DISPERSE DYE

Properties of disperse dye

1) Disperse dyes are non-ionic dyes. So they are free from ionizing group
2) They are ready made dyes and are insoluble in water or have very low watr solubility. Their solubility is at least 0.1gm/lit
3) They are organic colouring substances which are suitable for dyeing hydrophobic fibres from colloidal dispersion.
4) Disperse dyes are used for dyeing man-made , ester-cellulose and synthetic fibres specially acetic and polyester fibres and sometimes nylon and acrylic fibres.
5) Carrier or dispersing agent are required for dyeing with disperse dyes.
6) Disperse dyes have fair to good light fastness with rating about 4-5.
7) The wash fastness of disperse dyes are moderate to good with rating about 3-4
8) Disperse dyes have the ability to undergo sublimation that is they can be vaporized without fastness or wash fastness for sublimation fastnes of disperse dyes the following cause are responsible

a) Small molecular size of dye suff
b) No ionic group
c) No sulphonated group

Sublimation property of disperse dyes are used in transfer printing. But it is a disadvantageris matter. Because excessive hot ironing or pressing of disperse dyes/printed material may result in color loss.

9) Of all dyes stuffs disperse dyes are of the smallest molecular size.the size of dye molecules are 2-3 nanometre.
10) Generally disprse dyes are derivative of azo, anthraquinone, nitro and quinine group.
11) They do not undergo any chemical change during dyeing

Dyeing Mechanism of Disperse Dye:

The dyeing of hydrophobic fibres like polyester fibres with disperse dyes may be considered as a process of dye transfer from liquid solvent (water) to a solid organic solvent (fibre).Disperse dyes are added to water with a surface active agent to form an aqueous dispersion. The insolubility of disperse dyes enables them to leave the dye liquor as they are more substantive to the organic fibre than to the inorganic dye liquor. The application of heat to the dye liquor increases the energy of dye molecules and accelerates the dyeing of textile fibres. Heating of dye liquor swells the fibre to some extent and assists the dye to penetrate the fibre polymer system. Thus the dye molecule takes its place in the amorphous regions of the fibre. Once taking place within the fibre polymer system, the dye molecules are held by hydrogen bonds and Van Der Waals' force.
The dyeing is considered to take place in the following simultaneous steps:

1. Diffusion of dye in solid phase into water by breaking up into individual molecules. This diffusion depends on dispersibility and solubility of dyestuff and is aided by the presence of dispersing agents and increasing temperature.

2. Adsorption of the dissolved dye from the solution onto the fibre surface. This dyestuff adsorption by fibre surface is influenced by the solubility of the dye in the dye bath and that in the fibre.

3. Diffusion of the adsorbed dye from the fibre surface into the interior of the fibre substance towards the centre. In normal condition, the adsorption rate is always higher than the diffusion rate. And this is the governing step of dyeing.

When equilibrium dyeing is reached, the following equilibria are also established:

- Dye dispersed in the bath
- Dye dissolved in the bath

- Dye adsorbed on the fibre
- Dye diffused in the fibre

Method of the Dyeing Synthetic fibres with Disperse Dyes:

There are three common method of dyeing with disperse dyes which are as follows:-

1. **Carrier method of dyeing.**
2. **High temperature dyeing.**
3. **The thermosol process of dyeing.**

Carrier in Disperse Dye:

The extreme crystalline nature of **polyester fibers** creates problems in obtaining dark shades by conventional dyeing methods even at high temperature. The carriers are found to assist the disperse dyes to enter the polyester polymer, enabling dark shades to be produced. The carriers swell the polyester fibres, increase inter polymer space and let the dye molecules to enter the polymer system easily.

RECIPE:

Dye -

1. For light shade<0.5%
2. For medium shade 0.5-1.5%
3. For deep shade>1.5%

- Carrier (phenol) : 3gm/lit
- Acetic acid : 1gm/lit
- Dispersing agent : 2gm/lit
- Salt (NH4)2SO4 : 1-2gm/lit
- pH :4-5.5
- M:L : 1:10
- Time : 60 min
- Temperature : 90°C

Dyeing sequence of polyester is given below:

- Carrier and vessel washed by hydrose and caustic at 100° C for 20 min

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Load the package in the carrier and feed in the vessel

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Add washing agent and run at 80° C for 20 min

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Dyeing period

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Add leveling agent and acid, run at 60° C for 10 min

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PH check

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Color mixing at 70° C for 40 min

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Color dosing at 60° C for 20 min

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Polyester dyeing at 135° C for 50 min

