WP3
Synthesis of bio-dyes

BISCOL
ECO/09/256112

12 month meeting, September 26th, 2011
Role of the auxiliaries in dyeing

- Modify the interaction between the fibres and the dyestuffs
- The leveling agents reduce the adsorption kinetic by keeping high temperature (the solubility is not affected)
- Improve the solubility of the dyestuffs in presence of salts
## Role of the auxiliaries in dyeing

<table>
<thead>
<tr>
<th>Type of surfactants</th>
<th>Reccomended for use with</th>
<th>Dye class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-ionic</td>
<td>Cotton</td>
<td>Azoic, Vat, Direct</td>
</tr>
<tr>
<td></td>
<td>Wool; Nylon</td>
<td>Milling acid, Metal-complex</td>
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<tr>
<td></td>
<td>Polyester</td>
<td>Disperse</td>
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<tr>
<td>Non-ionic/Anionic</td>
<td>Polyester</td>
<td>Disperse</td>
</tr>
<tr>
<td></td>
<td>Wool; Nylon</td>
<td>Milling acid, Metal-complex</td>
</tr>
<tr>
<td>Non-ionic/Cationic</td>
<td>Wool</td>
<td>Acid, Mordant, Reactive, Metal-complex</td>
</tr>
<tr>
<td>Anionic</td>
<td>Wool; Nylon</td>
<td>Acid</td>
</tr>
<tr>
<td></td>
<td>Cotton</td>
<td>Direct</td>
</tr>
<tr>
<td></td>
<td>Polyester</td>
<td>Disperse</td>
</tr>
<tr>
<td>Weakly anionic</td>
<td>Polyester</td>
<td>Disperse</td>
</tr>
<tr>
<td>Anionic/Cationic</td>
<td>Wool; Nylon</td>
<td>Acid, Metal-complex</td>
</tr>
<tr>
<td>Cationic</td>
<td>Acrylic</td>
<td>Basic</td>
</tr>
<tr>
<td></td>
<td>Wool; Nylon</td>
<td>Acid, Metal-complex, Reactive</td>
</tr>
<tr>
<td>Weakly Cationic</td>
<td>Wool; Nylon</td>
<td>Acid, Metal-complex, Reactive</td>
</tr>
<tr>
<td>Cationic/polymeric</td>
<td>Cotton</td>
<td>Vat, Sulphur</td>
</tr>
<tr>
<td>Amphoteric</td>
<td>Wool</td>
<td>Acid, Mordant, Reactive, Metal-complex</td>
</tr>
</tbody>
</table>
Preparation of the BISCOL auxiliaries

Two different formulations have been set-up by ACHIMO in order to produce low environmental impact auxiliaries.

**Auxiliary 1 (Aux 1 – ACHISOL DAK\M)**

Derivative of Polyvynil Pyrrolidone with low molecular weight

**Wetting agent (important for the penetration of the dyestuffs)**

Etoxylated alchohol (9mmole) derived from natural sources
Dyeing of cotton fibres

A standard dyestuff has been used for the investigation of the effectiveness induced by the new auxiliaries.

Blue Dilamine Luce (C.I. Blue direct 71)
It is a sulphonic dyestuff similar to the dyestuff tested for the wollen fabric.
Characterisation of the BISCOL wetting agent

Wetting agent
Etoxylated alcohol (9mmole) derived from seed oil. The production of the chemicals form natural sources significantly increase the biodegradability (the secondary one is enhanced in comparison with conventional one – etoxylated alcohol from petrol sources or from palm oil).

Biodegradability new @ 28 d > 60% (OECD 301 F)
Biodegradability conventional @ 28 d < 60% (OECD 301 F)

There is the same COD for both compounds since it as a similar structure and carbon content but it is enhanced the biodegradability.
Characterisation of the BISCOL auxiliary 1

Aux1 – Low environmental impact auxiliary (biodegradable)

It is an unconventional surfactants since a polymer with a proper dimension has been used in order to simulate the behaviour of a fibres with an optimal length for the dyestuff.

The auxiliaries allow to reduce the treatment time enhancing the affinity between the dyestuff and the fibres/polymer.
Characterisation of the BISCOL auxiliary 1

Aux1 – Low environmental impact auxiliary

Ref. Amine Ethoxylated quaternized
(28 mmol)

It is **not biodegradable, toxic** and particular attention on the dosing must be paid in order to avoid a retarding action induced by its reaction with the dyestuff in the solution.
Moreover, it is not working as dispersing agent
Effectiveness of Auxiliary 1

Aux1 – Low environmental impact auxiliary
A preliminary test (COD measurements) has been performed in order to verify the reduction on the environmental impact of the new dyestuff in comparison with the conventional one.

COD aux1: 700 mg/kg (to be confirmed)
COD conventional: 1000 mg/kg

LC$_{50}$ aux1 (Daphnia: 96 h):
1000 mg/L

100x less

LC$_{50}$ conventional (Daphnia: 96 h):
1-10 mg/L

$\Delta = -30\%$
Effectiveness of Auxiliary 1

Aux1 – Low environmental impact auxiliary
The reduction is higher for the single dyeing process.

A lower amount of levelling agent is required:

- 0.3g/100g cotton fibres for Aux1
- 0.5g/100g wool fibres for Conventional product

\[ \Delta = -58\% \]
Effectiveness of Auxiliary 1

Aux1 – Low environmental impact auxiliary

The adsorption tests carried out by ACHIMO showed that no differences was recorded even if a higher penetration is achieved.
Effectiveness of Auxiliary 1

Aux1 – Low environmental impact auxiliary

The optimal dyeing process required 0.3% wt. of Aux1. In order to achieve the same results at least 0.5% of Amine Ethoxylated quaternized is required.
Conclusion

The new auxiliaries can be effectively reduce the environmental impact of the dyeing process.

The auxiliaries can be produced at large scale.

The optimisation of the dyeing process must be tested and optimised with the bio-dyes.