

Quadrant II – Transcript and Related Materials

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Module Name: Definitions, classifications of Dyes with examples and structures

Module No: 39

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Notes

Definitions, classifications of Dyes with examples and structures

Definition of Dye

Dye is a compound which is used to impart colour to the textile, leather, paper and other materials.

The application of dyes to textile fibres is one of the most important use of dyestuffs.

Dyeing is a process of application of dyes to the fibres to make it permanently coloured.

The dyes have different chemical structures with aromatic and hetero-aromatic compounds

They mainly differ in chromophores and auxochromes.

The colour of organic dyes is due to the presence of Chromophores & Auxochromes.

Chromophores are functional groups with multiple bonds, which are responsible for imparting colour.

-N=O Nitroso - C=O carbonyl -O-N=O Nitro
-N=N Azo -CH=N- Azomethine, etc.

Auxochromes are certain groups, while not producing colours themselves, but, when present along with chromophores in dyes, intensify the colour.

-NH₂, -SO₃H, -OH, -NHCH₃, -N(CH₃)₂, -Cl, -COCH₃, -CONH₂

Dyes can be classified based on:

the chemical structures.

the materials / fibres to be dyed.

the modes of application.

Classification based on the chemical structures

Dyes can be classified based on the basis of chemical structures, considering the chromophoric systems.

These Dyes have different organic structures

These structures mainly derived from aromatic and hetero-aromatic compounds

Example: Nitroso dyes (presence of -N=O)

Nitro dyes (presence of -O-N=O)

Azo dyes (presence of -N=N-)

Classification based on the fibres to be dyed.

Dyes can be classified based on the types of fibres present in the material to be dyed.

Examples of fibres; Cotton, Wool, Silk, Nylon, Polyester, etc.

Reactive dyes can be used for Cotton fibres

Acidic dyes can be used for Woolen fibres

Direct dyes can be used for Silk fibres

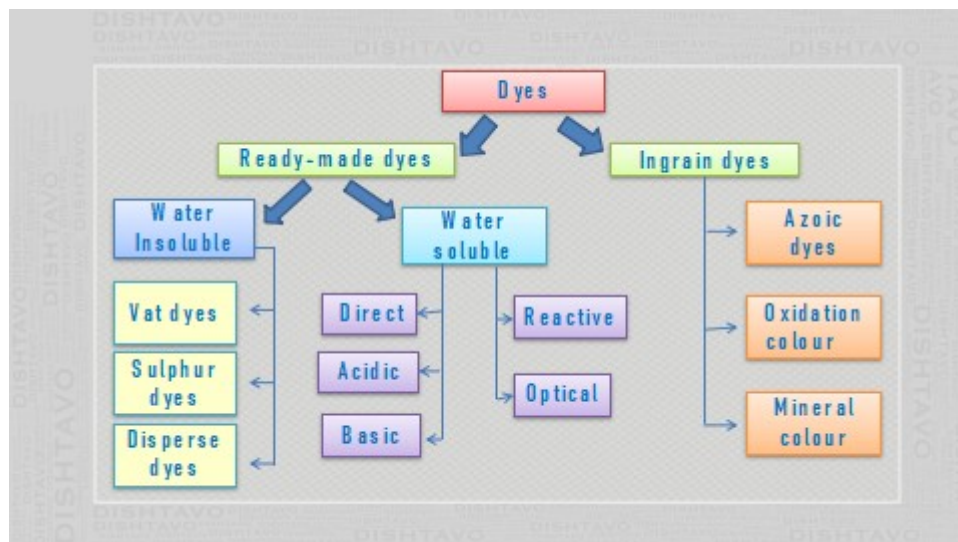
Classification based on the modes of application

There are different methods by which the dyes can be applied on the fibres.

This depends on the structure of the dye, nature of the fibre and physical properties of the dye, such as solubility.

