B.Sc Part III Paper ORGANIC

TOPIC: - SYNTHETIC DYES

COLLEGE: - PATNA SCIENCE COLLEGE, PATNA

DEPARTMENT OF CHEMISTRY

BY: - DR. PANKAJ KUMAR (GUEST FACULTY)

EMAIL ID: - pank9097@gmail.com

MOB NO: - 9097705750

WHY DO WE SEE COLOR ?

Visible light consists of electromagnetic radiations of wavelengths 400-750 nm. Each wavelength is associated with a define energy and produces a characteristic color sensation as it strikes the retina of the human eye. Light possessing all wavelength in the visible range appears white. The complete absence of these wavelengths causes darkness, black.

When a beam of visible light strikes a colored substance, certain wavelengths are absorbed, and others are reflected. Those reflected compose the color of the substance. For example, if a substance absorbs wavelengths in the blue-green region of the spectrum, it appears red which is the color of the remaining wavelengths. On the contrary, if red light is absorbed, the substance would look blue-green. The table below correlates the wavelengths absorbed with complementary colors observed.

RELATIONSHIP OF COLOR ABSORBED AND COMPLEMENTARY COLOR OBSERVED

Wavelenght absprbed (nm)	Color absorbed	Complementary color
400-435	violet	yellow-green
435-480	blue	yellow
480-490	blue-green	orange
490-500	green-blue	red
500-560	green	purple
560-580	yellow-green	violet
580-595	yellow	blue
595-605	orange	green-blue
605-750	red	blue-green

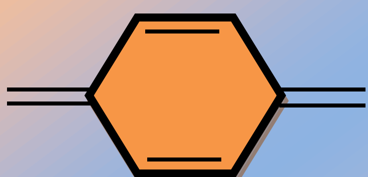
Note :- 1 nm = 1mu = 10 A°

COLOR AND CONSTITUTION

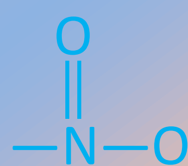
There are two theories of color its relation to chemical structure :

(1) **Chromophore-Auxochome Theory.** In an attempt to correlate color with molecular structure, Otto Witt put forth his theory of ‘Color and constitution’ as early as 1876. This theory which was originally named after him is often referred to as ‘The chromophore-Auxochrome Theory’. It postulates that :

(i) **The color of organic compounds is due to the presence of certain multiple bonded groups called chromophores** (Gr., Chroma = color ; phorein = to bear). A few important chromophore group are :



p-Quinoid



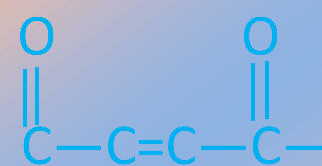
Nitro

—N=O

Nitroso

—N=N—

Azo

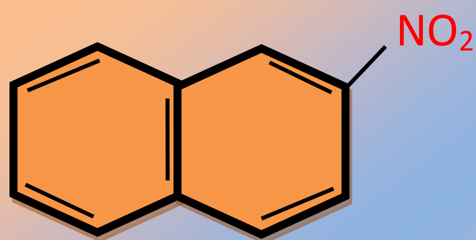


(n = 0 or more)

It has been noted that the presence of a chomophore is not necessarily sufficient for color. To make a substance colored, the chormophore has to be conjugated with an extensive system of alternate single and double bonds as exists in aromatic rings. Thus, nitromethane is colorless, while 2-nitronaphthalene is yellow.

CH_3NO_2 Nitromethane

(colorless)



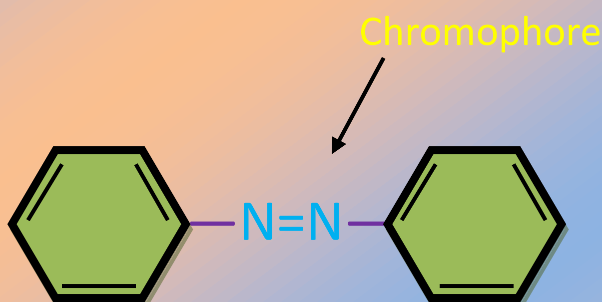
2-Nitronaphthalene

(yellow)

(ii) **Certain groups, while not producing color themselves, when present along with chromophores in an organic substance, intensify the color. Such color assisting groups are called auxochromes** (Gr., Auxanein = to increase ; Chroma = color). The auxochromes are acidic or basic functions, of which the more important ones are listed below.

