Master Training Program on Water (Water Supply, In-house Processing, End-of-Pipe) in Textile and Garment factories

Promotion of Sustainability in the Textile and Garment Industry in Asia - FABRIC

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

FABRIC Asia

Day 5: **Presentation 3**

Recent Developments in water conservation in textile processing

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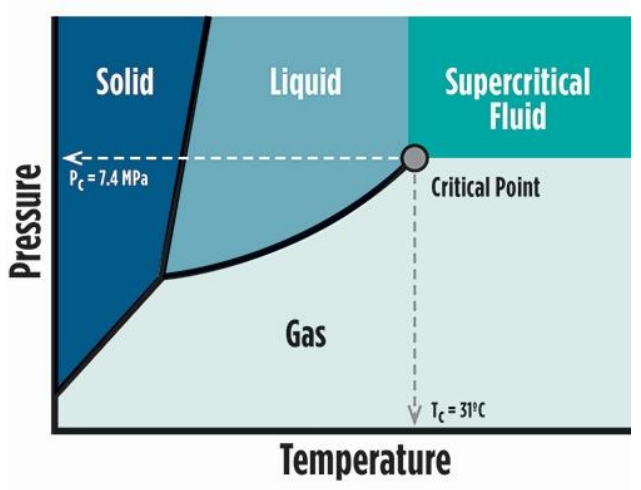
Outlines

Contents

- Supercritical CO_2 dyeing
- Cationic Cotton dyeing/nanodyeing
- Spray dyeing
- Plasma treatment or ozone treatment

Supercritical CO_2 disperse dyeing with synthetic fibres

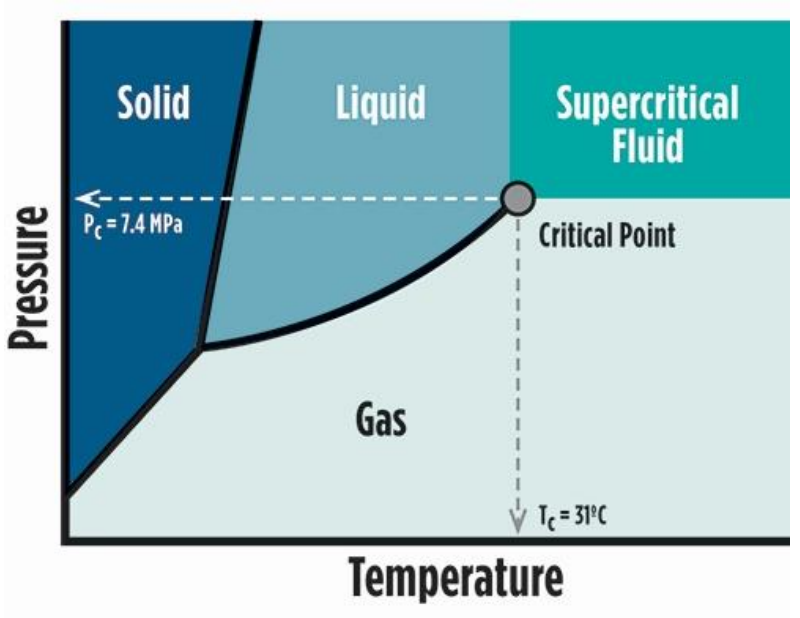
- Supercritical CO_2 is used as a dyeing medium instead of water in a closed-loop process to transport disperse dye into the polyester fibres
- No water or chemicals are required; therefore no water effluents are generated.
- The CO_2 used can be a by-product (waste gas) reclaimed from existing industrial processes; it is used in a closed-loop system with a 95% recycling rate



