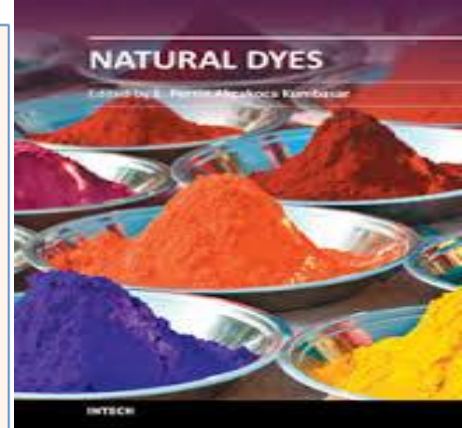




B.Sc. Third Year V Semester CHEMISTRY

Paper XII [Organic + Inorganic]

Organic Chemistry

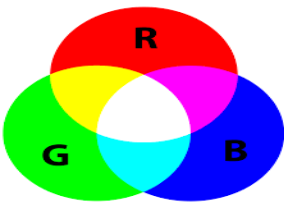


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SYNTHETIC DYES





SYNTHETIC DYES

Introduction



❑ Dyes are colored organic compounds that are used to impart color to various substrates, including paper, leather, fur, hair, drugs, cosmetics, waxes, greases, plastics and textiles materials or other agencies in regionably permanent fashion.



❑ A dye is a colored compounds, normally used in solution, which is capable of being fixed to a fabric.

❑ A dye substrate should be resistant to normal laundry or cleaning procedures (wash fast) & stable to light

Requisites of True Dye

❑ All colour substances are not dyes but obeys, following requisites are dyes.

➤ It must have suitable colour, An attractive colour.

➤ Able to attach to material from solution / capable at fixed on it.

➤ Soluble in water & must form stable, Soluble in the medium other than water.

➤ Good dispersion in water, Resistant to light, heat or other agencies.

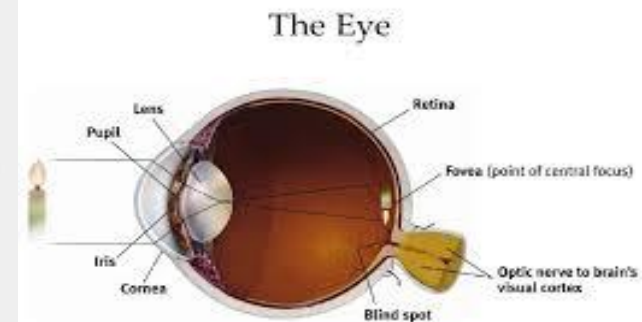
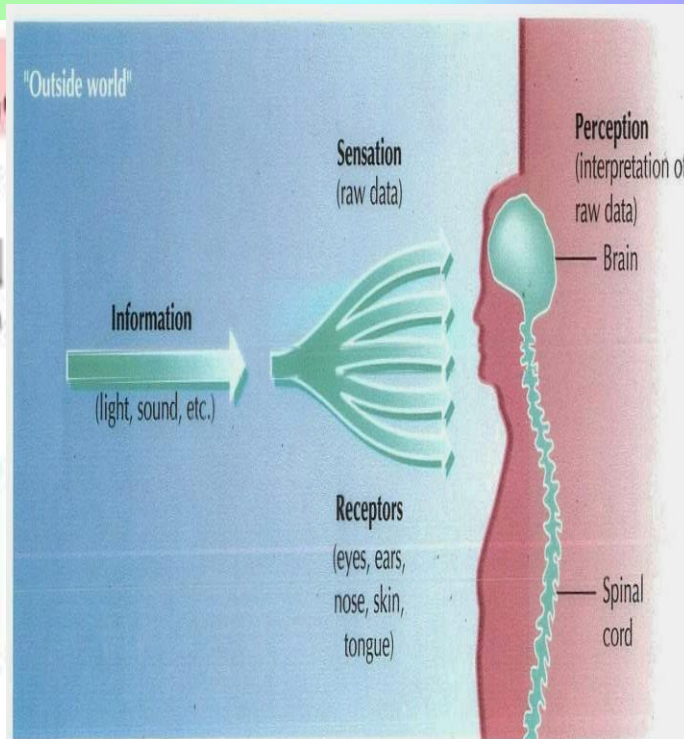
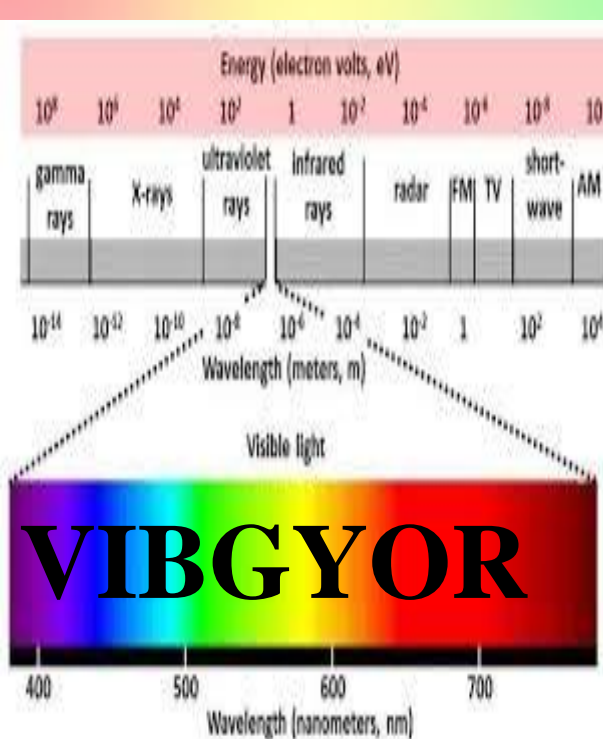
➤ Natural affinity for an appropriate dye, Dye from medium should be good.

