Comparative Industrial Wet Processing of Cotton-Spandex Knit Fabric Using Conventional Scouring, Bio-Scouring, and Integrated One-Bath Reactive Dyeing

Sayam[1,*], Md Riaj Hossen[2], Md. Mazharul Islam[1]

[1.] Department of Fabric Engineering, Barishal Textile Engineering College, P. O. Box: 8200, Barishal, Bangladesh

[2.] Department of Wet Processing Engineering, Shahid Abdur Rab Serniabat Textile Engineering College, P. O. Box: 8200, Barishal, Bangladesh

Corresponding author: mahubu.sayamm@gmail.com

(A): Stepwise industrial wet processing sequence, operating temperature, and runtime.

Step	Conventional Scouring	Bio-Scouring	One-Bath Dyeing
1	Fill Water, 25 °C, 2 min	Fill Water, 25 °C, 2 min	Fill Water, 25 °C, 2 min
2	Steam Up, 50 °C, 10 min	Steam Up, 40 °C, 13 min	Steam Up, 40 °C, 13 min
3	Load Fabric, 50 °C, 15 min	Load Fabric, 40 °C, 15 min	Load Fabric, 40 °C, 15 min
4	Levelling Injection, 50°C, 2 min	Levelling & Enzyme Injection, 40°C, 2 min	Special Chemical Dosing, 40 °C, 20 min
5	Steam Up, 60 °C, 2 min	Steam Up, 60°C, 7 min	Runtime, 40°C, 30 min
6	Alkali Injection (NaOH), 60 °C, 2 min	-	-
7	Steam Up, 70 °C, 3 min	-	1st Salt Dosing & Runtime, 40 °C, 20 min
8	Peroxide Dosing (H_2O_2), 70 °C, 5 min	-	Color Dosing, 40°C, 20 min
9	Steam Up, 98 °C, 6 min	-	-
10	Runtime, 98 °C, 50 min	Runtime, 60 °C, 40 min	1st Soda Dosing & Runtime, 60 °C, 36 min
11	Cooling, 80 °C, 6 min	Steam Up & Runtime, 80°C, 22 min	2nd Soda Dosing, 60°C, 30 min
12	Sample Check, 80 °C, 10 min	Sample Check, 80°C, 10 min	Color Steam, 60°C, 60 min
13	Hot Wash, 80 °C, 10 min	-	Shade Check, 60°C, 15 min
14	Hot Wash, 50 °C, 10 min	-	Drain & Recall (Fill), 25°C, 4 min
15	Acid + VHK Injection & Runtime, 55 °C, 12 min	-	Runtime, 40°C, 5 min
16	pH Check, 55 °C, 5 min	-	1st Wash, 60 °C, 15 min
17	Enzyme Injection & Runtime, 55 °C, 50 min	-	2nd Wash, 40 °C, 10 min
18	Sample Check, 55 °C, 10 min	-	-
19	Drain & Recall (Fill), 25 °C, 4 min	Drain & Recall (Fill), 25 °C, 4 min	Drain & Recall (Fill), 25 °C, 4 min
20	pH Check & Levelling Injection, 40 °C, 15 min	pH Check & Levelling Injection, 40 °C, 15 min	-
21	Color Dosing & Runtime, 40 °C, 40 min	Color Dosing & Runtime, 40°C, 45 min	-
22	1st Salt Dosing & Runtime, 40 °C, 20 min	1st Salt Dosing & Runtime, 40 °C, 20 min	-
23	2nd Salt Dosing, 40 °C	-	-
24	Steam Up, 60 °C, 20 min	Steam Up, 60 °C, 20 min	-
25	Salt Shade Check, 60 °C, 10 min	Salt Shade Check, 60 °C, 10 min	-

(A): Continue.

Step	Conventional Scouring	Bio-Scouring	One-Bath Dyeing
26	1st Soda Dosing & Runtime, 60 °C, 26 min	1st Soda Dosing & Runtime, 60 °C, 26 min	-
27	2nd Soda Dosing, 60 °C, 30 min	2nd Soda Dosing, 60 °C, 30 min	-
28	Color Steam, 60 °C, 60 min	Color Steam, 60 °C, 60 min	-
29	Shade Check, 60 °C, 15 min	Shade Check, 60 °C, 15 min	-
30	1st Wash, 60 °C, 10 min	1st Wash, 60 °C, 15 min	-
31	2nd Wash, 40 °C, 10 min	2nd Wash, 40 °C, 10 min	-
32	Drain & Fill, 25 °C, 4 min	Drain & Fill, 25 °C, 4 min	-
33	Hot Wash, 70 °C, 25 min	Hot Wash, 70 °C, 25 min	-
34	Drain & Fill, 25 °C, 4 min	Drain & Fill, 25 °C, 4 min	-
35	Acid Wash, 40°C, 15 min	Acid Wash, 40 °C, 15 min	Acid Wash, 40 °C, 15 min
36	Drain & Fill, 25 °C, 4 min	Drain & Fill, 25 °C, 4 min	Drain & Recall (Fill), 25 °C, 4 min
37	Soaping, 95 °C, 33 min	Soaping, 95 °C, 33 min	Soaping, 95 °C, 43 min
38	Cooling, 80 °C, 5 min	Cooling, 80 °C, 5 min	Cooling, 80 °C, 5 min
39	1st Wash, 60 °C, 15 min	1st Wash, 60 °C, 15 min	1st Wash, 60 °C, 15 min
40	2nd Wash, 40 °C, 10 min	2nd Wash, 40 °C, 10 min	2nd Wash, 40 °C, 10 min
41	Drain & Fill, 25 °C, 4 min	Drain & Fill, 25 °C, 4 min	Drain & Fill, 25 °C, 4 min
42	Fixing Dosing & Runtime, 45 °C, 30 min	Fixing Dosing & Runtime, 45 °C, 30 min	Fixing Dosing & Runtime, 45 °C, 30 min
43	Sample Check, 45 °C, 10 min	Sample Check, 45 °C, 10 min	Sample Check, 45 °C, 10 min
44	Drain & Fill, 25 °C, 4 min	Drain & Fill, 25 °C, 4 min	Drain & Fill, 25 °C, 4 min
45	Unload, 15 min	Unload, 15 min	Unload, 15 min