Ready-made dyes: Dyes which are prepared in the final form and then applied to the fibers.

Ingrain Dyes : Dyes which are prepared on the fibre itself.



1. Acidic dyes

These are water soluble dyes having acidic groups like

sulphnoyl ($-\text{SO}_3\text{H}$), phenolic ($-\text{OH}$) groups.

They are used as their Na-salts (called anionic dyes)

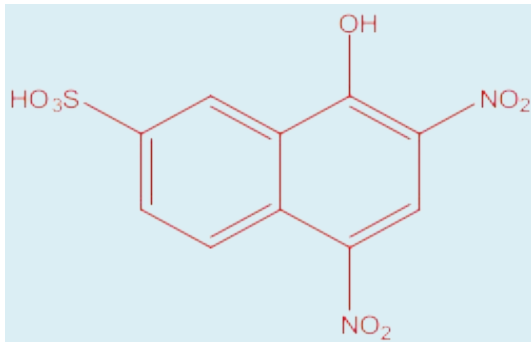
They are used for dyeing fibres containing basic groups.

They have affinity for protein fibres like wool, silk and leather.

They are applied to fibres from an acidic bath containing sulphuric acid or acetic acid.

The dye is held on the fibre by ionic forces

Example: Naphthol Yellow S



2. Basic dyes

They contain basic groups like -NH_2 , -NR_2 .

When dyes are treated with acid, the cationic dyes are formed.

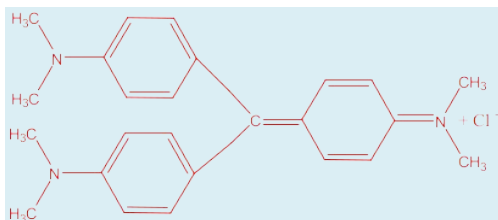
They can be directly applied to protein fibres like wool and silk.

They have poor affinity to cellulose fibres and needed mordant for dyeing such fibres.

The basic dyes form brilliant shades but do not have good fastness to light.

Example:

Crystal Violet



3. Direct dyes

They can be directly applied in aqueous solution to cotton fibres.

They contain sulphonyl acid group ($\text{-SO}_3\text{H}$) and hence soluble in water.

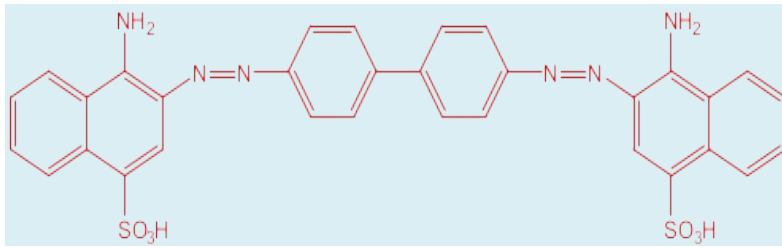
The dyeing is carried out in presence of sodium sulphate salts and hence called as salt dyes.

They have affinity to cellulose fibres and are attached to them by bonding.

They have poor light and washing fastness but are extensively used due to low cost.

Example:

Congo Red



4. Mordant dyes

Mordant is an intermediate organic or inorganic compound which is used to fix dye on the fibre.

They have groups capable of forming stable complexes with the metal atom.

Basic mordants like Hydroxides of Cr, Al, Fe, Co, etc used for acidic dyes.

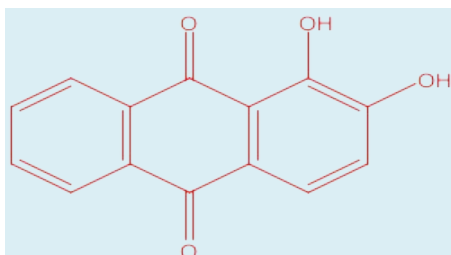
Acidic mordants such as tannins are used for basic dyes.

Mordants are used to increase the dye-fibre affinity

They have good fastness property.

