically to change the appearance of fabrics and garments (Art Quill Studio, 2014). Surface decoration entails enriching the surface of a fabric or garment using self-material and contrasting materials (Shah, 2023). Studies on fabric surface design involved a variety of techniques. Three fundamental techniques for decorating fabric surfaces identified by Pidilite (2024) are discharge, resist, and direct printing methods. Direct adds colour to the fabric, resist submerges fabric in colour, and discharge uses discharge agents to take away the colour. Handcrafted textile designers misunderstand discharge; neither the resist nor the direct printing processes yield soft, bright colours on dark fabrics (Ragab et al., 2021). Textile discharge style of printing is the most versatile and important of the methods used for introducing design to textile fabrics. Mukherjee and Mukherjee (2015) and Subrata et-al. (2018), emphasises the value of dye discharge in fabric decoration and emphasises how it can create vivid, opaque colours on dark textiles. Although, with the scarcity of discharge agents like Rexoleme Zinc Formaldehyde Sulphoxylate (ZES) and MELCOL RR, which caused a discharge boom in developed countries; Nigerian designers of handcrafted fabrics frequently ignore this technique.

In simple, discharge agents are colour removers because they bleach out fabric dye, revealing new colours through coloured discharge or regular discharge. Hand-crafted textile designers in Ogun State and Lagos draw designs on coloured fabric known as "Konko-Below" using common household bleaches. Because the designers had no control over the bleach's flow, the designs are inconsistent. Even though the fabric is prone to tearing after washing, the designers are unconcerned about the bleach concentration.

Staff (2023), Susan (2011), Karren (2010), Chris and Fabio (2010), and Chris and Candice (2010) discuss how to use common household bleaches to get rid of stains and lessen the harm bleaches do to cloth. Since these products chemically react with fabric colours to form new compounds that can damage the fabric, they stress the importance of concentration in their formulations. While Byju’s (2022) clarify that bleaches oxidise coloured substances to colourless ones, Sebastian and Sebastian (2024) says that bleach keeps white clothes white and removes many stains. Sodium hypochlorite, or NaClO, is another bleaching system that Candice and Chris mention. According to Abdel-Halim and Al-Deyab (2013) peroxides are crucial industrial bleaching agents for cellulosic products, particularly cotton cellulose. They both agree with Zubir et al. (2020) that chlorine-based bleaches are not a good option for stain removers due to their strong oxidising properties and potential to damage fabric.

Observation showed that the growing need for discharge methods is as a result of fashion trends. Designers of handcrafted textiles must contend with issues like expensive materials and a lack of suitable discharge agents. They have the opportunity to observe discharge print processes in Lagos textile mills, but these obstacles make it difficult for them to apply this method.

Borisova (2019) and Foshan (2010) highlights the importance of paste in textile printing, particularly in terms of clarity, brightness, and colour penetration. The development of new printing pastes, including Polyarylamide (PAA) paste, using inverse emulsion technology, improves color printing quality and increases homogeneous paste availability. These pastes control colour flow and prevent pigment spread, enhancing the performance of textile printing. Ortolani and Pavonine point out that not all fabrics are dischargeable, with only certain dyes on natural fibres being dischargeable. Fabrics made of 100% cotton, dyed with reactive or vat dyes, and not overdyed should be compatible with discharge agents. The best results are obtained with 100% cotton fabrics, because the discharge agent may only discharge the upper layer dye, revealing a phantom or ghost colour.

Hengyitek and Hengyitek (2023), Britannica, (2014), Terry (2004) and Picals (2004) considered the chemical reaction in discharge agents that transfer images to fabrics. Discharge agents are used to break down or bleach dyes, making them suitable for dark-colored cotton fabrics. However, the discharge method complicates fabric decoration because printed images are nearly invisible when the fabric is pulled off the press platen. This makes it difficult to assess print quality on the press, so some fabric designers avoid discharge. The process has the potential to transform the textile screen-printing industry.
Horvath et al. (2012), Bhachech (2009) and Kadolph (2007) highlight current technological advancements, with screen printing being the most widely used. Thickening agents such as starch derivatives, flour, gum Arabic, and tamarind are used to transfer designs from the screen to fabric with no loss. These agents, which are cold-soluble and only require extensive stirring, are critical to the textile manufacturing industry. Starch paste, a combination of wheat starch, cold water, and olive oil, is used to thicken in printing.

