Dyeing of Polyester Using Microencapsulated Disperse Dyes

—A Non-Afterwashing Dyeing Technology

The invention concerns an eco-friendship dyeing method in which the use of traditional auxiliaries such as the dispersing agents, penetrating agents, leveling agents or other auxiliaries are avoided, besides the after-washings including thorough rinsing, reduction-cleaning, and washing with detergents can be eliminated.

With this method the dyebath becomes very simple, i.e. there are only dissolved dye molecules, microencapsulated dyes and fiber. The dyeing could be conducted in a currently used dyeing machine such as a HT dyeing machine. At the dyeing temperature, e.g. 130℃, the water molecules can easily penetrate the microcapsule wall and dissolve the dyestuff there. The dissolved dye molecules can diffuse from the cell into the dyebath and then adsorb onto the bar fiber forming a monolayer over the surface of the fiber. The adsorbed dye molecules can easily diffuse into the temperature activated fiber and fixed in it. The dyeing process is thus realized in such a way.

At the end of dyeing, the supplements of dyes are ceased and there are only few dissolved dyes and adsorbed dye molecules on the fiber. If the dyeing process is conducted for further 10-20 min without additional dye supplements into the dyebath, most of the dissolved dyes and adsorbed dye molecules can get into fiber further. There are only extremely small quantity of the dye molecules, the so-called unfixed color, left on the fiber surface giving enough fastnesses.

For a comparison, let us consider the case of the conventional dyeing using disperse dyes under assistant of auxiliaries:
First of all, the ingredients of the dyebath are rather complicated. The surfactants, the so-called auxiliaries, formed numerous micelles in which the disperse dyes are solubilized, the single molecules of the surfactants and dyestuffs, and the fiber that already saturated adsorbed surfactants formed a monolayer on the fiber. The monolayer of surfactant can solubilize much many dyes while the dye molecules buildup a layer of relative thick onto the fiber. In the whole process of dyeing this layer is held constant. As the dyeing ended, this layer of disperse dye is left on the fiber as the unfixed color, making thorough washing and reduction clearing necessary. This troubles the dyeing of the microfiber PET fabric especially!

As to the effluent of new dyeing method, only few dissolved dye molecules remain in the water all the time, and there are neither obvious COD nor BOD sources in the absence of auxiliaries.

The following are some comparison of the new method to the conventional one:
a) Process steps:
The said: 1: only dyeing
The conventional: 2: dyeing + after-washing (Including: rinsing → reduction-cleaning → washing with detergents → rinsing)

b) Ingredients of the dyebath:
The said: simple, water + fiber + dissolved dye molecules (only ppm scale) + microencapsulated dyes
The conventional: complicated, water + fiber with adsorbed surfactants and solubilized disperse dye + micelles with solubilized disperse dye + soluble molecular dye + solid dye + single surfactant molecules

c) Wastewater:
The said: effluent from dyeing, about 10-20t/t (fiber), light colored, no additives
The conventional: ① effluent from dyeing, about 10-20t/t (fiber), deep colored, with a great deal of surfactants.
② drain from the after-washing unit, about 80-120t/t (fiber), with heavy load of COD, BOD and color.

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<th>Table I Properties of the wastewater</th>
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<td>Appearance</td>
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<tr>
<td>COD&lt;sub&gt;5&lt;/sub&gt; (mg/L)</td>
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<td>BOD&lt;sub&gt;5&lt;/sub&gt;</td>
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Patent Reference:
1 Dispersing dye microcapsule dyeing method
   Inventor: CHEN SHUILIN [CN]; LUO YAN [CN]; Applicant: UNIV DONGHUA [CN]
   Patent No.: ZL 03116244.4 - 2005-07-06

2 Preparation method of dispersing dye microcapsule
   Inventor: LUO YAN [CN]; CHEN SHUILIN [CN]; Applicant: UNIV DONGHUA [CN]
   Patent No.: ZL 03116243.6- 2005-08-31

3 Preparation process of dispersing dye microcapsule
   Inventor: CHEN SHUILIN [CN]; LI ZHUO [CN]; Applicant: UNIV DONGHUA [CN]
   Patent No.: ZL 03116242.8 - 2005-08-17

4 A non-washing dispersing dye dyeing method
   Inventor: CHEN SHUILIN [CN]; ZHONG YI [CN]; FENG JIHONG[CN]; JI JUNLIN[CN];
   Applicant: UNIV DONGHUA [CN]
   Patent No.: ZL 200410054220.9 - 2005-09-28