

Appendix 11

Detailed Breakdown of Operating Costs at Misr Mahalla

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a) Replacement of sodium hypochlorite by hydrogen peroxide

Table 1
Half-Bleaching - Comparison of Conventional and Modified Processes
(on the basis of 1 ton)

Item *	Conventional Half Bleach		Modified Half Bleach		Cost Difference (LE)
	Requirement	Cost (LE)	Requirement	Cost (LE)	
Chemicals					
Sodium Hydroxide (Kg) Scour: 25-28 mg/L Half bleach: 5 g/L	61.8	136.0	38.4	84.50	-51.5
Espycon 1030 (Kg) Scour: 2 g/L Half bleach: 3 g/L	7.2	17.1	4.8	11.4	-5.7
Reductol KB (Kg) 2 g/L	4.8	16.8	2.4	8.4	-8.4
NaOCl (Kg)	38.5	5.0	-	-	-5
H ₂ O ₂ (35%) (Kg) 7.5-8 g/L	18.0	31.5	9.6	16.8	-14.7
Organic Stabiliser (Kg) 1g/L	2.4	13.6	1.2	6.8	-6.8
Sodium Silicate (Kg) 3 g/L	2.4	0.9	3.6	1.4	+0.5
Water (m ³)	63.3	28.5	31.1	14	-14.5
Wastewater treatment costs	50.6	20.2	24.9	10	-10.2
Steam (Tons)	6.3	160	3.2	81.3	-78.7
Electricity (kWh)	425	80.8	184	35	-45.8
Labour	-	33.3	-	14	-19.3
Time (minutes)	100	-	56	-	
Total cost	-	543.7	-	283.6	-260.1

* Optimal recipes are given in italics

Table 2
Full Bleaching - Comparison of Conventional and Modified Processes
(on the basis of 1 ton)

Item *	Conventional Full Bleach		Modified Full Bleach		Cost Difference (LE)
	Requirement	Cost (LE)	Requirement	Cost(LE)	
<i>Chemicals:</i>					
Sodium Hydroxide (Kg) Scour: 25-28 g/L Full bleach: 3 g/L	61.8	136	42	92.4	-43.6
Espycon 1030 (Kg) 3 g/L	7.2	17.1	7.2	17.1	0
Reductol KB? (Kg)	4.8	16.8	2.4	8.4	-8.4
H ₂ O ₂ (35%) (Kg) 10-12 g/L	18	35.5	22.8	39.9	+4.4
Organic Stabiliser (Kg) 2 g/L	2.4	13.6	3.6	20.3	+6.7
Sodium Silicate (Kg) 2 g/L	2.4	0.9	6	2.3	+1.4
Water (m ³)	46.6	21	46.6	21	0
Wastewater costs (m ³)	37.3	14.9	37.3	14.9	0
Steam (Tons)	4.8	121.9	4.8	121.9	0
Electricity (kWh)	403	76.6	403	76.6	0
Labour		20.3		20.5	+0.2
Time (minutes)	82		82		0
Total cost		474.6		435.3	-39.3

* Optimal recipes are given in italics

b) Replacement of kerosene by synthetic thickener in pigment printing

Table 3
Cost-Benefit Analyses of Kerosene Substitution

Constituent	Full Emulsion Paste (full kerosene)		Low Kerosene Paste (partial substitution)		Zero Kerosene Paste (full substitution)	
	Quantity (kg)	Cost (LE)	Quantity (kg)	Cost (LE)	Quantity (kg)	Cost (LE)
Imperon thickener N2282	-	-	20	350	30	525
Ammonium Hydroxide	-	-	5	15	5	15
Imperon Binder MTB	80	412	100	515	100	515
Miner Daico Binder SME	80	409.6	100	412	100	412
Kerosene	675	472.5	150	105	-	-
Solegal WET (emulsifier)	150	120	5	40	-	-
Diammonium hydrogen phosphate (1/2)	30	50	38	63	38	63
Water	120	0.06	582	0.3	727	0.36
Total	1,135	1,464*	1,000	1,500*	1,000	1,530*
% increase in cost (relative to full emulsion paste)		0		2.5%		4.5%

* to the nearest unit

- c) **Elimination of six pigment colours and substitution of two pigment colours through alternate safe combinations to get similar shade to avoid formation of banned amines**

