

Applications of scCO₂ as a “Green” Solvent in the Textile Industry

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scCO₂ has many applications in the textile industry

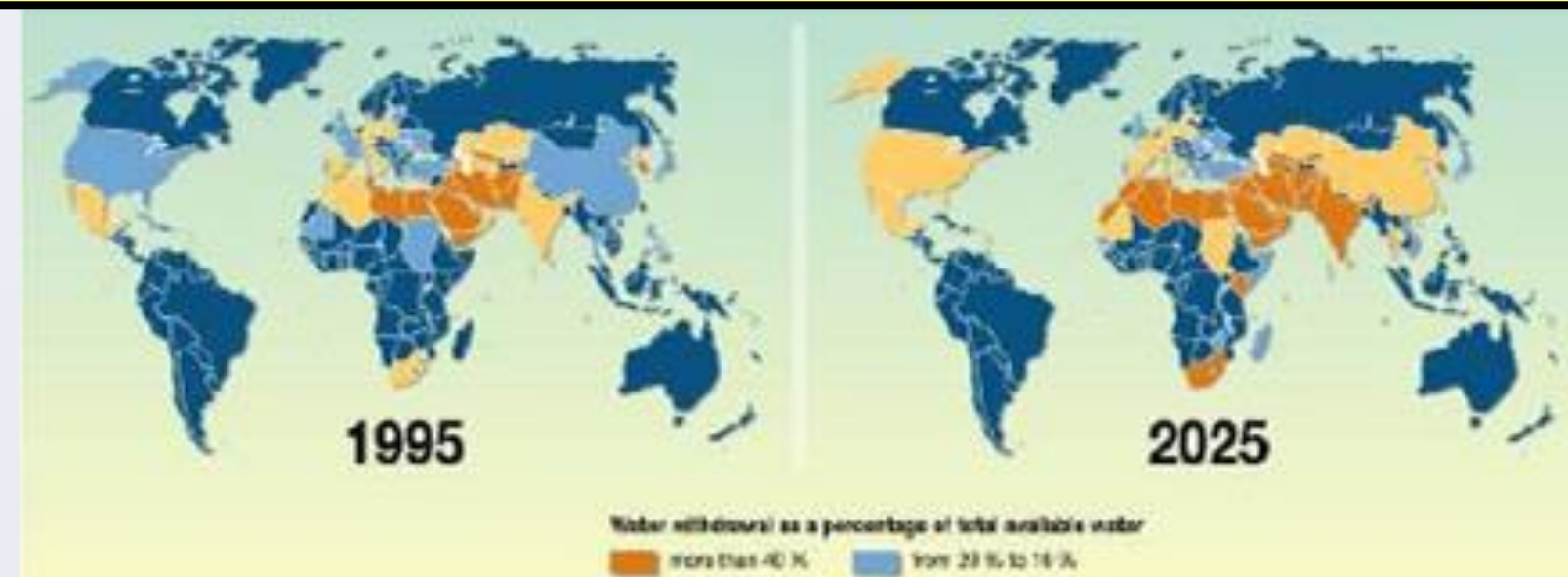
Textile Dyeing

- Polyester fabrics
- Garments
- Polyester knit yarn
- Nylon

Textile Scouring

- Nylon
- Cotton

Regions with the highest urbanization rates and expanding industry are often critically short of water

