
SUSTAINABLE COLOR AND PRINT IMPLEMENTATION ON EYEWEAR ACCESSORY

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Coimbatore, India¹18pf07@psgtech.ac.in and ²rpd.afd@psgtech.ac.in**ABSTRACT**

Arm covers is one of the eyewear accessories which is manufactured with the help of fabrics that is dyed and printed. The term sustainability is now becoming popular due to the alarming calls of the environmental changes in the nature. This paper aims in creating sustainable eyewear accessory using red cabbage as dye and floral as a source of print. The dimensional stability is analysed and the fastness properties of dyes and print are also tested. The eco – dyed and printed fabric is then produced into arm covers. From the subjective analysis the comfort and other factors of the arm cover is checked by making them to wear it for specific time period and a feedback survey is taken. It is evident from the evaluation that the consumers loved the arm covers and also it stands all the testing procedures.

Keywords: Eyewear accessory, Fabric analysis, Fastness, Myrobalan, Red cabbage, Subjective analysis

I. INTRODUCTION

Clothes can create the majority of your look but accessories are more important than you think. Famous designer Michael Kors once quoted “Accessory is an exclamation point to a woman’s outfit”. Accessories and garments are similarly significant in your outfit, cooperating to make a concordance that communicates your style and what your identity is. Eyewear alludes to the items that are worn by people for vision rectification or for shielding the eyes from different outer elements, including light, debris, harmful radiation and extreme natural changes. These items are generally more expensive and hence it cannot be changed often. So, to break the monotonous look, arm covers are produced by sustainable dyeing and printing. Sustainability is defined as meeting or needs without compromising the needs and resources of future generations While talking about sustainability, in addition to natural resources we should also keep in minds the need of social and economic resources. Sustainability is a crucial factor that revolves around conserving natural resources and also to live a more fruitful life. We should make decisions that are harmless and sustainable for years to come rather than making decisions that only provide quick near-term benefits. The fabric chosen for this paper is modal which justifies the word sustainability. The fabric is made from beech tree pulp. These beech trees require water less than cotton and hence the production process uses 10 to 20 times lesser water than cotton. Synthetic dyes account nearly 20 percent of global water pollution. These dyes involve the usage of non-biodegradable petroleum-based colorants which is a main contributor for pollution. This makes fashion industry, the second largest polluting industry in the world. And so in this research natural dyes are used. Except few natural dyes, most of them are eco-safe. Some dyes also have medical effects on skin. The user who is using natural dyes should know the chemistry behind them. The fastness properties depend on the fibers used, dye type and the mordant. Different combos of dye and mordant exhibit different fastness properties [1]. Dyes including indigo, alizarin dyes, tannins, and flavonoids may compete with synthetic dyes in terms of quality and stability. Madder, Indigo & woad can be cultivated even on wastelands [2]. Dyes extracted from marigold flower produces beautiful shades of light yellow to dark yellow. The henna leaves produced shades of brown to red. These dyes exhibited good color fastness properties when tested [3]. Among various dyes black carrot plant residue is considered to be eco-friendlier and more cost-effective source of natural dye. It is found that they produced darker shade of dye at a temperature of 70°C and a time of 55 minutes. Addition of 4 g of NaCl as an exhausting agents helped to produce darker shade [4]. Mordanting with ferrous sulphate produces darker shade than aluminium sulphate. Extraction time also has considerable effect on the dye shade. These mordants have excellent fastness ratings ranging from 4.5 to 5[5]. It is proved that mordanted fabric showed good results than non-mordant fabric. Material like lemon peel ash, onion ash, soap nut and hard a can also be used as mordants [6]. Lajoplin Nangziej, Nargis Fatima, Ekta Grover 2013, proved that banana pulp was a good source of natural thickener. From various results of physical testing, it showed that 60gm of banana pulp can be used as a thickener.

