

Metal Complex dyes

Role of metal

- Mostly the light fastness and the wash fastness of the direct dyed fabrics particularly cotton can be improved by the after treatment with metal salts of copper and chromium
- The role of the metal atom is to form a complex with the dyestuff already present on the fabric

Metal- Complex dyes

- These after treatments are essentially two bath process and therefore consume more time
- Sometimes wool dyes by chrome dyes, have separate chromium mordant added additionally during dyeing called the metachrome process
- This processes is lengthy and cumbersome

Metal- Complex dyes

- Some metal complexed dyes can be prepared from chrome dyes which are themselves not suitable for dyeing for that substrate
- Thus an azo dye(Neolan) can be converted to Palatine Fast blue GGN after complexing with chromium
- The dye has two sulphonic acid groups of which neutralizes the positive charge on the Chromium(chelated) forming a zwitter ion, while the other sulphonic acid group reacts with the amino group of the fibre by electrostatic forces on protein fibres

What actually happens

- The Neolan and the Palatine fast dyes are soluble because of the presence of sulphonic acid groups in them, however they require fairly large amounts of sulphuric acid in the dyebath
- Due to which free amino groups are protonated, which cannot then form coordinate bonds with the metal atom, as a result coordination between amino group of the protein and chromium atom of the dye is suppressed

Properties of Metal complex dyes

- No pre or post after treatment with metal salts is required
- Some of them are brighter than the chrome dyes
- However their fastness is slightly lower than chrome dyes, but still it is good enough
- Due to their ease of application and fastness properties, they are used for dyeing high class dress material, hosiery, ladies wear

Metal-complex dyes

- Metal-complex dyes that are otherwise known as pre-metallized dyes shows great affinity towards protein fibres.
- Generally it has been seen that metal complex dyes are Chromium or Cobalt complexes. Among the popular metal-complex dyes, a variety known as 1:2 metal-complex dyes finds application for dyeing polyamide fibres.
- For dyeing wool, metal complex dyes are the most favoured. The following table shows a comparison between 1:1 metal-complex and 1:2 metal complex dye.

- Metal-complex dyes generally cannot be said as belonging to a particular application dye class.
- In fact, Metal-complex dyes belong to numerous application classes of dyes. For example, they are found among direct, acid, and reactive dyes. When applied in the dyeing processes, metal-complex dyes are used in pH conditions that is regulated by user class and the type of fibre type (wool, polyamide, etc). The pH levels for wool typically ranges from:
 - Strongly acidic (ranging from 1.8 - 4 for 1:1 metal-complex dyes)
 - Moderately acidic neutral (ranging from 4 - 7 for 1:2 metal-complex dyes)

Types of Metal complex dyes

Chemically speaking, Metal complex Dyes can be broadly classified into two classes. 1:1 metal-complexes, where, one dye molecule gets co-ordinated with a single metal atom. In 1:2 metal complexes, one metal atom is co-ordinated with double dye molecules.

The dye molecules are typically a monoazo structure which can contain additional groups like hydroxyl, carboxyl or amino groups. They can form strong co-ordination complexes with transition metal ions, like Nickel, Chromium, Cobalt and Copper.

Feature of Metal complex dyes

- Excellent, light-fastness.
- Medium washing fastness.
- Shows very good level dyeing and penetration characteristics.
- Can cover up for the irregularities in the substrates.
- They are water soluble dyes

Application on different materials

- Metal Complex Dyes is using for a variety of applications like wood stains, leather finishing, stationery printing inks, inks, coloring for metals, plastic etc.
- These are suitable for wool, silk, polyamides
- The metal used are copper, chromium and cobalt and nickel

- Fastness properties of the fabric dyed by metal complex dyes show good light fastness, however wet fastness is moderate, particularly when darker shades are to be considered.
- However the fastness also is dependent on the choice of fibre and type of dye category
- These dyes are either dyed at neutral pH to weakly acidic to even sometimes strongly acidic pH

1:1 Metal complex dyes

These dyes have good levelling and good penetration into the carbonized wool

They work at very low pH 1.8-2.5 with sulphuric acid or 3-4 with formic acid, hence are not at all suitable for cotton or blends of cotton

Glauber's salt is used as exhausting agent organic levelling agent have to be used as well

1:2 Metal complex dyes

- These dyes show moderate migration properties on nylon but show overall very good fastness properties
- Both ionic and coordinate bonds are formed with metal complex dyes and fibre(nylon)

Delosol S type dyes

- Delosol S type dyes and the additive can keep the perfect physical state of wool and cashmere after dyeing.
Delosol S type dye series is made of improved high coloring strength neutral dye (1:2 metal complex dyes) and reactive dye. It has high fastness and very close dyeing properties. The pH of the dye bath adjusted by leveling agent and accelerant is 4.5.

Continued

- This dye system is characterized by high dyeing exhaustion rate and excellent dyeing reproducibility. Delosol S type dye series has only 15 colors but complete chromatogram that can blend almost all the trend colors.
- In Delosol S series dyes, Delosol yellow S-4GN, red-2B and blue S-2R can be used as three-primary colours of medium and light colors. Delosol yellow S-2R, red 5-G, grey 5-G can be used as three deep primary colours. This kind of dyes has the feature of good compatibility and constant levelling property and fastness.

- Delosol S type wool/cashmere dyeing system can provide the following features and benefits:
- **Features**
 - PH4.5-5 dyeing, less fiber damage
 - Different colors and depth can use the same dyeing method
 - Only fifteen varieties, concentrated colors
 - Complete chromatogram
 - High exhaustion rate

Benefits

- Protect wool/cashmere quality
Simple process, easy to control production
Reduce inventory
Better adaptability to market (match up trend color requirement)
Good reproducibility from sample to mass production, high reproducibility between cylinders, less sewage discharge

Favoured fibre to be used with

- Metal complex dyes are Chromium or Cobalt complexes. These dyes show great affinity towards protein fibers.
- For dyeing wool, 1:1 metal complex dyes are the most favoured and for dyeing polyamide fibres 1:2 metal-complex dyes are favoured.
- The following table shows a comparison between 1:1 metal-complex and 1:2 metal complex dye.

Comparison

Type Levelling Ability Wash Fastness pH Range

1:1 metal-complex Good Good 2

1:2 metal complex Poor Very Good 6-7

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