

ROLE OF MORDANTS IN TEXTILE DYEING

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Abstract

Mordants are essential to the dyeing process because they ensure that dyes are properly bonded to textile fibres, improve colourfastness, and allow for a variety of bright colors. These materials, which come in both natural and synthetic forms, improve dye absorption and stop color fading by forming a chemical interaction between the dye and fibre. While synthetic mordants like chromium and aluminium acetate produce stable and bright color effects, natural mordants like alum, tannin, and iron which are derived from plant sources and minerals offer more environmentally friendly options. Mordants also improve the sustainability of the dyeing process and make it possible for dyes to work with a variety of textiles, including synthetic and natural materials. Furthermore, the use of mordants raises health and environmental concerns and emphasizes how important they are to producing textiles that are both visually pleasing and long-lasting.

Keywords: Environmentally-friendly, Mordants, Sustainability, Long-lasting

I. Introduction

Dyeing is one of the oldest and most popular method in textile arts, used to add color and

personality to fabrics. Dyeing is a process used to apply colors and their variations to fabric, enhancing its appearance and giving it visual appeal. Dyeing can be done at every stage of the manufacturing process of textile fibre, yarn, fabric, or a fully finished textile product that includes clothing and accessories. The choice of the appropriate dye and the technique for the textile material to be dyed for dyeing are the two main determinants of color fastness (Daberao, *et al.*, 2016). Dyeing became a well-protected specialty because of highly skilled artisans and well-kept secret techniques. In ancient times, it was common practice to blend red, blue, and yellow dyes to create a variety of colors. Metal salts were also used to help dyes retain on the target material and to change the colors that were produced.

Unlike wool and silk, cotton cannot be dyed directly with natural dyes; nevertheless, it can be dyed by vatting or by treating it with artificial salts called mordants (from the Latin word '*mordere*', which means 'to bite'). These are adsorbed on the fibre and react with the dye to produce a less soluble form that is held to the fabric. Alum, potassium aluminum sulfate, as well as iron, copper, and tin salts were common

ancient mordants. (Stothers, 2007). However, mordant as a chemical that can both fix itself to the fabric and mix with the dyestuff. As a result, a bond is created between the fibre and the dyestuff, enabling the fixing of some dyes that have no affinity for the fibre. By creating an insoluble mixture of mordant and dyestuff inside the fibre, the mordant helps create quicker hues when the dyes can be dyed directly (Alegbe and Uthman, 2024).

II. Types of Mordants

A mordant is a substance that is used to fix or set dyes on fabrics or fibres. It ensures that the color will remain on the cloth for a longer period of time and aids in better dye absorption. Metallic salts (such as iron or aluminium), natural mordants and synthetic mordants can all be used as mordants.

Natural mordants are derived from plant sources or minerals and are often less toxic and more environmentally friendly. This category includes:

- **Tannins:** Used for both protein and cellulose fibres.
- **Alum:** Commonly used for all types of fibres.
- **Iron Salts:** Primarily darkens colors, mainly used with plant fibres.
- **Pomegranate Rind:** Known for providing rich colors and is high in tannins. (Prabhu and Bhute, 2012).

Synthetic mordants are chemically produced substances used to fix dyes onto fibres, ensuring consistent and vibrant color results. This category includes:

- **Chrome (Potassium Dichromate):** Produces vibrant colors but raises environmental concerns
- **Aluminium Acetate:** Preferred for cellulose fibres and helps achieve richer shades.
- **Aluminium Triformate:** Allows easier application without heat, suitable for both fibre types. (Pizzicato, *et al.*, 2023).

III. The Role of Mordants in the Dyeing Process

Mordants ensure that the color remains on the fibre by creating a chemical interaction between the dye and fibre. They develop the color and assure that it remains bright and long-lasting by forming a chemical bond between the dye and the fibre. In the absence of mordants, dyes, particularly natural ones, may not attach to fibres as effectively, resulting fading or washing away. Mordants also increase the colorfastness of the dye, which increases the fabric's resistance to fading, washing, light exposure, and other environmental conditions. The final color can also be greatly influenced by the mordant selection; different mordants result in varied color hues, intensities, and depths.

