

Nonaqueous Dry Dyeing of Aramid Spun Yarn with Disperse Dyes Under Supercritical Solvent Medium

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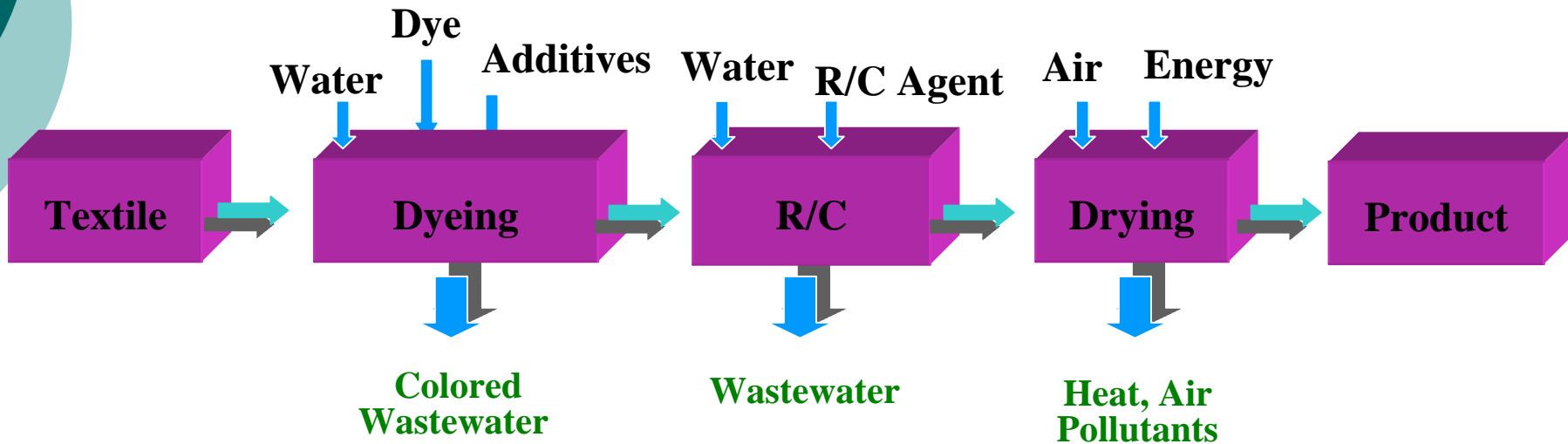
Objectives

- ❑ Relationship between properties of disperse dyes and supercritical fluid
- ❑ Finding of optimal dyeing condition
- ❑ Development of new dyeing technique for non-dyeable fiber
- ❑ Investigation of fiber properties in supercritical fluid



