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Effect of Dyes on Different Types of Fabrics

Album L From Northern India

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Abstract: ***The Analysis of different dyes on different Fabrics are different Fluorescein in dye has Absorphon maximum at 494 nm &emission maximum at 521nm(in water) .The Colour of this solution varies from green to red. Wool & nylon 6 fabrics are dyed using fluorescein dye . This dye is prepared by PH-4 using acetic acid. Methyle orange is prepared 0.5 ml of 3M sodium sulphate solution and 15ml of water & 5 drops of 3M H_2SO_4 Methyl orange is a type of azo dye.***

Keywords: fibrics, azo dyes, fluorescein

1. Introduction

Dyes are coloured compounds used for imparting colour to the textiles, silk, wool, food stuffs, etc. A dye is an organic compound which can absorb some band of the light falling on it. The rest of the light is reflected. The reflected light will eventually have colour complementary to that of the absorbed. A dye may absorb all visible light except one band that may be reflected. The dye will then have colour of the reflected band.

Necessary Conditions To be a Dye:

Dye is a natural or synthetic coloring matter which is used in solution to stain materials especially fabrics. All the colored substances are not dyes. A colored substance is termed as a dye if it fulfills the following conditions,

- It must have a suitable color.
- It can be fixed on the fabric either directly or with the help of mordant.
- When fixed it must be fast to light and washing,

i.e. it must be resistant to the action of water, acids and alkalies, particularly to alkalies as washing soda and soap have alkaline nature.

Classification of Dye

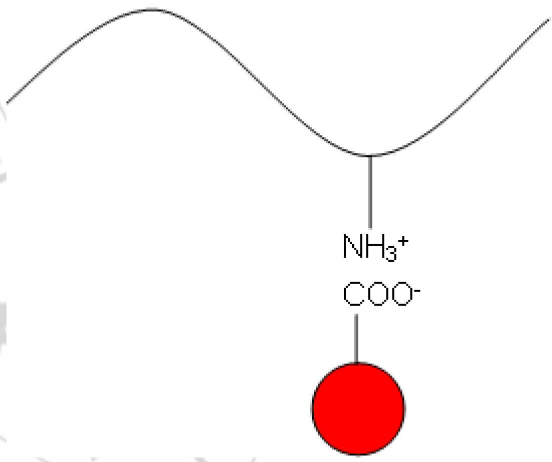
Dye stuff are classified on different bases:
1. Physical form
2. Application form
3. Chemical form

Classification of Dyes Based on Physical form

1) Powder form
   a) Grain form
   b) Fine powder form
   c) Micro or ultrafine powder form
2) lump form
3) solution form
4) paste form

Classification of Dyes Based on Application

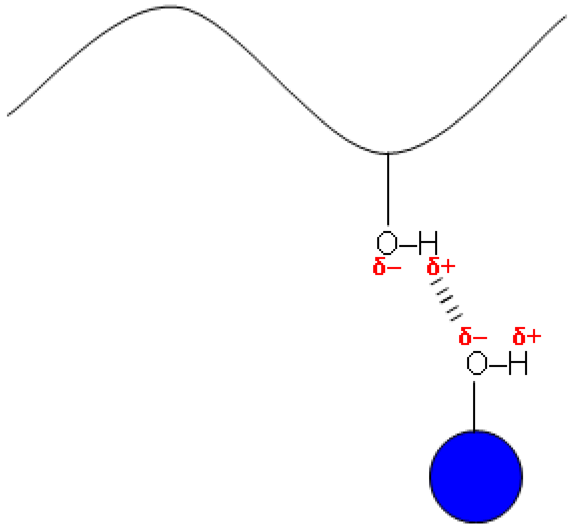
1. ACID DYES: Acid media is required for application of this dye. The substantivity of this dye is maximum to wool and least to cellulosic fiber. The acid causes adverse effect on silk in terms of appearance. The dye has good fastness to light. These dyes, which are sodium salts of organic acids just as sulphuric acid, have poor washing fastness property. These contain acid groups, such as –COOH and –SO_3H which form attractions to the slightly basic –NH groups in the amide links of wool, silk and nylon:



2. Basic Dyes: These dyes are the salts of the coloured basic groups containing amino group (--NH2 or - NR2). Modified nylon and polyesters can be dyed with these dyes. e.g. Aniline Yellow and Malachite Green

3. Direct Dyes: These are the Dyes which can be applied directly to the fabrics from an aqueous solution. These are most useful for fabrics which can form hydrogen bonds with the Dyeing of Fabrics. Thus they are used for dyeing cotton, wool, silk, rayon, nylon. These bond to fabrics by hydrogen bonding and so are particularly attracted to cellulose fibres, such as cotton and rayon, which have many –OH groups.

