Bangladesh PaCT:
Partnership for Cleaner Textile

IN DEPTHCLEANER PRODUCTION ASSESSMENT REPORT

Prepared for

ProbirSarkar

Executive Director

IRIS Fabrics Ltd.

Zirani Bazar, BKSP, Kashimpur, Gazipur, Bangladesh

Date : June'2016

Prepared&Submitted by

DEVELOPMENT ENVIRONERGY SERVICES LTD

819, AntrikshBhawan, 22 Kasturba Gandhi Marg, New Delhi -110001

Tel.: +91 11 4079 1100 Fax : +91 11 4079 1101; www.deslenergy.com

Supported By

ENGINEERINGRESOURCES INTERNATIONAL

Excellence | Reliability | Integrity

About PaCT

PaCT is a partnership between textile wet processing factories in Bangladesh, international apparel buyers, wet processing technology suppliers, the Embassy of the Kingdom of the Netherlands (Dhaka), the International Finance Corporation (IFC), and the NGO Solidaridad.

The PaCT partners share a commitment to bring about systemic, positive environmental change for the Bangladesh textile wet processing sector, its workers, and surrounding communities, and to contribute to the sector's long-term competitiveness.

To this end, the PaCT partners are collaborating to develop harmonized resource-efficiency procurement requirements, to build factory capacity, technical knowledge, and access to finance for Cleaner Production investments, and to create a platform for community and national dialogue on sustainable use of water in the textile sector.

PaCT is implemented by IFC and Solidaridad, in cooperation with BGMEA. PaCT benefits from the generous anchor sponsorship of the Embassy of the Kingdom of the Netherlands. The PaCT lead sponsors are C&A, H&M, and Inditex. Associate sponsors are G-Star, KappAhl, Lindex, Primark, and Tesco.

Disclaimer

IFC, a member of the World Bank Group, creates opportunity for people to escape poverty and improve their lives. We foster sustainable economic growth in developing countries by supporting private sector development, mobilizing private capital, and providing advisory and risk mitigation services to businesses and governments. This report was commissioned by IFC as part of implementing the Bangladesh Water PaCT: Partnership for Cleaner Textile.

The conclusions and judgments contained in this report should not be attributed to, and do not necessarily represent the views of, IFC or its Board of Directors or the World Bank or its Executive Directors, or the countries they represent. IFC and the World Bank do not guarantee the accuracy of the data in this publication and accept no responsibility for any consequences of their use

ACKNOWLEDGEMENT

Development Environergy Services Limited (DESL)and Engineering Resources International (ERI)Ltd. express their sincere gratitude to IFC's PaCT program team for their role in guiding and steering this prestigious assignment for "Promoting cleaner production in the washing/dyeing/finishing sector in Bangladesh".

The consultants are grateful toIFC-Bangladeshfor vesting its confidence in the team for carrying out this prominent assignment for the identification of cleaner production interventions in IRIS Fabrics Ltd. Andfor their full-fledged coordination and support throughout the study.

Consultants Team

Development Environergy Services Ltd. (DESL) (Formerly Dalkia Energy Services Ltd) is a subsidiary of VEIC, the consulting business of the €36 Billion Veolia Environment, one of the world's largest environment and energy services business group. Engineering Resources International (ERI) is the local associate consultants from Bangladesh for this project.

Particulars	Details
Date of assessment	10/04/2016
Team leader and co-coordinator	M. G. Dave
DESL Team members	Shridhar Manure
	D.A.Shaikh
	K.N. Trivedi
ERI team: Project leader	Dr. Zahid Hassan
ERI Team members	Amin Al Maksud
	SM Rezwanul Islam
	Faisal Rahman

Table of Contents

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

APCD	Air Pollution Control Device
BGMEA	Bangladesh Garments Manufacturing & Exporters Association
CNG	Compressed Natural Gas
CP	Cleaner Production
CPA	Cleaner Production Assessment
CW	Cooling Water
DESL	Development Environergy Services Limited
IFL	IRIS Fabrics Ltd.
ECR	Environment Conservation Rules
EGB	Exhaust Gas Boiler
ERI	Engineering Resource International (Bangladesh)
ETP	Effluent treatment plant
FTL	Fluorescent tube light
GHG	Green House Gases
H&M	Hennes&Mauritz
IFC	International Finance Corporation
NG	Natural Gas
KPI	Key Performance Indicator
PaCT	Partnership for Cleaner Textile
PHE	Plate Heat Exchanger
PLC	Programmable Logic Control
RFT	Right First Time
SOP	Standard Operating Procedure
UF	Ultra Filtration
VFD	Variable Frequency Drive
WHRB	Waste Heat Recovery Boiler
WTA	Walk Through Audit
WTP	Water treatment plant

UNITS OF MEASUREMENTS

Parameters	UOM
Ampere	A
Bangladesh Taka	BDT
Biological Oxygen Demand	BOD
Calorific value	CV
Cubic Feet per Minute	CFM
Chemical Oxygen Demand	COD
Days	d
GCV	Gross Calorific Value
Hours	H
Horse Power	HP
Hertz	Hz
Kilogram	kg
Kilo Volt Amperes	kVA

Parameters	UOM
Kilo Watt-hour	kWh
Liters	l
Cubic Meter	m^3
Meter	m
Million tons of oil equivalent	MTOE
Power Factor	PF
Parts per million	ppm
Revolutions Per Minute	RPM
Total Dissolved Solids	TDS
Tons Per Hour	TPH
Total Suspended Solids	TSS
US Dollar	USD
Voltage	V
Year(s) Green House Gas Emission	y GHG Emission

CONVERSION FACTORS

Parameters	UOM	Value
Emission factor natural gas	kg of CO_2/m^3 of natural gas	2.154
Emission factor electricity	kg of CO_2/kWh	0.564
Emission factor diesel	kg of CO_2/liter	2.65

BASELINE PARAMETERS

Parameters	UOM	Value
Electricity rate (Grid)	BDT/kWh	8.18
NG fuel rate (heating)	BDT/Nm^3	6.04
	BDT/Nm^3	5.25*
NG fuel rate (Power)	BDT/Nm^3	7.49
	BDT/Nm^3	3.74*
CNG fuel rate	BDT/Nm^3	35.0
GCV of NG fuel	kcal/liter	8,930
GCV of CNG fuel	kcal/Nm^3	8,930
Operating days	days/year	300
Average operating hours	Hours	24
Annual production	kg	4,999,580
Specific energy consumption		
Ground Water	Liters/kg	138.3
Process Water	Liters/kg	113.8
NG	m^3/kg	0.95
Power	kWh/kg	1.54

*before sept'15

Executive Summary

The International Finance Corporation (IFC) is implementing the Bangladesh Water PaCT (Partnership for Cleaner Textile) program to reduce environmental and related social impacts that result from prevailing practices in textile wet processing.

PaCT has led the successful implementation of the first two steps, and in-depth assessment in 35 factories. In order to expand the project to a larger scale DESL (Development Environergy Services Limited) has been engaged for in depth cleaner production assessment study in 27 Washing, Dyeing and Finishing units of textile sector in Bangladesh. In this case, DESL is working with the local consultant team Engineering Resources International (ERI).

IRIS Fabrics Ltd. (IFL) is located in Gazipur involved in the fabric dyeing & finishing operations. It has an annual dyeing & finishing capacity of approximately 6,000 tons of fabric. The wet processing comprises of scouring/bleaching, peroxide killing, bio-polishing, dyeing, soaping, fixing and finishing. Unit is in production of 3 shifts, 24 hours and 300 days per year.The factory has attached garments which run 10-12 hours per day. The factory employs approximately 228 workers in dyeing & finishing section.

The baseline assessment for the PaCT programme was carried out by IFC engaged both local and international consulting firms on 14 March and April 10, 2016.

Metering: The status of installed meters for IRIS Fabrics Ltd. along with recommended meters by IFC consultants are detailed below

Table 1: Metering status

Meter	Baseline Assessment	Recommended	Additional Required
Water	13	13	0
Electricity	4	4	0
Gas	2	3	1
Steam	0	1	1
Total	**19**	**21**	**2**

Tables below summarize the baseline water, waste water and energy post implementation and also the reduction for each of the resources.

The baseline KPIs along with projected KPIs are tabulated below

Table 2: Resource conservation and KPI

Resource	Unit for Resources	KPI (Key Performance Indicators)		% Reduction	Projected Annual Savings, Resources	Projected Annual Savings, BDT	Unit for KPI
		Baseline	To be				
Ground Water	m^3	138.3	132.3	4.3	30,000	270,000	Liters/kg
Process Water	m^3	113.8	107.7	5.4	30,000	270,000	Liters/kg
Chemicals	tons	236	236	-	-	-	gram/kg

Resource	Unit for Resources	KPI (Key Performance Indicators)		% Reduction	Projected Annual Savings, Resources	Projected Annual Savings, BDT	Unit for KPI
		Baseline	To be				
Power	kWh	1.54	1.43	7.0	541,085	1,308,105	kWh/kg
NG	m^3	0.95	0.50	47.8	2,265,025	12,625,884	m^3/kg
Others							
GHG Emission	Tons of CO_2	11,887	7,355	38.1	4,532		
Energy Bill	Million BDT/annum	56.5	42.3	25.1		14.2	