➤ Suitable condition for temperature & PH, Fast to washing & dry cleaners.

➤ Absorb energy to its environment without it self decomposing.

Color & Chemical Constitution

- ❑ The psychological sensation which is produced when the light of certain wavelength reaches to the eye is known as colour.
- ❑ Visible light consist of EMR of **wavelength (400 – 800nm)** each wavelength is associated with definite energy and produces a characteristics colour sensation as it strikes the retina of the human eye.
- ❑ Light possessing all wavelengths in the visible range appears white, the complete absence of these wavelength causes darkness, black.



Witt's Theory [1876]

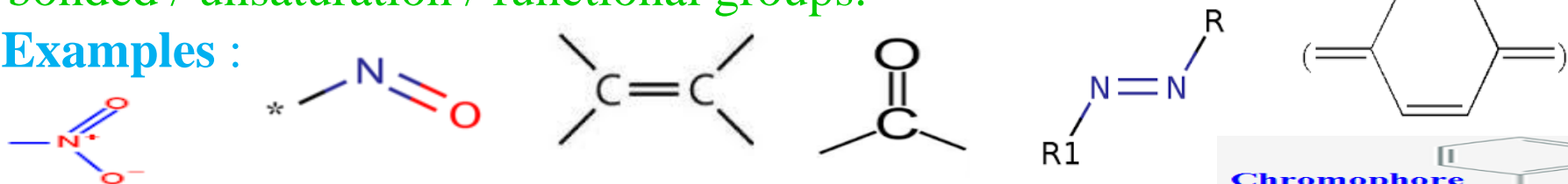


❑ In an attempt to correlate colour with molecular structure (chemical constitution) also called Chromophore - Auxochrome theory.

❑ **Chromophore** : Chroma = colour, Phore = bearing.

❑ The colour organic compound is due to the presence of certain multiple bonded / unsaturation / functional groups.