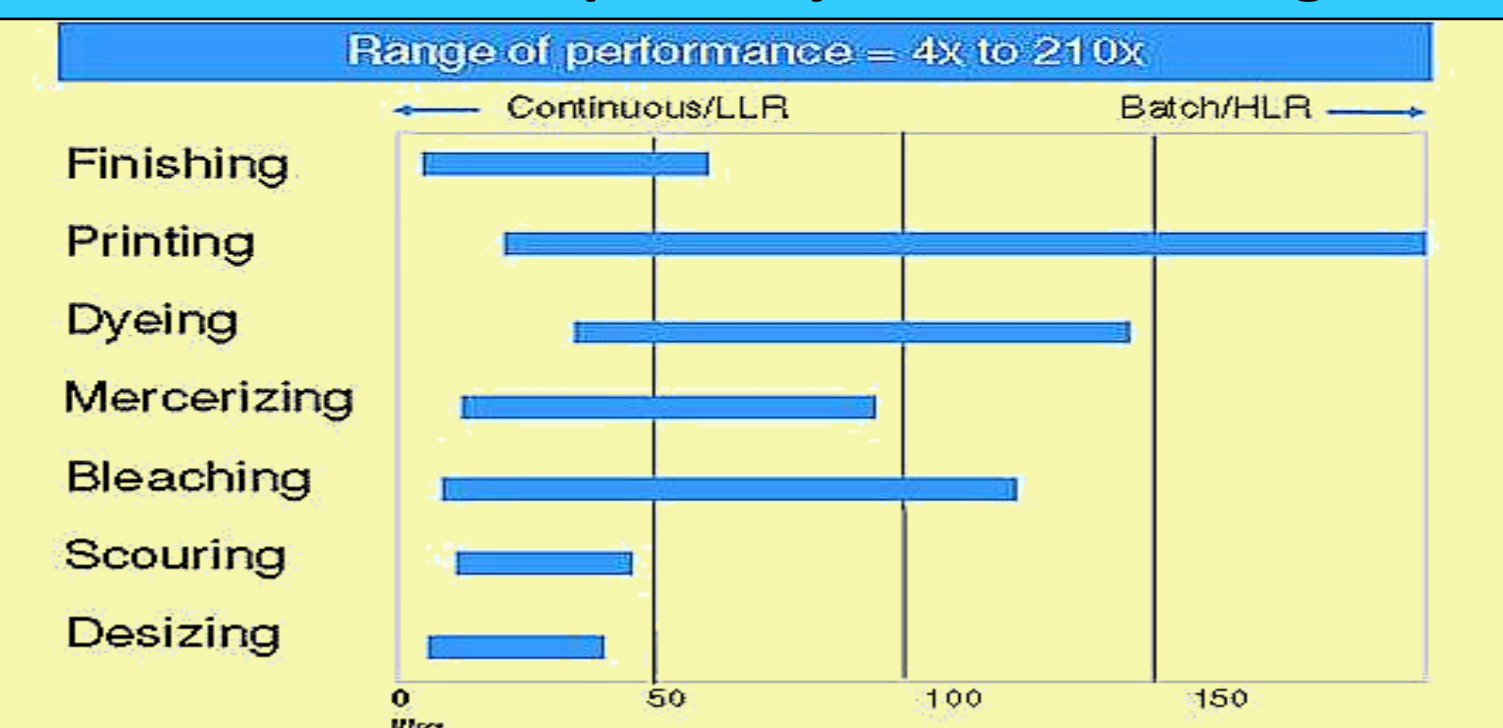


The needs of industry and agriculture have to be balanced against the demands of a growing population for a clean, safe, domestic water supply.

The textile industry uses an incredibly large quantity of water for its operations

Water footprint in textile processing

Water Consumption by Wet Processing



- Every kilogram of textiles processed uses over 100-150 kilograms of water for dyeing only
- Total industry usage is greater than one trillion liters annually
- Huge amount of fresh water
- Even greater amount of water to process as waste
- Regions with the highest urbanization rates and expanding industry are often critically short of water

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Carbon Dioxide Eliminates Water Use in Textile Dyeing

