



TYPES OF DYEING USED IN TEXTILE INDUSTRY

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ABSTRACT :

Dyeing is the application of applying a color in textile materials like yarn, fiber, fabric etc. Garment dyeing become an increasingly important part of dyeing and finishing scene in recent years. A considerable amount of development in garment field recently toward dyeing cotton and cotton mixture articles whether from woven or knitted construction. Varieties of dyeing was using for dyeing a garment like vat dye, direct dye, reactive dye, waterless dye in industry etc. Recent progress in waterless dyeing known as air dye or dry dye and carbon dioxide (SCo₂) assisted dyeing is a reviewed and discussed. Each trillion of freshwater and over ten thousand dyes of pigment globally. In order to reduce water level in dyeing process this two process are following to save from environment hazards.

KEYWORDS: varieties of dyeing, progress, improvement, environment friendly dyes.

INTRODUCTION :

In China, dyeing with plants, barks, insects have been traced back more than 5,000 years. Historically dyes came from nature, with primary source consists of animals and plants. Apparel cost more in garment rather than in piece form largely because of before and after dyeing and lower productivity in dyeing operation [1]. Archaeologists have even found evidence of textile dyeing going back to the neolithic period, otherwise new stone age, which began around 10,200B.c. Garment dyeing has become an increasingly important part of dyeing and finishing scene in recent years. The major interest in garment dyeing has developed to service the domestic market with expectational Speed of response as a mean of differentiating from traditional coloration method provide a continuous process. Number of machines used in garment dyeing like general machine, solvent dyeing, toroidal machine, sand wad process, rotary machine etc. Globally the textile dyeing industry is known to be a one of the major contributors to environmental pollution. In 1856, Perkin discovered the first synthetic dyes called mauves since then, natural and synthetic dyes are readily used to color a fabric, which give the color beautiful. Two such waterless dyeing's known as the air-dye process and supercritical carbon dioxide (scCO₂) assisted method, received considerable attention recently [2]. Most dyeing industry discharge wastewater without pretreatment it frequently causes hazardous which causes a direct and indirect impact on human health. so, in order to reduce this impact a two waterless dyeing known air dye and supercritical CO₂ dyeing process assisted method, received considerable attention today. An improvement in level dyeing of 100% cotton knit fabric with reactive dye could be ensured without additional chemicals or operational costs [3]. Sulphur, vat, direct and reactive dyes are among the major class of dyes used to colour cotton [4].

OBJECTIVES :

- Even color: Dyeing will give an even color to an fabric, thread, fibers etc.
- Achieve color fastness: The color should be durable enough to withstand further processing and normal use.
- Reproduce color: The same shade should be achieved from batch to batch.
- Increase attractiveness: Dyeing can make fabrics more attractive and suitable for different uses

MATERIALS AND METHODS

REACTIVE DYE

Reactive dye forms a covalent bond with cellulose or protine fiber are highly wash fastness and durable[5]. Consequently, the dyes become parts of the fiber, leading to outstanding color fastness to wash. Reactive dyes are used to dye a variety of fabrics, including cotton, wool, silk, nylon, and blended fabrics.

MORDANT

Washing soda (soda ash or sodium carbonate) is a mordant that can be used to fix reactive dyes.

SUITABLE FABRIC

Cotton, linen, wool, silk, rayon, nylon are reactive dyes used for dyeing.

ADVANTAGE OF REACTIVE DYES

- Color fastness
Reactive dyes form a chemical bond with fibers, making them more resistant to washing and light exposure.
- Wide range of colors
Reactive dyes can produce a wide range of bright, deep colors.
- Versatile
Reactive dyes can be used on variety of textiles, including cotton, silk, and viscose.
- Reduced allergic reactions
Reactive dyes bond securely with fibers, there's less chance of the dye rubbing off onto the skin.

VAT DYE

Vat dyeing is a process used to dye cellulose fibers like cotton which water insoluble[6]. The original vat dye is indigo, once obtained only from plants but now often produced synthetically Vat dyes are especially fast to light and washing. The fabric obtain a long lasting colour with excellent colorfastness, cotton and wool are used.

MORDANT

Mordants aren't usually required for vat dyeing because vat dyes can directly dye fibers without a mordant.