Historically, non-modified starch was the most commonly used thickener. Modified cold soluble starches are now widely used due to their consistent viscosity and short pasty rheology. To avoid damaging the engraved rollers or silk screen, thickenings must be strained prior to printing. Kitagawa and Nishizono's (2007) invention in Japan aimed to provide a discharge agent for fibres dyed with indigo or sulphide dyes, enabling stable and bright coloration.

The textile industries in Lagos and Abeokuta-Ogun states have expanded as a result of discoveries and advancements. However, handcrafted textile designers in these regions frequently oppose using discharge methods for fabric decoration, posing difficulties in controlling the flow and concentration of bleaches. As a result, designs repeat irregularly, and fabrics tear. The low production of fabrics decorated with discharge methods is due to the requirement for hot chamber drying and the scarcity of discharge pigments in Nigeria, particularly in Lagos and Abeokuta. To address this issue, a discharge agent with appropriate technology that combines household bleaches with a neutral thickener is required for discharge printing on dyed cotton fabrics and garments.

The objective of this study is to develop discharge printing paste for dyed cotton fabrics in using household bleaches by determining the concentration of bleach that could be used by handcrafted textile practitioners in the development of discharge printing paste. Produce neutral printing thickener that could be used in the formation of discharge printing paste. Develop a fabric discharge printing paste, based on the concentration of bleach combined with the neutral thickener. Test the effect of the discharge printing paste on dyed cotton fabrics.

**Materials and Methods**

The research designs involved experimental and R&D for the development of a discharge fabric printing technology combining bleaches with a neutral thickener. The study was conducted at the Federal University of Agriculture, Abeokuta Chemistry and Textile Laboratories, using five dyed cotton fabrics, five household bleaches, three thickening agents, and water. The experimental procedure involved research and development phases.

**Phase 1- Fabric and Bleach Tests:** To ensure that the fabrics were made of cotton, a flame test was performed. When yarn strands were ignited, a yellow flame, a burnt paper scent, and a grey ash that resembled wood ash were revealed. Cellulosic fibre is indicated by the yarn burning like grass and creating a white ash afterglow, proving that the yarn is originally from cotton. Additionally, a one-minute spot test was used to determine the fabric's discharge-ability. Hypochlorite bleach was mixed one to five times with water to create the bleach-water solution. To ensure penetration, a single droplet of solution was applied to the dyed fabric. The fabric sample was allowed to stand for a minute before being rinsed, dried, and checked for colour change.

**Phase 2: Production of neutral printing thickeners**

Dissimilar amounts of thickening agent (5.0, 5.5, and 6.0 grammes) were used in the thickening process, and to test the pastes' compatibility, 15 millilitres of sodium hypochlorite were added. After four hours, the gelatinous solution the starch ether had created with small lumps disintegrated to leave behind a transparent, homogenous substance.

The starch from maize, which was insoluble in water, was combined with water for the study. When heated, the mixture turned into a brittle substance that became colloid. The brittle material did not turn into a transparent, homogenous paste when 15 millilitres of sodium hypochlorite was added, suggesting that bleach and maize starch are
incompatible. Heat treatment of a dextrin solution in water did not change the substance; neither did the addition of sodium hypochlorite. It was discovered that starch ether worked best for making a paste as a thickener. The experiments were conducted using different amounts of starch ether (5.0, 5.5, and 6.0 grammes). The thickening paste made with 6.0 grammes of starch ether in 125 millilitres of water was used in experiments to create a thicker or thinner consistency that was appropriate for the study.

