



Reactive Dyeing of Cotton: Reducing the Water Use by Implementation and Application of Efficient and Advanced Dyeing Chemicals and Technologies

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INTRODUCTION

The actually presented international project InoCottonGROW with partners from research and industry deals with a contribution to a more sustainable use of water along the cotton textile supply chain "from the cotton field to the hanger".

Due to the EU-funded GSP+ (Generalized System of Preference) textile exporting countries like Pakistan are under pressure to improve the sustainability of their domestic industries. As one of the largest cotton producers and cotton-processing countries in the world Pakistan suffers from lack of water. With participation of German companies (Thies Textilmaschinen and CHT for chemicals), new dyeing technologies and formulations should be implemented by modifying dyeing machines, processes, used chemicals and dyestuff with significantly lower water consumption by maintaining the color quality according to the requirements of the consisting standards.

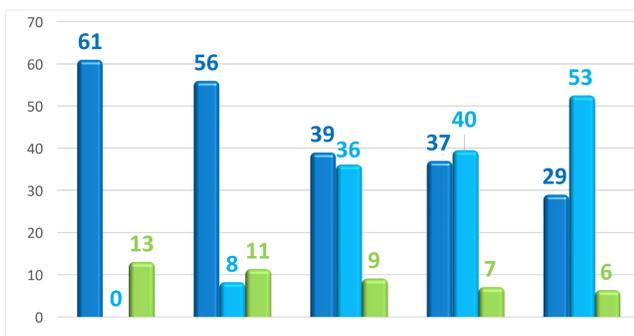


Figure: Dyeing machine HN, C. Albuquerque

PROCESS RESULTS OF INDUSTRIAL REACTIVE DYEING PROCESSES (BLACK)



Figure: Dyeing results HN, C. Albuquerque



REACTIVE DYEING PROCESSES IN COLOUR BLACK (100% CO single jersey)	P0	P1	P2	P3	P4
Recipe/Auxiliaries	STANDARD	STANDARD imitated	1st Improvement	2nd Improvement	3rd Improvement
Liquor ratio	1:6	1:6	1:5	1:5	1:6
Water use [l] per kg textile	61	56	39	37	29
Water saving [l] per kg textile	-	5	22	24	32
Water saving [%]	-	8	36	40	53
Processtime calculated [h:min]	13	11:30	09:05	07:03	06:31
Used black dye [g] per kg textile	unavailable	38	52	50	50
Dye fixation rate black only [%]	unavailable	82-83	88-89	90	68-79
Unfixed black dye [g] in drain per kg textile	unavailable	6,8-6,5	6,2-4,6	5	16,0-10,5

- Process **P0**: Standard recipe, dyed on-site at Pakistani dyehouse in Lahore/Pakistan with Synozol Dyestuff from supplier Kisco: Synozol Ultra Black DR, SYN YELLOW K-3RS 150 %, SYN RED K-3RS 150 %
- Process **P1 – P4**: Dyed at Thies Textilmaschinen in cooperation with CHT (chemicals)
- **P1**: Imitated process P0 with use of conventional dyes from CHT (ranges BEZAKTIV S and S-MATRIX: BEZAKTIV Cosmos S-MAX, BEZAKTIV Yellow S-MATRIX 150, BEZAKTIV Red S-MATRIX 150)
- **P2 - P4**: Use of advanced dye systems with BEZAKTIV GO dyestuff (BEZAKTIV Velvet Black GO, BEZAKTIV Golden Yellow GO)

Results

- Conventional dye process P1 shows standard water use
- **Water use**: reduction > 29 l/kg appear possible
- **Water saving**: > 50 % appear possible
- One dye bath process P4 not recommended for unprepared raw fabric
- **Process time**: reduction > 40 % (as side effect)
- **Dye fixation rate** increases from P1 to P3 by changing to advanced dyes (identified after determination of dye remains in collected and filtered drains using UV-Vis spectroscopy measurements)
- Best achieved fixation rate: 90 % in P3 - means 10 % less dye stuff in waste water

Expected Outcome

Process P3 is recommended using advanced dye system (CHT) due to best achieved fixation rate considering a reduced water use. The advanced process is established in Pakistan and has already been running at some CHT customers.

RESULTS OF WATER SAVINGS USING WATER-EFFICIENT TEXTILE MACHINERY

Project partner Thies Textilmaschinen developed Thies DyeControl which offers a visual display of the treatment curves. This allows control of liquor clarity as well as determination of dye exhaust from the liquor. The dyer recognizes if and when dyes migrate from the aqueous phase to the fiber.



Blue curve shows turbidity measurement using DyeControl



Figure: Thies DyeControl, Thies

Trial	Liquor Ratio	Water Use	Water Saving
	[:1]	[l/kg]	[%]
T1	6	69	Reference
T2	6	62	10,1
T3	5,5	62	10,5
T4	5,5	56	19,2

- Trial T1: Standard process without DyeControl
- Trial T2 – T4: Optimized processes & recipes with DyeControl

Expected Outcome

By introducing the new Thies DyeControl measurement technology water savings will be achieved.

Thies DyeControl is an additional system for analysis and optimization of dyes and treatments for the exhaust procedure.

Results

- Quality control of all four trials on a full-scale production machine type iMaster show identical results
- By use of optimized dyeing machines in combination with optimized recipes for dyes, water savings of 10 to 19 % have been achieved in experiments

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