Rising demand for eye protection, increases the demand for vision adjustment spectacles. Till now majority of people choose power glass over contact lenses. Expanding utilization of computerized contraptions among the young populace will build the requirement for vision correction spectacles and contact focal points. According

to the end user report, women segment is relied upon to hold the biggest portion of the market during the figure time frame because of the rise in demand for fashionable and global brands of spectacles[8]. In the course of the last decade, there has been an astounding expansion in the utilization of eyeglasses and contact focal points in India, attributable to the ascent in eye sicknesses and vision issues like myopia, hypermetropia, and presbyopia. Additionally, after some time, from working as a dream remedial item, eyewear has transformed into a style embellishment. This has additionally promoted the utilization of shades and eyeglasses in India. [9]

The natural dyes are chosen for its wide viability, its allergic & toxic free nature when compared to synthetic dyes. Natural dyes have the ability to protect the traditional dyeing method in order to provide livelihood to poor dyers. Natural dyes also enable a standard employment and income for people in rural and sub-urban areas. It also enables the study of traditional dyeing methods, colored museum textiles and other textiles recovered. Natural dyes can produce specialty colors and effects. Unique techniques of craftsman and artisans can also be explored. [10, 11]. Toxicity is the tendency of a chemical to destroy any living organism; it entails any impairment of the nervous system or serious illness when consumed, breathed, or absorbed by the skin. The main issues with toxicity are its irritant effects on the skin and eyes. Before using any material or natural dye, its potential for mutagenicity, carcinogenicity, or reproductive impacts is also examined. The LD-50 rating for toxicity is frequently used. The amount of material, measured in kilogrammes per kilogramme of body weight, that will cause 50% of the test animals to die, is known as the lethal dosage for 50% of the test animals. The majority of natural dyes are proven to be non-carcinogenic, according to the test that was done. Natural colours are also effective against bacterial and fungal development. According to a critical and realistic assessment of vegetable dyes, the metal toxicity of compounds used in the dyeing process is highlighted. Mordanting the dyes with metal salt as pre-requisite for application may contaminate the dyed textiles with some heavy metals that are toxic which turns out to be carcinogenic. [12,13]. The main objective of the paper is to extract dye naturally at home and to change the color of the dye by altering its pH value. To develop eco-print and finally creating sustainable eyewear accessory.

II. METHODOLOGY

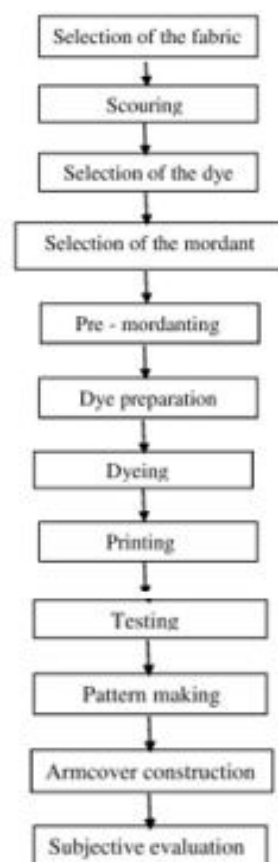


Fig 1. Flowchart

A. Selection of Fabric

In the market, neoprene (scuba) fabric and lycra fabric is the most commonly used fabric for eyewear accessory. But for the study, I have chosen modal the regenerated cellulosic fabric. Modal is a regenerated cellulosic textile which is more durable and flexible. Cotton and spandex are often blended with modal to improve the

dimensional stability for different purposes. There are even lighter versions of modal namely Micro Modal and Modal Air. The modal fabric is chosen due to its stretchiness. Modal has an incredible soft touch and also it is highly breathable due to the weave structure. Since beech trees don't need much water to grow, modal is typically seen as a more environmentally sustainable fabric than cotton because its production consumes 10 to 20 times less water.

B. Scouring

The main objectives of scouring are to remove the impurities from the fabric. This stage makes the fabric eligible to the next process by making it a highly absorptive condition. For this research, the raw fabric (grey) is machine washed with the help of detergent and hot water. It is washed for 60 minutes and then blow dried. It is then completely dried under the shade.