Hydrogen bonds are weak compared to covalent bonds and so the dyes are only fast if the molecules are long and straight; they must be able to line up with the cellulose fibres and form several hydrogen bonds.



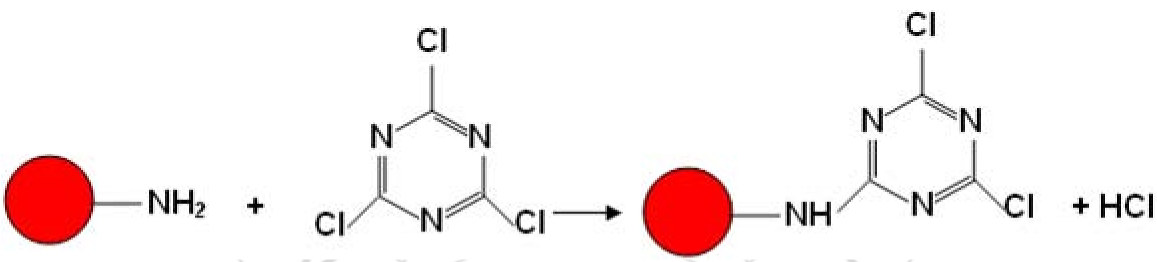
e.g. Congo red and Martius yellow

4. Insoluble Dyes: These are Insoluble Dyeing of Fabrics compounds produced in site on the surface of the fabric i.e. why they are also called as ingrain Dyeing of Fabrics. The reaction involves the coupling between napthal absorbed on the surface of the fabric with the diazonium salt. As there is only surface absorption, the colour is not very fast. These Dyeing of Fabrics are generally used for dyeing cotton, silk, nylon, polyester etc.
e.g. Orange - 1

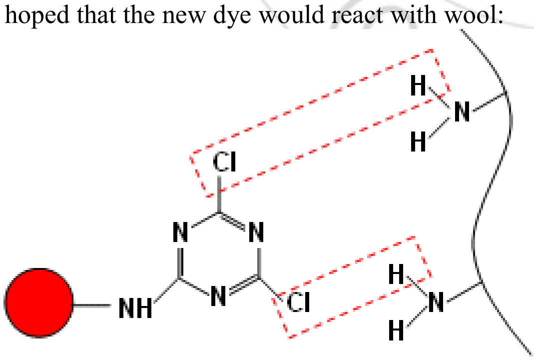
5. Vat Dyes: These are insoluble Dyeing of Fabrics which are first reduced to a colourless form in a large vat with a reducing agent such as alkaline sodium hypo-sulphite and then applied to the fabrics. Many azo compounds are examples of vat dyes
e.g. Indigo.

6. Fabric Reactive: These are the Dyeing of Fabrics which contain a reactive group which combines directly with the hydroxyl or the amino group of the fiber. Because of the chemical reaction the colour is fast and has a very long life. Cotton, wool or silk can be dyed with this type of Dyeing of Fabrics.

- Fastness is a measure of how strongly a dye is attached to a fabric and is an important indication as to whether the dye will move into water when the material is washed.
- For many years, chemists dreamed of developing fast dyes that would covalently bond to fabrics rather than only joining to the fabric by weak intermolecular forces.
- During the 1950's, a group of chemists working for ICI embarked on their search for a better dye for wool.
- William Stephen, a member of that group, decided to modify the structure of azo dyes by adding reactive groups in the hope that they would combine with the amino groups of proteins in wool.
- One of his ideas was to modify an azo dye containing an amino group by reacting it with trichlorotriazane:



- It was hoped that the new dye would react with wool:



- However, the results were very poor and so more work needed to be done on the dyes.
- Stephen realised that the reaction would be more likely to happen in alkaline conditions; however, this caused a problem, as alkaline conditions would damage the wool.
- Instead, they used the dyes with cotton, which would not be damaged by the alkaline conditions.
- This was a success; the dye molecules reacted with both the amine and hydroxyl groups on the cotton fibers. The first fibre reactive dyes had been produced.

7. Disperse Dyes: These Dyes are water soluble Dyeing of Fabrics which are dispersed in suitable reagents before application to the synthetic fibers. These Dyeing of Fabrics Dyeing of Fabrics are used for dyeing nylon and polyester. These do not dissolve in water, but instead are oxidised in the solution and physically held in place within the fibres.

