Study on Different Types of Dyeing Faults, Causes and Remedies of Knit Fabrics

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Abstract-- Dyeing faults are very common in textile industry. There are various types of faults occurs during knit dyeing. It is important therefore when assessing a fault to try to ascertain the root cause. Careful consideration of the possible cause of the fault will enable suitable corrective action to be taken to ensure that the same faults do not re-occur. For uniform dyeing, the fabric’s absorbency must be uniform. While preparation may not totally remove all the natural and synthetic chemicals present in the grey material, the residues should be minimal and uniformly distributed. This paper tries to find out the major dyeing faults of knit fabric & how we can remove or minimize these dyeing faults. Hope this paper will help those people who are in textile dyeing industry.

Index Term-- Knit fabrics, dyeing faults, causes and remedies

1. INTRODUCTION

Textile sector is the largest sector in Bangladesh. It is also highest foreign currency earning sector in Bangladesh. Now Bangladesh earns near about 80% of its foreign revenue from this sector. Cheap labor has made it easier to spread textiles based industries. More than 5.7 million of people are working in this sector now. Most of them are women. This sector is helping women to be self-reliant. Normally in Bangladesh single jersey fabric such as plain, lacoste, pique etc. fabrics are widely used for body fabric of garments. Interlock, rib, fleece fabrics are also turned to inside out when those are in unbalanced structures and used as body fabric of garments.

Dyeing is the process of adding color to the textile material. Dyeing process of knit fabric is different than others dyeing like fibre dyeing, yarn dyeing etc. During these dyeing observe different types of faults which is called dyeing faults. There are some processes, techniques which can apply to reduce these faults. Once the goods are in dyeing machine, they must be thoroughly wetted out to remove trapped air. This is to ensure that the dye solution will have equal access to all fiber surfaces. Wetting-out may involve running the material in the dyeing machine in warm or hot water, in the presence of a wetting agent if wetting is likely to be difficult. Fabric that has been scoured or bleached in the dyeing machine must be rinsed to remove residual chemicals. It will already be completely wet but must be run in water and the pH value checked, and adjusted if necessary, before dyes are added.

Dyeing is either a batch exhaustion process, or a continuous impregnation and fixation process. In the exhaustion technique, all textiles are in repeated contact with all the dye liquor during dyeing and the fibres gradually absorb the dyes. Careful control of the dyeing temperature, pH and auxiliary chemical concentrations is often necessary to obtain level, well-penetrated dyeing. This is essential if the initially absorbed dye is unable to migrate from heavily dyed to poorly dyed areas during the process.

2. MATERIALS AND METHODS

Dyeing is often one of the final processes in production. Many types of dyeing faults, such as color blotches and spots, color shading from side to side, end to end or face to face of the material, water marks and crack or crease marks, are often a consequence of poor preparation, or dye selection, or dyeing technique. For uniform dyeing, the fabric’s absorbency must be uniform. While preparation may not totally remove all the natural and synthetic chemicals present in the grey material, the residues should be minimal and uniformly distributed.

2.1 Pre-treatment flow chart of Dyeing

Most textile materials and fabrics require pretreatments before
they can be dyed. We use NaOH to remove wax, oil, fats and natural impurities from fabric, this process is called scouring which increase fabric absorbency. We use H₂O₂ to increase the fabric whiteness, this process is called bleaching. Because fabrics which have been prepared for dyeing must have sufficient absorbency and whiteness.

Fresh water and fabric Load at 45°C
↓
Temperature raise to 60°C
↓
Detergent, Peroxide Stabilizer inject
↓
Run for 5 min
↓
Inject Caustic and run 5 min
↓
Raise temperature to 70°C
↓
H₂O₂ inject and run 5 min
↓
Temperature raise to 105°C
↓
Run for 30 min
↓
Lower the temperature to 80°C
↓
Bath drain
↓
Peroxide killer inject and run 10 min
↓
Rinsing and unload the fabric.