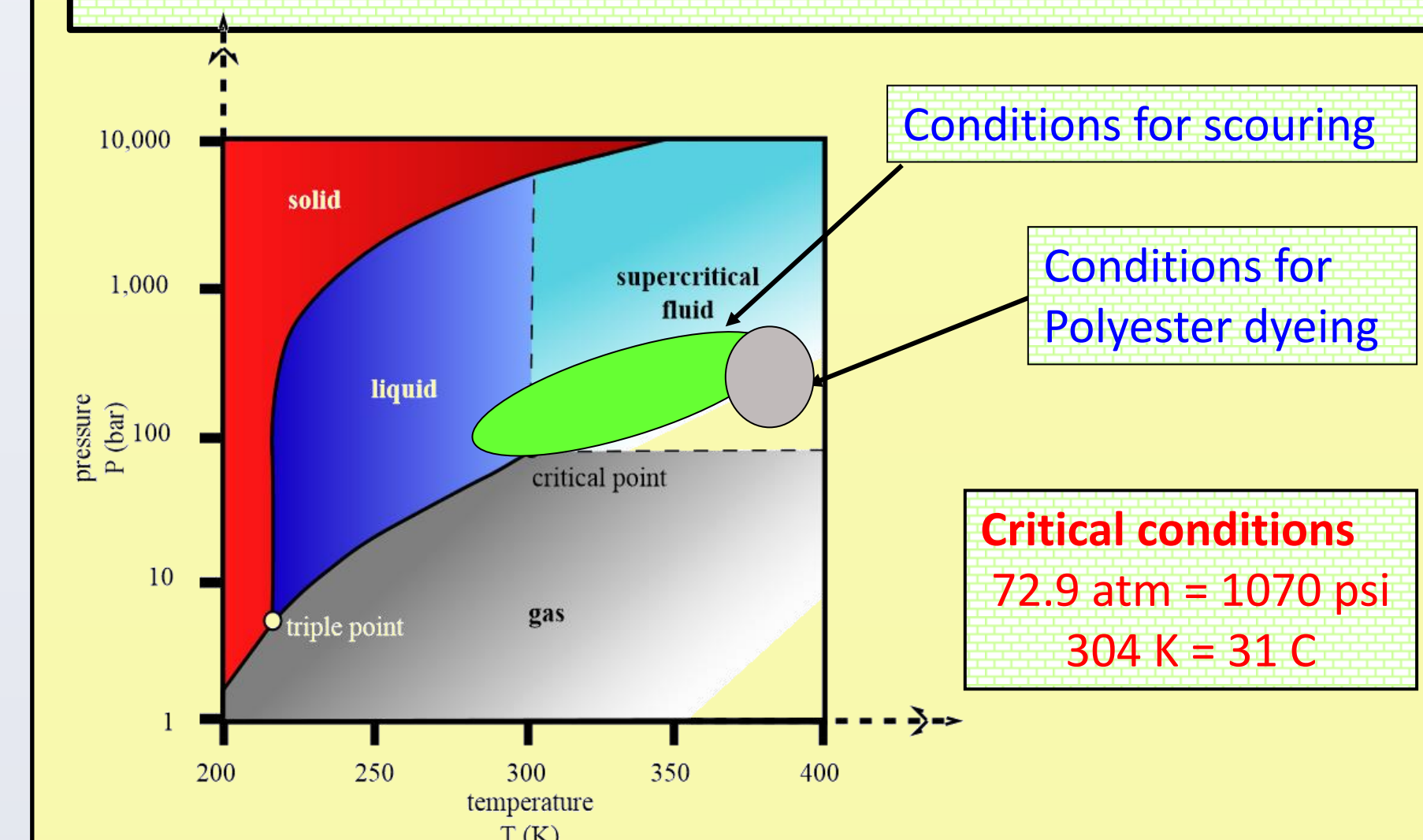
- CO₂ replaces water as the dye solvent
 - CO₂ in supercritical state as a solvent
 - Most CO₂ is recycled and not vented
- Significantly reduced contaminated and treated water
- Reduced operating costs
- Energy
 - Dyes, chemicals