8. Modrant Dyes: These Dyeing of Fabrics do not dye the fabric directly but require a binding agent known as mordant. The mordant acts as a binding agent between the fiber and the dye. These are used to dye wool.
e.g. Alizarin (Turkey Red) .

Classification of Dyes Base on Chemical form

1. Nitroso
2. Nitro
3. Azo
4. Stilbene
5. Diphenyl methane
6. Xanthane
7. Acridine
8. Quinone

9. Thiazole
10. Indamine
11. Azine
12. Oxazine
13. Thiazine
14. Lactone
15. Indigoid
16. Indophenol
17. Triaryl Methane

2. Dyeing

Dyeing is the process of adding color to textile products like fibers, yarns, and fabrics.

Dyeing is normally done in a special solution containing dyes and particular chemical material. After dyeing, dye molecules have uncut chemical bond with fiber molecules. The temperature and time controlling are two key factors in dyeing .There are mainly two classes of dye, natural and man-made. The primary source of dye, historically, has generally been nature, with the dyes being extracted from animals or plants .Since the mid-18th century, however, humans have produced artificial dyes to achieve a broader range of colors and to render the dyes more stable to resist washing and general use. Different classes of dyes are used for different types of fiber and at different stages of the textile production process, from loose fibers through yarn and cloth to completed garments. Acrylic fibers are dyed with basic dyes, while nylon and protein fibers such as wool and silk are dyed with acid dyes ,and polyester yarn is dyed with disperse dyes. Cotton is dyed with a range of dye types, including vat dyes ,and modern synthetic reactive and direct dyes.

3. Azo Dye

Synthesis of Azo Dyes Orange II or Methyl Orange Probably the most common type of dyes are the azo dyes. There are literally thousands of them. They are typically formed in a two-step reaction - by first oxidizing an aromatic amine to a diazonium salt, and then coupling the salt to an aromatic phenol (or a different methylated amine) via an electrophilic aromatic substitution reaction. For the synthesis of Orange II and Methyl Orange, everyone will form the same diazonium salt of sulfanilic acid in the first step according to the reaction scheme. Sulfanilic acid exists as a zwitter ion in aqueous solution. The procedures for the electrophilic aromatic addition are similar on paper, but a bit different in how they are executed experimentally. To make Orange II, the diazonium salt of sulfanilic acid is coupled with 2-naphthol in alkaline solution in the second step. To make Methyl Orange, the salt is coupled with N,N-dimethylaniline in a weakly acidic solution. These dyes will then be used to dye regular Multifiber fabric strips (the mordanted cloth gives pretty similar results).

4. Procedure

Formation of the diazonium salt

1) In a 50-mL Erlenmeyer flask dissolve (with boiling if necessary) 1.2g of sulfanilic acid in 12.5 mL of 2.5% sodium carbonate solution.
2) Cool the solution under tap water, add 0.47g of sodium nitrite, and stir until it is dissolved. . Pour the solution into a flask containing about 7.5g of ice and 1.3mL of concentrated hydrochloric acid. In a minute or two a powdery white precipitate of the diazonium salt should separate and the material is then ready for use. The product is not collected but is used in the preparation of Orange II or Methyl Orange dye while in suspension. It is more stable than most diazonium salts and will keep for a few hours.

Methyl Orange synthesis :

1) In a test tube, thoroughly mix 0.8mL of N,N-dimethylaniline and 0.63mL of glacial acetic acid.
2) To the suspension of diazotized sulfanilic acid contained in a 250mL beaker, add (with stirring) the solution of dimethylaniline acetate. Rinse the test tube with a small quantity of water and add it to the beaker.
3) Stir and mix thoroughly and within a few minutes the red, acid-stable form of the dye should separate. A stiff paste should result in 5-10min and 9mL of 3M sodium hydroxide solution is then added to produce the orange sodium salt.
4) Stir well and heat the mixture to the boiling point, when a large part of the dye should dissolve
5) Place the beaker in a pan of ice and water and allow the solution to cool undisturbed. When cooled thoroughly, collect the product on a Buchner funnel, using saturated sodium chloride solution rather than water to rinse the flask and to wash the dark mother liquor from the filter cake.
6) The crude product need not be dried but can be crystallized from water after making preliminary solubility tests to determine the proper conditions. The yield is about 1.25-1.5g.

Dyeing Test fabric strips

9. For the direct dyes, Methyl Orange and Orange II, the dye bath is prepared from 50mg of Orange II or Methyl Orange, 0.5mL of 3M sodium sulfate solution, 15mL of water, and 5 drops of 3M sulfuric acid in a 30mL beaker. Place a piece of test fabric (without mordant) in the bath for 5 min at a temperature near the boiling point. Remove the fabric from the dye bath, allow it to cool, and then wash it thoroughly with soap under running water before drying it.