SUITABLE FABRIC

Cotton, linen, wool, silk, rayon, nylon are vat dyes used for dyeing.

ADVANTAGE OF VAT DYES

- Fastness
- Vat dyes are known for their excellent fastness to washing, light, chlorine, and rubbing. This means that textiles dyed with vat dyes last longer than those dyed with other methods.
- Color range
- Vat dyes come in a wide range of colors, including yellow, black, bright, and general colors.
- Stability
- Vat dyes have excellent stability during post processing on printing and dyeing fabric.

DIRECT DYE

Direct dyes are water soluble dyes that apply direct to cellulose fibre like cotton, without need of chemical bonding agent. They bond with fabric through hydrogen bonding. It apply a dye into an material through aqueous solution ,then the dye is absorbed into an fibres. wash fastness of direct dyes is not good but light fastness of this is very good[7].

MORDANT

Metal salts, tannic acids, oil mordant are used for direct dyeing.

SUITABLE FABRIC

Cotton, paper, leather, wool, silk, rayon, nylon are direct dyes used for dyeing.

ADVANTAGE OF DIRECT DYES

- Cost-effective: Direct dyes are generally cheaper than other types of dyes.
- Easy to apply: Require simple processing and easy to apply
- Water solubility: Direct dyes are readily soluble in water, making it easier to prepare dye solutions.

SULFUR DYEING

Sulfur dyes is used to dye a cellulose fibre like cotton which are insoluble in water . sulfur dyes are known for producing dark and dull colour. It is good wash fastness and limited lightfastness[8]. It used for cotton, viscose, rayon.

MORDANT

Sulphur dyes typically do not require a mordant to fix the color onto the fabric.

SUITABLE FABRIC

Cotton, cambric, viscose, vinyl are Sulphur dyes used for dyeing.

ADVANTAGE OF SULPHUR DYES

- Cost: Sulphur dyes are inexpensive, especially when compared to other cotton dyes.
- Wash and light fastness: Sulphur dyes have good wash and light fastness properties.
- Easy to apply: Sulphur dyes are easy to apply.
- Colour range: Sulphur dyes are available in a range of colours, including black, brown, and dark blue.

WATERLESS DYEING

Waterless dyeing is an eco-friendly textile dyeing technique that eliminates or significantly reduces the use of water. Traditional dyeing processes consume large amounts of water, which leads to water pollution due to the chemicals used. Waterless dyeing typically uses alternative methods like

supercritical carbon dioxide (CO₂) to dissolve dyes and apply them to fabrics. This process not only conserves water but also reduces energy usage and eliminates the need for drying, making it more sustainable and efficient.

ADVANTAGE OF WATERLESS DYEING

- Reduced water waste: Waterless dyeing can reduce water use by up to 95%. It can also eliminate environmental water pollution.
- Reduced energy use: Waterless dyeing can reduce energy use by up to 85%. It eliminates water evaporation, which conserves energy.
- Reduced chemical use: Waterless dyeing can reduce chemical usage by more than 80%.

CONCLUSION:

In conclusion, each dyeing method reactive dyeing, vat dyeing, direct dyeing, Sulphur dyeing and waterless dyeing offers distinct advantages and challenges we have discussed. Reactive dyes Known for its vibrant colors and strong bond with fibers, reactive dyeing provides excellent color fastness and durability. It's particularly suited for cotton and other cellulosic fibers[9]. It requires a significant water and energy, raising environmental concerns. Vat dyeing is prized for its deep, long-lasting colors and resistance to fading. It is commonly used for dyeing indigo and other natural fibers. Direct dyeing method is straightforward and cost-effective, suitable for a wide range of fibers. It offers good color brightness but often results in less color fastness compared to other methods, making it less ideal for items subject to heavy wear. Sulfur dyeing is a commonly used in in cotton. It is a good fastness property and it include an black, brown, dark blue colors. Waterless Dyeing is an innovative approach, waterless dyeing technologies, such as supercritical CO₂ dyeing, address environmental concerns by eliminating the use of water and reducing chemical waste[10]. Although still emerging and potentially costly, it represents a significant step towards more sustainable dyeing practices. Each technique must be chosen based on factors such as fiber type, desired color effects, environmental impact, and cost considerations. Balancing these factors can help achieve optimal results while aligning with sustainability goals.

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