The dye and mordant combined to form a brilliant colour.

Example: Alizarin (with mordant $\text{Al}(\text{OH})_3$)



5. Vat Dyes

These dyes are insoluble in water and cannot directly applied on cotton fibres.

Such dye is reduced by sodium hydro sulphite ($\text{Na}_2\text{S}_2\text{O}_4$) in alkaline medium to give a soluble colourless leuco compound. This process is known as Vatting.

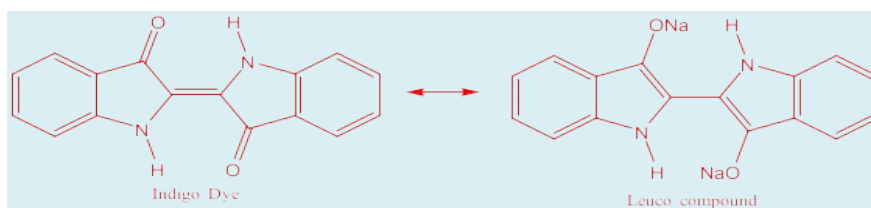
The fibres are immersed in leuco compound which has affinity to cotton fibres

Original dye is then regenerated by air oxidation

They are used for cotton and not suitable for wool and silk fibres

Example;

Indigo dye



6. Disperse dyes

Synthetic fibres like cellulose acetate and polyamides are hydrophobic fibres, hence cannot be dyed by aqueous solutions of dyes.

These insoluble dyes are finely powdered and dispersed in water using dispersing agent.

These dispersions are applied to fibres by using high temperature and pressure.

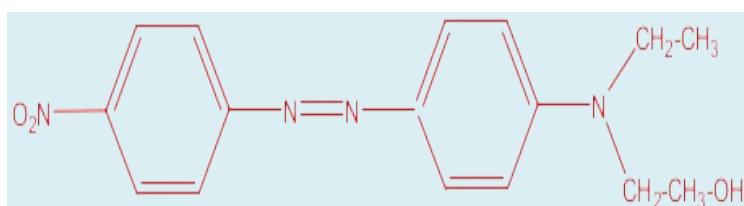
The fine particles of the dye are held by adsorption on the fibres.

The Nitro, azo dye, etc. are used as dispersed dyes.

They are applied as a mixture of insoluble dyes and dispersion agent in the powdered form.

Example:

Celliton Scarlet B



7. Reactive dyes

These dyes are mainly used for cotton fibres

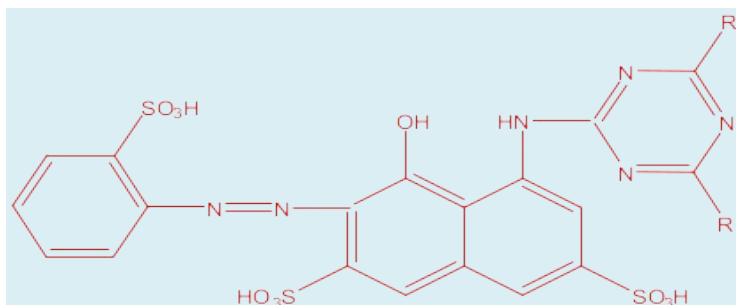
The reactive dye molecule consists of a dye attached to a fibre reactive system (like cyanuric chloride)

The reactive system is a heterocyclic compound having reactive groups like hydroxyl groups.

The chlorine atoms of the reactive dye react with hydroxyl groups of the cotton fibres. The dye and fibre are attached by an ether linkage. This is called fixation of the dye.

Example:

Cibracin Brilliant Red B



8. Azo dyes

They contain an azo (-N=N-) groups as a chromophore in between two aromatic groups.

They give wide variety of colours.

Based on the number of azo groups, they are classified as monoazo, diazo dyes, etc.

They are prepared by coupling a diazonium salt with an amine or phenol.

Example

Aniline Yellow.