Observation: A complete colour range is available for cotton, rayon, nylon. Other fabrics like wool, satin , tetron, tricot, chicken can not be dyed with azo dyes.

SAFETY INFO: Avoid skin contact with diazonium salts. Some diazonium salts are explosive when dry, so always use in solution. Acids and bases should always be dispensed carefully in the hood.

CLEANUP: The organic crystallization filtrate should be placed in the organic solvents container. The filtrate from the reaction should be poured into an aqueous inorganic waste container in the hood. Dye stains on glassware can be removed with a few milliliters of 6M HCl then washing with water. Neutralize the acid washings with sodium carbonate before pouring them down the sink or pouring them into the container for aqueous inorganic waste. Remove dye stains on the beaker, if necessary.

XANTHEN DYE

Introduction: Phthaleins are an important class of organic compounds which have many applications. Fluorescein dye is a synthetic organic compound available as a dark orange/red powder soluble in water and alcohol. Fluorescein dye has an absorption maximum at 494 nm and emission maximum of 521 nm (in water), the color of its aqueous solution varies from green to orange. The light fastness of the dyes was found to depend on the mobility of electrons through conjugated system from donating electron (OH) to electron withdrawing in (COO-) afforded a good value of light fastness.

It is known that acid dyes and their metal complexes are used for textile fibers dyeing, due to their high affinity to textile fibers, high strength and stability, bright colours and a variety of possible shades.This property depends on the number and position of the sulphonic groups, and their attraction to positive groups of the textile substrate. Furthermore, amino groups on the untreated fibers are capable of forming hydrogen bonds with the groups – OH and – CO of the dye molecules, therefore creating bridges between fiber and dye, consequently, increasing the affinity of dye to wool fiber.

Features of Fluorescent Dyes

Fluorescent Dyes are acknowledged for their unique and productive features that include:

- Highly detectable (some even below 1 part per trillion)
- Water solubility
- Extremely low toxicity ratings
- Fair stability in a normal water environment
- Excellent fastness properties
- Displays good stability
- High color strength

Dyeing Procedures

Wool and nylon 6 fabrics were dyed using fluorescence dye. The dye bath was prepared at pH 4 using acetic acid. Dyeing was started at 40°C and then the temperature raised to 100°C over 45 min. Also, we can dye Wool and nylon 6 by the same prepared dye in microwave and we can compare between two methods in dyeing time, liquor ratio and temperature. Dye exhaustion on wool and nylon 6 fabrics were evaluated spectrophotometrically. After dyeing, all dyed samples were rinsed with water and air dried. Dye exhaustion on wool and nylon 6 fabrics were evaluated spectrophotometrically.

5. Observation

This dye was used for dyeing wool and nylon 6 in microwave. Application of fluorescein on tetron & net fabric, degrade them. Satin, cotton, tricot, chicken type of fabric can not be dyed by this type of dye.

References

[1] Kirk othmer Ency clopedia of Chemical technology , V.7, 5th Edition. Wiley-Interscience;2004.
[2] Bafana A, Davi SS, Chakrabarthi T. Azo dye: past, present and Future. Environment Reviews 2011; 19 350-370.
[3] Zollinger, H Synthesis, Properties of organic dyes & Pigments. In Colour Chemistry New York, USA: VCH Publishers 1987.P.92-102.
[4] Robinson T, Mcmullan G,Marchant R, Nigam P. Remediation of dyes in textile effluent technology with a proposed alternative, Biosource techonology 2001; 7(12) 247-255.
[5] Ogugbue CJ, Sawidis T. Bioremediation & Detoxification of synthetic waste water containing triarylmethone dyes by Aeromonas hydrophila Isolated fro Industrial effluent. Biotecnology Research Internation 2011;DOI 10.4061/2011/967925.
[6] Aouto SR. Dye remoral by immobillised Fungi. Biotechnology Advance 2009; 27(3) 227-235.
[7] Forgacs E, Cserhati T, Oros G. Removal of Synthetic dyes from wastewaters: a review : Environment. International 2004; 30(7) 953-971.
[8] Sen S, Demirer GN. Anaorodic Treatment of real textile waste water with fluidzed bed reactor. water Research 2003;37(8) 1868-1878.
[9] Chung KT, Cernigilia CE. Mutagenicity of azo dyes ; Structure activity relationship Mutation Research 1992; 277(3) 201-220.