Experimental Study on the Feasibility of Utilizing Top Bond Adhesive As a Fastener for Textile Printed Fabrics

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Abstract
Adhesives are substances that are widely used in different areas for different functions for the sole aim of bonding surfaces together for stability and design. The potentials of adhesives can't be over emphasized when it comes to the field of design which textile is an integral part of. It has been observed by the researcher that the quality of textile fabric prints produced in the studios by textile designers do not fasten well to the fabric. Little washing fades off the inks. This is a thing of concern especially when it has to do with small scale textile industries. This study explored available means such as top bond a popular brand of water based glue; via experimental approach to see the possibility of using it as a binder in conjunction with textile ink as fastener. However, findings of this study disproves that top bond adhesive could be an effective fastener to textile ink. This is because after printing and initial washing, the ink shows signs of fading off. This study recommends the use of other kind of adhesives as outlined in the literature for similar effort for solution to be proffered.

Keywords: Feasibility, Top Bond,Adhesive, Textile Ink, Fastener, Fabric

Introduction
Adhesive is any substance that, when applied to the surfaces of materials, binds the surfaces together and resists separation. The term adhesive may be used interchangeably with glue, cement, mucilage, or even paste. According to Howstuffworks.com (2014), adhesives come in many forms, including glue, tape and sealant, and are used in a variety of everyday applications. In addition, natural substances can act as adhesives, such as soda and caramel. The stickiness of the adhesive is caused by molecular bonds, and its strength depends on how much stress is needed to pull those bonds apart. For two substances to bond, their opposing charges need to be attracted to each other in the exact amount of charge. The stickiness of adhesive caused by molecular bonds is an attribute that will be of importance in this experimental work, it is perceived that it will enable the textile ink stick to the fabric in some level of degree that was because the fabric used contains pores and space that possibly facilitate the penetration and enhance the colour fastness. Fastness enables resistance to fading or bleeding of printed and dyed fabric.

According to Jingfang et al (2011), textile printing pigment has a few problems, such as relatively high temperature curing, stiff hand feeling, clogging and poor crock fastness of printed textile, these disadvantages are related to the binders used. Therefore, reconsideration of the overall properties of binders is necessary to improve the quality of textile printed fabrics. The desire for a more improved textile screen printing ink led to the invention of flock adhesive by International Coatings Company™ (2000) which cures into a soft, elastic and pliable print. Flock adhesive is a 2-part system and is easily used, the catalyst will help adhere the flock fibers to the substrate to greatly improve wash fastness. Flock adhesive provides excellent adhesion to most flock fibers and a very soft and flexible flock print. Flock adhesive prints smoothly, holds flock fibers firmly, yet cures to a flexible, full-bodied print. However this adhesive is not in circulation in Nigeria and are hard to find even across Nigerian borders, therefore it becomes necessary to find an alternative in-other to enhance the performance of textile printing inks for a better printed fabrics.

Study Objectives
The objectives of the study were to:
1. further optimize the use of top bond adhesive in the art of finishing textile designs.
2. relate the density of textile printing ink and top bond adhesive combination in different ratios for textile surface printing.
3. carry out washing sample test to ascertain the colour fastness of the mixture of top bond adhesive and textile printing ink.

Ahmed (2007), revealed that adhesives are used in textile conservation to hold deteriorated and friable fibers together in order to improve physical strength of fibers or textiles.

According to Chemical Consultants Incorporated (2016), top bond adhesive is a high quality water-based pallet adhesive, as a screen printer's adhesive top bond is used on the pallet to secure garments

for printing and can be used on belt printers. Top bond adhesive is economic, friendly, possesses qualities like low odor, pressure sensitive, repositionable, quick tack / non-transferable, no voc (volatile organic compounds), no solvent propellant, non-hazardous / non-flammable, works on a variety of substrates, superior hold for heavy garments, heat resistant / not affected by flash cure station.

Fabric Embellishment

The art of fabric production and embellishment can be referred to as one of the oldest pre-occupation and most significant invention of man on earth. Fabrics over the years have been used for several purposes ranging from clothings, accessories, upholstered furnishings and functional use at homes. However, fabrics are mostly ornamented to further maximize its use. Textile resist methods is one of the oldest recognize textile fabric decorative techniques used in producing fabrics meant for clothings. They include tie/dye, folding, printing, marbling, batik, sleigh. Johnson in Chudi-Duru (2016), defines printing as the process of impressing an image onto a surface using paint or ink. Fernandez (2009) defines printing as the process by which the colourations of fabric according to the preconceived profiles or drawings.