C. Selection of the Dye

The dye selected was red cabbage which were collected from the vegetable market shop. The heads of the red cabbage are very compact and attractive. Red cabbage gives a very beautiful hue of intense pink, purple and blue. Red cabbage dye is pH sensitive dye and the dye color can be easily changed with the help of materials like lemon juice and baking soda which is not possible in other dyes.



Fig 2. Red cabbage

D. Selection of the Mordant

The mordant chebulic myrobalan (Kadukai) which is a natural chemical is chosen for the experiment. It is used as pre-mordant for the natural dye. This step is essential to make the color last for a long time. There are varieties of mordants like myrobalan, vinegar, alum, iron, tannin and so on. Myrobalan is a natural chemical used to build a bridge between the fabric and dyes.



Fig 3. Chebulic myrobalan

E. Mordanting

Based on the length and weight of the fabric the required amount of myrobalan required is calculated. This experiment required 4-meter length of fabric and hence I have used 400g of myrobalan. It is broken into small pieces with the help of a stone. A large vessel is taken, which is $\frac{3}{4}$ filled with water. Soak the myrobalan in the bath for 24-48 hours. The next day boil this bath for $\frac{1}{2}$ an hour in the simmer flame. After boiling immerse the fabric into the myrobalan bath for the pre-mordanting treatment and boil it for $\frac{1}{2}$ an hour. Turn the fabric often so that every side of the fabric gets proper and equal treatment.



Fig 4: Pre - mordanting

F. Dye Preparation and Dyeing

For this experiment, 4 meter of fabric is used. Based on the length and weight of the fabric the amount of red cabbage is calculated. This experiment required 4 kilos of large red cabbage. Grade the red cabbage and put it in a vessel which has a enough space for dyeing. Fill water in the vessel until it covers the cabbage and keep it undisturbed for 48 hours. Place the red cabbage bath in the stove and have the flame in the simmer. Add one tablespoon of salt for every 1/2 cup of cabbage. Boil the red cabbage for nearly 2 hours and you will notice the change in the water color and the cabbage losing all its color. Stir the cabbage from the base often. Then immerse the pretreated fabric completely into the dye bath and boil it for 1 hour. Turn the fabric often so that all the sides of the fabric gets proper and equal dyeing. Take the fabric from the dye bath, cool it and squeeze the fabric. Dry the fabric in the shade area. Then wash the fabric with cold water to remove the excess dye. Repeat the free from the dye color.



Fig 5. Dyeing

G. Altering the Ph Value of the Dye

After extracting the dye, when the dye bath is hot add 1 tablespoon of lemon juice and baking soda to each of the dye part. The lemon juice produces beautiful pink and baking soda process colorful yellow green. After changing the colors of the dye immerse the pretreated fabric for dyeing.



Fig 6. Altering the pH value of the dye

H. Printing

After dyeing, the fabric is now taken for the printing process. Floral and leaves are arranged on the fabric. It is then and with the help of the hammer the prints of the floral and leaves will be transferred to the fabric.

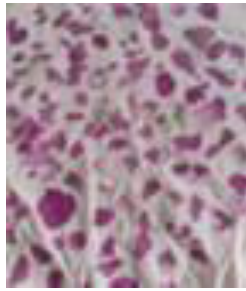


Fig 7. Print 1 - Blossom love



Fig 8. Print 2 – Retro Polka



Fig 9. Print 3 – Green days

Print 1 - Rose petals and its leaves are randomly shaped and placed on the fabric. A sheet is placed over the petals to ensure no movement. Then with the help of the hammer the imprints are created

Print 2 - Two different color roses and a leaf are randomly placed on the fabric. A sheet is placed over the floral to ensure no movement. Then with the help of the hammer the polka dot imprints are created

Print 3 - Two different shades of leaves are taken and it then cut into thin strips. The strips are randomly placed on the fabric. A sheet is placed over the petals to ensure no movement. Then with the help of the hammer the imprints are created

I. Testing

The following test parameters are conducted and analyzed the effectiveness of the print and dye on the fabric

- Color fastness due to wash - ISO 105 C06: 2010
- Color fastness due to rubbing - ISO 105 X 12: 2001
- Light fastness - AATCC 16.3: 2014

These tests are conducted to analyze the durability of the fabric

- Tear strength - ASTM – D 1424: 2010
- Stretch & Recovery - ASTM D 3107 – 07 (2019)
- Shrinkage test – AATCC 135 2018

J. Pattern Making

After analyzing the types of frames, it has been concluded that there are two categories namely small and large frames. Each category has thin and broad sized frames.

