Ecological dyeing and with minimum usage of water and energy

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THE TEXTILE INDUSTRY AND THE ENVIRONMENT

Environment problems in the textile industry:

- It uses an enormous quantity of water in dyeing with reactive dyes
- Color in the effluent difficult to eliminate (high solubility of dyes)
- High concentration of salt
- Alkaline pH
- Energy consumption
Consequences for western producers

- High emissions of CO2
- Effluent and water costs
- Low competitiveness
Water Consumption with reactive dyeing

- High level of water used in reactive dyeing
- Most of the water used in wash-off of hydrolysed dye
  - Between 6-10 separate washes
  - High energy consumption (one soaping, two rinses at 60ºC)
  - At least 50% total cost dyeing procedure
Alternative

Using H2COLOR PREMIUM PARTICLE DYES as a novel method of dyeing fibres.

- insolubility in water and therefore easy to remove.
- No soluble dye left in effluent (lower costs of treatment and no colour left in effluent)
- Easy to remove excess of H2COLOR (no need for extensive washing-off, saving in water, time and energy).
Technology of H2COLOR

- Combines existing dyes with a particle transforming the dye into a reactive nanopigment (200 nm)
- Dye will not separate from the particle even at high temperatures
- Reactive particle-dye behaves like a dye but is insoluble in water
- It will fix onto natural fibres (wool, cotton and silk) and regenerated fibres (viscose, Tencel) with good washfastness
System comparison

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Wash-off stages</th>
<th>Time (mins)</th>
<th>Water (l/kg fabric)</th>
<th>NaCl (g/kg fabric)</th>
<th>Na₂CO₃ (g/kg fabric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remazol RR</td>
<td>6</td>
<td>355</td>
<td>100-150</td>
<td>30-60</td>
<td>500</td>
</tr>
<tr>
<td>Procion H-EXL</td>
<td>7</td>
<td>455</td>
<td>150-200</td>
<td>80-90</td>
<td>500</td>
</tr>
<tr>
<td>H2COLOR</td>
<td>1</td>
<td>90-120</td>
<td>20</td>
<td>30-60</td>
<td>0</td>
</tr>
</tbody>
</table>
Discussion of results

• Water used is much less since there is only one rinse (10 to 30%)

• As the pH is neutral, no sodium carbonate is used

• Time is much less since 6 to 8 rinses are saved
Advantages

The great advantage of H2COLOR PREMIUM PARTICLE DYES relative to dyeing cellulosic fibres is the fact that there is no need of the washing off procedure at the end of dyeing, saving in this way more than 70% of water (95% if reused), 70% of time and 60% of energy. Since no dissolved dye is left in the dyebath it is easy to separate the H2COLOR from the dyebath and the water.
Effluent treatment

- Flocullants added
- Salt! Colour!
- River or water treatment station
- Sludge!
Reactive dyes effluent (right H2COLOR)
Effluent Indigo
RECYCLING THE WATER FROM DYEBATH
(saves 95% water)

It is possible to recycle the water from dyebath since H2COLOR dye particles are applied at neutral pH and can fix again on fibers.
REUSING H2COLOR

Recovering the H2COLOR may be a very significant saving, since all the H2COLOR that are left in the dye bath can be reused. Their re-use (recovery) can be done by measuring the color (absorbance) and replenishing the dye bath with fresh H2COLOR.

Also energy is saved since the water can be already at the dyeing temperature, or near.

No need for pH adjustment with alkali since dyeing is done at neutral pH
NEW PROCESS for cotton:
Dyeing with H2COLOR PREMIUM

- Classic process
- Eliminated with H2COLOR
Ecological clearing of disperse dyes in PE/CO blends (Ecoticlean)

- Reduction clearing of polyester is polluting and wastes water in intermediate washes (before dyeing cotton)
- Alternative ecological clearing will not use reducing agents and will not need intermediate washes
  - Product oxidises disperse dyes
  - Product bleaches cotton
  - Neutral pH
  - 60ºC
Dyeing PE/CO using ecological clearing, low-temp bleach and H2COLOR PREMIUM
Printed with H2COLOR
Indigo: Denim samples dyed 1,2 and 3 times
Feasibility and transferability of the GP

- Ecofoot was founded in 2012
- The team originated from the University of Minho, Center for Textil Science, a research center of excellence that has been working with the textile industry for many years, on international projects.
- This is an example of the transfer of technology from the university research to the market.
- Avepark played a key role in this process where new technological textile companies are incubated.
Conclusions

✓ Easy to apply (aqueous dispersion)
✓ Affinity for cellulosic fibres, wool and silk
✓ 75% less water, 70% less time and 60% less energy, no alkali, neutral pH
✓ Applied preferentially on knitwear and fabric by exhaustion dyeing (jet dyeing)
✓ Can apply by garment dyeing
✓ Can apply on woven fabrics by Pad-batch
✓ Uniform colours
✓ Good wash-fastness results, Good fastness to friction
✓ Can recycle 100% water, water can be recycled since pH neutral (H2COLOR removed by decantation and/or filtration)
✓ Can re-dye with same bath 2 to 3 times
Conclusions

The results of this new technology are:

- the reduction of financial costs in a traditional sector
- The reduction of ecological costs in the effluent process
- The reduction of process time
- and water consumption reduction.

- This is only possible with the evolvement of the University, the city of Guimarães, responsible for the development of the Avepark, and the traditional textile sector of the region.
THANK YOU

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