According to Pratoomtong (2015) creating pattern and colour on fabric can be done by dyeing, weaving, and printing. The method wipes ink through screen which is made of synthetic, nylon, polyester or metallic fibers on which the design is imposed. Through screen stencil, ink will apply onto the material beautiful and colorful image or pattern is created attractive to viewers. Printing inks are the mixture in various combinations of different materials in different ratios, and its essential ingredients are colorant, solvent, resin, oil or additive. Aran and Nik Semenoff (1991) in Pratoomtong (2015), however states that these synthetic ingredients pose adverse environmental effects. In art schools where screen printing is taught, there are concerns on health hazards caused by the solvents used in oil-based inks for screen printing on textiles. Water-based ink was introduced it can be observed that most of liquid printing inks use water as solvent but are thus without undesirable effects on both human and environment as they were derived from natural materials to substitute those hazardous products.

Info please in Chudi-Duru (2016), mentions that there are many techniques of printing, namely, block printing, burnout printing, blotch printing, digital printing, duplex printing, engraved roller printing, electrostatic printing, flock printing, ink-jet printing, jet spray printing, rotary screen printing, screen printing (flat screen), stencil printing, spray printing, transfer printing, warp printing and some other special methods like tie dye and batik printing. Fernandez in Chudi-Duru (2016) ascertained that all these techniques are grouped under traditional and digital techniques.

In a properly printed fabric, the printing ink is affixed to the fabric, so that it may not be affected by washing and friction. Ukena (2016) revealed that there are two types of ink that are used for textile printing: plastisol ink or water-based ink. Plastisol ink is a PVC (polyvinyl chloride) based system that essentially contains no solvent at all. Along with UV ink used in graphic screen printing, it is referred to as a 100% solid ink system. Plastisol is a thermoplastic ink in that it is necessary to heat the printed ink film to a temperature high enough to cause the molecules of PVC resin and plasticizer to cross link and thereby solidify or cure. On the other hand, water-based ink utilizes either dyes or pigments in a suspension with water as the solvent. The evaporation of the water is necessary to set or cure the ink.

The research aimed at discovering new way by which adhesive will enhance the printing quality of textile ink on fabric, promote its functionality, durability and aesthetics as well. This new discovery, could be an added advantage that will promote marketability of studio textile products. This study adopted the screen printing technique using water based textile ink and adhesive for fabric decoration which involves the use of paper design, stenciling, transferring of design unto the silk screen frame, using squeegee and textile ink in transferring the design unto the fabric.

Methodology

This study adopted the experimental research which involve the testing of textile ink (water based) and top bond adhesive (water based) mixture in different ratio for printing of designs on fabric and also washing test to establish colour fastness.

Design and Stenciling

The design produced was drawn (see Plate 1), a colour swatch and paper design were produced (see Plate 2). The design was then transferred to two separate sicker paper according to the colour

separations. After which the stanching began using the negative and positive method of cutting out design.

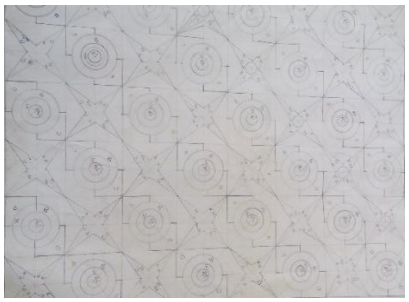

Plate 1: Pencil Paper Design

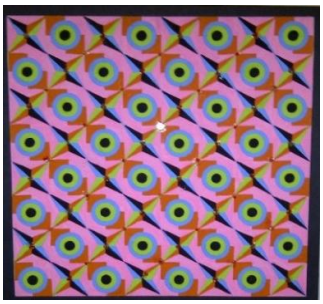

Plate 2: Colour Swatch

Materials

Materials used in the experiment include cotton white fabric(100%), total textile ink, top bond adhesive, sticker paper, organdy silkscreen fabric, smooth wooden frame, stable gum with staple, squeegee, piece of form, art knife, masking tape, water tape, measuring scale, colour mixer, empty containers for mixing inks, ruler, and note book. All materials are purchased from Sabo Gari market, Zaria, Kaduna State.

Plate 3: Top Bond Adhesives

Plate 4: Total Textile Ink, Water Based

Plate 5: 100% white cotton fabric

Studio Experiment

The studio experiment was conducted in the textile printing section, Department of Industrial Design, Ahmadu Bello University, Zaria, Kaduna State. A four corner frame was constructed. Evostic gum was applied on the frame and allowed for a while to dry up. This was followed by laying of the organizer silk fabric lightly (see Plate 6), then stretching of the fabric began from one angle of the frame by pressing and sticking it hard on the frame. The opposite side was tightly pulled and gummed as well, same was repeated for the remaining two sides of the frame and was further secured by staple pins (see Plate 7).