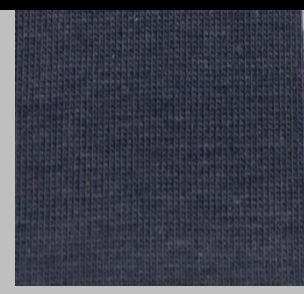
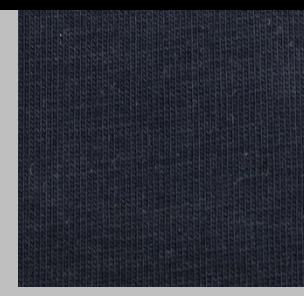
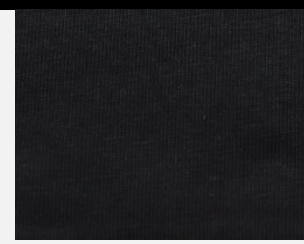
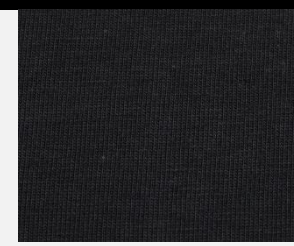
(B): Comparative chemical formulations for the conventional scouring, bio-scouring, and one-bath reactive dyeing processes.

Product name	Function	Conventional Scouring	Bio-scouring	One-Bath Dyeing
Pre-treatment				
Matquest FE Plus Liquid	Wetting/penetrating agent	0.5 g/L	-	-
Matclean BA Liquid	Scouring detergent	1.0 g/L	-	-
Matclean SCA Liquid	Scouring auxiliary	0.7 g/L	-	-
Matlube ACA Liquid	Lubricating agent	2.0 g/L	-	-
Matclean OSR Liquid	Wetting/scouring agent	1.5 g/L	0.5 g/L	-
Caustic Soda Liquid (Min. 42 %)	Alkaline scouring agent	2.0 g/L	-	-
H_2O_2 (Hydrogen Peroxide 50 %)	Bleaching agent	4.0 g/L	-	-
Matacid AS Liquid	Neutralizing agent	0.8 g/L	-	-

(B): Continue.

Product name	Function	Conventional Scouring	Bio-scouring	One-Bath Dyeing
Matzyme VHK Liquid	Enzyme auxiliary	0.5 g/L	-	-
Matzyme DS Ultra	Enzyme stabilizer	0.3 % owf	-	-
Matclean RWD Liquid	Wetting agent	-	0.5 g/L	-
Antifoam MX Liquid	Antifoaming agent	-	0.1 g/L	-
Matzyme PC Liquid	Pectinase enzyme	-	1.5 % owf	1.5 % owf
Matclean SDB Liquid	Special process auxiliary	-	-	1.0 g/L
Matclean MSP Liquid	Process stabilizer	-	-	0.5 g/L
Dyebath				
Matquest 1090 Liquid	Levelling agent	0.5 g/L	0.5 g/L	-
Matlevel DLR Liquid	Levelling agent	2.0 g/L	1.0 g/L	-
Matlube ACA Liquid	Lubricating agent	1.0 g/L	1.0 g/L	-
Antifoam MX Liquid	Antifoaming agent	0.1 g/L	0.1 g/L	-
Intracron Yellow DD-R	Reactive dye	1.1 % owf	-	-
Intracron Dark Red CD	Reactive dye	1.2 % owf	-	-
Intracron Black CD-G	Reactive dye	9.6 % owf	-	-
Sunazol Yellow HF-3R BS	Reactive dye	-	0.8 % owf	0.8 % owf
Novacron Deep Red EC-D	Reactive dye	-	1.08 % owf	1.08 % owf
Sunazol Black HF-G BS	Reactive dye	-	9.0 % owf	9.0 % owf
Glauber Salt	Electrolyte	100 g/L	100 g/L	100 g/L
Soda Ash (Sodium Carbonate, Min. 95%)	Alkali	20 g/L	20 g/L	20 g/L
Post-treatment				
Matacid AS Liquid	Neutralizing agent	0.5 g/L	0.8 g/L	0.5 g/L
Matwash DSP CONC	Soaping agent	1.0 g/L	1.0 g/L	1.0 g/L
Matwash CSI Liquid	Washing agent	1.0 g/L	1.0 g/L	1.0 g/L
Albafix ECO	Fixing agent	2.0 g/L	2.0 g/L	2.0 g/L
Matacid CN Liquid	pH adjustment	0.2 g/L	0.2 g/L	0.2 g/L

(C): Surface appearance progression of cotton-spandex knit fabric during conventional scouring, bio-scouring, and one-bath reactive dyeing processes.

Conventional Scouring			
			
Grey Fabric	Scoured Fabric	Dyed Fabric	Final Output
Bio-Scouring			
			
Grey Fabric	Bio- Scoured Fabric	Dyed Fabric	Final Output
One-Bath			
	**N/A**		
Grey Fabric		Dyed Fabric	Final Output