Dyes

Applications, Properties And Equipment
Definition of Dyeing

The application of color to the whole body of a textile material with some degree of fastness.

Natural Dyes

Cochineal  Safflower
Tyrian Purple  Saffran
Madder  Woad
Indigo  Logwood
Dyeing

I. Fiber
   A. Stock dyeing
   B. Dope dyeing

II. Yarns
   A. Skein dyeing
   B. Package dyeing
   C. Beam dyeing

III. Fabrics
   A. Piece dyeing
   B. Printing
      1. Roller
         a. Application
         b. Resist
         c. Discharge
      2. Flat screen
      3. Rotary screen
   C. Tie dyeing
   D. Garment Dyeing
Objectives Of Dyeing

- Shade

- Fastness Properties

- Cost
Keys To Good Quality

- Consistency
- Uniformity
- Knits-low tension
- Wovens-penetration
Types Of Dyeing Systems

- Aqueous - in water
- Non-aqueous - in organic solvents
- Sublimation - thermosol, heat transfer

Types of Fibers

*Hydrophilic Fibers*
cotton, rayon, wool, silk

*Hydrophobic Fibers*
acetate, polyesters, polyamides, polyacrylonitriles
Exhaustion Dyeing
(From Aqueous Bath)

Dyebath + Cloth

Key Terms

- Depth of shade (% dye owt)
- Liquor Ratio
- Fractional Exhaustion
- Equilibrium
  - Exhaustion
  - Fiber Concentration
  - Dyebath Concentration
  - Distribution Coefficient
Four Basic Steps In The Dyeing Process

1. Dissolve or disperse dye

2. Diffuse the dye to the surface of the fiber

3. Adsorb the dye "onto" the fiber surface

4. Diffuse dye "into" the fiber
Causes Of Non-Level Dyeings

- Too little agitation
- Too low liquor ratio
- Rate of dyeing too high
- Uneven pick-up in padding
- Uneven moisture penetration
- Migration during drying
- Chemical or mechanical barré in the fabric
- Dyebath Instability
- Construction
Dyestuff Classes

There are many types of colorants varying according to end use requirements for wash, light, resin, chlorine, heat, gas and crock fastness. Variations in dyeing charges are dependent upon many factors, including course, fastness, brilliance, depth and intensity.

**Direct Dyes**

Direct dyes are perhaps the most widely used and most economical of all classes. Some of the pastels and light shades possess good wash and light fastness but medium and heavy colors, particularly the latter, are not recommended.

The application of Direct dyes is the least complicated; chemically they are salts of complex sulfonic acids. They are soluble in water and have an affinity for a wide variety of fibers.

**Developed Dyes**

The wash fastness properties of Developed dyes are better than Directs, particularly in the medium and heavy ranges of colors. Generally speaking, Developed colors have a tendency to be dull. They are not recommended where light fastness is a requisite.

Developed dyeings are actually selected Direct dyeings treated in a cold bath with nitrous-acid and coupled with a developer to make a larger molecule of the original Direct dye, while on the other hand, the Direct dyes are physically held onto the fiber.

**Sulfur Dyes**

Sulfur dyes are relatively inexpensive; they are insoluble in water and have no affinity for the fiber until reduced with alkaline sulfide compounds. They are applied to the fiber in a reduced state and oxidized within the fiber to an insoluble dye again.

Shades in Sulfur dyes are dull, therefore these dyes are used chiefly for black. They possess good wash and light fastness and are satisfactory for dry crocking. They should be classed as poor for wet crocking and chlorine fastness.

**Reactive Dyes**

Very bright shades of pink, green, blue and turquoise can be produced with Reactive dyes. Fastness properties are generally good except to chlorine. These dyes are soluble in water and are salted out of solution onto the fiber where they are make to react chemically within the fibers.

*Used primarily on cotton and rayon*
**Naphthol Dyes***

Naphthol dyes are classified as fast dyes, usually slightly cheaper than Vat dyeings; the methods of application are complex and the range of colors limited. Brilliant reds are the most important but Naphthol dyes are also used for maroon, brown and black.

Naphthol dyes are insoluble azo dyestuffs that are produced on the fiber by applying a Naphthol to the fiber and then combining it with a diazoitated base or salt at a low temperature to produce an insoluble dye molecule within the fiber. Crocking fastness varies with shades but washing fastness is equal to Vat dyeings, generally with less light fastness than the Vats.

**Vat Dyes***

Vat dyes are best for all-around fastness and are generally the most expensive. They may be selected for fastness to overbleaching and are the best class for chlorine fastness. Reasonably bright shades can be produced except for brilliant red.

Vat dyes are insoluble compounds and have no affinity for the fibers until reduced with caustic soda and hydro. These dyes are applied in a solution in reduced state and oxidized to the insoluble dye again within the fiber.

**Acid Dyes**

Acid dyes are used for dyeing wool, nylon, certain acrylics such as Types 24 and 28 Orlon, and other chemical fibers. They are applied in a similar method to Direct dyes but usually from an acid bath. Fastness properties vary with the dyes as in other classes.

**Basic Dyes**

Basic dyes are applied mainly to acrylic fibers such as Types 42 and 75 Orlon and Type 61 Creslan, to produce bright and deep shades with good light and wash fastness. The application of Basic dyes is similar to that of Direct dyes on cotton but requires different and more precise controls with auxiliaries and temperature.

**Disperse Dyes**

Disperse dyes are used mainly on acetate, nylon, polyesters and acrylics. Their fastness properties vary with the dye, color and fiber on which they are used; on acrylics their fastness properties are generally inferior to Basic or Acid dyes. Disperse dyes are applied by a procedure similar to Direct dyes but with different controls depending on the fiber to which they are applied.

*Used primarily on cotton and rayon*
**Bleaching**

Bleaching is a process used to remove color from an undyed fiber, yarn, or fabric. The object is to produce a good white of uniform color, while maintaining the desirable elasticity, strength, luster and other physical properties. Hydrogen peroxide or sodium hypochlorite is used on cotton while hydrogen peroxide is used almost exclusively on synthetics.

**Blends**

The dyeing of blends, such as Dacron with Cotton or Orlon with Cotton, normally will require the application of several dyestuffs depending on the fastness requirements of the end use application. Because of the combination of different dyes and their individual processing requirements, the procedure (almost always a two cycle dyeing) may be lengthy and complicated, adding substantially to the cost of dyeing.
Fiber-Dye Possibilities

- Dye trapped in fiber
- Dye and fiber have opposite charges
- Chemical reaction between dye and fiber
- "Glue" dye on fiber
Factors In Selecting Dyes

- Economy
- Shade (brightness or dullness)
- Fastness Requirements
- Level Dyeing Properties
- Barré Control
- Ease of Dispersion/Dissolving
- Dusting
- Environmental Concerns