### Phase 3: Production of five (5) Discharge Agents

The study used thickeners and common household bleach to create five discharge printing pastes. Starch ether was used as the thickener and bleach was added in increments of 15, 20, 25, 30, and 35 millilitres. The mixture was thoroughly mixed to produce a series of pastes with the best discharge ability.

<table>
<thead>
<tr>
<th>Discharge Paste</th>
<th>Thickener (Starch ether) gm.</th>
<th>Water (ml)</th>
<th>bleach-(conc.4.29%) ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6.0</td>
<td>125</td>
<td>15</td>
</tr>
<tr>
<td>B</td>
<td>6.0</td>
<td>125</td>
<td>20</td>
</tr>
<tr>
<td>C</td>
<td>6.0</td>
<td>125</td>
<td>25</td>
</tr>
<tr>
<td>D</td>
<td>6.0</td>
<td>125</td>
<td>30</td>
</tr>
<tr>
<td>E</td>
<td>6.0</td>
<td>125</td>
<td>35</td>
</tr>
</tbody>
</table>

The variation in the quantity of bleach used in the study was to achieve a thicker or thinner consistency.

### Phase 4: Testing discharge Paste on five (5) fabric samples.

Using screen printing, the five (5) developed discharge paste was applied to cotton fabrics that had been dyed. Depending on the amount and concentration of bleach used, the paste was left to sit for 10 minutes in order to remove the colour. After that, the fabric was rinsed in room temperature water, dried before being ironed. The speed at which the process proceeds can vary based on the colour of the fabric and the amount of bleach used. If the concentration of the sodium hypochlorite in bleach used is very high and above 5.5%, then an after or post printing treatment is necessary.

**Post printing treatment:** Pour 10 litres of water into a plastic bucket and add 1 teaspoon of bleach stop. Soak the rinsed, discharged fabric in this mixture for 5 minutes, stirring occasionally. Remove the fabric and thoroughly rinse with room-temperature water. Then, wash in hot water and soap. Rinse thoroughly and dry.

The results of screen-printed fabrics using a series of developed discharge pastes revealed that discharge paste E was considered the most appropriate, and a large quantity of the newly developed discharge paste was produced. The new discharge paste was used to print fabrics and garments. Because the study's goal was to create a new product for discharge prints on dyed cotton fabrics that could be used by hand-crafted textile designers, the newly developed discharge agent came in two forms. The first is the ready-to-use “Bleach Thickener”; a paste and the second is “Bleach Thickener Powder” which can be used with any chlorine bleach of concentration 3.5 – 5.5% active agents.

The gathered data were put through a descriptive analysis, and the results were represented and described using frequency distributions, percentages, and means.

### Results

#### Visual Effects of Bleaches on Dyed Cotton Fabrics

It is not all colours on dyed cotton fabrics that strip. The One-Minute Spot Test carried out on fabric samples for discharge-ability to determine the visual differences in the effects of various household bleaches on samples of dyed cotton fabric samples is presented in table 2.

<table>
<thead>
<tr>
<th>Bleach Sample</th>
<th>Black</th>
<th>Brown</th>
<th>Navy-Blue</th>
<th>Purple</th>
<th>Green</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Bleach Sample</th>
<th>Black</th>
<th>Brown</th>
<th>Navy-Blue</th>
<th>Purple</th>
<th>Green</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6.0</td>
<td>125</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>6.0</td>
<td>125</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>6.0</td>
<td>125</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>6.0</td>
<td>125</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>6.0</td>
<td>125</td>
<td>35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
According to Table 2, it took an average of 20 seconds for Bleaches B and D to change the colour of the five dyed cotton fabric samples; it took roughly 35 and 70 seconds for Bleach C and A respectively, and there was no discernible colour change with Bleach E. Result reveals that dyed cotton fabrics can be stripped to off white or even completely white when being exposed to various bleaches after the first colour change.