Table 3: Saving Summary

Sr. No	CP Measures	Investment, Million BDT	Expected Annual Saving, Million BDT	Reference in report
	Utility Area			
1	Heat Recovery from Boiler Flue Gas by installing economizer	1.0	1.3	2.7.1
2	Heat Recovery from Gas Engine Flue Gas by WHRB	4.0	1.2	2.7.2
3	Heat Recovery from Gas Engine Jacket Water for Hot Water application	3.0	2.0	2.7.3
4	Pressure Reduction in Air Compressor by arresting leakages	Negligible	0.097	2.7.4
5	Replacement of existing submersible pump by energy efficient pump	0.2	0.06	2.7.5
6	Oxygen tuning in boiler	0.1	1.62	2.7.6
7	Lighting Optimization	2.7	1.15	2.7.7
8	Metering Requirement	0.4		
	Sub-total	**11.4**	**7.4**	
	Process Area			
9	Heat recovery from dyeing machine drained liquor at higher temperature	2.5	6.21	3.4.1
10	Recovery of water from Carino slitting machine	0.3	0.27	3.4.2
11	Reducing moisture in fabric before drying on Stenter machines	0.4	0.279	3.4.3
	Sub-total	**3.2**	**6.8**	
	ETP Area			
12	Bar screen	0.25		4.12
13	Storage tank	0.75		
14	Biological treatment	0.4		
15	Sludge Management	0.2		
	Sub-total	**1.60**		
	Total	**16.2**	**14.2**	

Impact of Cleaner production measures are graphically represented hereunder

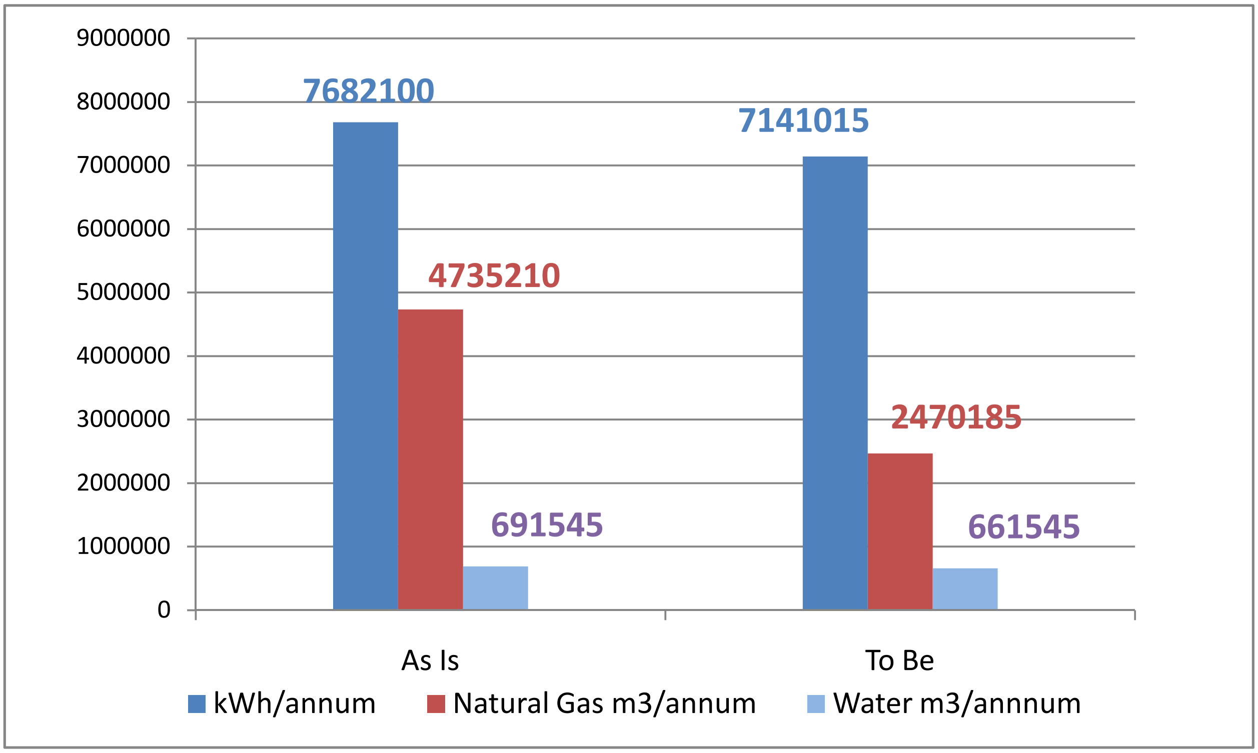


Figure 1: Impact of CP measures on resources

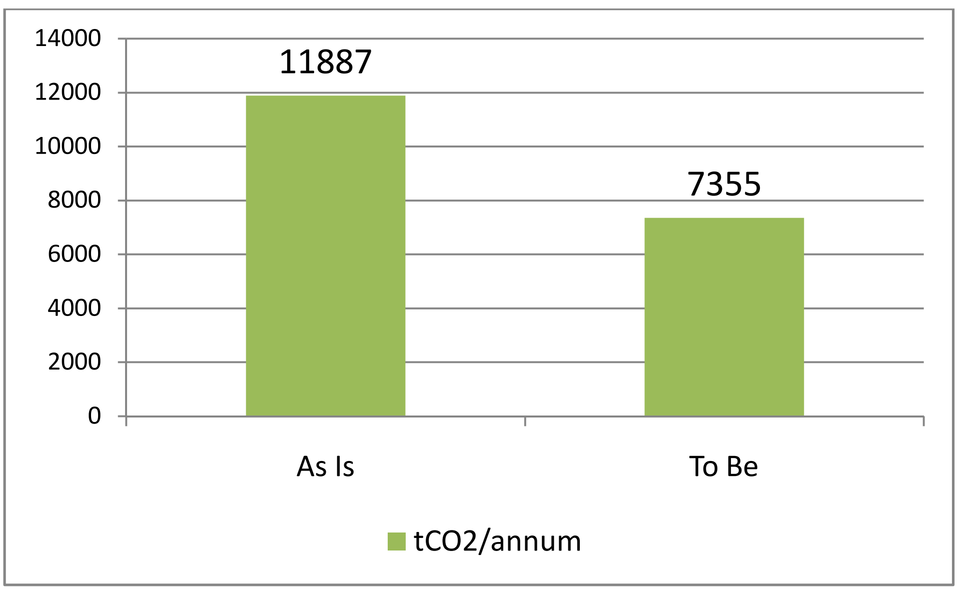


Figure 2: Impact of CP measures on GHG emission

GHG emission reduction is mainly due to process heat and water recovery, installation of heat recovery equipments, reducing most of the thermal losses and process optimization.

1 Introduction

International Finance Corporation (IFC) is implementing the Bangladesh PaCT (partnership for cleaner textile program to reduce environmental and related social impacts that result from prevailing practices in textile wet processing. The Program includes a component to support factories setting up and achieving cleaner production (CP) objectives. This component is implemented in 3 steps, viz. building factory awareness, providing factory level advise on adoption of low cost/no-cost measures and providing in depth CP assessments, leading to investment in technologies with significant water sustainability benefits. The program will focus on water as the primary driver for change, but will also address energy and chemical use (water-energy chemical nexus) for an integrated approach to resource efficiency.

PaCT is a partnership between textile wet processing factories in Bangladesh, international apparel buyers, wet processing technology suppliers, the Embassy of the Kingdom of the Netherlands (Dhaka), the International Finance Corporation (IFC), and the NGO Solidaridad. The PaCT partners share a commitment to bring about systemic, positive environmental change for the Bangladesh textile wet processing sector, its workers, and surrounding communities, and to contribute to the sector's long-term competitiveness.

To this end, the PaCT partners are collaborating to develop harmonized resource-efficiency procurement requirements, to build factory capacity, technical knowledge, and access to finance for Cleaner Production investments, and to create a platform for community and national dialogue on sustainable use of water in the textile sector.

PaCT is implemented by IFC and Solidaridad, in cooperation with BGMEA. PaCT benefits from the generous anchor sponsorship of the Embassy of the Kingdom of the Netherlands. The PaCT lead sponsors are C&A, H&M, and Inditex. Associate sponsors are G-Star, KappAhl, Lindex, Primark, and Tesco.

Development Environergy Services Ltd. New Delhi and Engineering Resources International have been engaged by IFC to provide in-depth assessments to identified textile units.

1.1 Objective

The specific objectives of this assignment are for identified factories, are to

1. Assess current usage of water, energy , chemicals,GHG emission and waste water discharge in factory

2. Identify saving opportunities by assessing wet dyeing process i.e. Washing, Dyeing and Finishing operations in textile units for delivering water and energy in a more efficient/less wasteful manner

3. Identify various options and investment plan to reduce water, energy , chemical consumption and effluent generation in the textile processing with improvement in ETP and WTP

4. Improve efficiency in resource utilization to make cleaner production at factory level and making the factory owners and decision makers aware of advantages of investing in technologies that

significantly reduce consumption of resources like energy, water and chemical use as well as reduce water effluent making the production process cleaner.