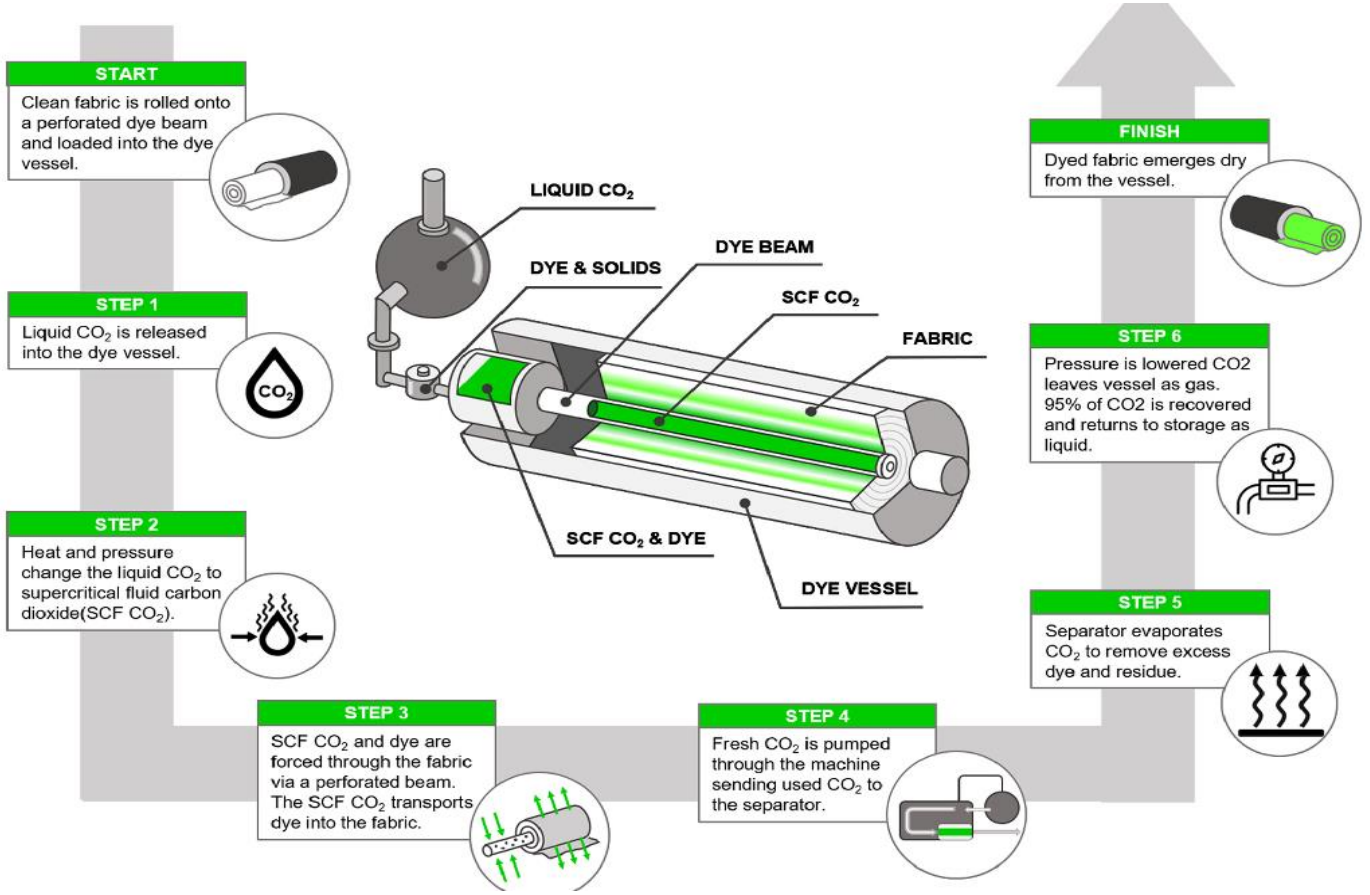
Supercritical CO_2 disperse dyeing with synthetic fibres

Advantages

- Uses pure dyes (preparations with 100% dye) and with more than 98% uptake.
- does not need additional chemicals to dissolve dyes
- Energy consumption is 20-50% lower compared to other water-based dyeing.
- Dyeing times are shortened due to the high dye diffusivity resulting in high extraction rates



Supercritical CO_2 disperse dyeing with synthetic fibres



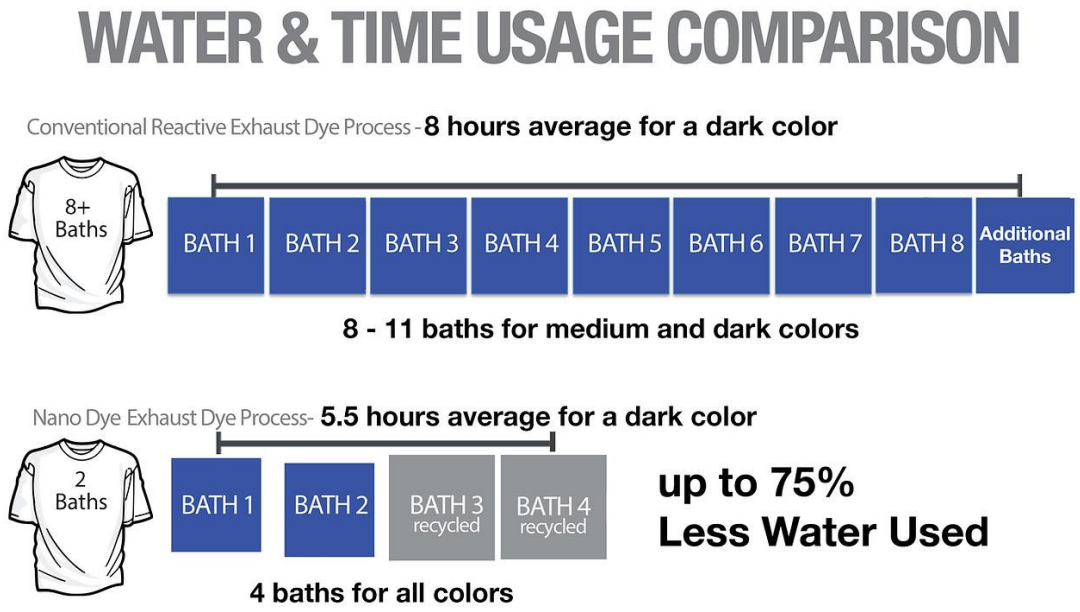
Source: Parkkuanhwan, Won Bae Kong , Youn-Woo Lee {2018}, Supercritical Dyeing Technology