Comparison of conventional wet dyeing & SFD

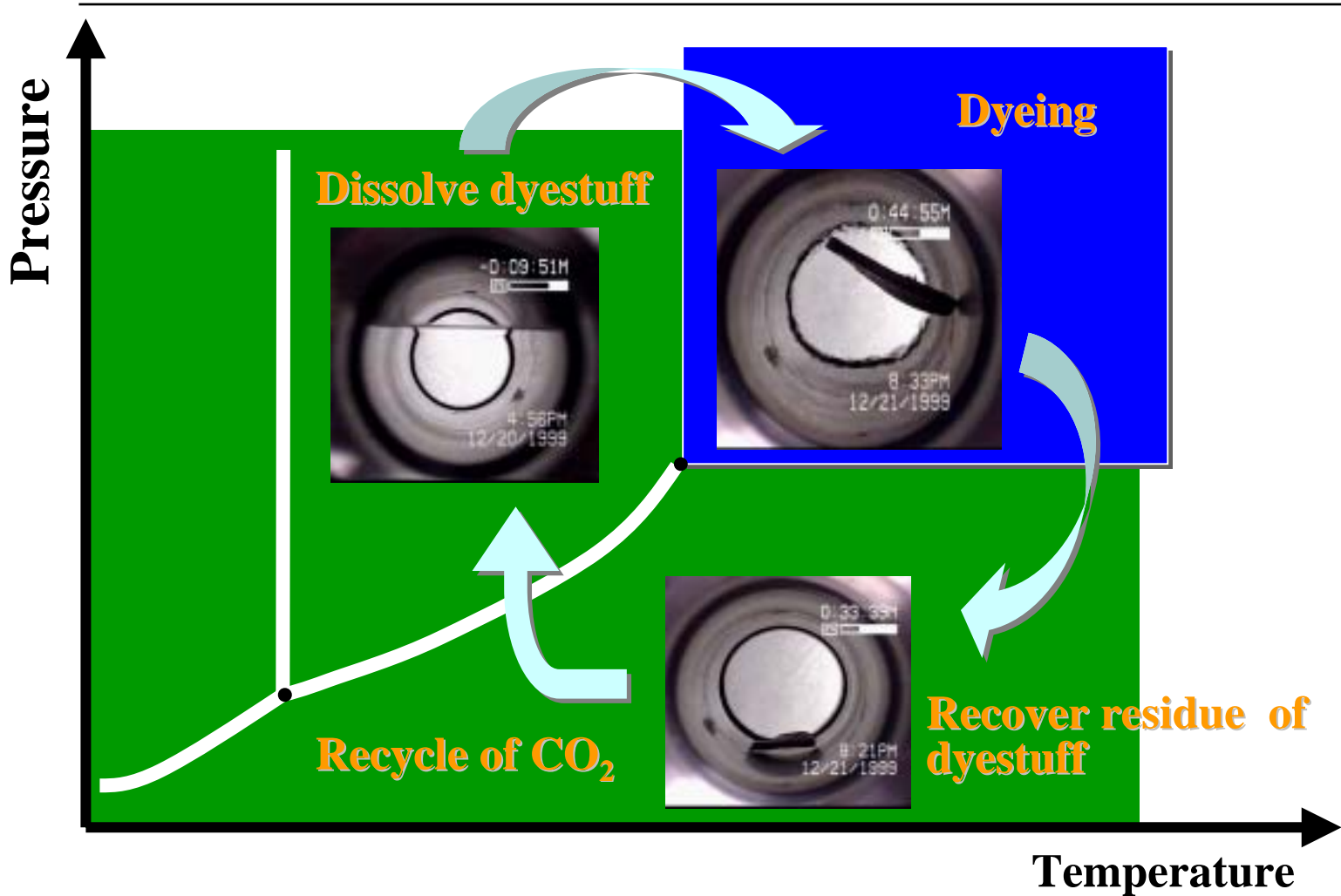
❖ Conventional Wet Dyeing Process



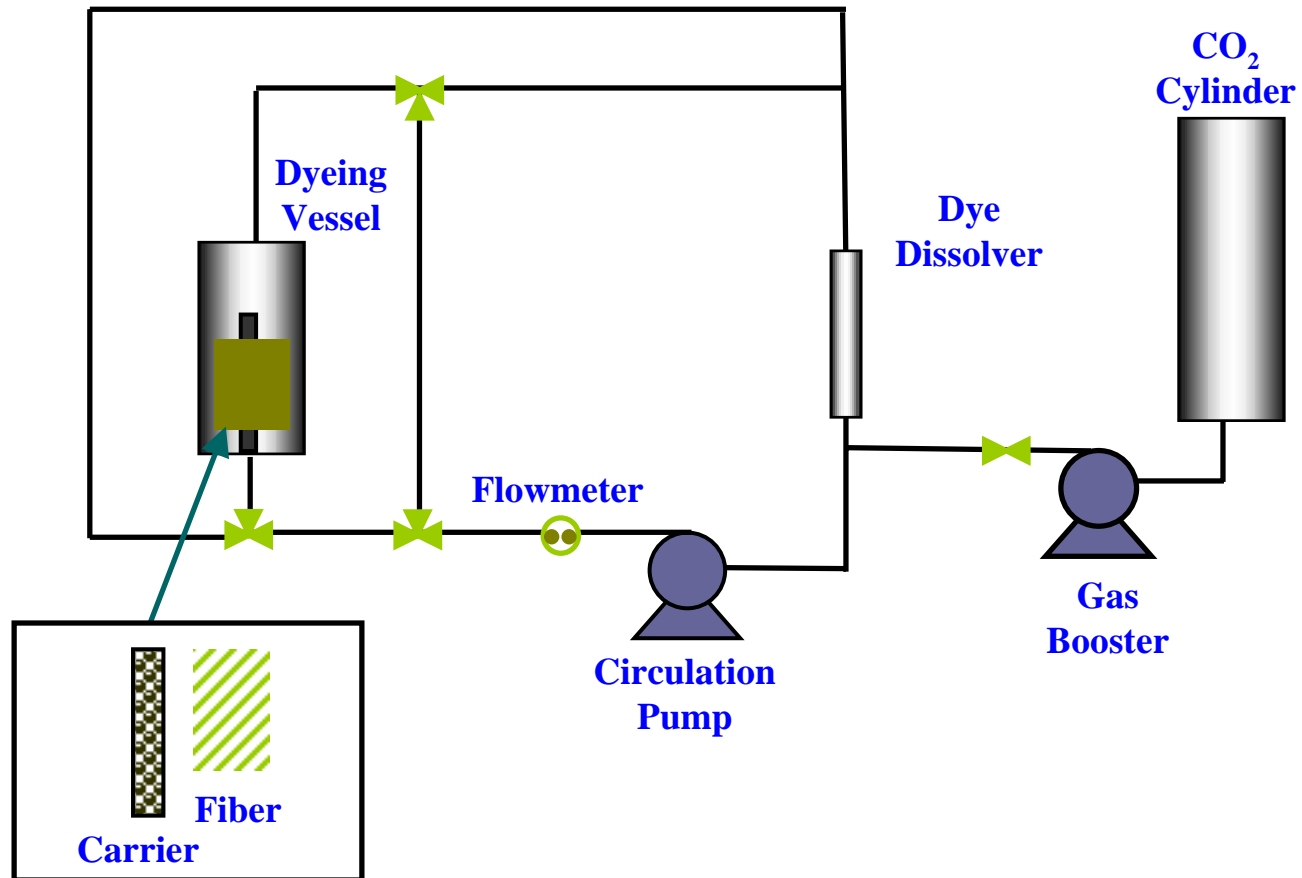
❖ SCF Dyeing Process



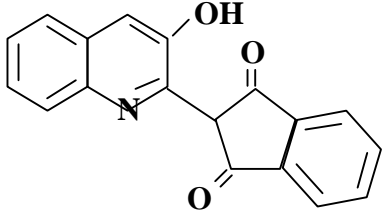
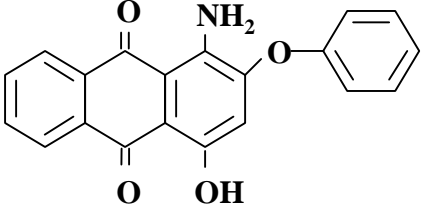
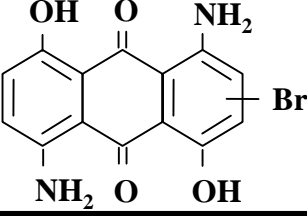
Principle of SFD Process



Schematic diagram of SFD apparatus



Properties of Disperse dyes (E type)

Dyestuff (E type)	Formula	Particle Size (PSA)	T _m (DSC)
C.I. Disperse Yellow 54		0.63 μm	270
C.I. Disperse Red 60		0.50 μm	187
C.I. Disperse Blue 56		4.12 μm	199



Experimental condition

Temperature	90 , 120 , 130 , 150
Pressure	10 MPa, 20 MPa, 30 MPa
% o.w.f	0.1 o.w.f, 0.5 o.w.f, 1.0 o.w.f, 1.5 o.w.f, 2.0 o.w.f, 3.0 o.w.f

o.w.f : on the weight of fiber



Measurement of K/S value

- C.C.M. (SF600, Datacolor, U.S.A.)