5. Identify opportunities for improving energy and water management system

6. On an ongoing system, share with IFC insights and lessons learned from the assessments, and prepare a formal note on lessons learned midway and at the end of the assignment

1.2 Scope of work

The objective shall be achieved through

1. Baseline data collection

2. Detailed technical assessment

3. Advice and demonstration of good practices in the dye house, ETP and utilities in selected 41 textile wet processing factories

4. Follow-up visits to factories for monitoring

5. Dissemination of results and awareness raising

1.3 Methodology

In order to assess the cleaner production opportunity toimprove energy efficiency and water consumption of its current operations in WDF textile factories by conducting a walk through audit (site work) along with local consultant's team:

- Walk through audit is planned to understand the process, practices and ground condition of the plants. The consultant's team will identify the opportunities for potential savings by observation and interrogation of plants personnel in Electricity and thermal energy usage, process equipments condition, following process flow up to final product. Use of energy, water and chemical will be critically studied to guide local team for necessary measurements during detail audit of the plant. ETP and water treatment will be studied to understand and identify the needs to improve the process and reduce consumption where possible.
- Data collection - Measure, monitor and collect all energy (electrical and thermal) and resource consumption data of the textile wet processing units including water, chemical usage, Effluent treatment plants' operation and chemical used for ETP
    - To help local consultant team to create a resource map of energy and water sources and users in the textile processing facility from the collected data analysis and make an energy/water balance
    - Historical data collection of resource consumption required for baseline establishment
    - The local consultant's team would measure different parameters such as energy consumption, fuel consumption, water consumption, steam consumption, performance of the boiler, compressed air consumption, thermal energy user areas and other relevant data points to make the complete resource map (energy, water, chemical and effluent)

    - The local consultants team will also collect the data for chemicals used in different processes and effluent discharge quantity, quality and effluent treatment process used in present condition
- Identify measures to reduce end-use demand for energy, chemical and water, for example by improving process system, improving equipment or system
- Identify measures to improve the efficiency of utility service; for example by steam distribution system improvements, reduction of heat loss, water consumption reduction potential, use of high-efficiency luminaries/motors,etc.
- Identify measures to enhance heat recovery or heat generation efficiency, processes, also identify measures improvement of ETP functionality, design, up gradation, etc.
- These reviews shall include all production operations and supporting utility systems such as boilers, Thermic fluid heaters, Diesel Generator sets, waste heat recovery systems, Insulation systems, dryer system operation, Fans and blowers, Pumps, compressed air systems, lighting systems and Effluent treatment plants etc.
- For each saving opportunity identified above,
    - Estimate the annual saving (energy (kWh), water saving; chemical saving; avoided water discharge, GHG emission (TCO2e), cost (BD Taka & USD) for the measure
    - Estimate the project cost or cost of implementation
    - Calculate the simple payback period.

1.4 In depth cleaner production assessment in IRIS Fabrics Ltd.

IRIS Fabrics Ltd. (which will be referred to herein after as IFL) is participating in the current project as a partner unit. It was established in the year 2007. It is an export oriented knit dyeing & finishing factory. This report describes the result of in depth Cleaner Production Assessment (CPA) of IFL. The goal of cleaner production is to avoid pollution by utmost utilization of resources and raw materials. This means that a higher percentage of the raw materials are turned into valuable products instead of being wasted.

- Basic CP assessment was carried out at IFLon September, 2014.
- IFL then participates in level 2 of CP assessment i.e. CP assessment.
- Engineering Resources International (ERI) Ltd. along with the brand sent deep dive questionnaire prepared by previous international consultants. Further missing data was requested to provide before the pre-assessment visit. ERI local consultant visited the factory on 14/03/2016.
- Walk through audit (WTA) was conducted by DESL (Development Environergy Services Limited) in co-ordination with ERIon 10/04/2016 to verify resources available, utilization, resources for process, water and chemical consumption in process, water and waste water utilization and recoveries.
- DESL asked for further data which was provided by ERI.
- DESL will de-brief the unit post WTA on unit specific observations, CP opportunities, measurement & monitoring needs etc.

2 Energy & Utility

2.1 Utility Mapping

IFL is using NG in one gas generator andone steam boiler. CNG is used in one stand by gas generator. Factory also has a grid power connection. IFL also use diesel in backup generators. Break up of various energy sources for different application in IFL is tabulated hereunder.

Table 4: Utility Mapping

Areas	Available on Site (✓)	Water	Electricity	Gas (Direct to Machine)	Steam
Offices& Domestic	✓	8%	5%		
Water extraction and pretreatment	✓		7.50%		
Fabric Dyehouse	✓	68%	28%		82%
Finishing	✓	5%	7%	13%	10%
Printing	✓	2%			
Generator	✓	2%		36%	
Boiler	✓	7%	1%	51%	
Garments	✓	8%	15%		8%
ETP	✓		6%		
Compressors	✓		30%		

Energy consumption from various sources of energy at IFL for last 12 months is tabulated and attached as **Annexure6**.

Percentage share of energy content resource wise is shown in pie chart hereunder.

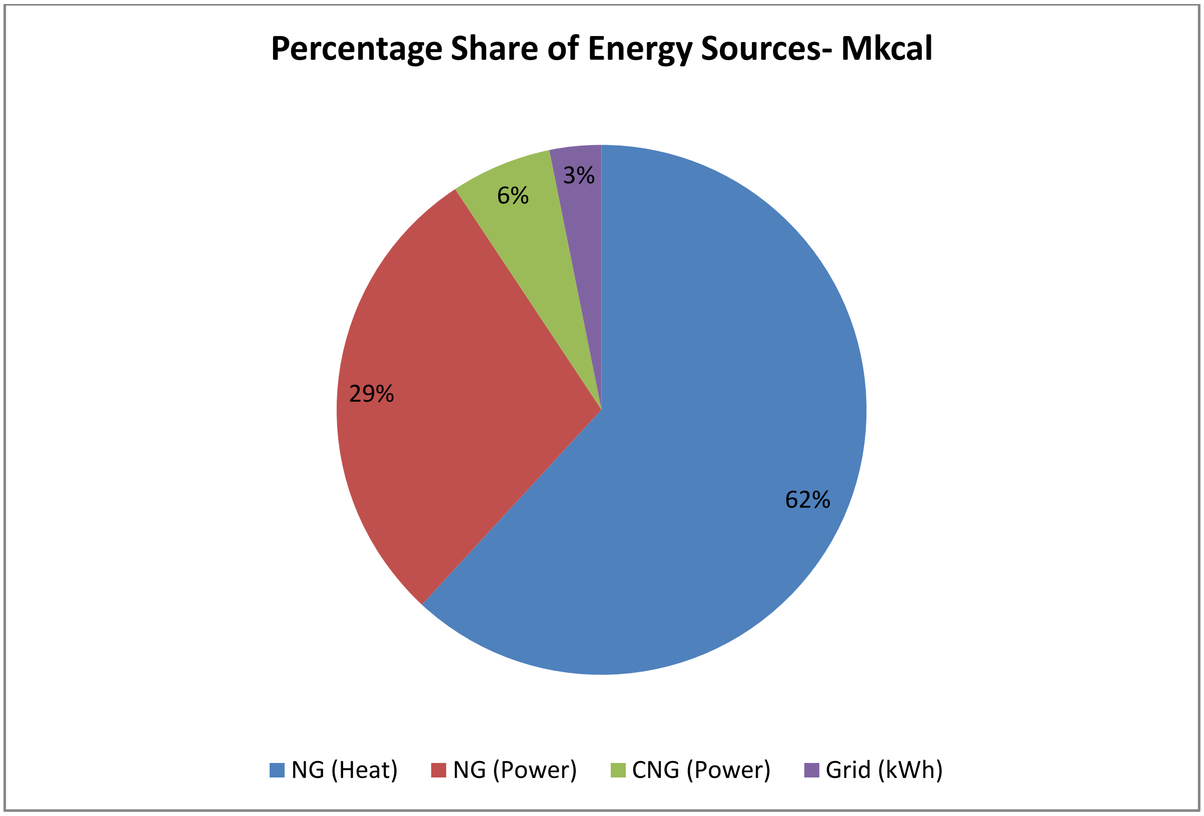


Figure 3: Percentage Share – Energy sources

For the various energy sources used in IFL the energy content, energy cost per unit of resource and total energy cost of the unit is summarized hereunder.

Table 5: Energy Content & Costing

Resource	Unit	Energy Content	Unit	Energy Cost
NG Heat	kcal/m^3	8,930	BDT/m^3	6.04
			BDT/m^3	5.25*
NG Power	kcal/m^3	8,930	BDT/m^3	7.49
			BDT/m^3	3.74*
CNG for Power	kcal/m^3	8,930	BDT/m^3	35.0
Electrical (Grid)	kcal/kWh	860	BDT/kWh	8.18
Resource	**Unit**	**Quantity**	**Unit**	**Energy Cost**
NG Heat	m^3	3,230,050	BDT/year	19,509,504
NG Power	m^3	1,505,160	BDT/year	11,273,653
CNG Power	m^3	321,060	BDT/year	11,237,095
Electrical (Grid)	kWh	1,765,960	BDT/year	14,445,553
Electrical (Captive)	kWh	5,916,140	BDT/year	-
Total (BDT/year)				56,465,805
Lac BDT/year				564.7
Million BDT/year				56.5

*before sept'15

Percentage share of energy sources cost-wise is shown in pie chart hereunder.