Table 4
Data on the Rates of Substitution of Pigments in Printing

No	Substituted pigment	Price per kg (LE and US\$)	No	Replacement pigment	Price per kg (LE and DM)
1	Ismament Yellow 2G5	LE 15	1	Imperon Yellow K5G110	LE 29
2	Imperon Yellow KR	LE 44	2	Imperon Yellow KGX	DM 295
3	Pigmatex Yellow TCGG	\$ 6.65	3	Imperon Yellow KRE	DM 52
4	Pigmatex Golden Yellow TGRM	\$ 6.50	-	n/a	-
5	Imperon Orange KG	LE 45	-	n/a	-
6	Imperon Red KGBR	LE 60	-	Imperon Red K-60	DM 30
7	Imperon Violet KB	LE 89.50	7	n/a	-
8	Imperon Dark Brown KBRC	LE 38	8	Imperon Dark Brown KBR	DM 20

Table 5 illustrates the costs incurred for three different printing conditions: 100% kerosene, using banned pigments; low percentage of kerosene, using safe pigments and zero percentage of kerosene, using safe pigments.

Table 5
A Comparison in Cost between 3 Different Printing Conditions

Cost of 1,000 kg printing paste before substitution		Cost of 1,000 kg printing paste after substitution		
Pigment No.	Full Emulsion Paste (full kerosene) (LE)	Pigment No.	Low Kerosene Paste (LE)	Zero Kerosene Paste (LE)
1	1171.8	1	1201	1225.2
2	1173.0	2	1202.4	1226.4
3	1172.0	3	1204.2	1228.2
6	1173.6	6	1202.4	1226.4
8	1172.7	8	1201.6	1225.6

It can be seen that substitution is accompanied by only a marginal increase in cost:

- Partial substitution (low kerosene paste) - increase of 2.5 - 2.7%.
- Full substitution (zero kerosene paste) - increase of 4 - 4.8%.

d) **Replacement and substitution of high formaldehyde resin with low formaldehyde resin**

In the finishing section, at Misr Mahalla factory, Arkofix NGET and Fixapret CPN were replaced by Arkofix NEC and Fixapret ECO. Table 6 shows the constitution and the cost of one ton of a typical finishing formula before and after substitution.

Table 6
Substitution of Finishing Agents

Constituent	Finishing formula before substitution		Finishing formula after substitution	
	Quantity (kg)	Cost (LE)	Quantity (kg)	Cost (LE)
Arkofix NG-ET* or Fixapret CPN*	120	696	-	-
Arkofix NEC** or Fixapret Eco.**	-	-	120	984
Leomin NI SI ET (softener)	30	366	30	366
Magnesium Chloride (catalyst)	12	33	12	33
Egyptol PLM (wetting agent)	2	12.8	2	12.8
Acetic acid	2	6.5	2	6.5
Water	834	0.42	834	0.42
Total	1,000	1,115	1,000	1,403

* High formaldehyde finishing agent

** Low formaldehyde finishing agent: It can be seen from the above table that the cost of 1 ton of finishing formula after substitution is about 26% more than that before substitution. Assuming a wet pick up of 80%, the cost of finishing 1 ton of fabric before substitution is about LE 892 compared to a cost of LE 1,122 after substitution.

Appendix 12

Detailed Breakdown of Operating Costs at Giza Spinning and Weaving

Detailed Breakdown of Operating Costs at Giza Spinning and Weaving

a) Replacement of sodium hypochlorite with hydrogen peroxide along with process modification in bleaching

A comparison between these methods for chemicals, water, steam, time and cost for processing 1 ton of knitted fabric on a winch machine is shown in Tables 1 - 6.

Table 1
Material Balance for the Conventional Method of Half Bleaching of 1 ton Knitted Fabric at Giza Spinning and Weaving

MATERIAL BALANCE			
Inputs (kg)		Outputs (kg)	
Fabric	1,000	Wet fabric:	
Nionil N	10	Dry Fabric	950
Na ₂ CO ₃	30	Water	950
H ₂ O ₂	30	Wastewater (67°C)	69,175
Organic Stabiliser	5	Condensate (98%)	4,500
Water	70,000		
Steam	4,500		
Total	75,575	Total	75,575

Table 2
Material Balance for the Conventional Method of Full Bleaching and Finishing at Giza Spinning and Weaving

MATERIAL BALANCE			
Inputs (kg)		Outputs (kg)	
Fabric	346	Wet fabric, (45 °C) assuming 150% wet pick up	830
Water	52,500	Wastewater (45 °C)	52,205.95
Nionil N	4.15	Condensate (98%)	2,700
NaOH (47%)	27.68		
NaOCl	103.8		
NaHSO ₃	0.69		
H ₂ O ₂ (50%)	20.76		
Organic stabiliser	3.46		
Uvitex 2B	1.73		
Net soft	10.38		
Acetic acid (11%)	17.3		
Steam	2,700		
Total	55,735.95	Total	55,735.95