Table 1: Size chart

CATEGORY	FRAME TYPE	LENGTH	WIDTH
SMALL	THIN	130 mm	4 to 9 mm
	THICK	130 mm	10 to 14.5 mm
LARGE	THIN	145 mm	4 to 9 mm
	THICK	145 mm	10 to 14.5 mm

After analyzing the size chart I have come up with the pattern for thin frame type under large category.

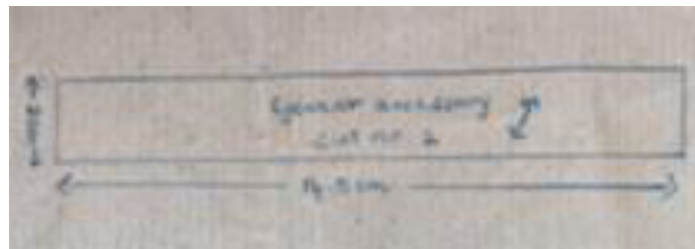


Fig 10. Pattern

The pattern drawn is of length 14.5cm (145mm) and width of 2cm (10mm+10mm). In general lycra fabric is used and so the pattern has been cut in the straight grain. But for this research modal fabric is used due to the concept of sustainability and hence the pattern should be cut in the bias direction to ensure some stretchability. The cut number is 2 because each spectacle requires two pieces of arm cover.

K. Construction of Armcover

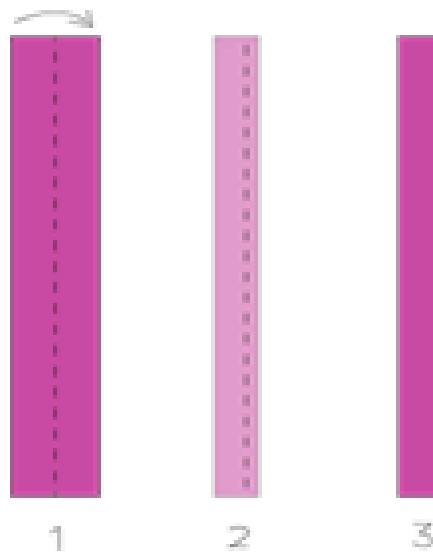


Fig 11. Construction steps

After the fabric has been cut, it is then sent to the construction step.

Step 1 - Cut the fabric in the bias direction of length 14.5 cm and breadth of 2 cm. Mark the middle point of the width. After then fold the fabric into half of it with the right side of the fabric facing inside and wrong side of the fabric outside.

Step 2 - Give an L – shaped stitch on the fabric with the help of a single needle lock stitch machine leaving one side open.

Step 3 - With the help of a needle or a seam ripper or a stick turn the fabric inside out.

L. Final Product



Fig 12. Blossom love



Fig 13. Retro polka



Fig 14. Green days

M. Subjective Evaluation

After construction, it is then taken for the subjective evaluation of the consumers. A group of 20 people has been selected for the survey of age groups 18 to 40 years of the gender of both male and female. They are made to wear the 3 pairs of constructed arm cover pieces each for 20 minutes and the survey has been collected. After analysing the subjects, a questionnaire was given to them to fill the results. The tool used for this research to collect the result is Google Forms. It is a simple questionnaire form where people of any field can undergo this survey and no prior knowledge and training is required. The subjects were allowed to wear these accessories by sliding the arm covers on to the spectacles. General questions like name, age and gender is recorded. Then the subjects were asked if they were interested in using sustainable products and have they used any product before. In the next step the subject were introduced to eyewear accessories and were allowed to wear them for 20minutes. After then the rating for the product on different aspects were collected.

