TECHNOLOGICAL OPTIONS IN TEXTILE PROCESSING WITH RESPECT TO NON USAGE OF RESTRICTED CHEMICALS

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TEXTILE PROCESSING HAS IMPACT ON THE ENVIRONMENT THROUGHOUT THE PRODUCT CYCLE.

- ALL FIBERS HAVE AN IMPACT
- ALL PROCESSING OPERATIONS HAVE AN IMPACT
- ALL RETAILING OPERATIONS HAVE AN IMPACT
- ALL PRODUCT DISPOSAL HAVE AN IMPACT
- ALL PRACTICES LIKE WASHING AND LAUNDERING HAVE AN IMPACT
The Textile Industry is changing

- Higher demand for quality.
- Higher pressure for price.
- Shift of manufacturing to Asia.
- Growing globalisation & commoditization.
- Brands & retailers gaining importance.
- Fast-changing consumer tastes.
- Newer fibres & blends.
- Trend towards continuous dyeing.
- Shortage of qualified personnel.
- Growing use of computers.
TEXTILE BUSINESS IS HIGHLY FRAGMENTED

World is turning to a Global village
Yarn spun in Europe
Woven in Egypt
Processed – Garmented and stiched in India
Sold in a retail show room in the US
## ...WHERE DO WE STAND?

<table>
<thead>
<tr>
<th>Sector</th>
<th>India</th>
<th>Global</th>
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</thead>
<tbody>
<tr>
<td>Processing technology</td>
<td>Manual &amp; semi-automatic</td>
<td>Mechanised &amp; advanced</td>
</tr>
<tr>
<td>In-plant defect rates</td>
<td>3-5 %</td>
<td>&lt;1% Canada</td>
</tr>
<tr>
<td>Expenditure on R&amp;D</td>
<td>0.2% of sales</td>
<td>1.5 to 2%</td>
</tr>
<tr>
<td>Workers’ training</td>
<td>Ad-hoc</td>
<td>systematic</td>
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WHAT HAS CHANGED IN THE LAST THREE DECADES OR SO?

Environment
Health
Safety
What are Restricted Substances?

Substances that are

- restricted or banned from use
- in finished home textiles, apparel and footwear articles
- either due to legislation or by brands.
USE OF SAFE CHEMICALS

A safe chemical used wrongly can be many times polluting than a classified chemical used correctly.
Previously products under went testing to check for its purity.

Now, tested for its impurity profile in PPM, PPB and in extreme cases PPT.
# RESTRICTED CHEMICALS

<table>
<thead>
<tr>
<th></th>
<th>Banned Amines</th>
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<th>PAH</th>
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<tbody>
<tr>
<td>1</td>
<td>Disperse Dyes</td>
<td></td>
<td>Organotin Compounds</td>
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<tr>
<td>2</td>
<td>Other Carcinogenic Dyes</td>
<td></td>
<td>Isocyanides</td>
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<tr>
<td>3</td>
<td>Solvents</td>
<td></td>
<td>Flame Retardants</td>
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<tr>
<td>4</td>
<td>Pesticides</td>
<td></td>
<td>Chlorinated Aromatics</td>
</tr>
<tr>
<td>5</td>
<td>Biocides</td>
<td></td>
<td>Dioxins and Furans</td>
</tr>
<tr>
<td>6</td>
<td>Chlorinated Phenols</td>
<td></td>
<td>Formaldehyde</td>
</tr>
<tr>
<td>7</td>
<td>Heavy Metals</td>
<td></td>
<td>Fluorinated GHG</td>
</tr>
<tr>
<td>8</td>
<td>APEO / NPEO</td>
<td></td>
<td>Unreacted Monomers</td>
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<tr>
<td>9</td>
<td>Phthalates</td>
<td></td>
<td>Per fluorinated Compounds</td>
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<tr>
<td>10</td>
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<tr>
<td>UNDERSTANDING TERMS</td>
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<tr>
<td>Ecology</td>
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<tr>
<td>Toxicology</td>
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<tr>
<td>Aquatic toxicity</td>
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<td>Oral toxicity</td>
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<td>Sustainability</td>
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<td>Biodegradability</td>
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<tr>
<td>Bioelimination</td>
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<td>Endocrine disruptors</td>
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<td>CMR</td>
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<td>POP</td>
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<td>PBT</td>
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<td>vPvB</td>
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<td>BOD</td>
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<td>COD</td>
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<td>AOX</td>
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<td>SVHC</td>
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<td>ppb</td>
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<td>mg/kg</td>
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<td>mg/L</td>
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Are our operations sustainable?

To some extent yes, but to a large extent no
Sustainability is all about

Following Best management practices

Following Best available technologies

Following cleaner production initiatives
Regardless of mill location, these practices are real solutions for sustainable processing.
Cleaner Production

- Good Housekeeping
- Process changing
- Technology Changes
- Substitution of input materials

- Supply of eco-friendly, non-toxic & bio-degradable
  - Fertilizers
  - Pesticides
  - Dyes
  - Bleaches
  - Chemicals
  - Solvents
  - Sewing threads
  - Technical Enzymes
  - Printing materials
  - Specialty finishes
  - Packaging materials

- Quality water
Sustainable processing:

- Water footprint
- Energy footprint
- Carbon footprint
- No usage of hazardous chemicals in process
- Build Up of Chemical pollutants in water & air.
- Recycling
- Use of renewable sources of energy
How can cotton’s environmental footprint in manufacturing be reduced?