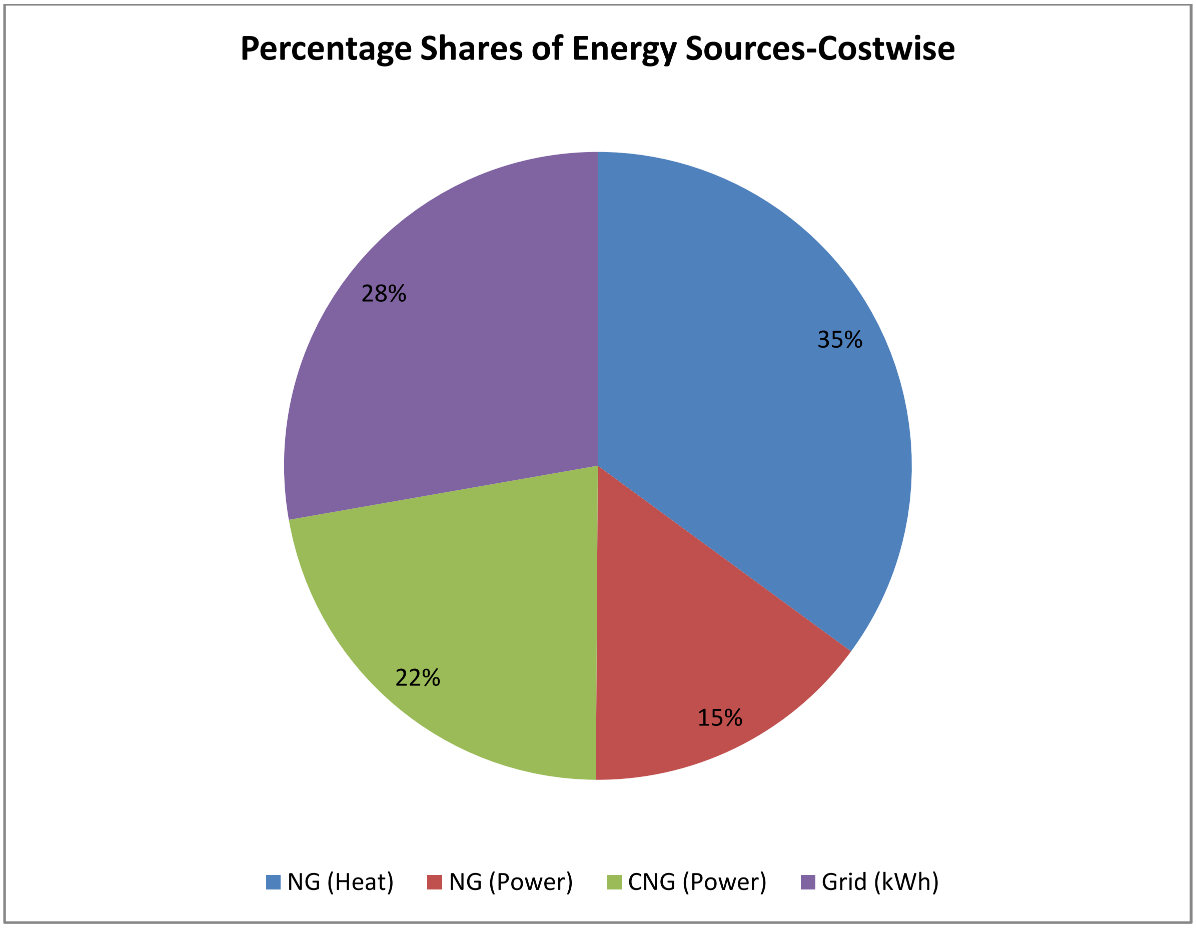


Figure 4: Percentage Share – Energy Cost

2.2 NG Consuming Equipments

NG as resource is mainly consumed in the following equipment:

Table 6: Natural Gas Consuming Equipments

Equipment	Quantity (numbers)
Boiler	1
Stenter	1
Generator	1

2.3 Thermal Energy

Thermal energy in the form of steam is generated from the only steam boiler. Steam generated is mainly utilized in process for dyeing & finishing purposes. Installation details of boiler are tabulated hereunder.

Table 7: Installation Details of Boilers

Parameters/Boiler Tag	Unit	Steam Boiler
Location	-	Boiler Room
Make	-	Mechmar
Model	-	AS2400/150 (24000 pph)
Running Status	-	Running
Fuel Type	-	NG
Rated Output	TPH	10

Parameters/Boiler Tag	Unit	Steam Boiler
Maximum Pressure	bar	10

Steam boiler is running continuously to meet the thermal demand.

Monthly steam generation and gas consumption data are attached as **Annexure7**.

Observations on steam generation and gas consumption are as follows:

- IFL has one number 10TPH boiler installed for thermal demand.
- Gas consumption is recorded by gas meter provided by utility.
- Gas flow meter also records gas consumption for process equipments.
- Separate gas flow meter should be installed to record gas consumption in process equipments.
- Installation of gas flow meter either at boiler or at process equipments inlet line can provide break up of gas consumption in boiler and other equipments

Performance evaluation of boiler/thermo boiler was carried out through indirect method using flue gas analysis. Performance evaluation results are summarized along with measured parameters.

Table 8: Performance Evaluation of Boilers

Parameter	Unit	Thermo Oil Boiler
Calorific Value of Fuel	kcal/m^3	8930
O_2 % in Flue gas	%	12.2
Excess Air	%	138.64
CO	ppm	243
CO_2	%	4.8
Fuel Consumption	m^3/hr	450.0
Ambient Temperature	^oC	36
Stack Temperature	^oC	210
Boiler Efficiency	%	70.55

Steam distribution system for IFL is shown in schematic hereunder. Steam is mainly used in dyeing & finishing sections. Steam is also used for 90 steam irons in garments section.

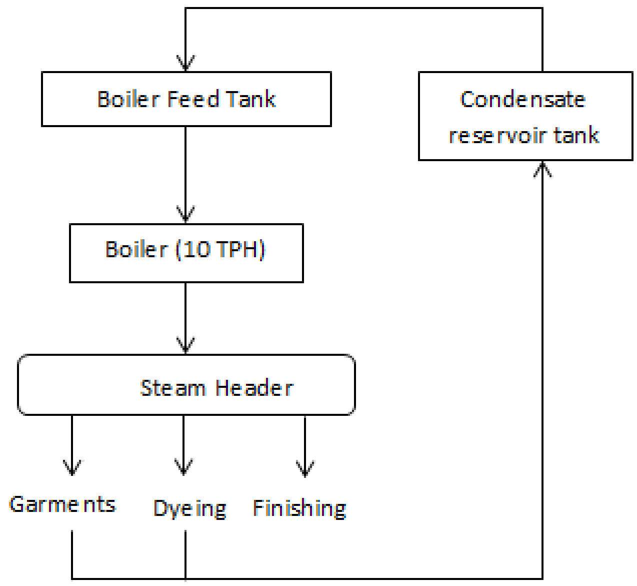


Figure 5: Steam distribution layout

2.4 Observations & Recommendations – Thermal Energy

Following are the observations & recommendations for steam & stem distribution system

- Average steam generation is 5-6 TPH.
- Oxygen tuning of boiler needs to be done, the present oxygen level in boiler is 12.2%.
- For gas fired boilers optimum oxygen level should be maintained in the range of 2-3%.
- IFL has installed auto blow down system in boiler.
- Condensate recovery system is very good.
- Feed water inlet temperature to boiler is more than 90^{o}C.
- Installation of steam flow meter can give steam generation and hence requirement on hourly/daily basis..
- We recommend installing steam flow meters individually in each of the boilers.
- Steam is generated at about 5.0kg/cm^2.
- No flue gas recovery is done from boiler/thermo boilers.
- Steam to fuel ratio for gas fired boiler should be around 13-14 kg of steam/m^3 of NG fuel.

2.5 Electrical Energy

At IFL electrical energy is mainly generated using gas engines which run on NG and CNG. The factory also has a power connection to the national grid. Power requirement is met through combination of gas engines and REB (Rural Electricity Board). Gas engine run by NG is the main power source while gas engine run by CNG is on standby. There are also three diesel generators for backup power supply.

Table 9: Diesel Engine Specification

Parameter/Diesel Engine	Unit	Gas Engine-1	Gas Engine-2	Diesel Engine-3	Diesel Engine-4	Diesel Engine-4
Make	-	CATERPILLAR	CATERPILLAR	VOLVO	MaxEnergy	KOHLER
Model	-	3516	3516	GSW275V	-	-
Serial Number	-	CAT0000CZBA 00460	-	214786/0 07	-	-
Capacity	kW	1030	1030	220	200	160
Frequency	Hz	50	50	50	50	50
Voltage	V	-	-	-	-	-
Current	A	-	-	-	-	-
Power Factor	pf	0.95	0.95	-	-	-

Average monthly power generation and gas consumption is tabulated hereunder.

Table 10: Monthly Power Generation and Fuel Consumption

Month	Gas Engine- 1&2		Gas Engine-1	Gas Engine-2
	NG (m^3)	CNG (m^3)	kWh	kWh
Jan'15	128,476	7,699	17,047	436,428
Feb'15	100,999	6,152	24,913	396,164
Mar'15	116,227	13,127	4,400	468,652
Apr'15	131,031	21,262	50,788	428,104
May'15	133,445	27,225	45,069	459,617
Jun'15	102,636	34,278	47,207	436,454
Jul'15	148,364	26,378	139,164	466,322
Aug'15	112,132	37,468	64,201	435,776
Sep'15	103,535	31,460	117,526	439,748
Oct'15	131,099	36,858	132,235	431,947
Nov'15	157,688	48,448	159,725	380,001
Dec'15	139,528	30,705	14,926	319,727
Total (year)	1,505,160	321,060	817,201	5,098,940

Observations and recommendations:

- Natural gas consumption along with power generation is recorded on daily basis.
- Natural gas consumption is recorded from utility installed gas flow meter.
- CNG is also used in one of the gas engine when there is shortage of gas or gas pressure is low.
- Contribution of CNG is about 17-18% of the total gas consumption in gas engines.
- Average specific power generation from gas engine is 3.24 kWh/m^3

- IFL should consult OEM (Original Equipment Manufacturer) for specific power generation from diesel engines.
- Specific power generation also depends upon loading on gas engines, hence IFL need to check the specific norms at different load conditions
- Natural gas cost for the power generation from gas engine is 7.49 BDT/m^3.
- Power generation from diesel engine is NIL.
- Contribution from REB grid is about 23% of the total power requirement.

