

AVENUES FOR COST REDUCTION IN CHEMICAL PROCESSING THROUGH UTILITIES

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INTRODUCTION

In the fast changing conditions/economic recession it is challenging to every one to keep up the pace with continuous improvements in quality, consistency, cost faster delivery schedule, etc. for the survival of industry. Major production cost in chemical processing include colour and chemicals, utilities, maintenance, wages and interest. For a mill situated in and around the metro and doing away with Bleaching, Dyeing, Finishing, the cost on account of colours and chemicals and utilities are almost comparable whereas in a mill engaged in Bleaching, Dyeing, Printing and Finishing the cost on colours & chemicals are comparatively slightly higher than the utilities/unit production. However, mills situated beyond the perview of metro and using coal as fuel for thermal energy have some relief on utilities particularly on steam and water cost.

Among the utilities, major cost in chemical processing is for thermal energy, which is about 50% of the cost on this head for those mill using coal as fuel. The cost on water and power is almost equal per unit production for mill situated in and around metro.

In wet processing, the consumption of thermal energy is largely related with the consumption of water. The textile wet processing industry utilise large volume of water for Bleaching, Dyeing, Printing, Finishing. The same is discharge along with various pollutants into the stream causing environment/natural resources damage. Thus, in adverse climatic conditions, water becomes scarcer on one hand. On the other hand, disposal of contaminated water into the ground/stream leads damage to the natural resources. Therefore, the regulatory authorities are tightening the nose of polluting industry by making the stringent regulations for effluent treatment prior their disposal and introducing cess/unit on fresh water at many places which lead to increase in cost on fresh water and escalate the cost of effluent treatment. Therefore, conservation/reduction in its usage is utmost important, for above, reasons which is possible only through optimisation of the processing conditions, use of new technique, upgradation of quality consistency thereby reducing the quantum of reprocessing which beside water and steam also lead to the reduction in other variable cost viz. power, colour & chemicals and liability for the effluent treatment prior its disposal.

In these areas, BTRA has taken a lead and continuously rendering the services to the mills producing cotton, polyester/cotton, polyester/viscose, polyester/wool, woollen, blended and/or union woven/knitted fabrics. This paper looks upon some salient findings of the recently concluded studies carried out in some mills making 100% cotton, polyester/cotton, worsted, polyester/wool blended, woven/knitted fabrics by us, the measures suggested/implemented/followed up for water conservation and accrued benefits from such study.

BTRA's Experience in Water Conservation

BTRA launched water conservation studies in the 80^s. In the beginning, consumption data were erratic with significant variation from mill to mill and had no correlation among the surveyed mills in respect even for similar products. However, recent studies carried out in many mills showed reduction in the variance level. Data from the eight recently surveyed mills, for the product mix, quality of water, water consumption before and after intiation of the investigation and the level of water consumption in many processes are given herewith.

Sector and Location of Industry Included in Study

Recently the shop floor investigations were carried out in many industries from various sectors. The same is given herewith.

Category	Mill Code	Location
Cotton Based Composite Mills	A	Mumbai
Cotton Based Composite Mills	B	Nearby Mumbai
Worsted Mill	C	Mumbai
Worsted Mill	D	Madhya Pradesh
Soddy Plant	E	Jalagaon, Maharashtra
Independent Processing Mills	F	Rajasthan
Knitting Industries	G	Mumbai
Knitting Industries	H	Nearby Mumbai

Plant Production/Product Mix

The data on product mix and the production capacity/pattern of mills/units included in the survey were collected and the same are summarised as follows:

Mill Code	Product Mix	Avg. production/Day
A	Medium superfine quality cotton and polyester/cotton blended, bleached, dyed, printed, over-printed cloth viz., Rubia Cambric, dress materials, dyed bottom wear and sheeting fabrics	42,000 metre
B	Towels, sheetings, industrial fabrics, flannelette, Momie, suitings, dress materials, poplin, cambric, etc, in cotton and cotton rich blended fabrics in small to wider width upto 300 cm	1,60,000 metre
C	Polyester/wool blended, all wool and union with silk, polyester/wool blended and union with silk, fibre, yarn piece dyed polyester/Modal/Lyocell blended suitings in worsted system	24,000 metre
D	Fibre, yarn and piece dyed polyester/viscose or Modal blended suitings with or without Lycra, all wool and polyester/wool blended worsted suitings	42,000 metre
E	Manufacturing and part processing of polyester/viscose and worsted suiting. All wool, wool/acrylic blended and acrylic rugs and shawl	17,500 metre and 1,775 pieces of Rugs and Shawls
F	Fibre and piece dyed polyester/viscose or Modal blended suitings with or without Lycra. Polyester/Lyocell blended suitings, polyester/Lyocell blended suitings, polyester/Modal or viscose piece dyed shirtings , polyester/cotton suitings	72,000 metre and job work for package dyeing
	Top and piece dyed all wool, polyester/wool blended Union with acrylic worsted suitings, package dyeing of 100% polyester fibre/yarn, polyester/Modal or viscose yarn, wool and polyester top dyeings	
G	Full bleached, dyed, printed and overprinted circular knitted garments for children and menswear	1,600 kg/day
H	Full bleached and dyed circular knitted fabrics for garment	3,500 kg/day

Quality of Water

Qualities of fresh (with or without regeneration) and effluent treated water used in the surveyed mills were also evaluated. Results are given in Table-1.

TABLE – 1
QUALITY OF FRESH WATER IN SURVEYED MILLS

Test Particulars	Results							
	A	B	C	D	E	F	G	H
PH	6.5-7.5	6.5-7.5	6.5-8.0	6.5-7.5	6.5-8.5	7.0-7.5	6.5-7.5	6.5-7.7
Hardness (ppm)	>50	>50	>100	Upto 150	90-200	90-150	>50	>50
Total Solids(ppm)	155	150	210-250	262	202-302	152.5-252.5	150	155
Suspended Solids (ppm)	5	NIL	7-10	22	2-3	0-2.5	NIL	5
Total Dissolved (ppm)	150	150	203-240	240	200-300	150-250	150	150
C.O.D (ppm)	NIL	NIL	NIL	10	NIL	NIL	NIL	NIL
B.O.D. (ppm)	NIL	NIL	NIL	4	NIL	NIL	NIL	NIL
Phenolic Compounds (ppm)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Detergent as ABS (ppm)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

N.B: C & D represent the quality of mixed water (Municipal Supply and Bore Well)

Table-1 indicates that the quality of fresh water in surveyed mills do not differ significantly. According to the requirement of water for textiles viz., bleaching, dyeing printing, finishing, boiler house, sizing, humidification, air washer towers, etc, water with hardness level below 50 ppm was used without the softening treatment.

However for steam generation the water was used after softening treatment in all the cases. Considering the escalation in cost of fuel, the same can be considered satisfactory and were suggested to continue upto the desired quality level.

Nature of Effluent of Raw/Treated Waste Water

To assess the level of impurity in effluent during chemical processing, wherever possible samples were collected and evaluated for pollutants. The same is given in Table-2