**Effect of Discharge Paste on Fabric**
The household bleach containing 4.29 % Sodium hypochlorite was combined with the neutral thickener (starch ether) selected, to form series of discharge pastes and was tested on the dyed cotton fabric samples. This is to determine if the product from the laboratory research work can be an effective discharge paste on dyed cotton fabrics. All the discharge pastes developed in the laboratory work in the course of the study when applied on dyed cotton fabrics by means of screen printing confirm that no matter how the paste is used, it will remove the colour of the fabric.

Result show that the product of the laboratory research work has effect on the dyed cotton fabrics, which is evident in the ability of the discharge pastes to remove the colour of the fabric samples and revealing a phantom colour of the fabric samples in design areas either screen printed or painted on the dyed cotton fabric. The excellent performance of discharge paste from the laboratory research work is effective as discharge agent when used on dyed cotton fabrics.

**ph of New Discharge Paste**

<table>
<thead>
<tr>
<th>Sample</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Hypochlorite</td>
<td>13.4</td>
</tr>
<tr>
<td>Bleach D</td>
<td>11.4</td>
</tr>
<tr>
<td>Thickening Paste</td>
<td>8.47</td>
</tr>
<tr>
<td>Developed Discharge paste</td>
<td>9.66</td>
</tr>
</tbody>
</table>

Table 3: The ph of Bleaching Agents, Thickener and Newly Developed Discharge Paste

When pH is 6 or lower, chlorite decomposes and chlorine dioxide gas generates, and stability deteriorates; in addition, a printing paste suitable for printing cannot be obtained and effective discharge printing treatment cannot be achieved. On the other hand, when pH is 13 or higher, the viscosity-increasing ingredient is gelled and the viscosity cannot be maintained appropriately, which is not preferred. Hypochlorite will continue to react with cellulosic fibres and damage fabric when pH is less than 6, 7 and higher than 11. This reason makes manufacturers of bleaches advice that the bleach be added to certain quantity of water before using on cellulosic fibres.

From Table 3, the pH of the pure Sodium Hypochlorite and most effective bleach- Bleach D used in the study are above 11.00 thus, making the pure Sodium Hypochlorite and most effective bleach inappropriate to be used directly as discharge agent on dyed cotton fabrics not
considering their viscid (having a glutinous consistency) property. The pH of the raw thickener is 8.47 while that of the newly developed discharge paste is 9.66. Chlorine bleach can damage cellulosic fibres, but is safe if strength and exposure time are limited, and the discharge paste pH is maintained at about 9.5, the safety pH range for chlorine bleach to chemically combine with cellulosic fibres of cotton to add or remove colour. From the above observation, differences exist between the newly developed discharge paste and the most effective household bleaching product.

**Discussions**

The concentration of bleach that could be used by hand-crafted textile practitioners in the development of discharge printing paste was determined. According to Staff (2023) and Robert (2004) study, not all household bleaches remove colours, but rather stains. Three out of five bleach samples support Robert's argument that bleaching agents are frequently mixed with optical brighteners, which absorb ultraviolet light and convert it to blue-green light.

The discharge visual effects of bleach samples B and D on dyed cotton fabrics showed significant colour changes with concentration. Bleach D and Bleach B contain 4.29% and 3.40% hypochlorite, respectively, discharged most dyed cotton materials faster than the other three samples impact. Bleach samples containing 3.5% to 5.5% hypochlorite can discharge most dyed cotton garments.

Chung et al. (2022) stated that Sodium hypochlorite, a common cleaning component, offers good bleaching and sterilising properties. Exposure to this hypochlorite bleach can have negative health consequences. The study looked at reports of health consequences along the exposure pathway, with a focus on acute high-concentration exposure. Serious toxicity occurs when sodium hypochlorite is consumed in significant doses at concentrations more than 6%. This demonstrates that the concentration of active chemicals in bleach samples used in this study significantly influences the discharge effect, safe for use by handcrafted textile designers and also eco-friendly (Benzoni and Hatcher, 2023).