The month-wise variation in electricity consumption is shown graphically in the figure below, red line indicates average monthly electricity consumption:

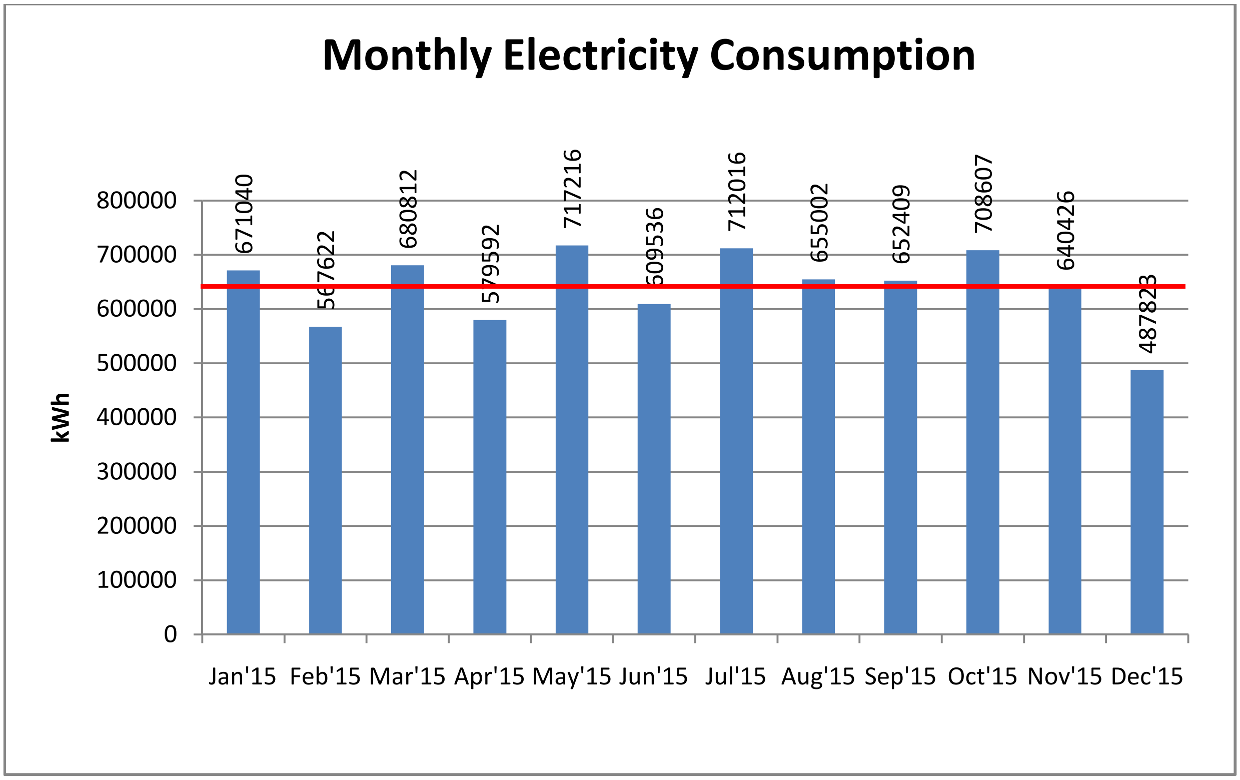


Figure 6: Monthly Electricity Consumption

2.6 Compressed Air System

Air compressors are installed to generate compressed air which are used in process area mainly for pneumatic equipments/instruments, compressed air is also widely used in industry for cleaning purpose. Specifications of the air compresors installed at IFL is tabulated hereunder.

Table 11: Air Compressors – Installation Details

Description	Unit	BOGE	SANLION	SANLION	GARDNER DENVER	GARDNER DENVER	PARISE
Model	-	S-40-2	SK5008DS-B	-	VS55	ESM 55	PVF50/EC0 6-8
Type	-	Screw	Screw	Screw	Screw	Screw	Screw
Quantity	numbers	3	1	1	1	1	1

Description	Unit	BOGE	SANLION	SANLION	GARDNER DENVER	GARDNER DENVER	PARISE
Status	-	Running	Running	Running	Running	Running	Running
Flow rate	m^3/min	-	-	-	-	-	-
Maximum Pressure	bar	10.0	10.0	10.0	10.0	10.0	10.0
Motor Rating	kW	30	37	25	50	50	30
Air Dryer	-	Yes	Yes	Yes	Yes	Yes	Yes

Compressed air distribution schematic is shown in **Annexure8**.
IFL has installed eight numbers air compressors. Air is collected in receiver, passed through air dryer to remove moisture and then through common header air is distributed to various sections.

Observations:

- Present unload pressure of air compressor is 8.0 bar.
- Present load pressure is 7.0 bar.
- Operating pressure of air compressor is 7.1-7.2 bar.
- Header pressure after dryer is observed to be 6.3 bar.
- Power consumption of air compressor is in the range of 43-45 kW.
- Out of eight, 4-5 compressors are running contineously as per air demand.
- Performance of compressor#7 and compressor#8 was evaluated by measuring power (kW) and taking flow rate from compressor panel.
- For compressor#7, specific power consumption is 0.181 kW/CFM.
- For compressor#8, specific power consumption is 0.174 kW/CFM.

Recommendations:

- Recommend to perform regular leakage test and monitor the leakage level.
- Compressed air leakages should not be more than 15%.
- Regular pump up test can also performed to check capacity delivery.
- For any future requirement of additional air compressor unit should opt for VFD (Variable Frequency Drive) driven compressors.
- VFD driven compressor will give better pressure control and also would lead to power saving.
- With VFD unload power consumption will be avoided.

2.7 Action plan for CP Measures – Electrical & Thermal Utilities

Based on the analysis, cleaner production actions have been identified; each of which are described below:

2.7.1 CP measure no 1: Heat recovery from boiler flue gas by installing economizer

Project

Preheat feed water by utilizing heat from flue gas of Boilers.

Study & Investigation

Presently flue gas heat from boilers is released into atmosphere at temperature of 220°C. We recommend installation of economizer at the outlet of boilers to recover heat and hence preheat boiler feed water. This preheated feed water can be returned back to feed water tank.

Recommendation Action

- Install economizer at the outlet of boilers.
- Lower feed water temperature contains oxygen which when heated inside boiler gets oxidized resulting into pitting and corrosion of water surface.
- Feed water entering boiler shall have maximum temperature ideally above 95°C, to avoid damage to water surface.
- Preheat boiler feed water and return back to feed water tank.
- Preheated feed water will result in substantial saving of natural gas.

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 12: Saving & Cost benefit for heat recovery from boiler flue gas

Parameter	Unit	Values
Temperature of flue gas	°C	220
Proposed Flue Gas Temperature	°C	130
Temperature difference of flue gas	°C	90
Boiler capacity	kg/hr	10,000
Flow rate of flue gas	m^3/hr	13,722
Boiler Efficiency	%	71%
Density of flue gas	kg/m^3	0.80
Specific heat of the substance	kCal/Kg	0.26
Heat Loss	kCal/hr	256,875
Operating Days	days	300
Operating hours	hours	24
Gas saving	m^3/hr	28.8
Gas price	BDT/m^3	6.04
Gas Saving	m^3/annum	207,111
Financial saving (BDT)	BDT/annum	1,250,951
Financial saving (USD)	USD/annum	16,038
Investment for economizer (BDT)	BDT	1,000,000
Price of economizer (USD)	USD	12,821
Payback period	Months	10

Action Plan

Item	Action
Operation & maintenance	Install economizer at the outlet of boiler to preheat feed water to boiler.

Retrofit	Install economizer, flue gas ducting, water piping, connection with feed water tank, connection with combustion blower etc
Replacement	Economizer installation, piping, insulation, automation system, connection with feed water tank, connection with combustion blower etc
Procurement	APH, Economizer, piping, valves, insulation, instrumentation etc
Construction	Necessary fabrication work to install economizer with necessary piping, flue gas ducts, instrumentation etc
Costing	Estimate BDT 1,000,000
Project Specific Baseline Parameters	Cost of natural gas 6.04 BDT/m^3 Operating days – 300 Operating hours – 24
Baseline	Natural gas consumption in boilers, present flue gas temperature at outlet of boiler
Implication, If any & precaution	None
Social Benefits	Improved working conditions, reduced natural gas consumption.

2.7.2 CP measure no 2: Installation of exhaust gas boiler (EGB)

Project

Heat recovery from flue gas of gas engine.

Study & Investigation

During the field visit it was observed that flue gas of one number gas engine (1030kW) running at IFL is not being utilized for heat recovery option, flue gas from this engine is released into atmosphere without any heat recovery at temperature more than 500-550^{o}C.