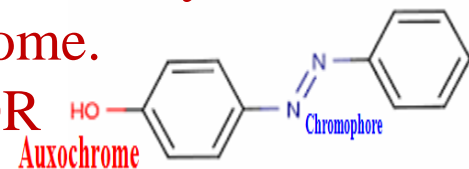
❑ **Examples :**



❑ **Auxochrome** : Auxanein = to increase, chroma = colour.

❑ Certain functional groups while not producing colour them selves, when present along with chromophores in an organic substance intensity increases of the colour, such colour assisting group called Auxochrome.

❑ **Examples :** --OH, --NH₂, --SO₃H, --COOH, --NHR, --OR



❑ **Bathochromic Auxochrome:** Which increase depth of colour, shift of absorption maximum from violet to red. **Red shift.**

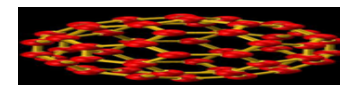
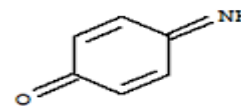
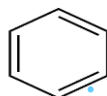
❑ **Hypsochromic Auxochrome:** Which decrease depth of colour, shift of absorption maxima from red to violet. **Blue shift.**

❑ Its called Witt's theory & it provide empirical guide in developing many of dyes..

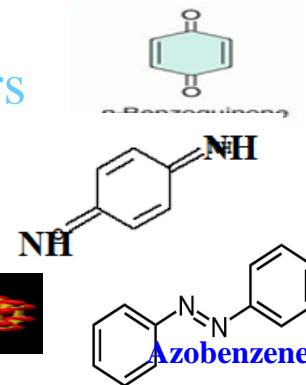


Armstrong's Theory [Quinonoid Theory]

- According to this theory, all coloured compound represents by quinonoid structures, *O / P*.
- On the basis of this theory, its possible to explain colouring properties of some of the important compounds.
- *Benzene* is colourless whereas *benzoquinones* are yellow colours
- Although *iminoquinone & diiminoquinone* have quinonid structures yet they are colourless.
- Large number of coloured compounds are known which does not contain quinonid structures but coloured.



Fulene



Classification of Dyes

- There are several ways for classification of dyes.
- Each class of dye has a very unique chemistry, structure and particular way of bonding . While some dyes can react chemically with the substrate forming strong bond in the process, others can be held by physical forces. Some of the prominent ways of classification are:
- Classification based on the source of materials.
- Classification of the dyes based on the nature of their respective chromophores. Classification by methods of application.

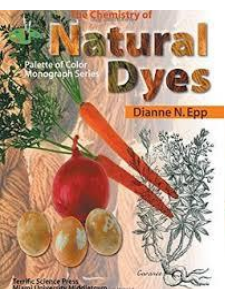
Classification Based on Sources of Material

□ A very common classification of the dyestuff is based on the sources from which it is made. Accordingly the classification could be: Natural Dyes & Synthetic Dyes.

Natural dyes



- Natural dyes are dyes or colorants derived from plants, invertebrates, or minerals.
- The majority of natural dyes are vegetable dyes from plant sources. E.g. roots, berries, bark, leaves, and wood.
- Other organic sources include fungi and lichens.



Synthetic dyes



- Almost all the colors that you see today are Synthetic dyes. Synthetic dyes are used everywhere in everything from clothes to paper, from food to wood. This is because they are cheaper to produce, brighter, more color-fast, and easy to apply to fabric.
- E.g. Acid Dyes, Azo Dyes, Basic Dyes, Mordant Dyes, etc



Classification by Methods of Applications

Method used for application depends on the nature of both..... Dye and **Fabric**.



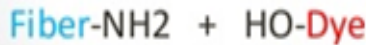
They are classified on the basis of technique employed for their application.

Direct Dyes

- Carried out in a neutral or slightly alkaline dye solution.
- It contains acidic or basic Auxochrome.
- polar in nature , It have poor fastness of washing.
- Strongly absorbed on cellulose and contains sulphonic acid group
- Used on cotton, paper, **leather**, wool, **silk** and **nylon**.