2.2 Dyeing process flow chart
Grey fabric receive from knitting section
↓
Batching
↓
Turning of fabric (only for Single Jersey)
↓
Selection machine no
↓
Fabric loading
↓
Select production program
↓
Select recipe for dyeing
↓
Pretreatment
↓
Dyeing
↓
After treatment
↓
Fabric Unload

2.3 Shade variation (Batch to batch):
Batch to batch shade variation is common in exhaust dyeing which is not completely avoidable. Even though, to ensure a consistent batch to batch production of shade the following matters should be controlled carefully.

Causes:
- Use of different brand dyes and chemical.
- Poor pretreatment procedure.
- Different dyeing procedure of the same depth of shade.
- Use of different liquor ratio.

Remedies:
- Use standard dyes and chemicals.
- Maintain the same liquor ratio.
- Follow the standard pretreatment procedure.
- Maintain the same dyeing cycle.
- Identical dyeing procedure should be followed for the same depth of the shade.
- Make sure that the operators add the right bulk chemicals at the same time and temperature in the process.
- The pH, hardness and sodium carbonate content of supply water should check daily.

2.4 Dimensional stability (shrinkage):

Causes:
- Insufficient relaxation during pretreatment.
- Inadequate setting of material.
- Lengthwise distortion caused by dyeing machine.
Remedies:
- Adapt relaxation and setting to material.
- Adjust dyeing machine to material.

2.5 Pilling:
Causes:
- Too high mechanical stress on the surface of the fabric.
- Excess speed during processing.
- Excess foam formation in the dye bath.

Remedies:
- By using of a suitable chemical lubricant.
- By using antifoaming agent.
- By turn reversing the Fabric before dying.

2.6 Dye spots:

Fabric construction: - 70/30 CVC Fleece
Color: - Pink
Machine name: - Fongs dyeing m/c
Fault name: - Dye spots

Causes of faults: -
- Colored spots due to dye deposits on the m/c.
- Improper mixing of dye stuff into the solution.

Remedies: -
- Need to clean the m/c properly.
- By proper dissolving of dyes & chemicals.
- By passing the dissolved dyestuff through a fine stainless steel mesh strainer, so that the large un-dissolved particles are removed.

2.7 Uneven dyeing:

Fig. 1. Dye Spots

Causes of faults:
- Correct pH value not maintained.
- Inadequate scouring & bleaching of the grey fabric.
- Water hardness.
- Improper migration.
- Uneven pretreatment.
- Uneven heat setting.
- Improper soda dosing.
- Quick addition of dyes & chemical.

Remedies:
- Maintain the correct pH value.
- Scouring & bleaching fabric properly.
- Maintain water hardness.
- Proper migration.
- Ensuring even pretreatment.
- Ensuring even heat setting.
- Proper soda dosing.
- Proper neutralization.

2.8 Crease Mark:

Causes:
- Poor opening of the fabric rope.
- Shock cooling of synthetic material.
- If pump pressure & reel speed is not equal.
- Due to high speed m/c running.

Remedies:
- Maintaining proper reel speed & pumps speed.
- Lower rate rising and cooling the temperature.
- Reducing the m/c load.
- Higher liquor ratio.

2.9 Softener Mark:
Causes:

- Improper mixing of the Softener.
- Improper running time of the fabric during application of softener.
- Entanglement of the fabric during application of softener.

Remedies:

- Maintaining proper reel speed & pumps speed.
- Proper Mixing of the softener before addition.
- Prevent the entanglement of the fabric during application of softener.

3. Survey Result & Analysis

Here we see the major dyeing faults percentage (%) for various types of knit fabric in existing process and developing process where we can minimize the existing faults percentage (%) in a Lot by taking the above remedies which are discussed earlier.