What technologies exist or need to be developed?
WATER: CRITICAL RESOURCE

- ESSENTIAL FOR LIFE AND INDUSTRY
- WILL BE CRITICAL RESOURCE FOR TEXTILE PROCESSING IN THIS MILLENNIUM
- WILL BE THE IN THE 21ST CENTURY WHAT OIL WAS IN THE 20TH CENTURY.
WEC USE IS GREATEST FOR DYEING & FINISHING

Distribution of water, energy & chemical use in textile processing (% of total use)

- Yarn spinning
- Fabric production
- Dyeing & finishing
- Garment manufacture

Water: 85% (2% Yarn spinning, 10% Fabric production, 8% Dyeing & finishing, 8% Garment manufacture)
Energy: 80% (5% Yarn spinning, 8% Fabric production, 8% Dyeing & finishing, 1% Garment manufacture)
Chemicals: 65% (22% Yarn spinning, 12% Fabric production, 1% Dyeing & finishing, 1% Garment manufacture)

FACTORS AFFECTING THE CONSUMPTION OF WATER

QUALITY

Source

Water Treatment

RECEIPE

Dye & Chemicals

ML Ratio

TECHNOLOGY

REPROCESSING
WATER CONSUMPTION PATTERN FOR A TYPICAL TEXTILE UNIT

- BLEACHING: 38%
- DYEING: 16%
- PRINTING: 8%
- BOILERS: 14%
- OTHERS: 24%
INPUT/OUTPUT ANALYSIS OF CHEMICAL PROCESSING

Wet Processing (pre-treatment, dyeing, printing, finishing)

- Dyes
- Base Chemicals: Eg. Acid, Alkali, NaCl
- Auxiliaries
- Textile Energy:
  - Natural Fibers: 10-20 MJ/kg
  - Chemical Fibers: 5-50 MJ/kg
- Polluted Air
- Water: 60-360 l/kg textile
- Water Effluent
- Waste: Sewage Sludge: 60-70 g/kg textile
More than 26 Different Technologies and Practices

50% Reduction in Water, Chemicals and Energy
OPTIONS AVAILABLE

- Shortening / eliminating processes wherever possible.
- High performance, high exhaust dyes available.
- Speciality chemicals performing one or more functions.
- Machineries more robust than before. Very low liquor ratio machines available
Tinkering with chemicals and enzymes

- Low temperature peroxide bleaching of cotton / cellulosic materials
- Single bath dyeing of polyester /cotton by Ph sliding method
- Dyeing of polyester at 100c
- Use of enzymes in soaping of reactive dyes
High Fixation Reactive Dyeing with Reduced Salt

- Higher fixation rates (85-90%)
- Higher affinity-reduced salt amounts
- Requires process control for level dyeing
- Hydrolyzed dye more difficult to remove
- Two reactive groups
- New alkali chemistry
- More expensive
Low Salt Reactive Dyes

- Lower total dissolved solid in effluent
- Water usage for rinsing reduced by 25% to 33%
- Improved hydrolyzed color removal
- Better colorfastness
- Better crocking
Combining Enzymes with Dyeing

- Normal Bleaching
- Hot rinse
- Add Enzyme Blend
- Add aux. and salt
- Add dyestuff
- Alkali dosage
- Start dyeing
- Adjust pH 6-7

Temperature

Minutes
Combining Enzymatic Processes

- Desize and Bio-scour
- Desize, Bio-scour, and Bio-Polish
- Bio-scour and Bio-Polish
- Bio-Polish and Dye
Soaping Aids

- Facilitate the removal of unfixed reactive dye
- Reduce the amount of rinsing required
- Reduce water and energy
- Increase productivity
Low Liquor Ratio Jet Dyeing

- Soft flow for gentle fabric action
- Use air rather than water to move the fabric
- Dyeing takes place in the venturi not in the bath
- Reductions in water, salt and auxiliary chemicals.
Alternative Reduction Chemistry

- Borohydride/Bisulfite reduction chemistry
- For both vat and sulfur dyes
- More environmentally friendly
- Lower odor level
- Reduction in total dissolved solids in effluent
- Reliable and efficient alternative
Why make cotton cationic?

- Can obtain tone-on-tone shades on fabrics, garments, rugs, etc. with the appearance of yarn dyeing
- Salt and alkali can be eliminated
- Higher dyebath exhaustion
- Improved colorfastness
Cationic Cotton

Untreated

Treated
Dyes for Cationic Cotton

- Direct
- Reactive
- Acid
- Vat
Imagine an economy

that purifies air, land, and water.

that uses only current solar income and generates no toxic waste.

whose materials replenish the earth or can be infinitely recycled.

whose benefits are shared by all.