TABLE – 2

NATURE OF RAW/TREATED EFFLUENTS

Test Particulars	Results									
	Mill B		Mill C		Mill D		Mill E		Mill F	
	B	A	B	A	B	A	B	A	B	A
PH	8.5	7.5	6-6.5	7-7.5	6.0	6.75-7.5	6-6.5	7-8	9-10.5	7-9.0
Total Solids (ppm)	3330	-	-	-	1032	1148	1150-1600	550-780	Upto 4500	Upto 4000
Total Dissolved Solids (ppm)	3076	-	-	-	912	1116	800-1100	500-700	Upto 4500	Upto 3500
Suspended Solids (ppm)	153	40	-	40-50	120	32	350-500	50-80	400-550	30-60
Chemical Oxygen Demand (ppm)	2290	100-150	450-650	100-150	423	280	500-700	40-90	Upto 750	30-40
Biochemical Oxygen Demand (ppm)	785	60-80	350-450	60-80	206	38	300-500	15-30	Upto 450	15-30
Phenolic Compound(ppm)	-	-	-	0.01-0.2	-	-	-	-	-	-
Detergent ABS (ppm)	4.6	-	-	-	6.8	-	-	-	-	-
Hard ness	Not Evaluated	-	40-60	-	<5	5.0	40-60	30-50	40-80	50-80
Chloride	-	-	-	-	160	280	-	-	-	-
Oil and Grease	-	-	0-8.0	-	14	-	0-7.0	-	-	-
Chromium	-	-	0.2-0.3	0.2-0.3	-	-	-	-	-	-
Sulphide	-	-	-	-	-	-	-	-	-	-
Bioassay Test	-	-	-	-	-	4 days 100% Survival of Fish				
Alkalinity	-	-	-	-	-	-	115-140	40-70	-	-

B = Raw Effluent Before Treatment.
A = Effluent After Treatment for Disposal.

The mills given in Table-2 were treating their effluent adequately so as to meet the permissible standards for the treated effluent water as laid down by the local pollutional control authority prior to its disposal. Mill B was discharging the treated water outside the drainage system, whereas Mill C was recycling some of the treated water into wet processing for cooling/quenching the odour. In advent of short supply Mill D was partly recycling in their wet processing section.. Mill E was recycling about 15% of the treated water in chemical processing with additional softening and desalination treatment. About 70% of the effluent was recycled in Mill F with adequate treatment in their effluent treatment plant without desalination. In addition, all mills were recycling some quantity of water without any physical/chemical treatment in the plant, which varied significantly from mill to mill and from time to time.

PROCESSING SEQUENCES AND RECIPES USED IN THE MILLS

During shopfloor investigations, processing sequences and recipes used on various machines for processing cotton, polyester/cotton, polyester/viscose, polyester/wool blended, woolen, wool/silk unions, woven/knitted fabrics were also collected from the mills. Detailed sequences and recipes with the desired modifications on various machines/product were suggested to the mills.

EVALUATION OF WET PROCESSING CONDITIONS

Keeping in view the products being manufactured, their quality, consistency, reproducibility, scope of optimisation of dyestuff and chemical quantity (pollutants for water) in processing, evaluation of the processing conditions were carried out to standardise them in surveyed mills. The data collected from various unit operations for fibre/yarn/fabric made from cotton, polyester/cotton, worsted and other blended and union fabrics for different qualities on various machines have been evaluated. The standardised conditions were suggested individually to the surveyed mills.

MEASURES SUGGESTED FOR REDUCING WATER CONSUMPTION

Besides standardising the high water consuming batchwise and continuous wet processing operations for fibre, top, yarn, fabrics (knitted/woven) many other areas existed in the possible surveyed mills which were also detected, evaluated and suggested and extended the help in implementation, along with the possible monetary benefits through. The necessary guidelines for possible savings by way of reducing water consumption and the load of pollutants were recommended to the participating mills. Some of them are summarised herewith.

Suggestions Made for Cotton Mills

- Optimisation of the water flow.
- Installation of auto-on/off devices.
- Modification of water in feed lines.
- Recycling of reusable water.
- Optimisation of the chemical recipes and their concentrations.
- Adequate proportionations of fresh and reusable water.

WORSTED SECTOR

Recommendations Made for Processing of Woollen, Polyester/ Wool and Polyester/Wool/Silk Blended/ Union Fabrics

- Optimisation of water flow.
- Optimisation of washing procedures/cycle.
- Recycling of process water with and without treatment.
- Modifications in the microprocessors on batchwise processing machines and reduction of processing steps wherever possible.
- Modification/optimisation of chemical recipes in dyeing and finishing section.
- Installation of auto on-off devices on high water consuming machines and also the automation in washing cycles on batchwise scouring machine.