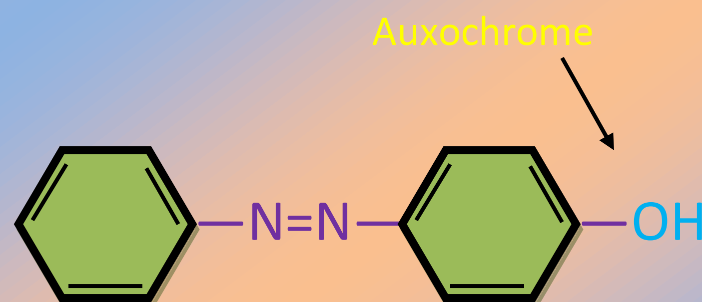
Acidic :	—OH	—SO_3H	—COOH
	Hydroxy	Sulfonic acid	Carboxyl
Basic :	—NH_2	—NHR	—NR_2
	Amino	Alkylamino	Dialkylamino

For example, azobenzene has red color, while p-hydroxyazobenzene is brilliant red.



Azobenzene

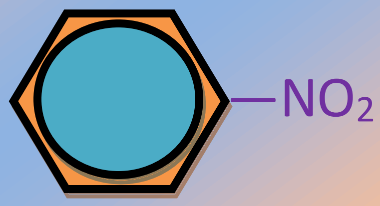
(red)



p-Hydroxyazobenzene

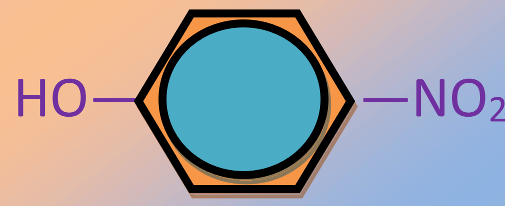
(bright red)

Similarly, nitrobenzene is a pale yellow substance but when the auxochrome –OH is present in ortho or para position, the product becomes deep yellow.



Nitrobenzene

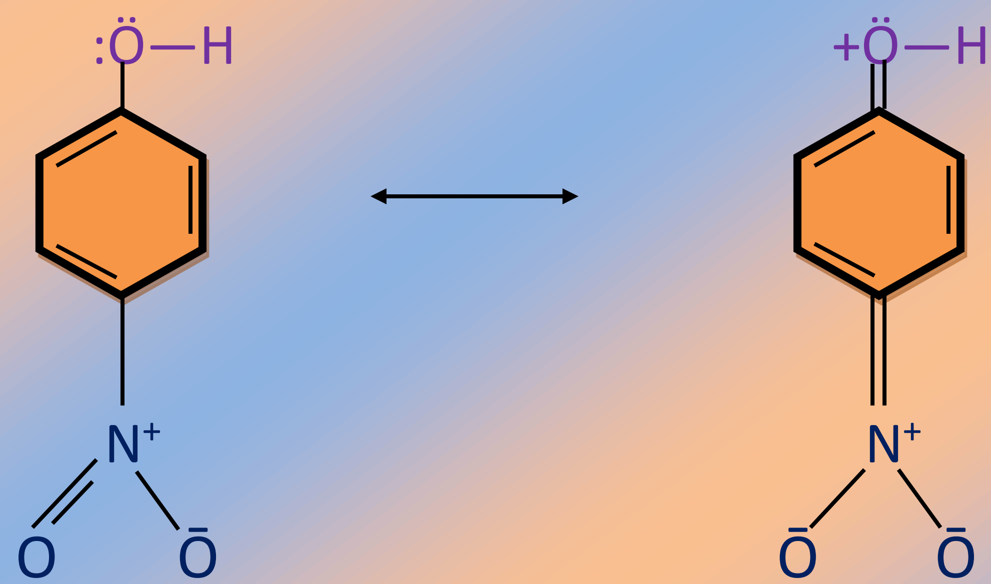
(pale yellow)



p-Nitrophenol

(deep yellow)

The auxochrome –OH deepens the color by extending the conjugated system between the chromophore and the auxochrome due to resonance.



p-Nitrophenol

p-Quinoid structure (extended conjugated system)

WHAT IS A DYE ?

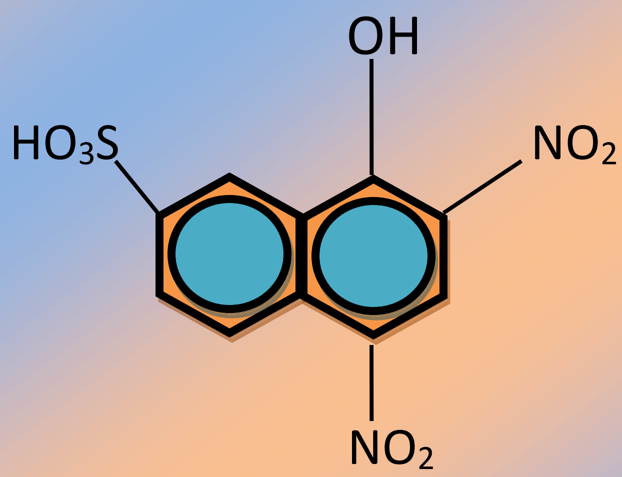
A dye is a colored compound, normally used in solution, which is capable of being fixed to a fabric. The dye must be 'fast' or chemical stable so that will not wash soap and water, or fade on exposure to sunlight (ultraviolet light).

