Overview

Fabrics prepared from polyester yarns containing Nofia flame retardant, a non-migrating polymer additive, are permanently flame retardant. However, some auxiliary agents, used in the various process steps from fiber spinning to finished fabric, may decrease the flame retardant properties. In particular, the process lubricants (spin finish, coning oils, warp sizes, warp waxes and other applied finishes) are known to reduce fabric flame retardant properties. These auxiliary agents are wholly, or in part, aliphatic hydrocarbon based compounds and can be flammable. Proper scouring procedures need to be implemented in order to remove these compounds from the fabric.

In order to prevent a loss of flame retardant properties, the methods established for each processing step need to be well defined and followed with great care.

The information provided is intended to highlight the process areas where a high level of care is necessary. However, all process steps need to be fully evaluated.

Process Lubricants

The efficient processing of fibers, yarns and production of finished textile goods is dependent on a number of properties including the coefficient of surface friction and electrostatic discharge. The application of a controlled amount of an oil based coating on the fibers/yarns is the primary means of controlling these properties.

A primary consideration when selecting a process lubricant is the ease with which the material can be removed from the fabric during scouring. Complete removal of all applied lubricants is necessary to avoid any decrease in flammability properties.

In weaving, wereft oils are used, it must be possible to wash these out without leaving residues. Wax discs (paraffin based) must not be used; a residue typically remains in the fabric after scouring. Silicone based lubricants should not be used, for these compounds are also difficult to remove. Paraffin and silicone based lubricants must also not be used in the yarn
preparation for warp and weft knitting. The figure below illustrates the typical application points and characteristic add-on levels for process lubricants.

**Fabric Washing**

All process lubricants (spin finish, coning oils, warp sizes, warp waxes and other applied finishes) need to be fully removed. The presence of residual material on the fabric will have a negative effect on the flame retardant properties. The ease with which materials can be removed through scouring should be a consideration in selecting process lubricants.

Below is an example of a continuous scour formulation:

- 1.5 g/L Hostapal MRN® (Archroma)
- 1.0 g/L Calgon® T
- 2.0 g/L soda ash
- Temperature: 80 °C

Adequate quantities of water should be used for washing. Rinsing should initially be at 80 °C, followed by warm (40 °C) and then cold water. This is to help prevent re-depositing the process lubricants that have been removed from the fabric.

However, the effectiveness of this formulation needs to be confirmed for the particular process equipment used.
Washing of the fabric should be performed prior to heat setting. This is to avoid heat fixing of process lubricants, making them more difficult to remove.

**Bleaching**

When dying light shades it may be necessary to bleach the fabric before dying. An eco-bleach on a hydrogen peroxide basis should be considered. As with all treatment processes; the bleaching formulation should be thoroughly rinsed from the fabric.

**Dyeing**

Care must be taken in selecting the types of dyes used. Generally, disperse dyestuffs are used to dye polyester. It is possible for flame retardant properties to be reduced by the presence of dye auxiliary agents and residues on the fiber surface. Silicone defoaming agents should not be used. As with process lubricants, all dye auxiliary agents must be removed in washing. Typically, the dyeing temperature can be set at 120°C because FR PET dyes deeper than standard PET at lower temperatures. The hydrothermal treatment during a dye process at higher temperatures can affect the polymer and may result in worse FR properties.

**Printing**

Each printing method needs to be evaluated for the potential to add materials to the fabric that could negatively affect flammability properties.

- **Direct printing.** Seed gum derivatives and carboxymethylated starch are difficult to remove after steam or hot air processes. Residues of thickening agents can reduce flame retardant behavior.
- **Heat transfer printing.** Varnished papers should not be used, potential for a varnish layer to remain on the fabric.
- **Disperse resist printing.** Disperse resist process can lead to a deterioration in flame retardant properties. Alkaline disperse printing should be evaluated.
- **Pigment printing.** Bonding agents and synthetic thickening agents will diminish flame retardant properties.

**Fabric Treatments**

Fabric surface treatments (e.g., softeners, soil release, water repellency) can have an effect on flammability properties. All treatment auxiliaries should be tested prior to use. The softeners itself have to be flame retardant with Pekoflam (Archroma)

Some auxiliaries that can be evaluated include:

- Softeners: Leomin NI® (Archroma) has been used (pad system up to 20 g/L) on FR fabrics without affecting FR properties. Use Pekoflam as as FR additive
● Soil release finish: Cassapret SRH® (Clariant) (30–50 g/L, exhaust or pad system). Use Pekoflam as FR additive.

Sizing recommendations

Textured, flat, FR-PET filament yarns should be processed according to the single-end sizing principle. The following table provides details. The size coating is to a large degree dependent on the size product employed. The table is based on polyester sizes usually found in the trade (e.g. SF-2 from BASF).

<table>
<thead>
<tr>
<th></th>
<th>Flat Filament Yarns</th>
<th>Textured Filament Yarns</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 dtex, size coating [%]</td>
<td>5 - 6</td>
<td>11 - 14</td>
</tr>
<tr>
<td>76 dtex, size coating [%]</td>
<td>5 - 6</td>
<td>11 - 14</td>
</tr>
<tr>
<td>167 dtex, size coating [%]</td>
<td>5 - 6</td>
<td>10 - 12</td>
</tr>
<tr>
<td>Liquor Uptake [%]</td>
<td>30 - 50</td>
<td>75 - 100</td>
</tr>
</tbody>
</table>

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