Textile Processing Chemistry

Lecture-2
Textile Raw Materials

The science of textile materials includes: Fibers and Chemicals

Fibers are divided into two groups-

- Natural Fibers—includes the protein fibers such as silk and wool, cellulose and its related fibers such as cotton, linen, ramie and jute, plus certain other minor vegetable fibers derived from palm, banana, sunhemp, pineapple, coconut (coir) etc.

- Man made fibers of natural origin are derived from cellulose such as rayon, acetate and triacetate, however the man made fiber of synthetic origin are polyamides (nylons), polyacrylics and polyesters. These are produced by the polymerization of synthetic chemicals.
Chemicals used

Large number of chemicals used in textile processing are due to two factors:

1. Those which are intended to remain on the fiber such as dyes and finishes

2. Those which are intended to wet or clean the fiber such as surface active agents or surfactants having a hydrophobic end and a hydrophilic end represented by RY where R is long hydrocarbon chain and Y may be charged positively (Quaternary ammonium NH$_4^+$ or negatively (COO$^-$, SO$_4^{2-}$, PO$_4^{3-}$ or neutral moiety (Ethyloxylate (CH$_2$CH$_2$O)$_n$).
Types of Textile Chemical processing

**Preparation**- It is a group of wet chemical processes for the removal of all foreign matter from the fabric—this rendering which is usually accomplished by washing with water and mild detergent which is capable of emulsifying the oils and waxes.

Special scouring processes are necessary for cleaning materials like silk and wool, since the protein fibres are very sensitive to alkali and strong detergents, they are usually washed with sulfated alcohols.
Mercerization

Mercerization is a special process applied only to cotton.

The fabric or yarn is treated with strong sodium hydroxide solution (20%), while being held under tension.

This process causes chemical and physical changes within the fiber, resulting in substantial increase in lustre and smoothness of the fabric.

This also improves dye affinity, stabilization, tensile strength and chemical reactivity of the material.
Coloring

Coloring of the textiles is accomplished by 1) Dyeing or 2) Printing.

Dyeing consists of immersing the fabric or yarn in a solution of a dyestuff, which in turn is attracted to the fiber and penetrates through it, thereby rendering colored fabric.

Printing in contrast is done by the use of pigments which are neither soluble in solution nor in the fiber, they are simply deposited on the surface of the fabric, generally held by an insoluble binder.
Dyestuffs

The choice of dyestuff depends on the physical and chemical nature of the fiber, various types of dyes used are:

**Direct dyes:** This dye is applied directly to the cloth, usually low cost and easy to apply.

**Developed dyes:** This dye is applied to the cloth and diazotized, and the color is developed with a secondary chemical called developer.

**Naphthol dyes:** The naphthol is applied to the developer for coupling, thus producing further brightness in color.

**Sulphur dyes:** This dye is put on the cloth in a reduced state and is then oxidized.

**Aniline black dyes:** Aniline is oxidized on the fabric by air or steam aging.

**Vat dyes:** This dye is put on to the fiber in its reduced state and is then oxidized.
Other Dyeing Chemicals

Many other chemicals are used in the dyeing process apart from dyestuff. They are used with an aim to increase the dye penetration, for color build up gradually thus ensuring uniformity.

Other type of chemicals are migrating agents which help the dye molecules to move from one site to another within the fiber thereby promoting uniformity.

Penetrants may be surfactants of appropriate type which are mainly used in the case of polyesters and are known as swelling agents.

Retarder agents by use of either a material of reverse charge or a non-ionic, or both, to form an unstable complex with the dyestuff.
Finishing

Finishing includes a group of mechanical and chemical operations which give the fabric its ultimate feel and performance characteristics.

The fabric may be compressed, to minimize shrinkage, or the surface may be polished or roughened. All these processes are mechanical operations.

Many other desirable characteristics may be imparted to the fabric through the application of various chemical finishing agents included as chemical operations.
Chemical Operations

Softeners are used to give a desirable hand or feel to the fabric.

These are chemicals which may have solubilizing groups such as cationic, non ionic or rarely anionic having a long fatty acid chain.

In case of cellulosic fabrics, various cross linking agents are applied to react with cellulose chains and impart resistance to shrinking and creasing.

Other types of highly specialized treatments such as antistatic, antibacterial or soil repellent finishes may be applied to get special effect on the fabric.
Mechanical Operations

Finishes are usually applied by an operation known as padding, which consists of drawing fabric through a water solution of the chemical being applied, followed by passage through a set of squeeze rolls which removes the excess liquid.

A wetting agent, or a penetrant is frequently included in this padding solution to help better penetration into the fabric.

Sometimes the solutions are directly sprayed on the fabric instead of padding to reduce the use of excess of water.