

SUSTAINABLE TEXTILES – PART XIV

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Innovations in colorants and its application techniques

Apart from natural colors which are extracted from biodegradable plant sources, textile industry is constantly in a process to innovate sustainable colorants and coloring methods.

Here are few of them which are developed to contribute towards sustainability.

- **Poly-reactive dyes** – Poly-reactive dyes for cotton has been developed to meet the global environmental requirement by reducing water, energy and salt usage. These dyes readily bond to fiber, provide a high reaction and fixation rate. More of the dye is absorbed by the fabric, with very less dye remaining unfixed. The unfixed dye is also easier to remove at lower washing-off temperatures, as it is not bound to the fabric fibers in a high-salt solution. The dyeing and washing-off cycles are being substantially shorter, less water and less energy consumption happens during the processing.
- **Hybrid pigments** - Hybrid pigments composed of a dye chemically linked to a polymer particle that reacts with cellulose fibers at low temperature. This technology does not require the use of salt. This technology can be used for dyeing cotton garments at low temperatures and also to wool. A hybrid pigment can also be used in dyeing denim that avoids using toxic reducing agents that are conventionally used in converting indigo pigment to a water soluble form. Common reducing agents are not environmental friendly, as the sulfite and sulfate generated in the dyebath can cause various problems when discharged into the wastewater.
- **Engineered microorganism** - In a new development, engineered microorganisms/bacteria is being used to color the textiles. This can reduce the use of water significantly. The innovative steps in this process are to fix the dye-producing bacteria directly onto the fabric using a carbon source solution, followed by deposition and fixation of the dye onto fabrics with a single heating cycle by the lysis of the microorganisms. This technology does not require a dye extraction process, which uses organic solvents, or fixing and reducing agents containing organic compounds. Researchers are working on developing on denim dyes using genetically modified E.coli bacteria which can be turned into indigo by an enzymatic treatment. This new process removes the need for harsh chemical reducing agents for indigo dye solubilization, replacing it with an enzyme.
- **Pre-reducing indigo** – Pre-reducing indigo has been developed to prevent the release of hazardous chemical produced during the manufacturing and dyeing of synthetic indigo.



- **Power dye** – A research and development has been done to produce the sustainable dye range using recycled clothing, fiber material, and textile scraps. It is a process in which all the fabric fibers are crystalized into an extremely fine powder that can be used as a pigment dye for fabrics and garments made of cotton, wool, nylon, or any natural fiber. These dyes can be applied to the fabrics using various methods such as exhaustion dyeing, dipping, spraying, screen printing, and coating. They are applied as a suspension while most dyes are used as a chemical solution and hence can be easily filtered from water, thus reducing the environmental impact.

Below listed are some of the sustainable processing techniques.

- **Cotton pretreatment** - As cotton requires more water than other textiles for dyeing; a new pretreatment process has been developed that is applied before the dyeing process to produce cationic cotton. The pretreated cotton acquires a permanent positive charge, enabling it to have a higher affinity for negatively charged molecules such as dyes. This technology decreases the use of dye and water for cotton dyeing.

Another technology for pretreatment of cotton fibers using a solution comprising of wetting agent, caustic soda, and an ammonium salt has also been developed. This pretreated cotton exhibits increased ability to retain the dye without the need of fixation chemicals, thus reducing the usage of toxic chemicals and also reduces the water wastage.

- **Digital printing** - Digital textile printing saves significant amount of industrial water usage and energy consumption. The principal reason for this lies in the digital print process itself. In the digital print head, there are much smaller physical forces to overcome as the ink is applied. The Piezo-electric print head generates an ink droplet after an electric charge actuates a vibration plate inside the print head. Each droplet consists of a precise amount of ink fired at precisely the right time according to an electronic charge relating to the detail of a design being printed.

Further innovation in this has led to the development of **waterless digital printing**. Nano pigment inks provide an efficient solution when combined with digital technologies. It is a one step process, the fabric is coated using ink-jet technology in-line, as ink is applied, to the surface of the fabric and then dries it in one pass, saving water and energy.

References:

1. <https://www.environmentalleader.com/https://www.prescouter.com/>
2. <https://www.the-sustainable-fashion-collective.com/>
3. <https://www.sustainyourstyle.org/>
4. <https://www.fespa.com/>

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