Why SC-CO₂

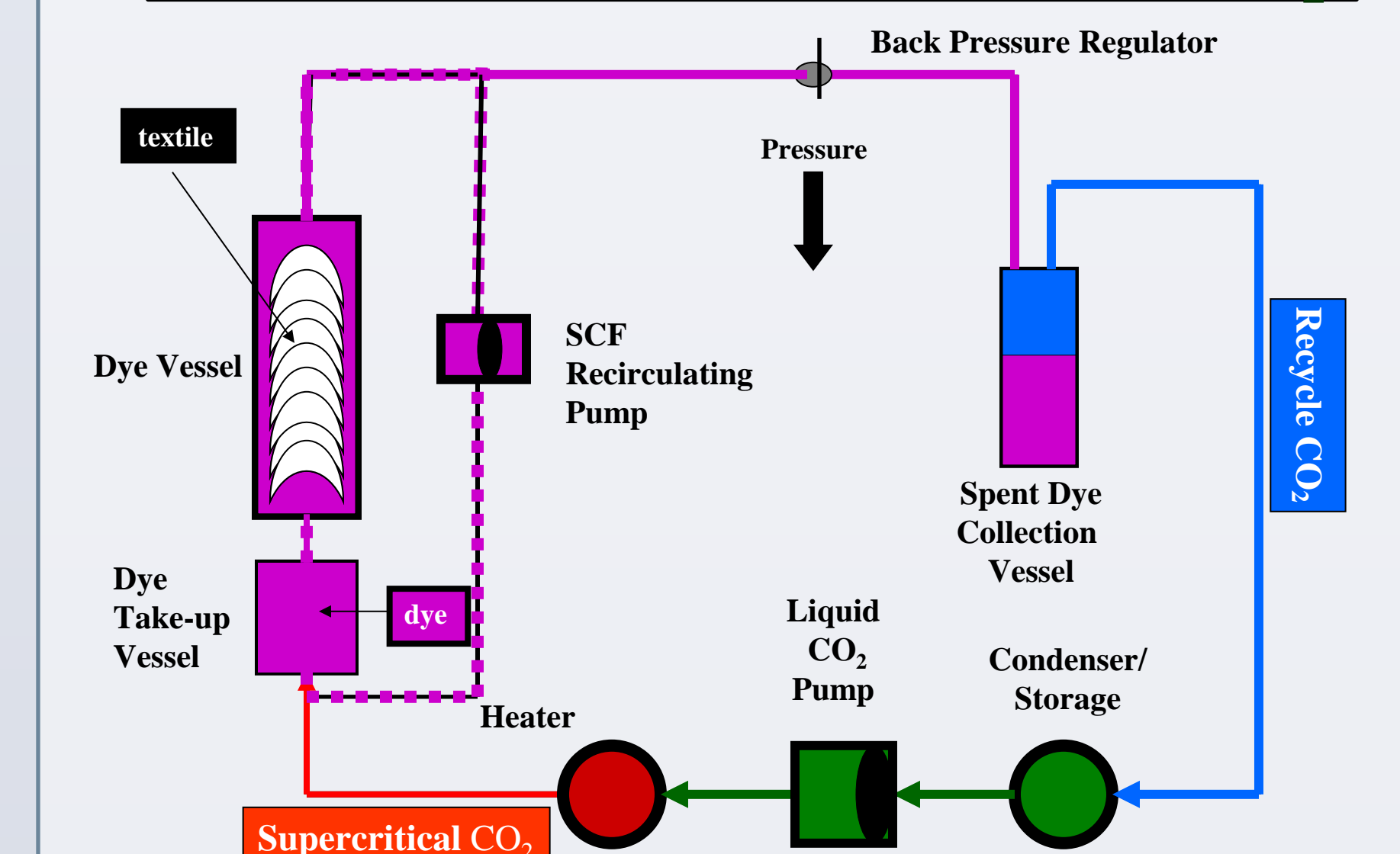
scCO₂ is a solvent (can dissolve dyes, oils, waxes)
Adjust solvent properties (tunable)

- Low cost
- Safe, environmentally benign/non-toxic, readily recyclable
- Does not oxidize
- Remove from dye vessel already dry