Congo red dye, zambesi black- D



- Insoluble in water. **Vat Dyes**
- Soluble in sodium hydrosulfide (Na-S-H).
- Great affinity for **cotton** and fibers.
- Indigo is a good examples of Vat dyes.



- Alkaline sodium hyposulphide in a large wooden vat hence name vat dye
- Used to dye **vegetables** and animal fibers.

Indigo dye, **antroquinone dye**.

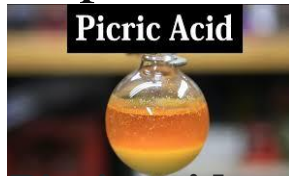


Acid Dyes

- ❑ Dyes contain sodium salt of acids, sulphonic / phenolic groups
- ❑ These dyes comprise a large number of dyes used for the dyeing of **wool**, **silk** & **nylon**.
- ❑ They vary considerably in their basic chemical structure, but have one common feature-they dye from an acid dye bath.
- ❑ All acid dyes can be grouped in 3 subgroups:
 - Level dyeing acid dye
 - Acid milling dyes
 - Pre- metalized dyes



Fluorescent Fuchsia Acid Dye

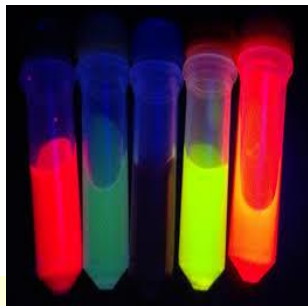


Picric acid, **naphthol yellow**, **orange II**



Cationic & Basic Dyes

- **MAUVENE**, the first to be discovered by Perkin, was a basic dye & most of the dyes which followed, including **magenta**, **malachite green** & **crystal violet**, were of the same type.
- “**Basic dyes**” dye wool & silk from a dye bath containing acid but dye cotton fibres only in the presence of a **mordant** usually a metallic salt that increases affinity of the fabric for the dye.
- Basic dyes include the **most brilliant** of all the synthetic dyes known, but unfortunately they have very poor light & wash fastness.



❑ Anionic / acidic group formation of salt linkage to fibers.

❑ Methyl violet, methylene blue, rhodamine magnera

❑ Cationic dyes for dyeing acrylic (Acrilan, Courtelle, Orlon) paper, wood, dried flowers & silk & silk flowers in very brilliant colors.

YELLOW	BLUE
ORANGE	TURQUOISE
RED	VIOLET
PINK	GREEN
RHODAMINE	BLACK

Disperse Dyes

❑ The introduction of a new regenerated cellulose acetate fiber in 1920 led to the necessity to develop new range of dyes.

❑ It was found that acetate (or Celanese) fiber had hardly any affinity for water soluble dyes.

❑ A new dyeing principle was introduced: dyeing with water dispersed colored organic substances.

❑ These finally colored particles are applied in aqueous dispersion to the acetate material & actually dissolved in the fibers.

❑ It contains small amount of -OH and -NH₂ group to give finite water solubility at dyeing. Chemical action between two reactant.

❑ Coupling reaction. Phenol, resorcinol and amines.



❑ Disperse dyes are also use for dyeing of polyamide (Nylon) & acrylic (Orlon & Acrylan) fibers.

❑ With addition of carriers or swelling agents also used in dyeing of polyester (terylene, Dacron, etc.)



Solvent Dyes

❑ These dyes containing no sulphur or other water solvent groups, its soluble in organic solvent & nature of which varies different applications.