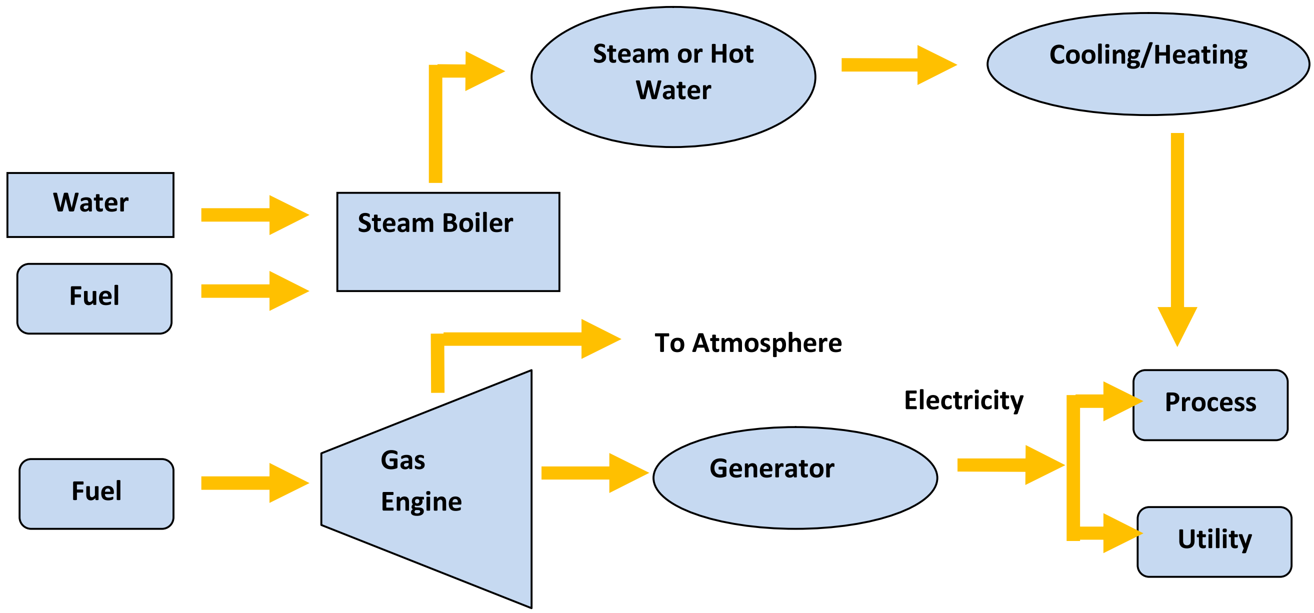


Figure 7: Existing Steam & Electricity System

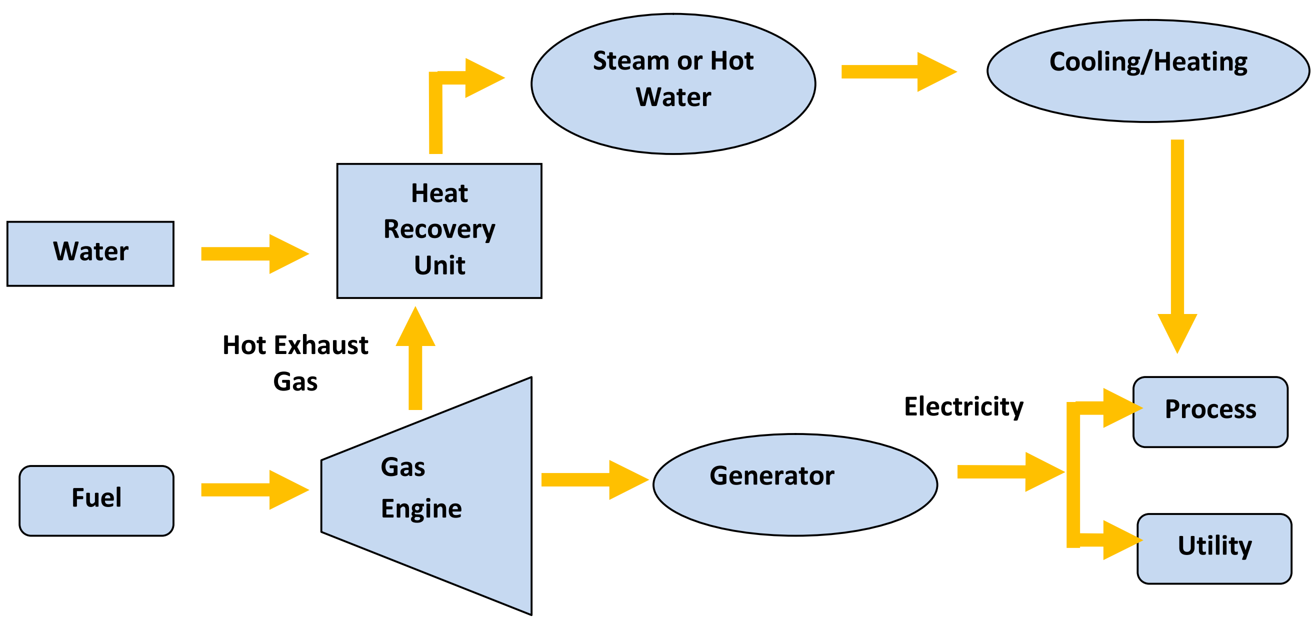


Figure 8: Proposed Steam & Electricity System

Recommendation Action

- Recommend installation of exhaust gas boiler to recover flue gas heat from gas engine.
- Flue gas heat can be recovered from 575°C to 220°C.

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 13: Saving & Cost benefit for installation of exhaust gas boiler

Parameter	Unit	Values
Temperature of flue gas	°C	575
Proposed Flue Gas Temperature	°C	220
Temperature difference of flue gas	°C	355
NG Consumption in Gas Engine	m^3/hr	200
Actual Load on Engine	%	80%
Flue gas per m^3 of NG	m^3/m^3	17
Calculated Flue Gas Flow Rate	m^3/hr	3,400
Density of flue gas	kg/m^3	0.80
Specific heat of the substance	kCal/Kg	0.26
Heat Loss	kCal/hr	251,056
Steam Generation	kg/hr	412
Operating Days	days	300
Operating hours	hours	24
Gas saving	m^3/hr	28.1
Gas price	BDT/m^3	6.04
Gas Saving	$m^3/annum$	202,419
Financial saving (BDT)	BDT/annum	1,222,612
Financial saving (USD)	USD/annum	15,675
Investment for WHRB (BDT)	BDT	4,000,000
Investment for WHRB(USD)	USD	51,282
Payback period	Months	39

Action Plan

Item	Action
Operation & maintenance	Installation of exhaust gas boiler would require regular maintenance of water side, flue side and air side path for efficient performance of boiler
Retrofit	Install exhaust gas boiler in the flue gas path
Replacement	Arrangement is to be made in the flue gas path for the installation of exhaust gas boiler
Procurement	Exhaust gas boiler, steam piping, water piping, electrical connection and compressed air supply to commission exhaust gas boiler
Construction	Necessary fabrication work to install EGB in the flue gas path.
Costing	Estimate BDT 4,000,000
Project Specific Baseline Parameters	Cost of natural gas 6.04 BDT/m^3 Operating days – 300 Operating hours - 24

Baseline	Exhaust flue gas temperature – 575°C Steam generation from EGB – 412 kg/hr Present fuel consumption for steam generation (412 kg/hr) – 202,419 m^3
Implication, If any & precaution	None
Social Benefits	Improved working conditions, reduced natural gas consumption.

2.7.3 CP measure no 3: Heat recovery from gas engine jacket water for hot water application

Project

Install heat recovery system to trap available heat from gas engine jacket water.

Study & Investigation

During the field visit it was observed that jacket water heat is being released through cooling tower into the atmosphere. Substantial heat is available in jacket water which can be utilized for generating hot water.

Recommendation Action

- Install hot water recovery system in parallel with existing heat exchanger, which will tap heat from jacket water and generate hot water.
- As and when there is requirement of hot water existing system will be bypassed and new system will generate hot water.
- Whenever there is no requirement of hot water then existing system will work.

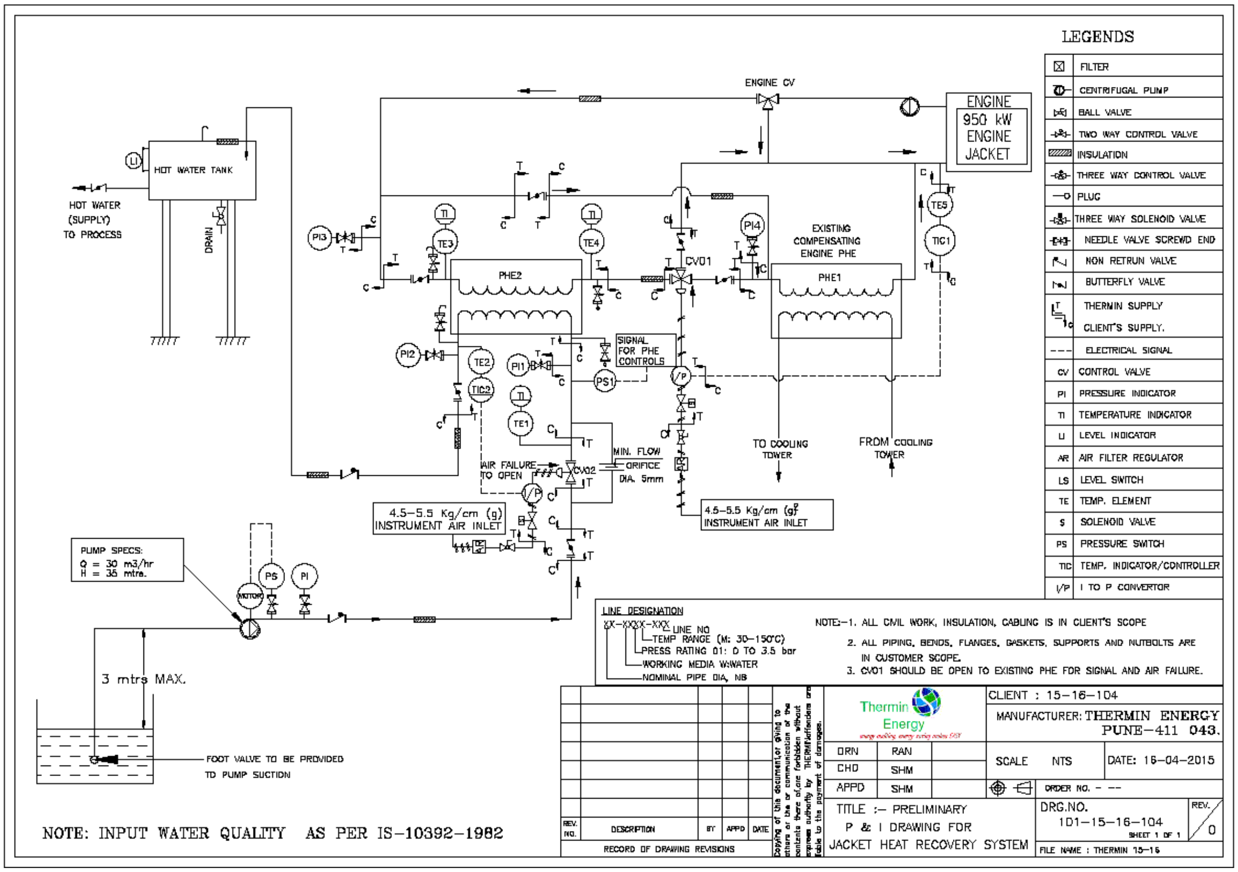


Figure 9: Jacket water heat recovery system (Illustrative)