For example, alum, can provide vibrant colors, but iron produces tones that are deeper. Mordant





s also improve how effectively dyes are absorbed, especially in plant-based fabrics like cotton that usually have complications bonding with dyes. Furthermore, a variety of colors can be created from a single dye by changing the type or concentration of mordant. Lastly, by increasing the dye's compatibility with various fibre types, such as cellulose fibres like cotton and linen and protein fibres like wool and silk, mordants make sure dyes cling to them correctly. For the dyer to achieve stunning, long-lasting results, mordants are necessary for fixing the dye, boosting colorfastness, influencing the final color, promoting dye absorption, and providing compatibility with different textiles (Repon *et al.*, 2024).

IV. Applications of Mordants in Dyeing

Mordants play a crucial role in dyeing by strengthening the relationship between the dye and fabric, enhancing color fastness, and allowing a range of colors. Their applications include:

- i. **Natural Dyeing:** Mordants, which use materials like alum, tannin, and iron to produce different colors, attach natural dyes to fabrics and improve color variation.
- ii. **Industrial Dyeing:** Mordants, especially when used with synthetic fibres, assure uniformity, improve colourfastness, and improve dye absorption in large-scale production.
- iii. **Eco-friendly Dyeing:** Sustainable, non-toxic dyeing that has a reduced

environmental impact using natural mordants like tannin and alum.

- iv. **Cultural Dyeing:** In ancient textile techniques, such as indigo dyeing, mordants are utilized to produce bright shades with cultural meaning.
- v. **Specialty Dyeing:** Mordants produce unique colors for premium and customized textiles, including lightening and darkening effects (Singh and Bharati, 2014).

V. Environmental and Health Considerations

Mordants are important for dyeing since they increase the stability and brightness of the color. Still, there are health and environmental issues with their use in dyeing. Conventional mordants such as iron, copper, and chromium are poisonous and can damage human health and ecosystems. Workers in the textile industry are exposed to these chemicals, which can cause organ damage, breathing problems, and skin irritation. Water bodies may become contaminated by dyeing process wastewater. Eco-friendly substitutes, such as natural and biodegradable mordants derived from fungi and plants, are being studied to address these problems. To reduce the negative effects of dyeing mordants on the environment and human health, guidelines, wastewater treatment, and enhanced safety procedures are also required (Manhita *et al.*, 2011).



VI. Future Trend of Mordant in Dyeing

The textile industry is moving towards sustainable mordants, such as tannins, plant-based compound, and biopolymers, to lessen environmental pollution. Because of their toxicity, traditional mordants including copper, chromium, and aluminium are raising concerns. Natural substitutes such as tannins, plant-based compounds, and biopolymers are also being investigated. Advances in biotechnology and creative approaches to applying mordants, including supercritical CO₂, are also being evaluated. It is expected that this trend toward sustainable innovations along with efficiency will continue (Benli, 2024).

VII. Conclusion

Mordants are essential to the dyeing process because they help dyes bond to textiles in a way that produces bright, durable colors. Their application improves the fabric's durability against fading, washing, and climatic conditions by increasing color fastness. They allow dyers to produce an extensive range of colors, from bright, energetic tones to rich, deep hues, whether they use synthetic mordants like chromium and aluminium acetate or natural ones like tannin and alum. Mordants enable the suitability of colors with different fibre types, both natural and synthetic, in addition to improving dye absorption, particularly in plant-based fibres like cotton. Additionally, mordants support sustainable and environmentally friendly dyeing methods; natural mordants are favoured due to their low

environmental impact. The use of mordants will continue to be crucial as dyeing methods advance in order to create fabrics that are superior, long-lasting, and visually appealing. This will contribute to sustaining cultural customs and promote the creation of creative, environmentally friendly textile options.

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Journal of Textile Science & Engineering, **11**(10): 1-5.

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