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Sample check
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Ok
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Temperature cool down at 78° C and drain
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Hot wash for 10 min
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Rinse for 15 min for light shade and 25 min for dark shade
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Add hydrose, soda ash, run at 80° C for 20 min
↓
Drain
↓
Rinse for 10 min

PROCEDURE:

1. At first, a paste of dye and **dispersing agent** is prepared and then water is added to it.
2. Dye bath is kept at 60°C temperature and all the chemicals along with the material are added to it. Then the bath is kept for 15 min without raising the temperature.
3. pH of bath is controlled by acetic acid at 4-5.5.
4. Now temperature of dye bath is raised to 90°C and at that temperature the bath is kept for 60 min.
5. Then temperature is lowered to 60°C and resist and reduction cleaning is done if required. Reduction cleaning is done only to improve the wash fastness.
6. Material is again rinsed well after reduction cleaning and then dried.

Advantages of Carrier Dyeing

- In conventional dyeing method, the extremely crystalline polyester fibres can not be dyed in deep shade. But by using carrier we can get medium to dark shade in boiling temperature.
- Materials can be dyed with simple equipments at atmospheric pressure and temperature below 100°C.
- Moderate level dyeing of polyester fabric can be done.
- Rate of dyeing can be increased by using carriers.
- Can be dyed quickly by using carriers.
- Improves fastness properties of fabric except **light fastness**.

Disadvantages of Carrier Dyeing

- Carriers add to production cost of dyeing. Firstly, for dyeing it is used which is costly and secondly for its removal alkali is required.
- Carriers are unhygienic and toxic. It creates skin diseases.
- Some dyeing machines may create carrier spot.
- Carriers affect the light fastness property of dyed material. This effect may be reduced by treating the material with hot air for 30 min.
- Some carriers are dyed specific. They posses different efficiencies with different dyes; others have compatibility with certain dyes.

High Temperature Dyeing Method:

Pretreatment:

Pretreatment of polyester fabric is a must before starting the dyeing operation. The pretreatment is essential to remove the lubrication oils and other auxiliaries used during spinning and weaving or knitting operation.

Dyeing Process:

Polyester Texties require a Heat Setting operation before dyeing. Heat settings eliminates the internal tensions within the fibre generated during manufacture and the new state can be fixed by rapid cooling. This heat settings fixed the fabrics in the relaxed state and thus avoids subsequent shrinkage or creasing of fabric.

Dye bath settings & Dyeing:

Recipe:

- Lyogen DFT: 0.5 gm/lit
- Sandozen PES: 1.0 gm/lit
- Acetic Acid: 1 gm/lit
- PH: 5.5-6.0
- Temperature: 130°C
- Time: 1 hr

Procedure:

1. At first a paste of dye and dispersing agent is prepared and water is added to it.
2. PH is controlled by adding acetic acid.
3. This condition is kept for 15 minutes at temperature 60°C.
4. Then the dye bath temperature is raised to 130°C and this temperature is maintained for 1 hour. Within this time, dye is diffused in dye bath, adsorbed by the fibre and thus required shade is obtained.
5. The dye bath is cooled as early as possible after dyeing at 60°C.
6. The fabric is hot rinsed and reduction cleaning is done if required.
7. Then the fabric is finally rinsed and dried.

Dyeing of Polyester Fabric in Thermasol Dyeing Method:

Thermasol dyeing method is continuous methods of dyeing with disperse dye. Here dyeing is performed at high temperature like 180-220°C in a close vessel. Here time of dyeing should be maintained very carefully to get required shade and to retain required fabric strength.

Recipe:

- Dye: X gm/lit
- Dispursing Agent: 2 gm/lit
- Sodium Alginate Thickener: 5-10 gm/lit
- Citric Acid to get PH: 4-5

Sequence: Pading- Drying- Thermofixing- Aftertreatment

Procedure:

1. At first the fabric is padded with dye solution using above recipe in a three bowl padding mangle.
2. Then the fabric is dried at 100°C temperature in dryer. For dyeing, infra red drying method is an ideal method by which water is evaporated from fabric in vapor form. This eliminates the migration of dye particles.
3. Then the fabric is passed through thermasol unit where thermo fixing is done at about 205°C temp for 60-90 seconds depending on type of fibre, dye and depth of shade. In thermasol process about 75-90% dye is fixed on fabric.
4. After thermo fixing the unfixed dyes are washed off along with thickener and other chemicals by warm water.
5. Then soap wash or reduction cleaning is done if required. And finally the fabric is washed .