$$K/S = \frac{(1-R)^2}{2R}$$

Where, **K** : the coefficient of absorption of the dye

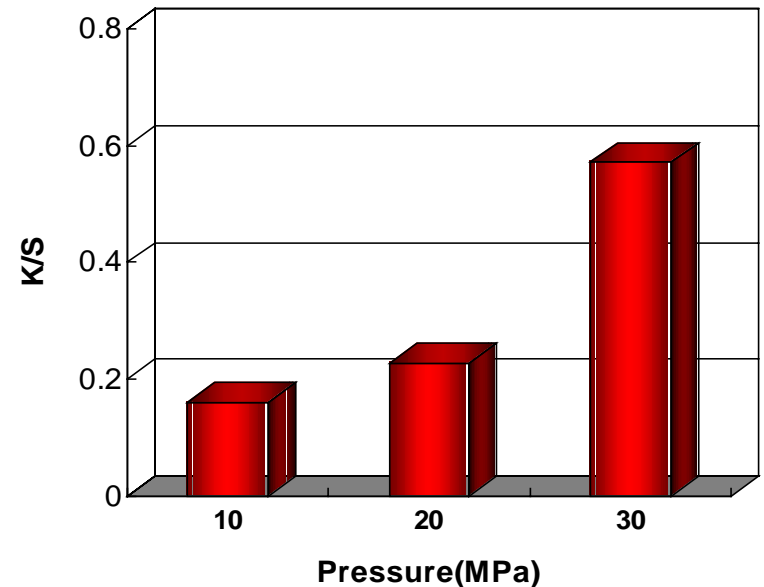
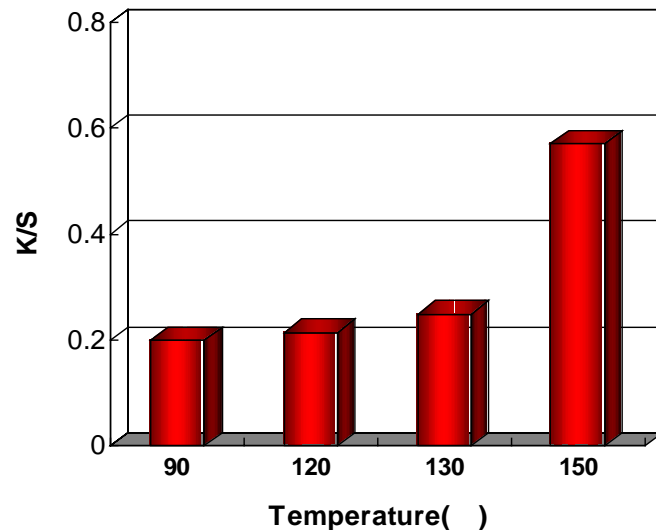
S : the coefficient of scattering

R : the reflectance



Dyeability with temperature and pressure

C.I Disperse RED 60



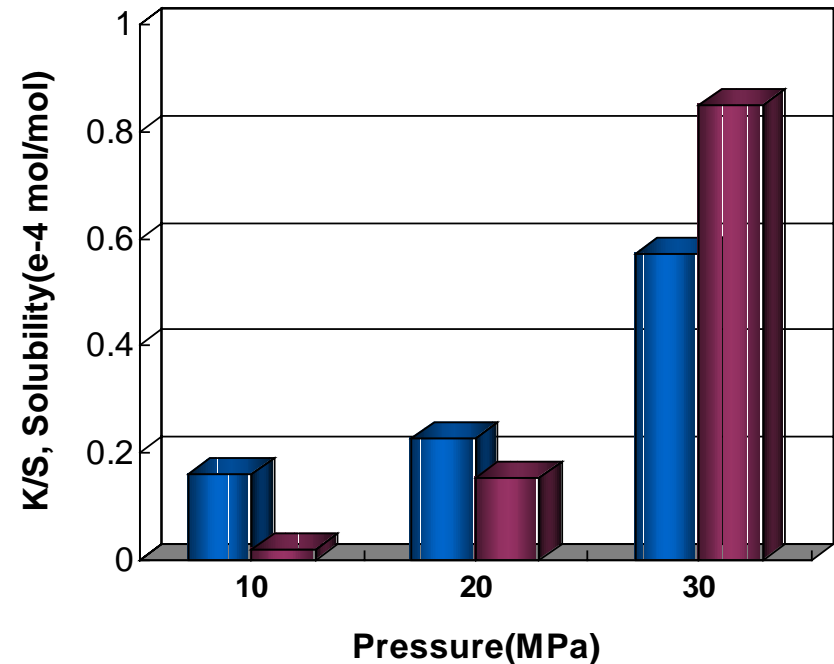
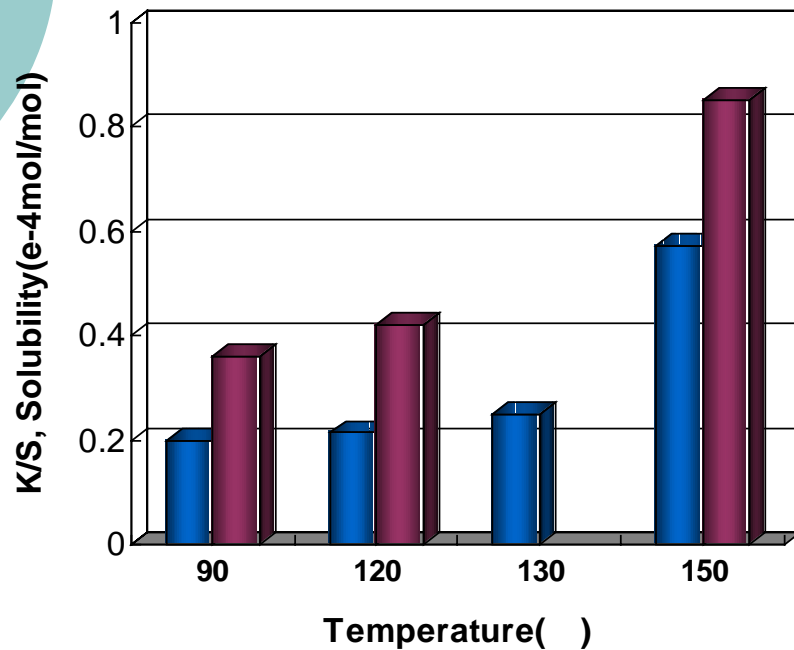
Dyeing condition : 30MPa, 60min,
C.I.Disperse Red 60, 0.5 % o.w.f.