Textile Operations T, P Ranges



Textile Dyeing using Supercritical CO₂

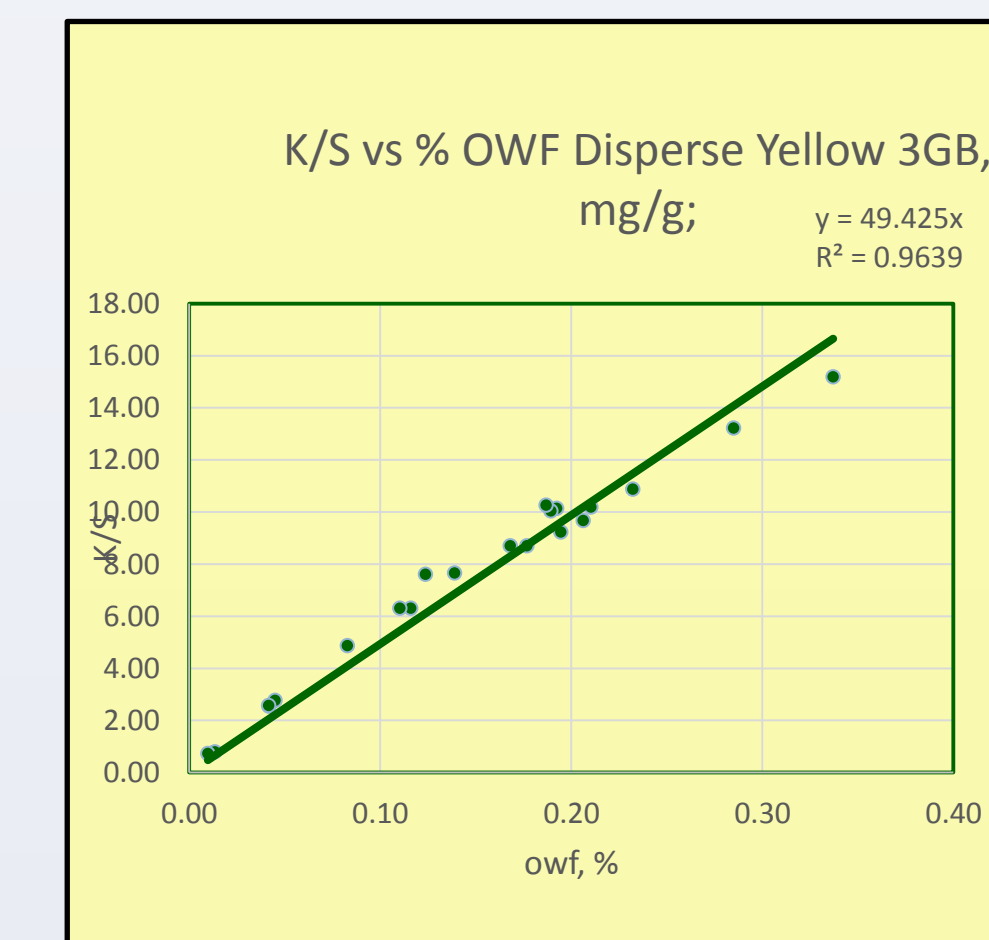


Lab Equipment for Dyeing and Scouring



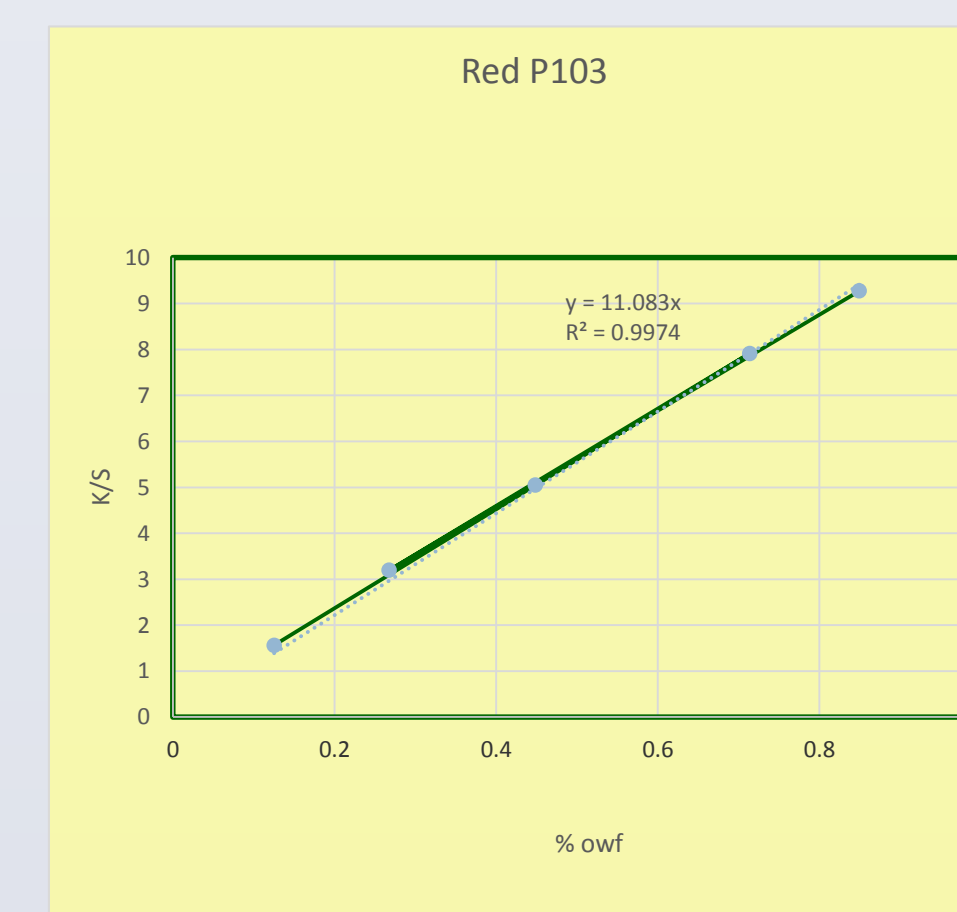
Yellow Primary Dye

Excellent correlation between K/S and dye amount used

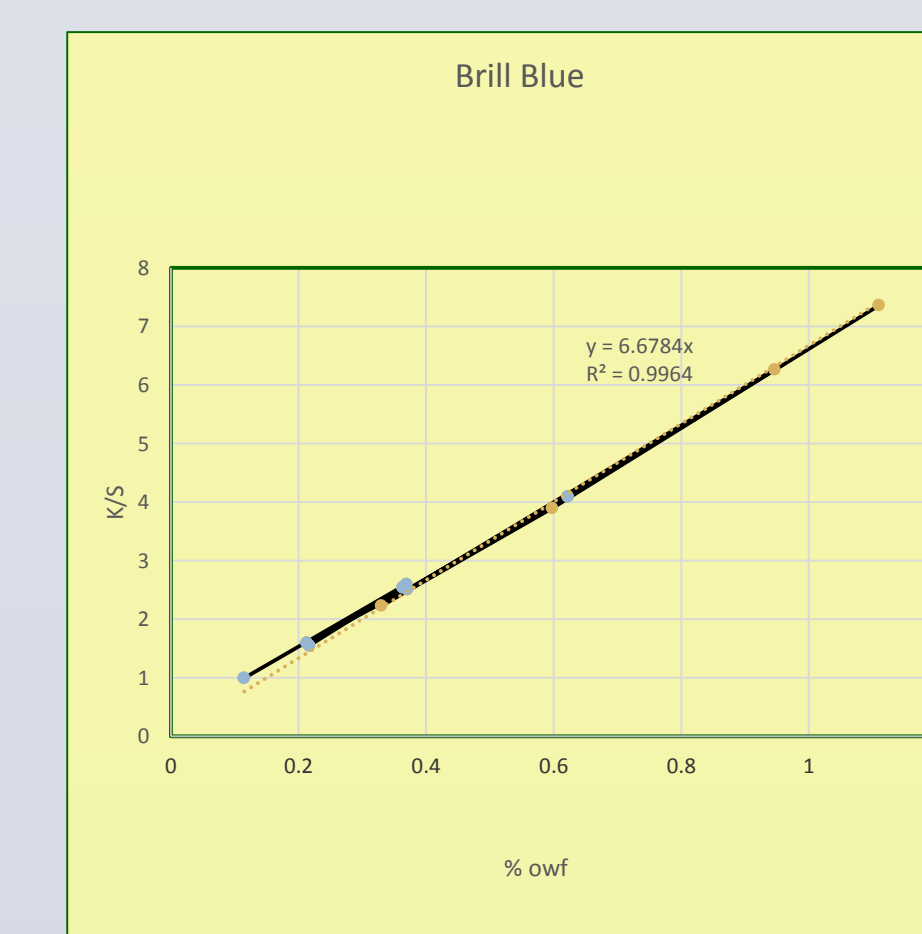