SUGGESTIONS MADE FOR SODDY PLANT

- Optimisation of water flow and time.
- Recycling of process water with and without treatment.
- Modification/optimisation of chemical recipes.
- Modification of washing cycles in dyeing and finishing

RECOMMENDATIONS MADE FOR KNITTED GOODS PROCESSING

- Optimisation of water flow on mercerizing machine.
- Recycling of process water with and without treatment.
- Optimisation of processing sequences during bleaching and dyeing on winches, jet dyeing machines.

BULK SCALE SHOPFLOOR TRIALS CARRIED OUT IN THE MILLS

After necessary suggestions/guidelines to the surveyed mills, trials were carried out in bleaching, dyeing, printing and finishing in cotton based composite mills, worsted mill, independent processing unit, etc. Guidelines in other areas viz., distribution, generation, effluent treatment, etc., were also extended to these mills. Monitoring of water consumption in various operations was also carried out and compared with the actual water consumption before the commencement of the survey. Comparative water consumption data before and after the trials/implementations are given in Table-3.

TABLE – 3

WATER CONSUMPTION (IN KL/DAY) BEFORE AND AFTER TRIAL/IMPLEMENTATIONS OF THE SUGGESTIONS

Mill Code	Average Production Per Day (m)	Before (kl)				After (kl)			
		Fresh	Without Treatment	With Treatment	Total	Fresh	Without Treatment	With Treatment	Total
'A'	42,000	1140 (24,78)	NIL	NIL	1140	700 (17,95)	2.30	NIL	930
'B'	1,60,000	3900 (25,83)	2200	NIL	6100	2922 (20,66)	2020	NIL	4944
'C'	24,000	4570 (190.4)	1240	550	6360	2950 (122.9)	2110	550	5610
'D'	5,000	904 (42.69)	NIL	NIL	904	655 (30,9)	NIL	NIL	655
'E'	42,000	4843 (120.92)	1200	1003	7046	3518 (87.85)	976	577	5071
'F'	72,000	1252 (18.05)	362	1361	2965	896 (14.2)	356	1329	2480

Figures in bracket indicate consumption in kilo litre/thousand metre.

- Mills A, B and D do not consume water for domestic purposes, whereas the remaining mills consume water for domestic usages (viz., colony, staff quarters, etc.,)
- Mill C consumes additional about 130 kilo litre/day of fresh water for sister concern other than textiles. The residential consumption in this unit is about 425 kilo litre/day, whereas the same for Mill E and F is about 225 and 150 kilo litre/day respectively.
- The consumption in kilo litre/thousand metre include the consumption for domestic purposes before and after the survey trials/ monitoring, etc.
- Since the implementations are still in progress in many mills, the consumption is likely to show further reduction.

- In Mill D, the consumption for part processing is 7.5-kilo litre/thousand metre. Whereas including everything the same for full processing is 151.5 and 126.6 kilo litre/thousand metre before and after the survey implementations, etc.

It is seen from Table-12 that after partial implementation, load on fresh water consumption is reduced by 27.6% in Mill A and 20% in Mill B which were achieved by partial recycling, modified distribution and standardisation of the processing conditions in bleaching and dyeing.

Similarly, in Mill C, E and D with similar type of product mix, the fresh water consumption reduced by 35.5%, 27.3% and 21.3% respectively after partial implementation of the recommendations for optimised processing conditions, recycling, modification of distribution system, etc.

In Mill D, which has an altogether different product mix, it was possible to achieve about 16.5% reduction in consumption of the fresh water by standardisation of the processing conditions and other measures recommended.

CONCLUSION

Shop-floor survey and evaluation of the consumption data after implementations of the recommendations for standardising the processing conditions in the surveyed woven, knitted, worsted mills showed not only reduction of water consumption from 25 to 38% for the similar production pattern but also helped in reducing the cost of thermal and electrical energy. In addition, the measures suggested helped the mill to reduce the wet processing cost/unit production on colours and chemicals, improved consistency of results thereby lowering down reprocessing and load of pollutants in the discharged effluent stream, etc.

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Reference book:

BTRA & FAITMA Seminar on Conservation of Utilities in Indian Textile Industry

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