A dye owes its color to the presence of a chromophore and its fixing property to the acidic or basic auxochromic groups such as OH, SO_3H, NH_2, NR_2, etc. The polar auxochrome makes the dye water-soluble and binds the dye to the fabric by interaction with the oppositely charged groups of the fabric structure.

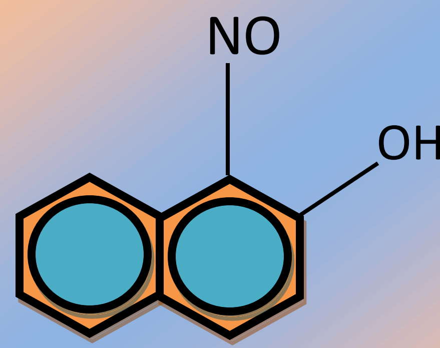
CLASSIFICATION OF DYES BY STRUCTURE

Dyes may be classified according to the type of chromophores present I their structures. This method of classification includes the following main types :

(1) **Nitro and Nitroso Dyes.** The NO_2 and NO groups are chromophores in this class of dyes. Examples are,



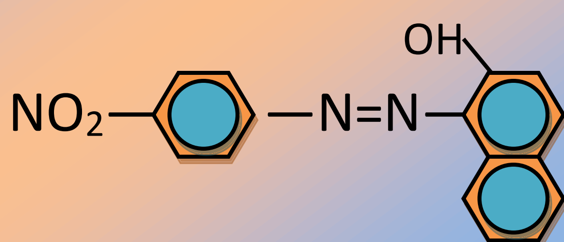
Naphthol yellow S



Mordant green 4

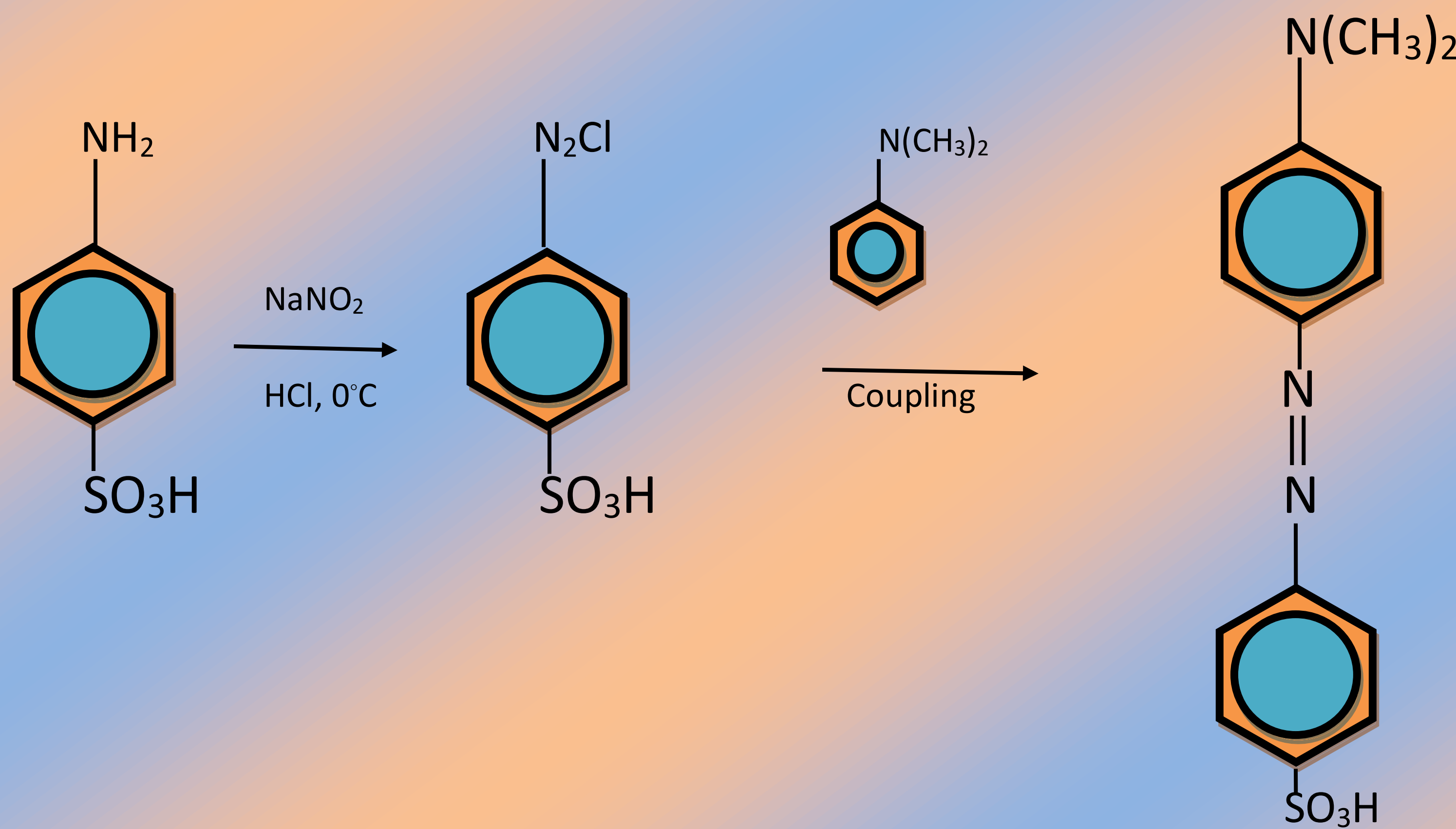
(2) **Azo Dyes.** The azo dyes contain one or more azo groups, -N=N-, as the primary chromophore. The common auxochromes are NH_2, NR_2, OH, SO_3H, etc. Azo dyes form the largest and most important group of synthetic dyes. They are highly colored and can prepared by diazotizing an aromatic amine and subsequent coupling with a suitable aromatic phenol or amine. By varying the substituents present in both the diazonium salt and the coupling compound a series of azo dyes can be produced with almost any color. Examples are,