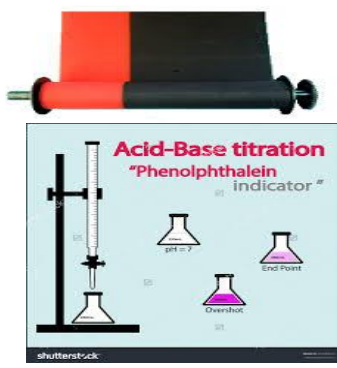
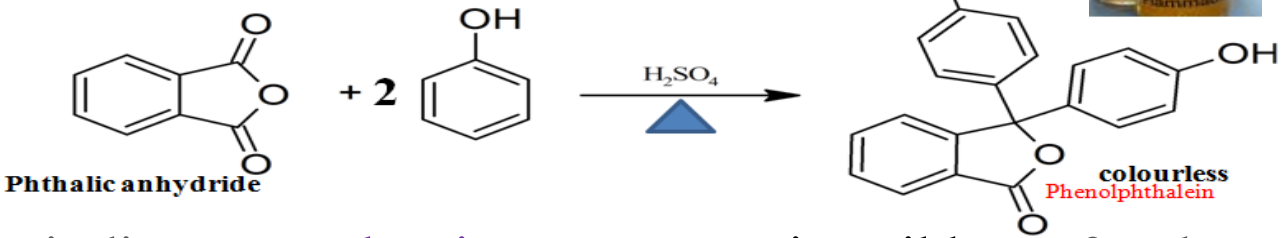
❑ Manufacture for stains, varnishes, ink, lacquers, copy papers, typewriter ribbons, candles, polishes, soaps & cosmetics.

❑ Also used especially for dyeing polyester fibers, nylon, terylene & orlon.



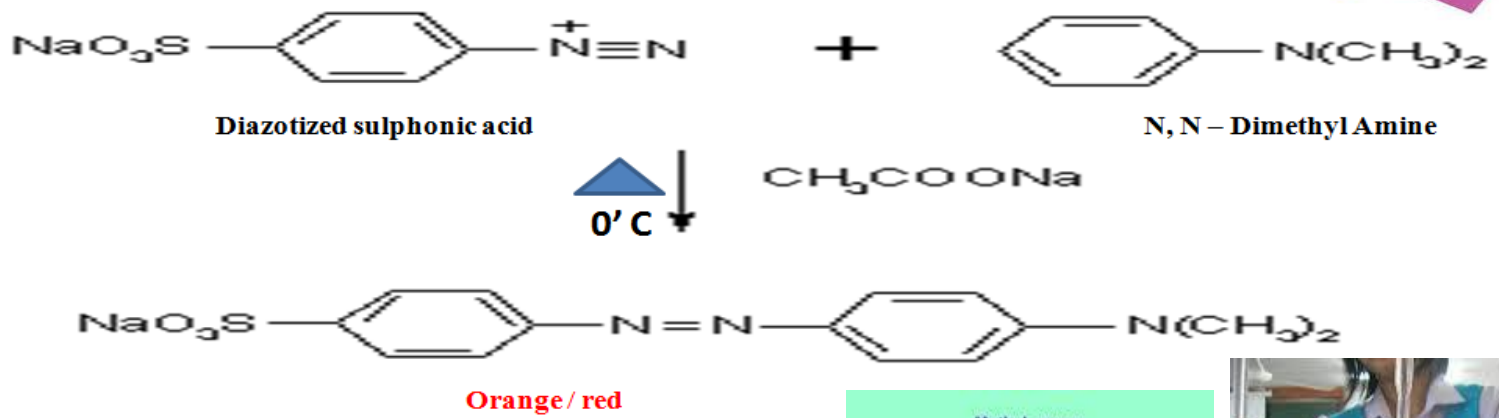
Synthesis and Applications of Dyes

1. Phenolphthalein



- ❑ Acid base indicators, **colouring papers**, writer ribbons & other articles.
- ❑ **Phthalien dye**, soluble in alkali to form deep red colour.