3.1 For single jersey: (500 meter)

<table>
<thead>
<tr>
<th>Types of faults</th>
<th>Size of fault</th>
<th>No. of fault in existing process</th>
<th>No. of fault in developing process</th>
<th>% of fault in existing process</th>
<th>% of fault in developing process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unevenness</td>
<td>2.25” to 3.0”</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Reproducibility</td>
<td>3.25” to 6.0”</td>
<td>25</td>
<td>10</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Fastness variation</td>
<td>1.25” to 2.5”</td>
<td>30</td>
<td>5</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>Appearance of the goods</td>
<td>2.5” to 3.0”</td>
<td>30</td>
<td>5</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>(Shrinkage, Handle)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pilling</td>
<td>2.2” to 2.25”</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Uneven drying</td>
<td>1.67” to 3.0”</td>
<td>30</td>
<td>5</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>Shade variation</td>
<td>3.10” to 6.0”</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Dye spot</td>
<td>1.11” to 2.5”</td>
<td>20</td>
<td>10</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Crease mark</td>
<td>3.0” to 6.0”</td>
<td>30</td>
<td>5</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>Softener mark</td>
<td>2.25” to 9.0”</td>
<td>30</td>
<td>5</td>
<td>6%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Calculation:

% of fault in existing process:

For Unevenness:

Number of Fault in 500 meter fabric is 20,
So the no. of fault in 100 meter fabric is = (20x100)/500 = 4%
The rest fault percentage is calculated in the same way.

% of fault in developing process:

For Unevenness:

Number of Fault in 500 meter fabric is 5
So the no. of fault in 100 meter fabric is = (5x100)/500 = 1%
The rest fault percentage is calculated in the same way.
3.3 For Interlock Fabric: (500 meter)

Table III
Faults of Interlock Fabric: (500 meter)

<table>
<thead>
<tr>
<th>Types of faults</th>
<th>Size of fault</th>
<th>No. of fault in existing process</th>
<th>No. of fault in developing process</th>
<th>% of fault in existing process</th>
<th>% of fault in developing process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uneveness</td>
<td>1.25&quot; to 2.25&quot;</td>
<td>30</td>
<td>10</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>Fastness properties</td>
<td>2.25&quot; to 3.0&quot;</td>
<td>25</td>
<td>5</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Appearance of the goods</td>
<td>1.75&quot; to 6.0&quot;</td>
<td>20</td>
<td>10</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Pilling</td>
<td>2.25&quot; to 3.25&quot;</td>
<td>25</td>
<td>5</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Uneven dyeing</td>
<td>1.5&quot; to 6.0&quot;</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Shade variation</td>
<td>3.16&quot; to 6.0&quot;</td>
<td>20</td>
<td>10</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Dye spot</td>
<td>1.11&quot; to 2.5&quot;</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Crease mark</td>
<td>3.0&quot; to 6.0&quot;</td>
<td>25</td>
<td>10</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Softener mark</td>
<td>2.25&quot; to 3.0&quot;</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Calculation:

% of fault in existing process:

For unevenness:
Number of Fault in 500 meter fabric is 30
So the no. of fault in 100 meter fabric is = (30x100)/500 = 6%
The rest fault percentage is calculated in the same way.

% of fault in developing process:

For Uneveness:
Number of Fault in 500 meter fabric is 10
So the no. of fault in 100 meter fabric is = (10x100)/500 = 2%
The rest fault percentage is calculated in the same way.

3.4 For Lacoste Fabric: (500 meter)

Table IV
Faults of Lacoste Fabric (500 meter)

<table>
<thead>
<tr>
<th>Types of faults</th>
<th>Size of fault</th>
<th>No. of fault in existing process</th>
<th>No. of fault in developing process</th>
<th>% of fault in existing process</th>
<th>% of fault in developing process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uneveness</td>
<td>1.25&quot; to 2.25&quot;</td>
<td>30</td>
<td>10</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Fastness properties</td>
<td>2.25&quot; to 3.0&quot;</td>
<td>25</td>
<td>5</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Appearance of the goods</td>
<td>1.75&quot; to 6.0&quot;</td>
<td>20</td>
<td>10</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Pilling</td>
<td>2.25&quot; to 3.25&quot;</td>
<td>25</td>
<td>5</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Uneven dyeing</td>
<td>1.5&quot; to 6.0&quot;</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Shade variation</td>
<td>3.16&quot; to 6.0&quot;</td>
<td>20</td>
<td>10</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Dye spot</td>
<td>1.11&quot; to 2.5&quot;</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Crease mark</td>
<td>3.0&quot; to 6.0&quot;</td>
<td>25</td>
<td>10</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Softener mark</td>
<td>2.25&quot; to 3.0&quot;</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Calculation:

% of fault in existing process:

For unevenness:
Number of Fault in 500 meter fabric is 30
So the no. of fault in 100 meter fabric is = (30x100)/500 = 6%
The rest fault percentage is calculated in the same way.