Dyeing condition : 150 °C, 60 min,
C.I.Disperse Red 60, 0.5 % o.w.f.



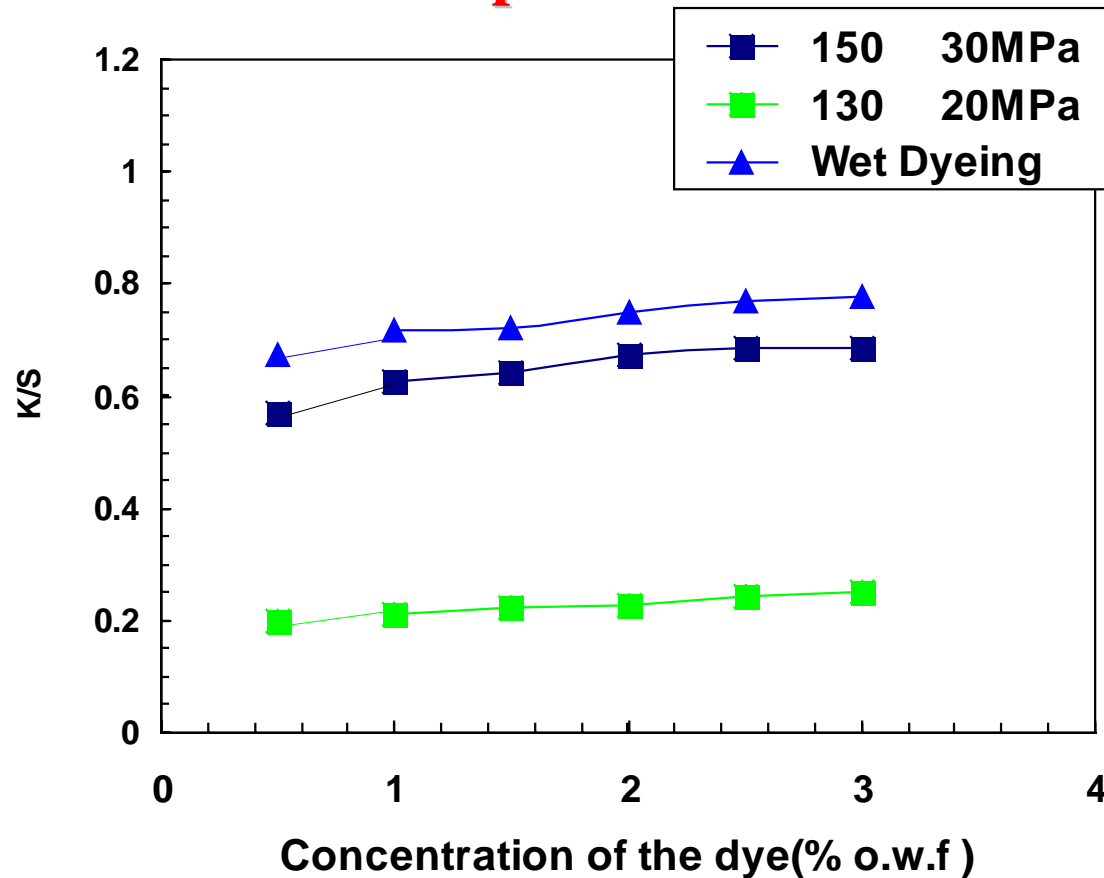
Dyeability, solubility with temperature and pressure