Supercritical CO_2 disperse dyeing with synthetic fibres

Source: DyeCoo supercritical CO_2 dyeing machine

Cationic Cotton dyeing/nanodyeing

- The surface of cellulose fibres can be chemically modified by a pretreatment step like cationization or aminisation to increase their affinity for reactive dyes.
- The cationisation solution may be applied in different ways (exhaustion, pad-batch, pad-steam, pad-dry or a combination thereof) and to different textile substrates.
- Low- or zero- salt or alkali consumption;
- due to higher dye fixation, the dosed dyes are almost completely exhausted.
- The salinity of the effluent and the load of the unfixed dyes.

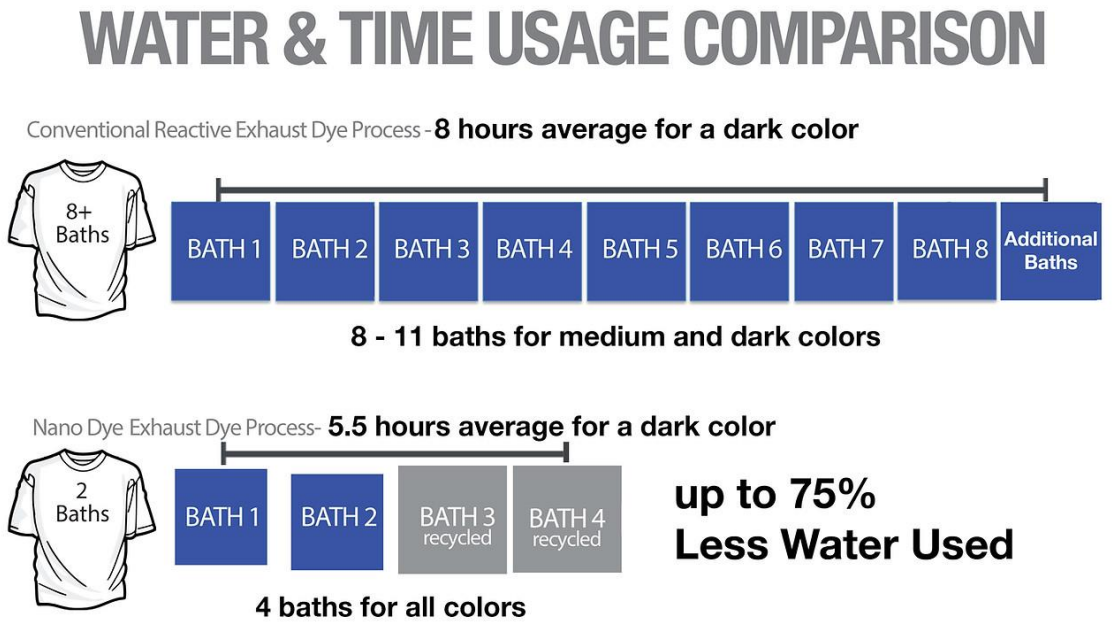


Source: https://www.nano-dye.com/

Cationic Cotton dyeing/nanodyeing

Advantages

- It is claimed by the nano-dye company that their technology can provide
- Up to less 75% water consumption in textile dyeing
- Up to less 90% energy consumption



Source: https://www.nano-dye.com/

Spray dyeing

- Dyes are applied by spraying on the textile material (fibre or fabric). The aerosols and droplets are formed through different physical mechanisms.
- Spray dyeing can be used for many dye/fibre combinations. For example,
- cellulose fibres dyeing with reactive dyes/pigments, with no salt requirements
- Dyeing synthetic fibre (PES and dispersive dyes, PA and acid or reactive dyes);
- dyeing wool with acid and reactive dyes
- Application of high affinity optical brighteners, fixing agents, functional chemicals, special neutralization agents and oxidation chemicals.