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 14: Saving & Cost benefit for jacket water heat recovery system

Parameter	Unit	Values
Water Flow Rate in Gas Engine	m^3/hr	70
Jacket Water inlet temperature	°C	86
Jacket Water outlet temperature	°C	80
Heat Recoverable	kCal/hr	336,000
Hot Water inlet temperature	°C	35
Hot Water outlet temperature	°C	70
Hot Water Generation	m^3/hr	9.6
Operating Days	days	300
Operating hours	hours	24
Gas price	BDT/m^3	6.04
Gas Saving	m^3/hour	47
Gas Saving	m^3/annum	338,634
Financial saving (BDT)	BDT/annum	2,045,348
Financial saving (USD)	USD/annum	26,222
Investment for Hot Water System (BDT)	BDT	3,000,000
Investment for Hot Water System (USD)	USD	38,462

Parameter	Unit	Values
Payback period	Months	18

Action Plan

Item	Action
Operation & maintenance	Operation and maintenance of plate type heat exchanger, operation of instrumentation and automation system.
Retrofit	Some provisions are to be done for retrofitting so that both existing as well as new system will work as per requirement.
Replacement	None
Procurement	New heat recovery system will include plate type heat exchanger, hot water tanks, diverter valves , piping etc
Construction	Installation of plate type heat exchanger, pumps, tanks, piping, valves, instrumentation and piping.
Costing	Estimate : BDT 3,000,000
Project Specific Baseline Parameters	Cost of Natural gas – 6.04 BDT/m^3 Operating days – 300 Operating hours - 24
Baseline	Present gas consumption for steam generation through boiler, with proposed CP measure gas consumption in boiler will reduce as presently steam being used for hot water generation shall reduce.
Implication, If any &precaution	None
Social Benefits	Improved working conditions, reduced electricity consumption.

2.7.4 CP measure no 4: Pressure reduction in air compressors by arresting leakages

Project

Opportunity to reduce pressure in compressed air system by arresting leakages in the distribution system.

Study & Investigation

During the field visit it was observed that supply pressure is kept in the range of 7.1-7.2bar. Unload pressure of air compressor was kept at 8.0 bar and load pressure at 7.0 bar. Set points are kept high to meet the air pressure requirement at user end. It is anticipated that there may be air leakages in the system hence air has to be generated at higher pressure.

Recommendation Action

- Leakages in the air distribution system are to be identified.
- Once identified these leakages are to be plugged.
- As the leakages are plugged the set point of air compressor can be reduced
- It is expected that once leakages are arrested air pressure can be reduced by 0.5bar.
- Leakage identification and arresting of air leakages should be taken up as routine maintenance practices.

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 15: Saving & Cost benefit by pressure reduction

Parameter	Unit	Values
Present Unload Pressure	kg/cm^2	8.0
Present Load Pressure	kg/cm^2	7.0
Proposed Unload Pressure	kg/cm^2	7.5
Proposed Load Pressure	kg/cm^2	6.5
Pressure Reduction in Air Compressor	kg/cm^2	0.5
Saving Potential	%	3.0
Present Power Consumption	kW	229
Proposed Power Consumption	kW	222
Saving Potential	kW	6.9
Operating Days	days	300
Operating hours	hours	24
Saving Potential	kWh/annum	49,407
Gas Saving	m^3/annum	13,002
Gas price	BDT/m^3	7.49
Gas Saving	BDT/annum	97,383
Investment	BDT/USD	Negligible
Payback period	Months	Immediate

Action Plan

Item	Action
Operation & maintenance	Leakages identification and systematic plugging to be taken up as routine maintenance practice.
Retrofit	None
Replacement	Damaged leakage joints like ferrules, valves, connectors etc
Procurement	Connectors, ferrules, valves etc

Construction	None.
Costing	Negligible
Project Specific Baseline Parameters	Cost of natural gas for power generation – 7.49 BDT/m^3 Operating days – 300 Operating hours - 24
Baseline	Present Power consumption – 229.0kW
Implication, If any & precaution	None
Social Benefits	Improved working conditions, reduced electricity consumption.

2.7.5 CP measure no 5: Replacement of existing submersible pumps by energy efficient pump

Project

Install new energy efficient pump instead of existing submersible pumps.

Study & Investigation

During the field it was observed through measurement of flow, head and power that the efficiency of existing submersible pumps are in the range of 45-50%. Hence it is recommended to replace existing submersible pumps by energy efficient pump with 65% efficiency.

Recommendation Action

- It is recommended to install new energy efficient pump.
- Once installed flow, pressure and power to be measured for new pump.
- New pumps shall have efficiency of 65%

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 16: Saving & Cost benefit for replacement of submersible pump by energy efficient pump

Parameter	Unit	Submersible#1	Submersible#2
Existing Water Flow	m^3/hr	144.0	168.0
Total Head	m	24.2	24.1
Existing Pump Power	kW	24.4	26.1
Pump Efficiency	%	45.8	49.7
Proposed Flow	m^3/hr	144.0	168.0
Proposed Head	m	25.0	25.0
Proposed Efficiency	%	65.0	65.0
Proposed Power	kW	17.2	20.0
Saving Potential	kW	7.2	6.1

Parameter	Unit	Submersible#1	Submersible#2
Saving Potential	kWh/annum	17,313	14,718
Saving in Natural Gas	m^3/annum	4556	3873
Cost of Natural Gas	BDT/m^3	7.49	7.49
Saving Potential	BDT/annum	34,125	29,009
Investment	INR	100,000	100,000
Payback Period	months	35	41

Action Plan

Item	Action
Operation & maintenance	New pumps are to be maintained as per OEM suggestion for regular maintenance practices
Retrofit	Installation of energy efficient submersible pumps.
Replacement	None
Procurement	Submersible pumps with strainer and cables
Construction	Installation & testing of new submersible pump.
Costing	Estimate : BDT 200,000
Project Specific Baseline Parameters	Cost of Natural Gas (Power) – 7.49 BDT/m^3 Operating days – 300 Operating hours – 24
Baseline	Present Power consumption Submersible pump#1 – 24.4kW Submersible pump#2 – 26.1kW
Implication, If any & precaution	None
Social Benefits	Improved working conditions, reduced electricity consumption.

2.7.6 CP measure no 3: Oxygen tuning of Boiler

Project

Optimum oxygen level in boiler to reduce natural gas consumption.

Study & Investigation

During the field visit it was observed that oxygen level in boilers is 12.2% which is high for boiler of this capacity. We recommend maintaining oxygen level in the range of 2-3% for fuel saving and hence improved combustion efficiency of boiler.

Recommendation Action

- Recommend oxygen tuning in the boiler to maintain oxygen level in the range of 2-3%.
- An online oxygen tuning system can also be installed which will sense set oxygen level and continuously operate the fan damper to maintain the oxygen level.
- With oxygen controller boiler combustion efficiency can be improved in between 2-6%.

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 17: Saving & Cost benefit for oxygen tuning of boiler

Parameter	Unit	10.0TPH
Present Oxygen Level	%	12.2
Proposed Oxygen Level	%	3.0
Present Excess Air	%	138.6
Proposed Excess Air	%	17
Efficiency Improvement	%	8.28
Present NG Consumption	m^3/hour	450
Proposed NG Consumption	m^3/hour	413
NG Saving	m^3/hour	37
Operating Days	days	300
Operating hours	hours	24
Natural Gas Saving	m^3/annum	268,272
Cost of Natural Gas	BDT/m^3	6.04
Total Cost Saving	BDT/annum	1,620,363
Total Cost Saving	USD/annum	20,774
Investment for Oxygen Tuning	BDT	100,000
Investment for Oxygen Tuning	USD	1,282
Payback Period	months	1

Action Plan

Item	Action
Operation & maintenance	Maintain oxygen level in boiler by routine testing of flue gas parameters or alternatively installation of online oxygen analyzer which shall sense the oxygen level and give feedback to the fan damper to maintain the set oxygen level. Oxygen analyzer calibration to be carried out at regular interval.
Retrofit	Install oxygen sensor along with controller to maintain set oxygen level (Optional)
Replacement	Arrangement is to be made in the flue gas path for the installation of oxygen sensor with controller or access point for routine testing of flue gas parameter

Procurement	Arrangement to be made for testing of flue gas parameter.
Construction	Necessary fabrication work to insert flue gas probe or install oxygen sensor in the flue gas path.
Costing	Estimate BDT 100,000 (Costing considered for routine testing of flue gas parameter)
Project Specific Baseline Parameters	Cost of natural gas 6.74 BDT/m^3 Operating days – 300 Operating hours - 24
Baseline	Boiler Oxygen Level – 12.2% Present fuel consumption - 450 m^3/hr
Implication, If any & precaution	None
Social Benefits	Improved working conditions, reduced natural gas consumption.