% of fault in developing process:

For Unevenness:
Number of Fault in 500 meter fabric is 10
So the no. of fault in 100 meter fabric is = (10x100)/500 = 2%
The rest fault percentage is calculated in the same way.
3.5 For pique Fabric: (500 meter)

Table V

<table>
<thead>
<tr>
<th>Types of faults</th>
<th>Size of fault</th>
<th>No. of fault in existing process</th>
<th>No. of fault in developing process</th>
<th>% of fault in existing process</th>
<th>% of fault in developing process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uneveness</td>
<td>1.25’’ to 3.0’’</td>
<td>30</td>
<td>10</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>Appearance of the goods (Shrinkage, Handle)</td>
<td>2.0’’ to 2.95’’</td>
<td>15</td>
<td>5</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>Pilling</td>
<td>2.36’’ to 2.95’’</td>
<td>20</td>
<td>10</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Uneven dyeing</td>
<td>1.69’’ to 2.75’’</td>
<td>40</td>
<td>10</td>
<td>8%</td>
<td>2%</td>
</tr>
<tr>
<td>Shade variation</td>
<td>2.16’’ to 8.0’’</td>
<td>30</td>
<td>5</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>Dye spot</td>
<td>2.11’’ to 8.95’’</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Crease mark</td>
<td>2.0’’ to 6.0’’</td>
<td>30</td>
<td>10</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>Softener mark</td>
<td>2.5’’ to 6.0’’</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Calculation:

% of fault in existing process:

For unevenness:

Number of Fault in 500 meter fabric is 20

So the no. of fault in 100 meter fabric is = (20x100)/500 = 4%

The rest fault percentage is calculated in the same way.

% of fault in developing process:

For Uneveness:

Number of Fault in 500 meter fabric is 5

So the no. of fault in 100 meter fabric is = (5x100)/500 = 1%

The rest fault percentage is calculated in the same way.

3.6 For Fleece fabric: (500 meter)

Table VI

<table>
<thead>
<tr>
<th>Types of faults</th>
<th>Size of fault</th>
<th>No. of fault in existing process</th>
<th>No. of fault in developing process</th>
<th>% of fault in existing process</th>
<th>% of fault in developing process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uneveness</td>
<td>1.25’’ to 3.0’’</td>
<td>30</td>
<td>10</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>Appearance of the goods (Shrinkage, Handle)</td>
<td>2.0’’ to 2.95’’</td>
<td>15</td>
<td>5</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>Pilling</td>
<td>2.35’’ to 2.95’’</td>
<td>20</td>
<td>10</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Uneven dyeing</td>
<td>1.69’’ to 2.75’’</td>
<td>40</td>
<td>10</td>
<td>8%</td>
<td>2%</td>
</tr>
<tr>
<td>Shade variation</td>
<td>2.16’’ to 6.0’’</td>
<td>30</td>
<td>5</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>Dye spot</td>
<td>2.11’’ to 6.95’’</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Crease mark</td>
<td>3.0’’ to 6.0’’</td>
<td>30</td>
<td>10</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>Softener mark</td>
<td>2.5’’ to 6.0’’</td>
<td>20</td>
<td>5</td>
<td>4%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Calculation:

% of fault in existing process:

For Uneveness:

Number of Fault in 500 meter fabric is 30

So the no. of fault in 100 meter fabric is = (30x100)/500 = 6%

The rest fault percentage is calculated in the same way.