(a) **Para Red**

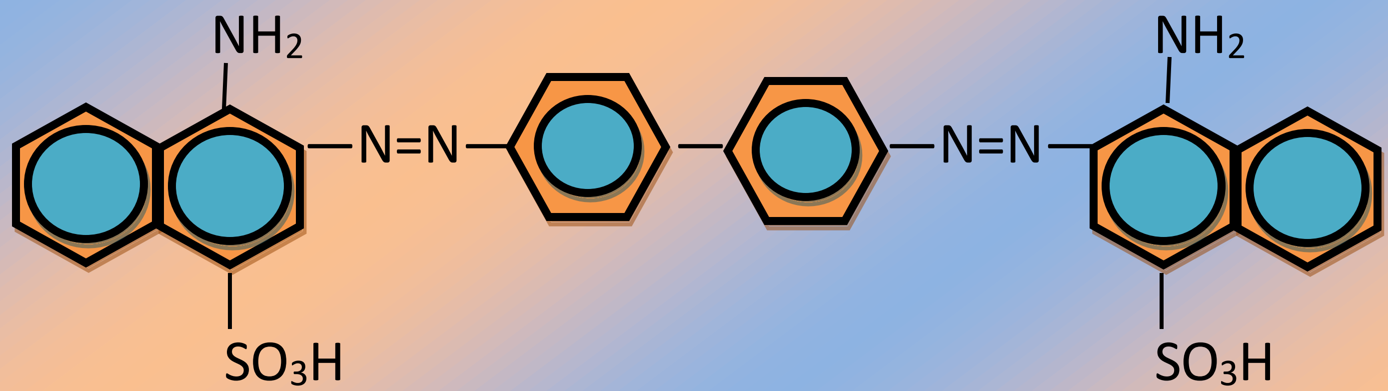


It was the first azo dye to be prepared. Para red is obtained by the reaction of diazotized p-nitroaniline with β-naphthol on fabric itself.

(b) Methyl Orange. Methyl orange is obtained from sulfanilic acid by the following steps

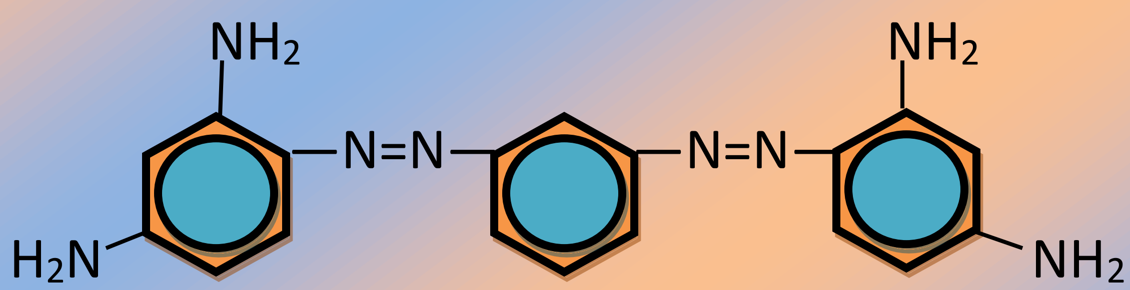


(C) **Congo Red**



Congo red contains two azo groups, It is obtained by coupling tetrazotized with two molecules of naphthionic acid.

(d) **Bismarck Brown**



It is obtained by coupling tetrazotized m-diaminobenzene with two molecules of m-diaminobenzene.

Thank you