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A STUDY ON APPLICATION OF NATURAL DYES ON PLASMA TREATED POLYESTER KNITTED FABRIC

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Abstract - The sole sources of fabric dyes in prehistoric times were natural colours made from roots, stems, flowers, leaves, bark, minerals, and vegetables. Throughout history, man has coloured his fabrics using various locally accessible materials. Natural dyeing is a process that employs colourants originating from plants, invertebrates, or minerals. India's skill in vegetable dyes extends back to the Vedic era. Due to the widespread availability and low price of synthetic dyes, the majority of textile dyers and manufacturers have shifted to employing synthetic colourants. These synthetic colourants are created using hazardous chemical processes that put the environment at risk from petrochemical sources. They occasionally explode and are frequently highly carcinogenic and deadly. The aquatic life is harmed by the very poisonous dye effluents that are released into rivers.
Plasma treatment of textiles is a growing function of plasma technology. Using Thierry's low-pressure systems, plasma treatment of textiles is used to pre-treat fibers to increase wettability which allows for solvent free dyes to absorb and bond very strongly. Also, plasma treatment of textiles is used to coat fabric with a specialized layer with varying characteristics. These surface coatings can have properties such as the ability to repel water or other liquids. This is known as a hydrophobic surface. They can also apply protective coatings to make textiles more durable. This paper presents some relevant scientific overview on dyeing of polyester textile with natural dyes and related issues.

***Key Words*:** Natural Dyes, Henna, Indico, Plasma, Polyester

1.INTRODUCTION

Dyeing is the process of adding colour on textile products. The main purpose of the dyeing on textile material can be increase value addition, improvement of the performance and fulfill of the customer's needs. Natural dyes refer to those colourants which are obtained from plant, animal and mineral resources. The main natural dyes used in India have been extracted from the roots, barks, flowers and fruits of various dye producing plants. synthetic dyes have been widely used due to their lower prices and wide range of bright shades with considerably improved color fastness properties as compared to natural dyes. Almost all the synthetic dyes being synthesized from petrochemical sources through hazardous chemical processes pose threat towards the environment and human body health. Several synthetic colorants have been banned because they cause allergy-like symptoms or are carcinogens. Hence, interest in natural dyes has increased considerably on account of their high compatibility with environment, as well as availability of various natural coloring resources as from plants, insects, minerals and fungi. It is reported that some natural dyes can not only dye fabrics in unique and elegant colors but also impart antibacterial and ultraviolet protective functions.

Henna commonly being known as lawsone or hennotannic acid, a red–orange pigment, is the chief constituent of henna leaves. Henna is a shrub or small tree frequently cultivated in India. Powdered leaves of this plant are used as a cosmetic for staining hands and hairs. The dyeing property as well as the UV absorption is attributed to the presence of Lawson. Indigo dye is the king of natural dyes. Its use in dyeing and printing is as ancient as human civilization. Characteristic for its rich, deep, royal blue colour, Indigo is used in Ayurvedic medicine as a remedy to help protecting the body from heat and serving as an anti-septic. The only waste product of the extraction process is natural compost, to revive our farm lands.

Polyester fabric is a synthetic material made from the polymerization of petroleum-derived ethylene glycol and purified terephthalic acid, which meltdown to produce polyethylene terephthalate (PET). Polyester is a synthetic fabric that's usually derived from petroleum. This fabric is one of the world's most popular textiles, and it is used in thousands of different consumer and industrial applications.

Plasma technology is an eco-friendly technique to modify the surface of the textile fabrics and increase the adhesion of the deposit materials. Plasma treatment improves the surface without changing the bulk properties of the material. Plasma treatment is a surface modification technology through high / low temperature offers innovative solutions to adhesion and wetting problems. Plasma treatment of textiles is used to pre-treat fibers to increase wettability which allows for solvent free dyes to absorb and bond very strongly. Plasma treatment is a dry and eco-friendly technology, which offers an attractive, alternative to add new functionalities such as water repellence, long-term hydro-philicity, mechanical, electrical and antibacterial properties as well as biocompatibility due to the nano-scaled modification on textiles and fiber. This study provides a scientific review of colouring polyester fabrics with natural dyes and related concerns. The paper investigated the use of natural dyes on polyester fibres, focusing on the types of natural dyes and their suppliers, as well as the application of dyes and their colour fastness properties.

2. OBJECTIVES OF THE STUDY

- Selection of natural dye for polyester fabric
- Development of plasma treated polyester fabric
- To identify the suitable dyeing parameters of polyester fabric.
- To assess the fabric in terms of depth of shade and different colourfastness properties.
- To investigate the properties related to effect of plasma treatment on polyester knitted fabrics.