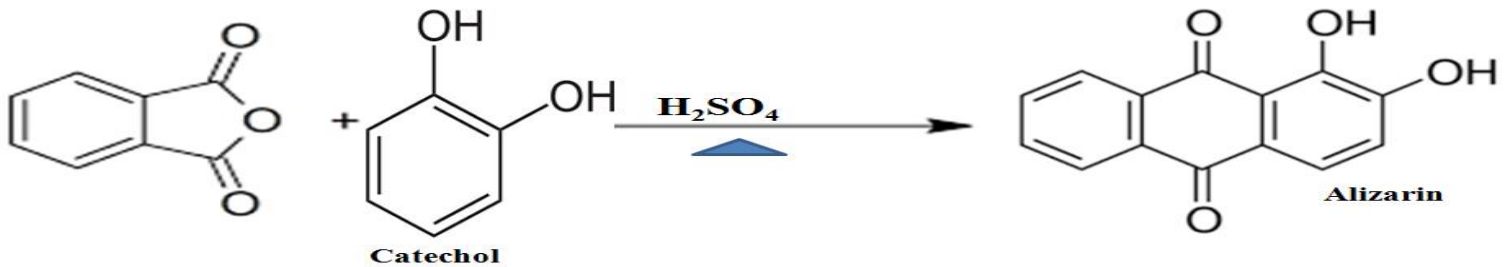
2. Methyl Orange



- ❑ A valuable indicator for **acid base titrations**.
- ❑ It imparts orange colour to **wool** and **silks**.



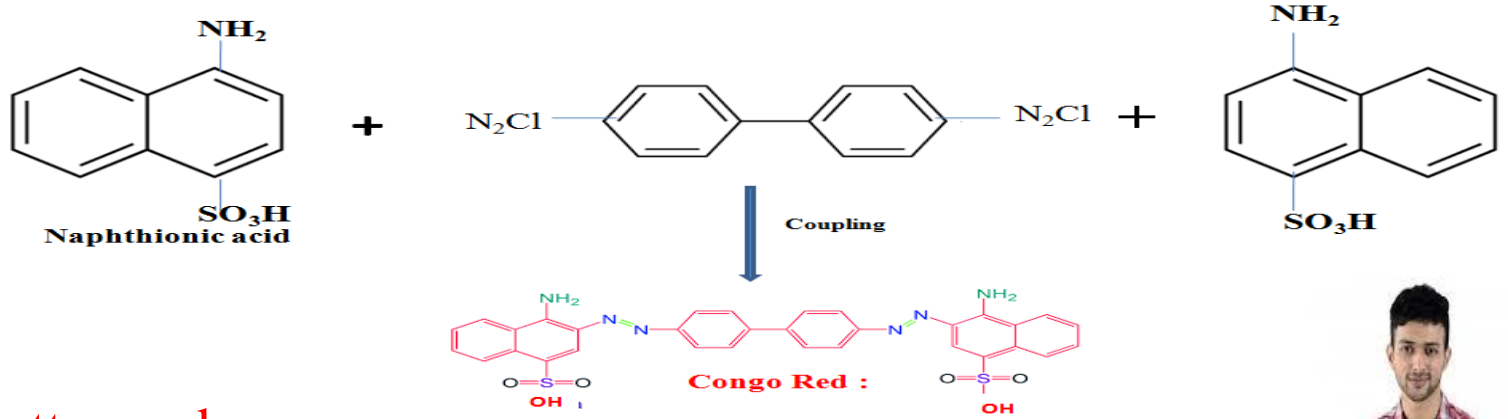
3. Alizarin: [1,2-Dihydroxy anthraquinone]



- Mderant red dye.
- Manufacture printing ink.
- Applied for wool.
- Pigments.
- Textiles fabrics.



