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PROBLEMS AND THEIR REMEDIES IN POLYESTER PROCESSING

COLOURATION

The fibre can be dyed in the form of fibre, yarn, fabric or slivers. They are usually processed as blends – with cotton, rayon, wool or acrylics.

Polyester fibres are dyed by disperse dyes due to their firm inner structure, large proportions of crystalline regions, smaller numbers of attaching points for different dye types and pronounced hydrophobic nature. The dyeing is chemically called 'solid solution theory', as the disperse dyes do not dissolve but remain finely dispersed in water. The crystalline areas adsorb the dye at high temperature (130-140°C).

Pale to medium dyeing can be obtained by using carriers at the lower boiling point of water (100°C), under atmospheric pressures. However, carriers (based on chlorobenzenes di or tri) are not eco-friendly, and banned. Hence, loosening intermolecular links helps to dye darker shades, as the fibre structure allows dye molecules to diffuse easily and rapidly.

The thermosol process is the third method. In it, disperse dyes dissolve rapidly in the polyester fibre, producing dyeing with good fastness properties, when heated to approximately 200°C. Dyeing polyester from organic solvents and using liquefied CO_2 (which is recovered and reused) are catching on.

Problems:

- Variations in the dyeing behaviour of the fibres due to variations in their production or thermal pretreatments
- Hard water can have significant effect on the colour value of disperse dyes
- Moiré effect due to heat setting problems and uneven relaxation of fabric tensions

- Off shades is the biggest problem and it occurs due to combination of various factors like:
    - Choice of dyes
    - Choice of auxiliaries like dispersing agent, leveling agent , carrier etc.
    - Choice of machinery
    - Operation negligence during various processing steps like heat setting, washing and reduction clearing, etc
    - Dyeing method
    - Pretreatment will still leave behind some sizes, coning oil, etc.
    - Concentration of dyes and various auxiliaries
    - Rapid dye uptake by polyester above glass transition temperature may cause off shades The dye uptake is less than 10% below 75°C and it increases rapidly above it causing higher strike rate
    - Inappropriate increase rate of temperature in the HTHP dyeing method
    - Dispersion stability of disperse dyes
    - Density of fibre structure
    - Dye bath pH
    - Dye bath circulation efficiency
    - Simmering temperature and rising temperatures, as well as substrate to liquor ratio

Other problems include:

- Oligomers
- Pilling
- Migration

Oligomers

Oligomers are still the biggest problem in wet processing of polyester fabric leading to variety of problems.

When the dyeing is not solid and appears skittery, the fabric is rejected. Warp-wise and weft-wise streaks lead to streakiness which usually occurs during warping and weft insertion. Some of the main causes of warp streaks in processing include:

- Rubbing of fabrics on a rough surface on roller
- Faulty shearing blades

- Faulty stitching leading to stitch opening during processing
- Superimposed ends during mercerising
- Improper functioning of tension guide bar on jigger
- Channeling during jigger dyeing
- Shrinkage of leader cloth on jigger
- Improper jet dyeing nozzle
- Low M:L in jet dyeing
- Insufficient rinsing of dyed fabric in rope form
- Faulty calendar rolls
- Improper sequence (e.g. singeing before dyeing in P:V fabric)

Pilling

Pilling is the formation of fibre balls on the fabric surfaces, when a group of loose, or short and broken fibres get entangled or accumulated on the fabric after abrasion. The tiny balls are pill. It cannot be eliminated totally, but it can be minimised by proper handling during fabric washing.

A possible explanation for its occurrence is that polyester fibres have a high strength compared to the natural fibres. The problems of pilling is severe in the case of 67/33 PET/COT blends.

Migration

Migration is the shifting of the colour to the surrounding areas. It is the unwanted reaction between the dye and the fibre.

Migration is a serious problem encountered both in dyeing and printing. Dye migration is generally more on 100 per cent polyester fabrics. It results in the colouring of unintended areas. Hence, any fabric containing the polyester is vulnerable to dye migration and bleeding.