Table 3

**Material Balance for the Modified Method of Half Bleaching of
1 ton Knitted Fabric at Giza Spinning and Weaving**

MATERIAL BALANCE			
Inputs (kg)		Outputs (kg)	
Fabric	1,000	Wet fabric:	
NaOH (47%)	75	Dry fabric	950
H ₂ O ₂ (50%)	30	Water	950
Organic Stabiliser	10	Wastewater (74°C)	28,175
Water	28,960	Condensate (98%)	2,700
Steam	2,700		
Total	32,775	Total	32,775

Table 4

**Material Balance for the Modified Method of Full Bleaching and
Finishing at Giza Spinning and Weaving**

(Basis: 346kg/batch on a winch machine. LR: 1/10)

MATERIAL BALANCE			
Inputs (kg)		Outputs (kg)	
Fabric (25°C)	346	Wet fabric (45 °C) 150% wet pick up	830
Water (25°C)	20,400	Wastewater (45 °C)	20,031.91
Nionil N	3.46	Condensate (98%)	2,300
NaOH (47%)	36.33		
H ₂ O ₂ (50%)	36.33		
Organic Stabiliser	10.38		
Uvitex 2B	1.73		
Acetic acid	17.3		
Net soft	10.38		
Steam	2,300		
Total	23,161.91	Total	23,161.91

Table 5
A Comparison between the Conventional and Modified Methods for
Half Bleaching of 1 ton of Knitted Fabric on a Winch Machine at
Giza Spinning and Weaving

Parameter		Conventional		Modified	
		Requirement (kg)	Cost (LE)	Requirement (kg)	Cost (LE)
A.	Chemicals:				
	Nionil N	10	25.63	10	25.63
	NaOH (47%)	-		75	45
	Na ₂ CO ₃	30	24	-	
	H ₂ O ₂ (50%)	30	66	30	66
	Organic stabiliser	5	11	10	22
	Cost of chemicals		126.63		158.63
B.	Water (m ³)	70	35	28.96	14.50
C.	Steam (t)	4.50	109.60	2.70	65.80
D.	Electricity (kWh)	30	5.90	13.10	2.80
E.	Time (h)	7.45	-	3.50	-
F.	Labour	-	37.25	-	17.50
Total cost			314.38		259.23

Table 6

A Comparison between the Conventional and Modified Methods for Full Bleaching of 1 ton of Knitted Fabric on a Winch Machine at Giza Spinning and Weaving

Parameter	Conventional		Suggested	
	Requirement (kg)	Cost (LE)	Requirement (kg)	Cost (LE)
A. Chemicals:				
Nionil N	12	30.76	10	25.63
NaOH (47%)	80.52	48.32	105	63
NaOCl	300	105	-	-
NaHSO ₃	2	10	-	-
H ₂ O ₂ (50%)	60	132	105	231
Organic stabiliser	10	22	30	66
Uvitex 2B	5	57	5	57
Knit Soft	30	100.32	30	100.32
Acetic acid (11%)	50	37	50	73
Cost of chemicals		542.40		615.95
B. Water (m3)	151.734	75.86	58.96	29.48
C. Steam (t)	7.803	190.39	6.647	162.18
D. Electricity (kWh)	69.2	14.53	50.44	10.60
E. Time (h)	18.45	-	13.45	-
F. Labour		92.25	-	67.25
Total cost		915.43		885.46

b) Replacement of Copper Sulphate (CuSO₄) with a Polymeric Agent for Fabrics dyed with Direct Dyes

**Table 7
Cost Breakdown of CuSO₄ Substitution**

	Substituted (CuSO ₄)	Substitute (Dalton Fix N62)
Price per kg	3 LE	7 LE
Amount used per ton of fabric 3% owf	30 kg	30 kg
Cost of treatment of ton of fabric	90 LE	210 LE

Assuming that production is 40t/month, the cost of treatment before substitution works out to 40 x 90 = LE3,600. After substitution, the cost works out to 210 x 40 = LE8,400, with a net increase in operating costs of LE4,800 per month.

Useful References

1. Smith, B., *Identification and Reduction of Pollution Sources in Textile Wet Processes*, Pollution Prevention Pays Program, Department of Natural Resources and Community Development, Raleigh, North Carolina, USA, 1986.
2. *Textile Industry and the Environment*, Technical Report No 16, United Nations Environment Program - Industry And Environment Office (UNEP IEO), 1992.
3. *Criteria in Environmental Labelling: A Comparative Analysis of Environmental Criteria in Selected Eco-labelling Schemes*, Environment and Trade, UNEP, June 1995.
4. *Environmental Quick Scan Textiles*, compiled for CBI and SIDA by Consultancy and Research for Environmental Management, published by CBI, SIDA, VIVO, 1996.