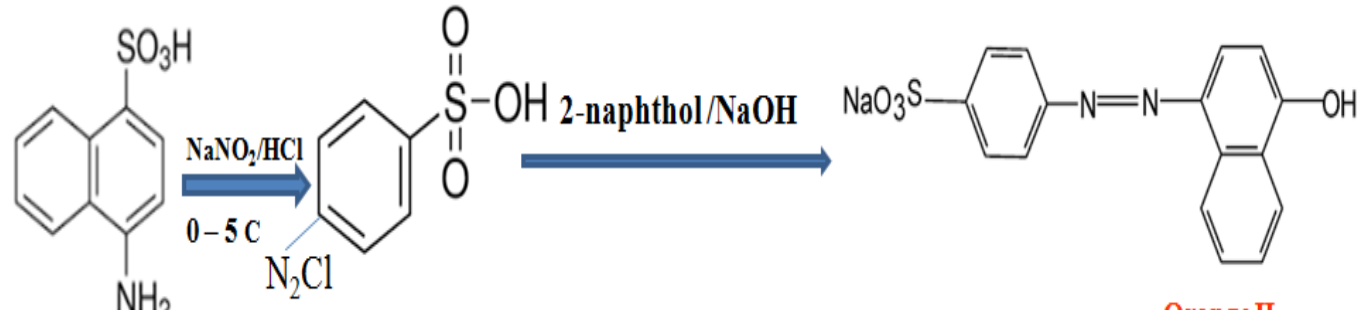
4. Congo Red



- Indicator
- Colouring cotton red
- Blue colour in acid media
- Red colour in alkaline



5. Orange II

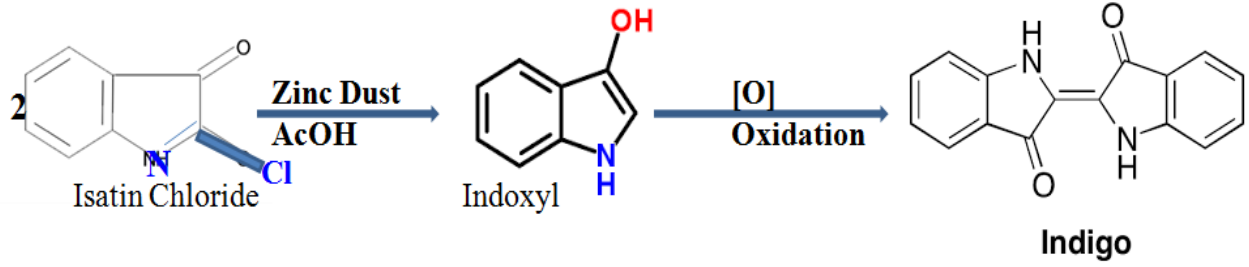
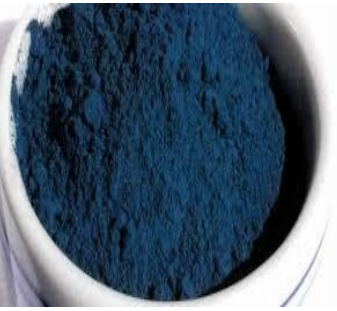


Orange II

- ☐ Wool, cotton, fibers, silks .
- ☐ Papers, lathers.