3. SIGNIFICANCE OF THE STUDY

The use of natural dyes promotes the sustainable textile industry. Natural dyes neither contain harmful chemicals nor carcinogenic components. They are nontoxic and nonallergic too. This means that they are much better for the environment and for use around humans. Synthetic dyes causes allergies and irritation to skin after certain usage. Synthetic dyes need more water consumption that cannot be reversed and they are difficult to remove from textile effluents but natural dyes are biodegradable which can be dyed without the use of any oxidant or reductant agents. Synthetic dyes based effluents can cause a serious hazard to the water stream and environment due to their synthetic origin and complex molecular structures, which decrease their ability to biodegrade. Polyesters are widely used in clothing fabrics. Anything made from cotton can also be made with polyester. From everyday shirts and pants to glamorous eveningwear, the apparel applications of polyester fabric are endless. Manufacturers use polyester fabric to make suits, jackets, socks, underwear, and pretty much anything that you can wear for casual, business, or formal occasions. Polyester fabric is usually dyed with disperse dyes which has severe limitations specially toxicity and environmental issues. The aim of the present research is to introduce an ecofriendly dyeing process for polyester fabric with natural dyes.

4. METHODOLOGY

Selection of fabric:

Polyester fibers are incredibly strong, meaning they don't tear, stretch, or pill easily like cotton and other natural fibers. Polyester is lightweight and has a slightly silkier feel to it than cotton does. It's also perfect for sports. For this study 100 percent polyester knitted fabric is procured in single jersey structure

Plasma Treatment:

Polyester fabrics were treated with plasma to enhance surface modification to increase the dye absorbtion. The Various type of plasma treatments are used on textile according to fiber, finishing or requirement such as oxygen plasma and air plasma are used for hydrophilic finish and depth of shed of PET. It was observed that the change in the surface structure of the polyester fibres was closely dependent on the gas type and treatment conditions.

Extraction of henna dye:

Fresh leaves of henna were dried in the sunlight for 1 day and then dried at 80 °C for 1 h in an oven followed by washing and cleaning with distilled water. Dried leaves were ground to powder form to ensure proper extraction results. The extracts were obtained by soaking the henna powder in water–ethanol mixture (90:10 v/v) at room temperature for 24 h.

Extraction of Indigo dye:

Indigo plants are harvested and soaked or compostled, and through bacteriological action (fermentation) which was replaced by the used of an alkali solution and acidified hydrogen peroxide the airing, combined with oxygen (oxidation) to form indigo, the concentrated blue pigment (powdered form). Highest yield of indigo dye (powdered form) was obtained from using 2.0 sodium hydroxide solution.

Dyeing of polyester Knitted fabric :

Application of aqueous solution/dispersion of Henna and Indigo on polyester fabric was done at a temperature of 130C for 45 minutes keeping a fabric-to-liquor ratio of 1:50 in a glycerin bath beaker dyeing machine. The pH of the dye bath was maintained at 4.5 - 5.0. The dyed fabrics were then treated with 2 g/l non-ionic detergent at 60C for 10 minutes to remove the unfixed dyes present on the fabric surface. Finally the fabric samples were cold washed and dried.

Testing Parameters for Dyed fabric:

In order to determine the depth of shade, the K/S value of the fabric samples dyed with the above mentioned natural colourants under the specified conditions was measured. The colour value i.e. L*(lightness and darkness), a*(redness andgreenness) and b*(yellowness and blueness) were also measured. Other color fastness properties like Colourfastness to Washing, Colourfastness to Light, Colourfastness to Rubbing and Colourfastness to Perspiration are measured.

Evaluation of the fabric:

The dyed polyester knitted fabric were evaluated to various properties related to effect of plasma treatment like Geometrical characteristics, Air permeability , Water vapour permeability, Thermal properties (Thermal conductivity and Thermal resistance) and Moisture management properties

5. CONCLUSIONS

Natural dyes produce very uncommon, soothing and soft shades as compared to synthetic dyes. Plant leaves, fruits and other are potential sources of natural dyes because of their easy availability and abundant nature. For successful commercial use of natural dyes for polyester fiber, the appropriate and standardized techniques for dyeing the polyester fiber-natural dye system need to be adopted. Thus, relevant scientific studies and its output on standardization of dyeing methods, dyeing process variables, dyeing kinetics and test of compatibility of selective natural dyes have become

very important. This paper presents some relevant scientific overview on dyeing of polyester textile with natural dyes and related issues. For success of commercial use of natural dyeing on polyester fiber it should be essential to produced new shades with acceptability of fastness behavior. So, there is need for using of appropriate scientific techniques and methods. Before producing uncommon shades with balance colour fastness and eco performing textile, there has also need for reinvestigation of traditional process of natural dyeing in each step of treatment (preparation, mordant, fastness). Presented paper carried out application of natural dyes on polyester fibers and focused on type of natural dyes and sources, understanding the application of dyes and colour fastness property.

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