Thickeners are viscosity-increasing chemicals; a neutral printing thickener capable of forming the discharge printing paste was developed. Because household bleaches have very low viscosity, ranging from 1.2cp to 860cp, they cannot be used directly for discharge printings. Therefore, the viscosity of the bleaches needed to be increased to a range that would allow absolute control during printing. Three thickeners thought to be inert to hypochlorite were produced as bleach thickeners, to be used to thicken or raise the viscosity of bleaches (Borisova, 2019).

Demir (2023) emphasises the importance of employing starch as a thickening in the textile industry. The technique involves the use of starch derivatives such as maize starch, British gun (dextrin), and starch ethers. Libretexts (2023) and Admin (2022) emphasise the use of plant starches such as maize, rice, and tapioca as thickeners.

Neutral printing thickeners formed were by adding varying amounts of Maize starch and starch ether to specific water volumes. Water density is the mass-to-volume ratio. Maize starch and starch ether were chosen as thickening agents for bleaches due to their high viscosity when coupled with water, Egharevba (2020) confirmed that starch is a significant product, and a versatile biomaterial that is used in a variety of industries worldwide, including food, health, textile, chemical, and engineering. The water-to-starch ratio was 1:28, which is 28 milliliters of water for every one grammie of starch. Hypochlorite and dextrin were considered inappropriate for printing due to their low viscosity.

A fabric discharge printing paste was developed with 4.3% hypochlorite bleach and 125ml maize starch thickening. The paste was tested on dyed cotton fabrics, and the discharged dye resulted in crisp, sharp images. However, the pattern was blotchy and did not match the planned print. The study established that maize starch was not an appropriate neutral thickening for hypochlorite bleaches, implying that the paste might not be suitable for printing on dyed cotton garments. Discharge fabric using maize starch as a thickening agent is disadvantageous as it produces a partial homogenous mixture and reduces bleach penetration, resulting in poor printed images or designs and a hard texture. The inability to completely remove the starch thickener from the
fabric, even after multiple treatments, further complicates the process.

A series of discharge pastes were produced using starch ether as a thickening agent. Discharge printing paste A was created using 4.5gm of starch ether in water and 15ml of bleach containing 4.5% hypochlorite. The printed fabric was then dried at 25°C. The discharged patterns took 120 seconds to appear, after which post-printing treatment was carried out. Discharge paste B was produced by increasing the volume of bleach from 15ml to 25ml. The printing process on a dyed cotton fabric sample using discharge printing paste B resulted in a slow and unsharp pattern. To address this, a new paste, C, was produced, consisting of 5gm of starch ether in 125ml of water, to create a thickener.

Then discharge paste C, was created by adding 25ml of hypochlorite bleach to dyed cotton fabric with a T120 mesh. The printed fabric was dried at 25°C and rinsed in water. The printed area discharged faster than pastes A and B, but slower on dark fabric. To improve the printing process, the quantity of starch ether and bleach was increased. The reduced viscosity of the discharge pastes led to the use of fine mesh in the printing process, allowing for a smoother discharge.

Dyed cotton fabric was printed using discharge printing paste D, made of starch ether, water, and 30ml bleach. The print produced sharp and neat patterns in just 20 seconds. After drying, the leftover paste decomposed, reducing viscosity. To explore the effectiveness of the thickening agent for hypochlorite, another paste was created, E, which was made of starch ether, water, and bleach. The paste was then combined with 35ml of bleach containing 4.3% hypochlorite, forming a discharge printing paste. This process demonstrated the potential of discharge pastes in printing fabric.

This discharge printing paste E was used with open and fine meshes to print patterns on dyed cotton fabrics. As a result, when the discharge paste E was printed, before lifting the screen from the fabric, discharge patterns had already been seen. This means colour discharged from dyed fabric is almost instantaneous. This one was referred to “Xpress Discharge” paste. The prints were sharp, clear and excellent with brilliant colour emerging. The emergence of discharge paste E is a welcome development to the world of eco-friendly discharge paste.