Primary Disperse Red Dye P103

Color development similar to traditional water based dyeing



Blue Disperse Dye Affect of Dye Used on Depth of Color



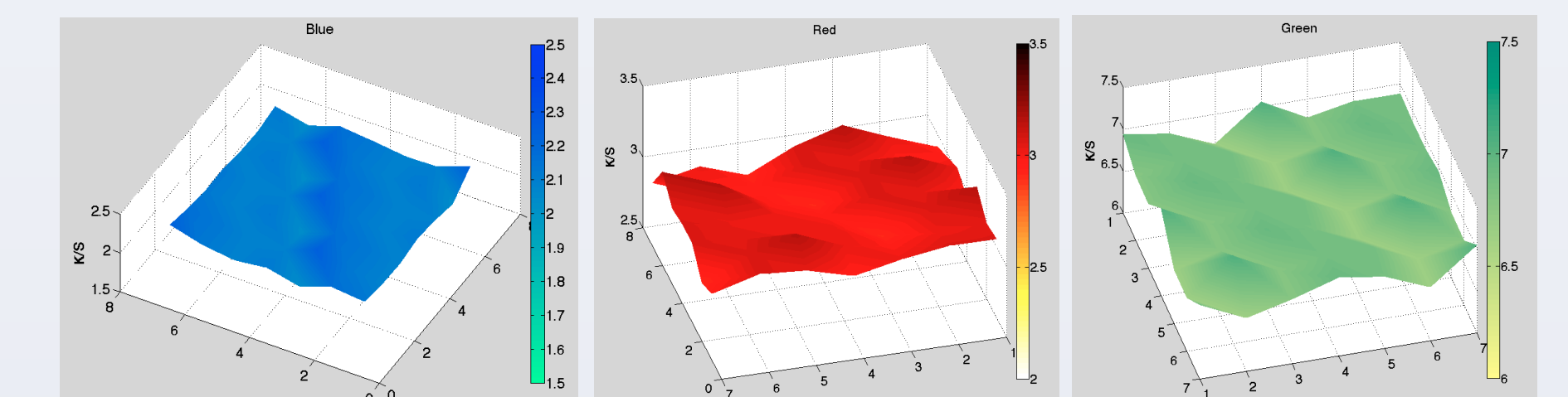
for color database development

Pilot Plant Equipment for Dyeing and Scouring



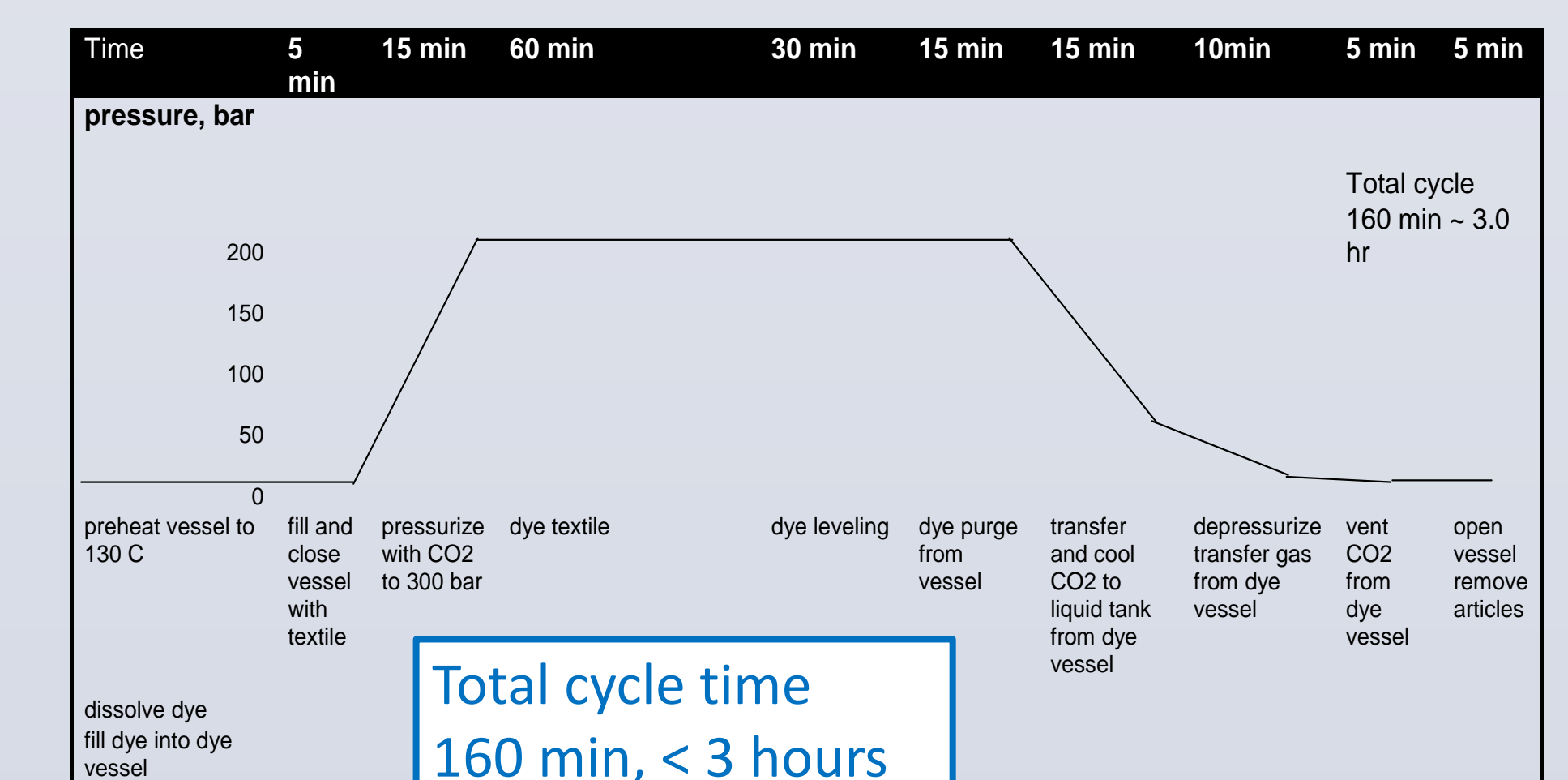
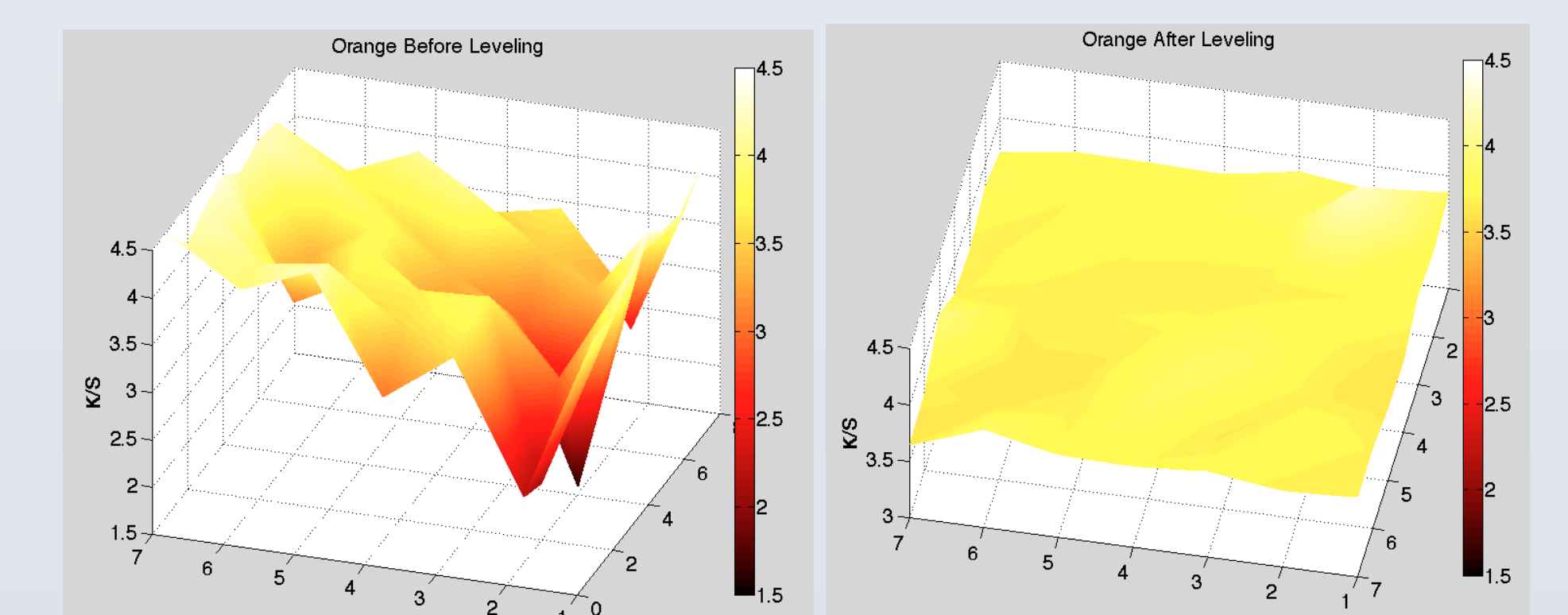
Color Characterization and Mapping

- Measure reflectance using Datacolor Colorimeter (calculate K/S)
- Map surface of fabric for uniformity (K/S variation at minimum reflectance)



Effective Leveling Step in Dyeing Process (Red+Yellow = Orange)

Leveling reduces local color variations to acceptable levels



Conclusion

Demonstrated success dyeing yarn, fabric or garment
Flexibility

- Geographically – no need for water source
- Geographically – close to market
- Stage of textile production
- Opportunity for new applications with more controllable process variables

Novel color match technology

- In-process color measurement technique