Condition : 30MPa, 60min , C.I.Disperse Red 60, 0.5 % o.w.f.



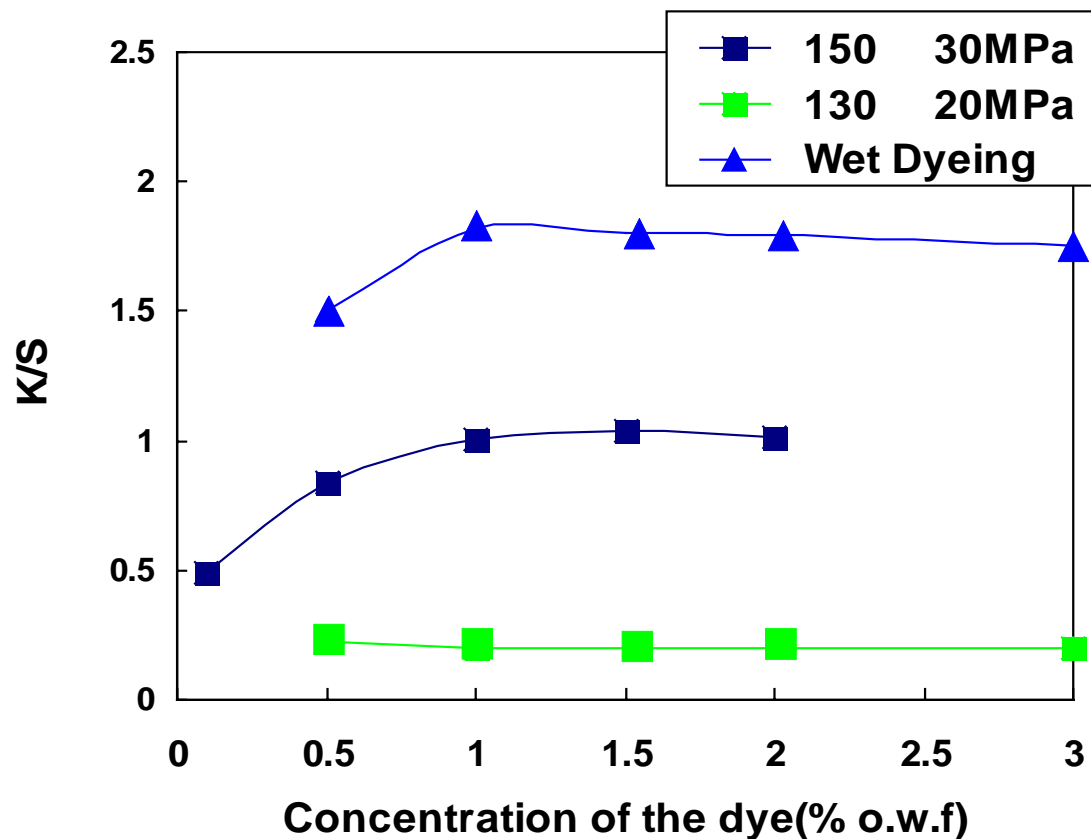
Adsorption isotherm of dyestuff for Aramid