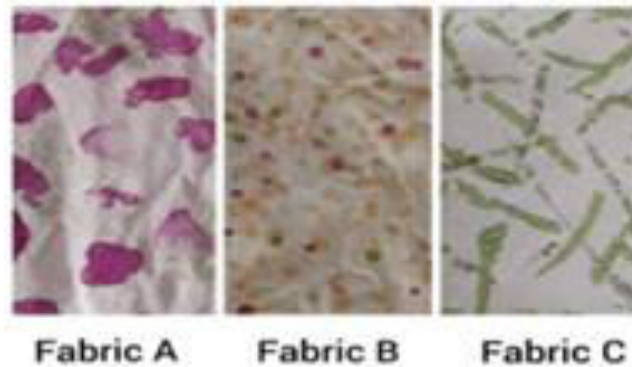


Fig 15: Fabric samples

III. RESULTS AND DISCUSSION

A. Colourfastness Due to Wash

The shade variation and staining resulting due to desorption and abrasive action is calculated. Fabric A and Fabric C showed ratings of 4 and Fabric B showed a rating of 3. The ratings are found to be good to excellent. The ratings are given on a scale of 5.

B. Colourfastness Due to Rubbing

Not only washing, rubbing also influences the color fastness properties. Hence dry and wet rubbing has been conducted on the specimen. In both dry and wet rubbing, all the three fabrics showed a rating of 4 out of 5 which is good according to the grading system.

C. Colourfastness Due to Light

Analysing the color difference between the exposed part that has been kept under carbon/xenon arc lamp for continuous 10 hours and the protected area are compared. The test result showed excellent light fastness of 5 for Fabric A and Fabric C. Fabric B showed good light fastness of 4. The ratings are given on a scale of 5.

D. Tear Strength

After conducting, the Elmendorf test to determine the tear strength of the modal fabric. Warp and weft direction is found to be around 640 Grams - force (Gf) under 6.3 Newton-force (Nf) which is an excellent value for eyewear accessory.

E. Stretch And Recovery

After conducting the experiment, the fabric stretches, fabric growth, fabric growth after extension and fabric recovery in percentage is observed. The result has been found that both warp and weft direction show good stretch and recovery properties which makes the fabric eligible for an eyewear accessory.

F. Shrinkage Test

The test is conducted to identify the dimensional change of the fabric after washing and drying it the home laundering process according to the AATCC standard mentioned. The result has been found that the fabric has no shrinkage which makes it eligible as an eyewear accessory.

G. Evaluation Result

The survey was conducted among 20 members of the age group 18 – 40 years (10 people in the age group of 18 – 25, 5 people in 26 – 32 age group and the rest 5 people in the age of 33 – 40) who wear spectacles of the gender both male and female as there is no specific target group of gender. Among them 85% of people are interested to use sustainable product and the remaining 15% people felt like they may use it based on the product category and if that meet their usage they want. 65% people have already used some sustainable related products and the remaining 35% of people haven't used any. Among these subjects 80% of people are not aware of eyewear accessory and all these people are interested to try this new fashionable product line. The subjects were then explained about the eyewear accessory and then made to wear these eco – printed eyewear accessory.

Design 1 – Blossom Love

After allowing the subjects to wear the eyewear accessory, they were asked to grade how much they like the colour, print, aesthetics and how comfort they are feeling. Twenty persons were polled; ten of them rated the colour as being five out of five; eight rated it as four out of four; and two rated it as three out of three. Four persons rated the prints a rating of 5, twelve provided a rating of 4, and four gave a rating of 3. Considering the aspect of aesthetics, nine people rated 5, five people rated 4 and six people rated 3. The last aspect comfort got a rating of 5 from nine people and the remaining eleven people rated 4.