RotoDyer spraying indigo (source: RotaSpray GmbH)

Spray dyeing

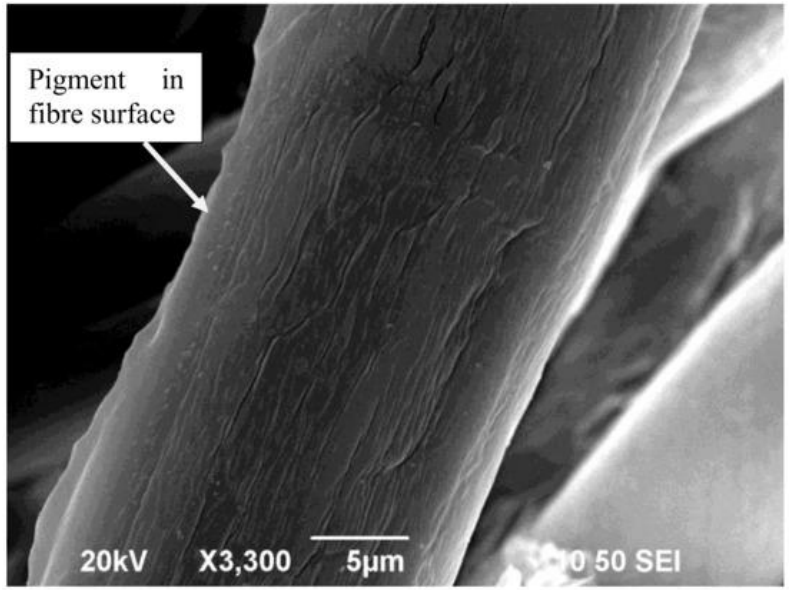
Advantages

- In indigo spray dyeing, the dyeing liquor volume is 90 litres (versus 10,000-50,000 litres with conventional slasher dyeing) and
- In sulphur spray dyeing 45 litres (versus 1,200-4,000 litres by using conventional boxes)

RotoDyer spraying indigo (source: RotaSpray GmbH)

Plasma/laser/ozone treatment

- Processes such as plasma/laser/ozone treatment can reduce water use.
- Plasma, a mixture of partially ionised gases, are able to modify surface physically and chemically. Plasma treatment can be performed on natural fibres and synthetic fibres, to achieve -
- wool degreasing;
- desizing;
- change of fibre wettability (hydrophilic, hydrophobic properties);
- increase in dyestuff affinity;
- improved dye levelling properties;
- anti-felt finishing in wool
- sterilisation (bactericidal treatment), etc.

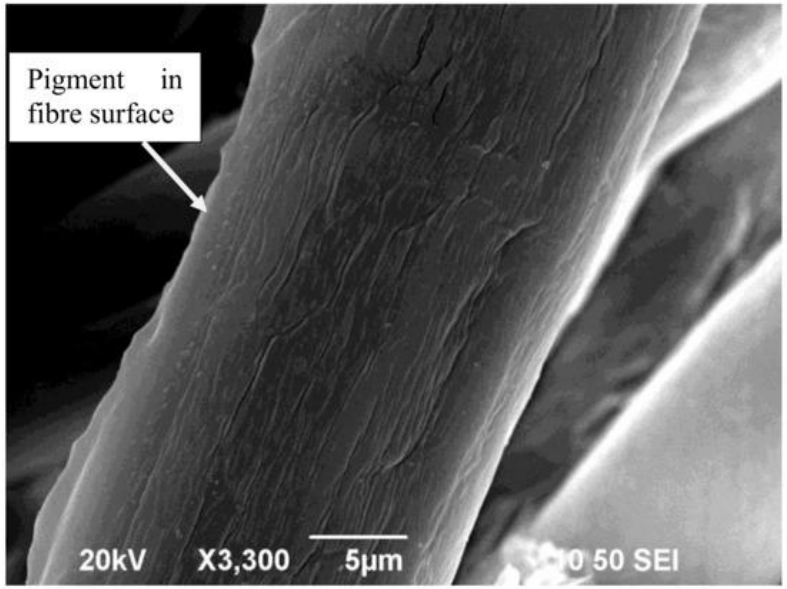


SEM image of atmospheric pressure plasma-treated cotton fibre after 5 g/L pigment dyeing
Source: https://www.mdpi.com/2076-3417/8/4/552/htm

Plasma/laser/ozone treatment

Advantages

- Almost no water or solvent use
- No or less chemical is required
- Extremely short processing time
- Low application temperature



SEM image of atmospheric pressure plasma-treated cotton fibre after 5 g/L pigment dyeing
Source: https://www.mdpi.com/2076-3417/8/4/552/htm

Reference

- Checklist based on best available techniques in the textile industry, Germany Federal Environment Agency (UBA) https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/4294.pdf
- Best Available Techniques (BAT) Reference Document for the Textiles Industry, European IPPC Bureau, https://eippcb.jrc.ec.europa.eu/sites/default/files/2020-01/TXT_bref_D1_1.pdf

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