C.I.Disperse Red 60



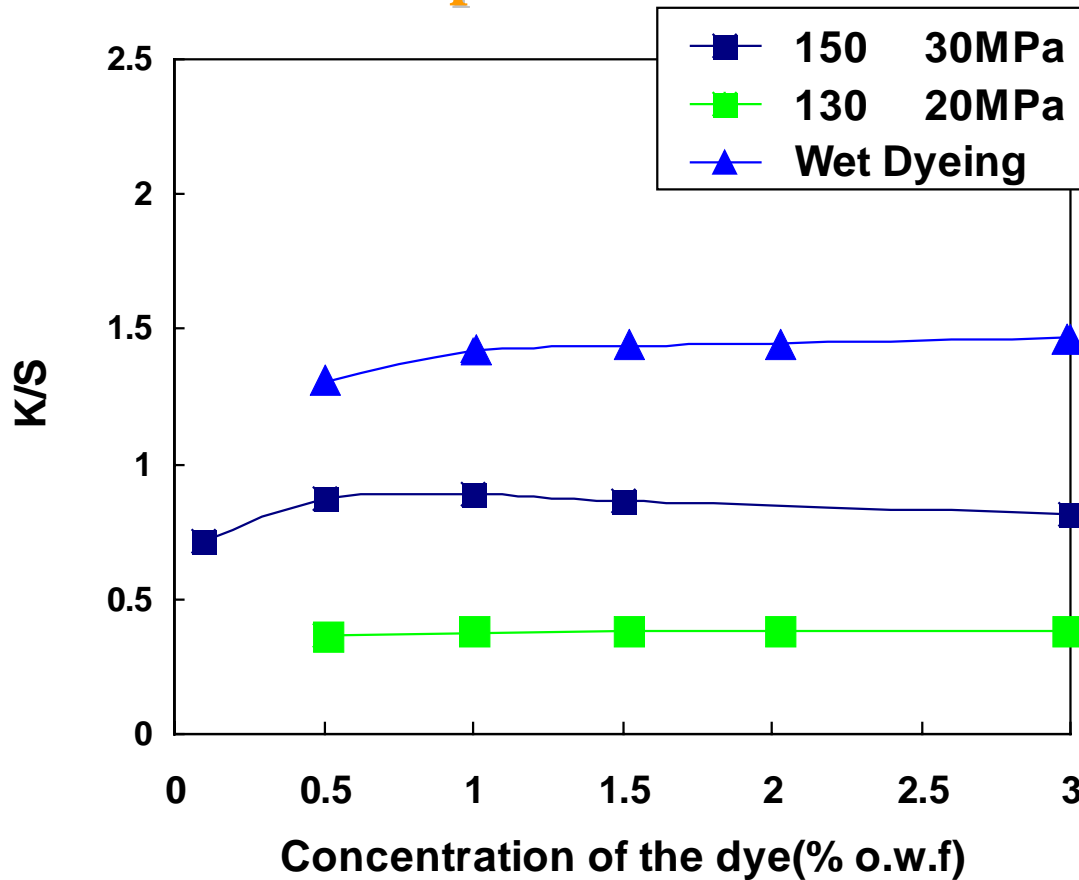
Adsorption isotherm of dyestuff for Aramid

C.I. Disperse Blue 56



Adsorption isotherm of dyestuff for Aramid

C.I.Disperse Yellow 54



Fastness of Aramid Fiber dyed by SFD & WD

Sample	Washing							Rubbing		Light	Subli- mation
	Staining						Fade	D	W		
	A	C	N	P	Ac	W					
C.I Disperse Red 60, 0.5% (ARAMID)	5	5	5	5	5	5	4~5	4~5	5	1	4~5
C.I Disperse Blue 56, 0.1% (ARAMID)	4~5	5	4	4~5	5	4~5	4~5	4~5	4	1	4~5
C.I Disperse Yellow 54, 0.5% (ARAMID)	4~5	4	4	4~5	5	5	5	4~5	4	1	3~4
C.I Disperse Red 60 Wet dyeing, 0.5% (ARAMID)	4-5	5	4-5	5	5	5	4	4-5	4-5	1	3-4