Plate 6: Stretching of Printing Screen

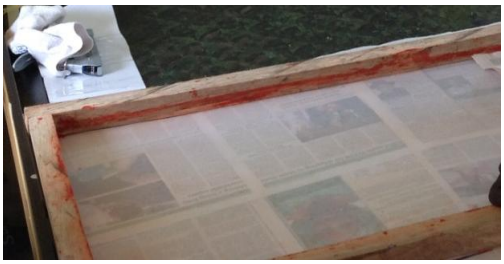

Plate 7: Stretched Printing Frame

The cotton fabric was de-sized (see Plate 8) to remove factory starch and any previous treatment given to the industrial fabric that might prevent the textile ink from penetrating the fabric. It was dried and ironed to remove rumples in order to achieve smooth surface while printing. The Fabric was spread on the printing table. Masking and paper tape were used to properly fix the four sides of the fabric on the table. Measurement was taken to get the actual dimension of the design on the fabric to avoid a lot of miss-fits. Acrylic yarn was mixed with charcoal powder and used to draw line on the fabric to help in registering the designs.

Plate 8: De-sizing of Fabric

Marking was carried out on the screen for accuracy and the blocked sticker paper was spread on the screen. To avoid distortion of design, the blocked screen was well covered with newspapers and ironed while all the excess space around the screen was well covered with water tape and masking tape.

Printing Ink Composition

Textile ink and top bond gum were mixed in different percentages using measuring scale. A sample test printing was done on quarter yard as shown on the table below according to the percentage of mixture.

Top bond adhesive and textile ink that were used are both water based, therefore enabled a successful mixture to form a paste. They were used in the following ratios: 100% textile ink as Control, 90 by 10%, 80 by 20%, 70 by 30%, 60 by 40%. Sample "A" was free of top bond (100% textile ink) which served as the control that was used to ascertain the different changes occurring during the experiment. While samples "B-E" contained different ratios of mixture.

Table 1. Mixing Ratio of Top Bond and Printing Ink

Samples	A	B	C	D	E
Textile Ink (%)	100%	90%	80%	70%	60%
Top Bond Adhesive (%)	0%	10%	20%	30%	40%

Plate 9: Printing in Progress

Pate 10; 100% Textile Ink (Control)

Plate 11; 90% ink / 10% top bond

Plate 12; 80% ink / 20% top bond

Plate 13; 70% adhesive / 30% top bond

Plate 14; 60% ink / 40% top bond

Results /Analyses of Printing Experiment

The following were the results achieved by direct observation of the printed samples.

Plate 10 shows the control sample to that was used to ascertain the changes that occurred as the result of top bond adhesive mixture. Plate 11 has 10% top bond and 90% textile ink. In figure 11, it was observed that the print out is fading a little as a result of the inability of the ink to pass through the mesh comfortably as was the case with the control sample (Plate 12) which have 80% textile ink and 20% top bond. The fading here became more obvious in all the colours except the orange colour because with the addition of top bond adhesive, the paste became thicker and don't flow well through the mesh, as a result water was added to the ink to enable the flow of the ink. Plate 13 has 70% ink and 30 % adhesive. It was observed here that with the addition of water, the printing ink became clearer, except that the blue screen blocked due to fast drying nature of top bond adhesive. Plate 14 has 60% ink and 40% top bond. The screen in this figure became almost completely blocked and affected the flow of the printing ink thereby making the print out to be pale.

Washed Experiment

Plate 15; control (washed)

Plate 16I; 90% ink / 10% top bond (washed)

Plate 17; 80% ink / 20% top bond (washed)

Plate 18; 70% ink / 30% top bond (washed)

Plate 19; 60% ink / 40% top bond (washed)

Analysis of Washed Printed Experiment

Washing fasteness test was conducted with bar soap and water, to check the rate of fasteness of the combination of adhesive and printing ink to the fabric. The following results were observed. The clear the adhesive the more the printing washed away. The control retains its colour better than the samples with top bond mixture.

Results/Findings

The following were the results obtained from this study:

1. It was observed that the mixture of top bond and printing ink blended well together to form a paste
2. Visual examination of the sample with 70% adhesive and 30% ink after treatments revealed that the addition of water to the mixture reinforce the easy passage of the ink through the screen and gave a more shining effect.
3. The addition of top bond to printing ink, gave a hard feel when felt.
4. Top bond added to the quantity reduced the quality of water based textile printing ink.

5. The addition of top bond to printing ink thickens the ink and hinder the flow of ink. It dries the designs faster than usual, thereby blocking the designed areas and making printing difficult.

Conclusion and Recommendation

The study showed that top bond adhesive, though water based is not a suitable combination for producing or improving the quality of printing paste. It might be wise to try other adhesives especially the plastisol adhesives which are thermoplastic ink and require heat treatment as well as polyurethane adhesives which are chemically reactive formulations are usually fast curing and are often used with primers.

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