The pH of the newly developed discharge paste is 9.66 and safe for use on cellulosic fabric like cotton. Pomelo (2023) and Yaman et al. (2012) agreed that the pH of a textile material can have a considerable impact on its qualities, including colour, texture, and performance. For example, if the pH of a dye bath is too high or too low, it might have an impact on the fabric’s colour. Similarly, if a fabric’s pH level is not adequately maintained during processing, it may result in uneven dye uptake and poor colourfastness. Furthermore, pH can influence the strength and durability of textile fibres. High or low pH levels can weaken fabric, causing them to degrade over time. Thus, maintaining the right pH level is critical for guaranteeing high-quality, long-lasting printed textiles.

Pomelo (2023) further confirmed that during the dyeing and printing operations, pH levels are critical in defining the final colour of the fabric. Different dyes require different pH levels to provide maximum colour fastness and stability. Acid dyes, for example, require an acidic environment with a pH of 4 to 6, whereas reactive dyes need an alkaline environment with a pH of 10 to 11. If the pH level is not maintained within the appropriate range, it might cause uneven dyeing or colour fading over time. Cotton fibre degradation is minimal at pH 9.0, but what occurs at pH 10.0 is well within tolerable limits.

The study's findings demonstrated that the laboratory research product works well as a discharge agent when applied to dyed cotton garments. It demonstrated that at the conclusion of the laboratory research, which was primarily experimental, a new product, discharge printing paste, was developed. The study's distinguishing feature is the development of a discharge agent composed of hypochlorite and viscosity-increasing starch ether.

**Conclusion**

In the study, laboratory experiments were carried out to create a novel printing product utilising home bleaches and a suitable thickening agent. The paste's viscosity was compared to the most effective bleach, which had a fine consistency. A narrow mesh was used to bleach print designs on fabric since the pores were so small that only
thinner consistency pastes could pass through. The developed discharge paste was compared to the most efficient bleach. Also, the newly developed discharge paste was allowed to decompose to a thinner consistency and printed to a dyed cotton fabric. The printed fabrics were allowed to dry; and post printing treatment was carried out on the printed fabrics.

The result obtained using the newly developed discharge paste to print on dyed cotton fabric with the fine mesh showed that the thickener prevents the free flow of the Bleach as the printed patterns are sharp with straight edges. The design did not bleed and became blurry. Also the printing process was controlled as the squeegee easily moves the paste across the screen which was not so when printing with ordinary bleach.

The observation made on the print quality using newly developed discharge paste and the ordinary bleach coupled with the pH of both products resulted in the findings of the study, which revealed that there is difference on the effect of dyed cotton fabrics designed using newly developed discharge agent and the most effective household bleaching product.

Finally, textile industries in the process of R & D with latest technology are concentrating on new product development especially high-tech smart textiles. However, for the convenience of the study, starch ethers, a modified starch, has been mixed with water to form a thickener which combined easily with Hypochlorite Bleach for discharge printing. The new Discharge Paste developed require no sophisticated equipment to produce; made up of starch ethers, water and hypochlorite with a safe pH tat will not damage the fabric printed.

**Recommendations**

1. The new product developed should be introduced to hand-crafted textile designers through hands on training workshops,
2. Availability of the new product will be a tool for massive exploration of discharge technique of fabric surface decoration and designs
3. Textile chemist and designers should collaborate to development more discharge agents for discharge technique, the untapped goldmine in textile production in the study area.

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Appendix


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A discharge printed wall hanging

A discharge printed garment (shirt and blouse)

Developed discharge paste printed fabric

Developed discharge paste E printed fabric

Developed discharge paste F printed fabric

A discharge printed garment (shirt and blouse)

Developed discharge Paste used for Screen Printing a Fabric