Conclusions

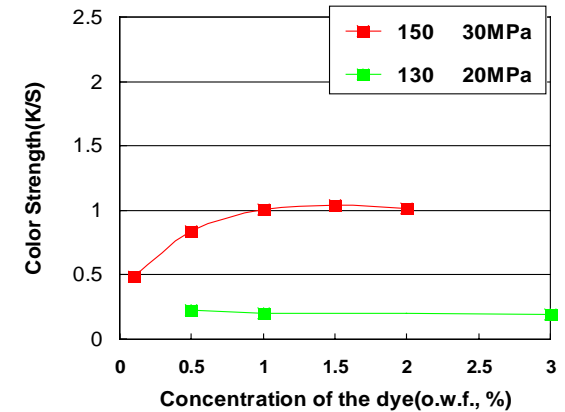
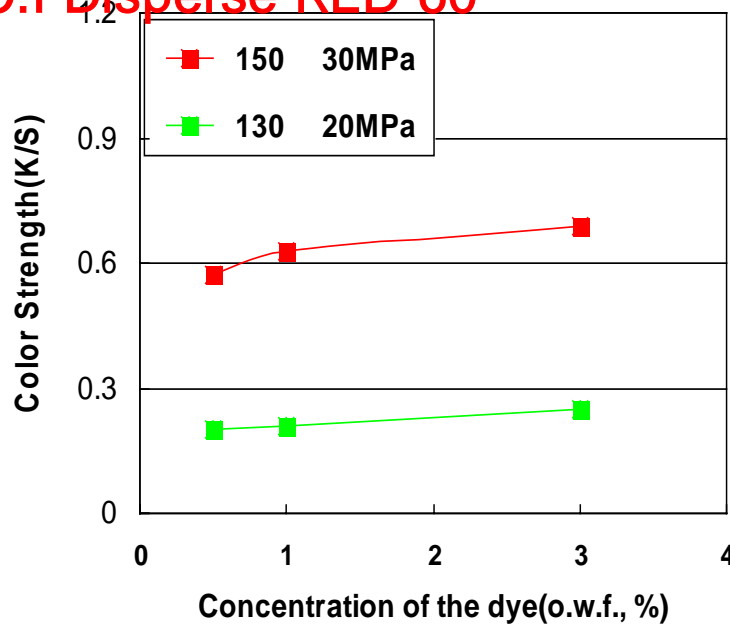
- ❑ The highest color strength (K/S) of the dyed Aramid spun yarn was obtained when the experiment was performed at 150°C and 30MPa
- ❑ The adsorption isotherms were obtained with the concentration of the three dyestuffs . These adsorption isotherms follow Langmuir type
- ❑ Dyeability of SFD with dyestuffs were better in the order of **DB56** > **DY54** > **DR60**
- ❑ Fastness properties of the dyed yarn were fair except for light fastness and color fastness for sublimation



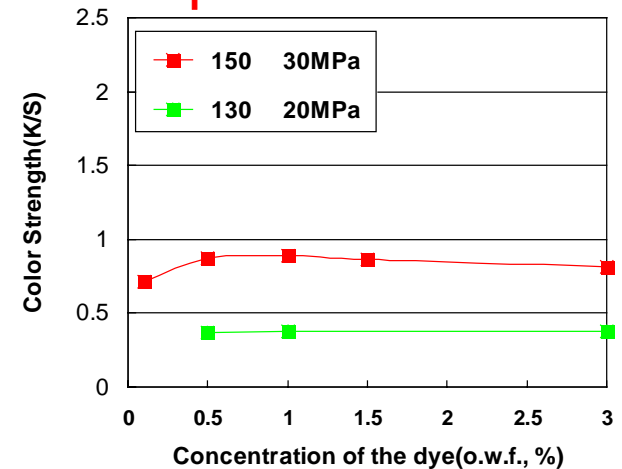
Adsorption isotherm of dyestuff for Aramid

C.I Disperse BLUE 56

C.I Disperse RED 60



C.I Disperse YELLOW 54



SFD system



- SFD Device
(MAX P & T , 35 MPa & 170 °C)



2. Circulation Pump



3. Gas Booster

Some Results from SFD

C.I Disperse Red 60



150 c, 300 atm 0.5 %owf

C.I Disperse Blue 56



150 c, 300 atm 0.5 %owf

C.I Disperse Yellow 54



150 c, 300 atm 0.5 %owf



150 c, 300 atm, 2 %owf



150 c, 300 atm, 2 %owf



150 c, 300 atm, 2 %owf