6. Indigo Dyes

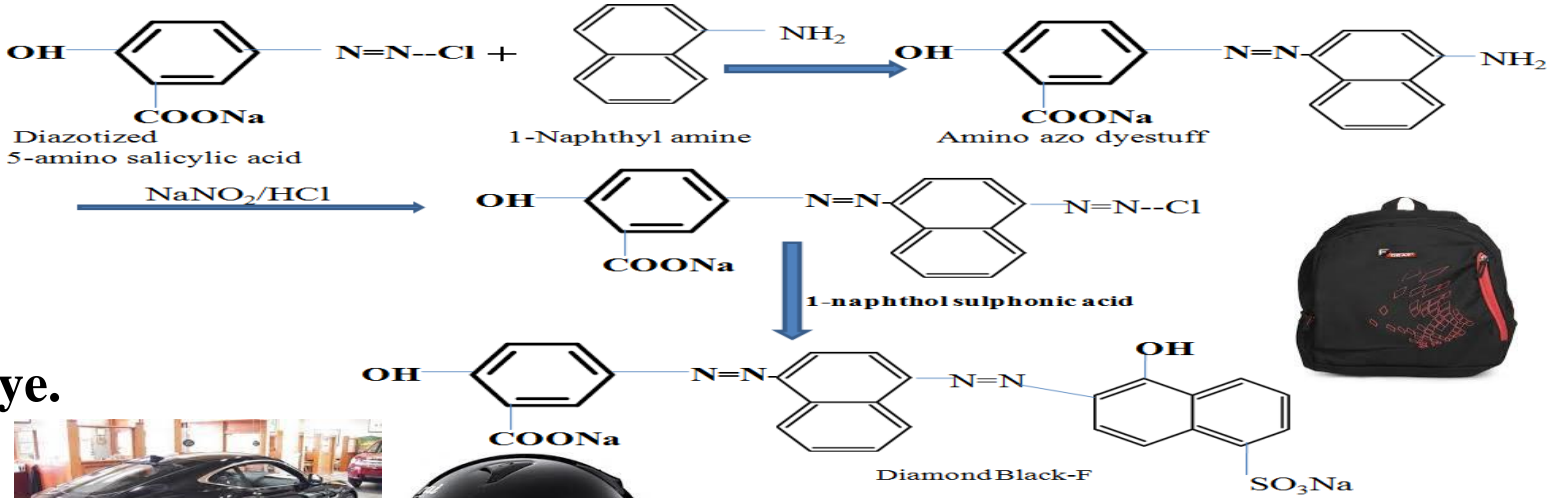


Indigo

- ☐ Natural dye.
- ☐ Developed blue colour.
- ☐ Blue shades of clothes.



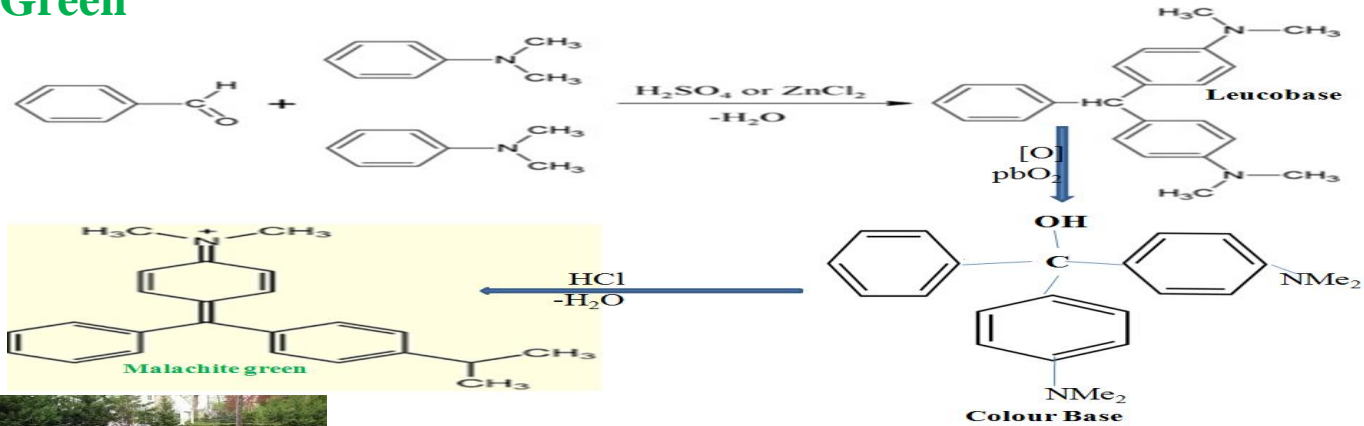
7. Diamond Black-F



- Moderant dye.
- Wool, Silk.
- Cotton.
- Printing.



8. Malachite Green



- Wool.
- Silk .
- Cotton.
- Tannin used as mordant.



.....SUGGESTIONS ?

Created by, Dr. Subhash Lonkar

THANK YOU!