% of fault in developing process:

For uneveness:

Number of Fault in 500 meter fabric is 10

So the no. of fault in 100 meter fabric is = (10x100)/500 = 2%

The rest fault percentage is calculated in the same way.
4. Faults in Dyeing Process and Remedies

4.1 Chemical spot

Fabric construction: 70/30 CVC Fleece
Machine name: Dyeing and softening m/c
Fault name: Chemical spot.
Causes of faults:
- Use low quality de-foaming agent.
- Access chemical use in softening machine.
- Improper dosing
Remedies:
- Use good quality de-foaming agent.
- Appropriate chemical use.
- Proper dosing.

4.2 Soda spot

Fabric construction: 70/30 Lacoste
Color: Black
Machine name: Fongs dyeing machine
Fault name: Soda spot
Causes of faults:
- Not carefully use of NaOH.
- Alkalinity.
Remedies:
- NaOH should be use carefully.
- Proper neutralization.

4.3 Pilling

Fabric construction: 70/30 CVC Terry Fleece
Color: Royal blue
Machine name: Fongs dyeing m/c
Fault name: Pilling
Causes of faults:
- Due to friction of fabric.
- Improper enzyme treatment.
- Poor yarn quality.
Remedies:
- Proper enzyme treatment.
- Need good quality yarn

4.4 Lycra out

Fabric construction: - 97/3 1x1 Rib
Machine name: - Fongs dyeing m/c
Fault name: - Lycra out
Causes of faults:
- High temperature
- Access chemical use
- Access processing time.
Remedies:
- Control the temperature
- Appropriate chemical use
- Appropriate processing time.

4.5 Hole

Fabric construction: - 97/3 2x1 Rib
Machine name: - Fongs dyeing m/c
Fault name: - Hole

Causes of faults:

- Present of Fe (iron) in dyeing machine.
- Access NaOH use.
- Lack of proper operating.

Remedies:
- Use aluminum dyeing machine.
- Maintain NaOH use.
- Super operating in dyeing.

4.6 Percentage of dyeing faults in s/j fabric

Fig. 14. Percentage of dyeing faults in s/j fabric

4.7 Percentage of dyeing faults in rib fabric

Fig. 15. Percentage of dyeing faults in rib fabric

4.8 Percentage of dyeing faults in interlock fabric
4.9 Percentage of dyeing faults in lacoste fabric

4.10 Percentage of dyeing faults in pique fabric

4.11 Percentage of dyeing faults in fleece fabric

5. FINDINGS AND SUGGESTIONS

- Knit dyeing faults are coming mainly for the uncontrolled dyeing conditions. So we must be controlled dyeing conditions more appropriately.
- Some faults are come from the poor pre-treatment process. So during pre-treatment process we must be followed the process very consciously in order to ensure good pre-treatment process.
- Many faults are coming from both knitting and dyeing but we have to ensure that from where the fault is coming and causes/remedies will also be according to the source.
- Use of chemicals and their activity must be checked before broad use. It is important for good dyeing quality.
- Knit fabrics contain large amounts of lubricants which were added to make the fabric manufacturing process run efficiently. These lubricants must usually be removed in order to dye the fabric satisfactorily.
- When the inside surface of the dye bath is made of Fe included material then it can react with the chemicals. So the latest machineries can provide some special benefits for good dyeing quality.
- It is very important that the dyeing machine operators are must be expert and trained. Maximum dyeing faults are occurred due to the careless handling of material and machine operation.
- Machinery for dyeing must be resistant to attack by acids, bases, other auxiliary chemicals, and dyes. Type 316
stainless steel we can use as the construction material for all parts of dyeing machines that will come in contact with dye formulations.

5. CONCLUSION

Most common and some special faults of knit dyeing are interpreted in my report. According to this report we can observe how and when the faults are coming in the process and how is it possible to control or remove it. It is practical base knowledge where only the experienced person playing the important role to solve the faults of field. Some knitting faults are remain till the fabric is finished but here I have identified only the knit dyeing faults. This report is able to give a deep concept about knit dyeing faults, causes and their remedies. Finally think the report will contribute significantly to develop and enrich our knowledge on knit dyeing faults.

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INDUSTRY


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