Design 2 – Retro Polka

After allowing the subjects to wear the eyewear accessory, they were asked to grade how much they like the colour, print, aesthetics and how comfort they are feeling. Among twenty people, six people gave a rating of 5 for the colour, nine people gave a rating of 4 and five people gave a rating of 3. Two people gave the prints a rating of 5, thirteen people gave it a 4, and five people gave it a 3. Regarding aesthetics, three respondents gave the item a rating of 5, eleven gave it a rating of 4, and seven gave it a rating of 3. The last aspect comfort got a rating of 5 from ten people and the remaining ten people rated 4.

Design 3 – Greeny Days

After allowing the subjects to wear the eyewear accessory, they were asked to grade how much they like the colour, print, aesthetics and how comfort they are feeling. Among twenty people, six people gave a rating of 5 for the colour, fourteen people gave a rating of 4. For the prints, seven people gave a rating of 5, thirteen people gave a rating of 4. Considering the aspect of aesthetics, seven people rated 5, eleven people rated 4 and two people rated 3. The last aspect comfort got a rating of 5 from seven people and the remaining eleven people rated

IV. CONCLUSION

The natural environment makes the human life possible on earth and the cultural environment helps to define who we are. We shouldn't destroy the natural resources in order to develop our cultural development. Sustainable activities should be implemented to save the resources for our future generations. Most of the brands are now shifting to the act of sustainability and it's a wise decision that consumers also should adopt sustainability in their fashion life to save the water and air resources from pollution. The products produced had met the main objectives of this paper. Sustainability is defined as meeting the requirements without compromising the needs of future generations in order to meet our needs. While talking about sustainability, in addition to natural resources we should also keep in minds the need of social and economic resources. Sustainability is a crucial factor that revolves around conserving natural resources and also to live a more fruitful life. We should make decisions that are harmless and sustainable for years to come rather than making decisions that only provide quick near-term benefits. The fabric chosen for this paper is modal which justifies the word sustainability. The fabric is made from beech tree pulp. These beech trees requires water less than cotton and hence the production process uses 10 to 20 times lesser water than cotton and hence it is considered more eco-friendly than cotton fabric. Synthetic dyes account nearly 20 percent of global water pollution. These dyes involve the usage of non-biodegradable petroleum-based colorants which is a main contributor for pollution and thus it makes fashion industry the second largest polluting industry in the world. In many countries, the company that produces synthetic textile dyes has been shut after tough new legislation was enacted. Industries are now looking into greener ways to colour clothes after the wakeup call from the environment as well as because of those closures and strict environmental regulations. Natural colours from biodegradable plant sources can be a viable alternative to synthetic colorants. So in this experiment, red cabbage has been use as an alternative. Rather than using different colours we can use red cabbage to shift the colours. The fabric was pre-mordanted with chebulic myrobalan which is a natural mordant and it exhibited good result by acting as a bridge between dye and fabric. It is high time that consumers are shifting to more sustainable activities. For the printing process, naturally available roses and leaves are used. The prints obtained are bright, fashionable and can be worn with any kind of outfits by both male and female by all the age group of people. These eco – printed arm covers will elevate the beauty of the spectacles and will break the monotonous of these high rated power glasses. The results showed that the eco-dyed and eco-printed fabric has good colourfastness properties to wash, rubbing, light. The fabric also has excellent tear resistance property, stretch and recovery property and shrinkage properties. Hence the modal fabric dyed with eco - friendly red cabbage dye can be used as an eyewear accessory. Subjective analysis had been carried out to find how much the consumers like the colour, print, aesthetics and comfort. The subjective analysis showed good ratings for the liking of colour, print and aesthetic. The eyewear accessory should not cause any itchiness or rashes on the skin and ear since it will be worn by the consumers for a whole day. The comfort factor got good ratings for all the three designs among the subjects which proves that red cabbage dye and modal fabric is a good choice for an eyewear accessory. There are various kinds of natural fibres and dyes in the nature. Using the naturally available resources will create a sustainable environment. Furthermore, this research can be carried out by experimenting with various natural fibres/fabrics, dyes and mordant.

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