2.7.7 CP measure no 7: Energy Efficient Lighting System

Project

Install energy efficient LED lamps.

Study & Investigation

During the field visit it was observed that 36W tube-lights with conventional ballast were installed at many locations in unit and these lamps are running 24hours. Comparisons of various lamps are shown hereunder.

Table 18: Comparison of lamps

Type of Lamp	Diameter of lamp (mm)	Lumens/Watt	Typical Life (hours)	Colour Rendering (%)
T12	38	60	5,000	65
T8	26	68	8,000	72
T5	16	104	20,000	85
LED	18/22	104	50,000	80

Recommendation Action

- Existing 36W tube lights with conventional ballast consume more power

- LED lamp would consume less power.
- Saving potential to the tune of 50% can be achieved.

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 19: Saving & Cost benefit for energy efficient tube lights

Parameter	Unit	AS IS	TO BE
Type of Fixture		FTL	**LED**
Type of Choke if Applicable		Electronic	Electronic
Type		36W X 1	18W X 1
Number of Fixtures	#	2660	2660
Rated Power of Fixture	Watt/Unit	36	18
Consumption of Choke		6	0
Operating Power	Watt/Unit	42	18
Operating Hour per Day	Hours/Day	300	300
Operating Days per Year	Days/annum	24	24
Annual Energy Consumption	kWh/annum	804,384	344,736
Annual Energy Saving	kWh/annum	459,648	
Saving in Natural Gas	m^3/annum	153,216	
Cost of Natural Gas	BDT/m^3	7.49	
Annual energy cost savings	BDT/annum	1,147,588	
Investment	BDT	2,660,000	
Payback	months	28	

Action Plan

Item	Action
Operation & maintenance	LED lamps will have less maintenance issues compared to conventional ballast, also the life of the lamp will be increased because of electronic ballast.
Retrofit	Retrofitting can be done in existing tube fittings
Replacement	None
Procurement	LED lamp
Construction	Retrofitting/replacement of existing lamps with energy efficient lamps.
Costing	Estimate : BDT 2,660,000
Project Specific Baseline Parameters	Cost of natural gas (Power) – 7.49BDT/m^3 Operating days – 300

	Operating hours – 24
Baseline	Present Power consumption – 42W
Implication, If any & precaution	None
Social Benefits	Improved working conditions, reduced electricity consumption.

2.8 Summary of CP measures in Utility area

2.8.1 Electrical energy consumption areas

Table 20: CP measures for Electrical System

Name of Area	Present Set-up	Observations during field Study & measurements	Proposed Cleaner production actions
Efficient Water Pumping System (Submersible Pumps)	Pump efficiency was found to be poor	Measured flow, pressure and power of existing submersible pumps, and derived efficiency of the pump.	Energy efficient pump will lead substantial saving in energy consumption.
Lighting System	36 Watts tube-lights installed in entire factory	Mostly these tube lights are running even in day time	Recommend replacing 36W tube lights by 18W energy efficient LED lamps with electronic ballast
Compressed Air	Compressor unload and load pressure set point are high	Due to air leakages in the distribution system set points may have to be kept high.	We recommend regular monitoring of compressed air network and arrest leakages on regular basis. Once the air leakages are arrested the load and unload set points can be brought down.

2.8.2 Thermal energy consumption areas

Table 21: CP measures for Thermal System

Name of Area	Present Set-up	Observations during field Study & measurements	Proposed Cleaner production actions
Boiler	Oxygen level in flue gas is high	It was observed that oxygen levels in boilers are 12.2%, which is high for natural gas.	Recommend online oxygen tuning system which will maintain optimum oxygen level of 2-3% in boiler.
Gas Engine	No heat recovery from flue gas	Flue gas exit temperature from gas engine was at 550°C. This available heat can be utilized by installing appropriate heat recovery system	Recommend installing Exhaust Gas Boiler (EGB) at the exit of gas engine to generate steam. After EGB the flue gas temperature will be less than 220°C
Gas Engine	No heat recovery	Jacket water temperature	Recommend installing jacket

Name of Area	Present Set-up	Observations during field Study & measurements	Proposed Cleaner production actions
	from engine jacket water	from gas engine was 85-90^{o}C. This available heat can be utilized by installing appropriate heat recovery system	water heat recovery system along with existing PHE (Plate heat exchanger) to generate hot water. During the period when hot water requirement is reduced existing cooling water system will take over.
Boiler	There is no heat recovery from boiler flue gas	Boiler flue gas has temperature of 220^{o}C, This heat can be utilized for feed water pre-heating or pre-heating of combustion air	Recommend installation of economizer to pre-heat feed water entering to boiler.

3 Unit & Process details

3.1 Introduction

IFL is situated at Zirani Bazar, BKSP, Kashimpur, Gazipur, Bangladesh and is the member of Bangladesh Garments Manufacturer and Exporter Association (BGMEA). Details of the unit are tabulated hereunder.

Table 22: Industry details

Parameters	Details	
Name of the industry	IRIS Fabrics Ltd.	
Address	Zirani Bazar, BKSP, Kashimpur, District: Gazipur, Division: Dhaka	
Production capacity	6,000,000 kg (Actual -1,792,603 kg. – Jan to Mar 2016)	
Products	Knit dyeing & finishing	
Number of workers	228	
Number of working days in a year	300	
Quantity of NG used	m^3/year	4,735,210
Quantity of CNG used	m^3/year	321,060
Quantity of Electrical energy used	kWh/year	7,682,100
Quantity of water used (process)	m^3/year	568,820
Waste water discharged	m^3/year	555,430
GHG emissions avoided	**tCO_2/year**	**11,887**
Chemical consumption	tons/year	1,183*

*based on chemical KPI'2016 and dyeing & finishing production'2015

The production facility comprises the different type of machines and equipment. A list of plant machines and equipment is given **Annexure1**.

3.2 Raw material and finished products

IRIS Fabrics Ltd. is a textile-processing unit (dyeing & finishing) of knitted grey fabric (75% cotton, 15% PC & 10% CVC). IFL has knit products of different varieties as per style, fashion and color of customer requirements and order preferences. The category wise finished garments production is given below

Table 23: Average Monthly Production

Product Type	Average Monthly Production
Knit dyeing & finishing (kg)	597,534

3.3 Manufacturing process description – Dyeing, Washing and finishing

Dyeing Process

Bulk production at IFL dyeing and finishing units are carried out by dyeing and finishing machines. Dyeing unit is equipped with Canlar (Turkey), Fongs (China), Tong Zeng (China), Brazoli (Italy) &Startex (China) machines. A total of 13 Canlarmachines, 3 Fongs machines, 3 Brazoli machines, 1 Tong Zeng& 2 Startex machines are installed in the current setup where 8 are sample machines. PLC control is available for all dyeing machines. But only Brazoli machines are PLC operated. Water flow meters are available in almost all dyeing machines to measure the water quantity in the machines.

The plant process flow is shown in **Annexure2**.

Finishing Process

The finishing process means dyeing finishing where fabric is finished to make ready for garments cutting section. The major process includes slitting, squeezing/dewatering, drying at stenter, compacting in tubular or open width compactor &various operations depending on the desired hand feel, shade and quality of the fabric.

Laboratory procedures for testing and establishing the process/sample

There is in-house laboratory where regular testing on sampling basis are carried out for PH testing, tear and tensile strength of fabric etc.

Performance results of sample to bulk production:

The record of lab sample RFT to Bulk process RFT is 80-85%.This needs to be investigated for further improvement. Mainly, the lab process parameter and bulk process parameters like Liquor ratio, batch cycle time, temperature, pH, specific gravity, dyes and chemical dozing as per recipes etc. should be strictly monitored and records should be analyzed when the variations are observed. Every batch which is reprocessed should be carefully investigated for root causes and if variations are found due to chemicals, procedures, manual operational mistakes or fabric quality etc. should be recorded and corrective actions to be taken for improving bulk RFT.

Tablebelow summarizes the established parameters as per data available:

Table 24: Process Performance

Process Parameters	Description	Figures
Lab RFT to Bulk RFT	Lab to Bulk right first time %	80-85%
	Bulk right first time % (except white)	95%
	% Batches topped up	3%
Re-Wash	% Batches re-dyed	<1%
	% batches completed within the set programmed time	80%
	% downgrades	0%
Liquor Ratio	Liquor Ratio for Bulk	1:4.5*/1:10

*only for Brazoli machines

Chemical dispensing methodology used for process:

Manual weighing and dispensing of chemical is used on machines. Dyers and processors use their own experience for correction of required batch variation.

Calibration status of dyes and chemicals weighing scales

There is no systematic procedure of regular calibration of weighing scales used in dye stores.There are no calibration procedures for the instruments on the machines for important parameters like temperature, Specific gravity or PH. Calibration records are not maintained.

Factory specific Baseline Key Indicators

Factory specific baseline condition based on data provided by IFL is summarized hereunder.

Table 25: Key Performance Indicators – Factory

Resource	Unit	Value	Production (kg)	KPI (Key Performance Indicators)		Unit for KPI
				As Is	To Be	
Ground Water	m^3	691,545	4,999,580	138.3	132.3	liters/kg
Process Water	m^3	568,820	4,999,580	113.8	107.7	liters/kg
Chemicals	kg	1,182,950	4,999,580	236.6	236.6	gm/kg
Power	kWh	7,682,100	4,999,580	1.54	1.43	kWh/kg
NG (Heating + Power)	m^3	4,735,210	4,999,580	0.95	0.50	m^3/kg
CNG (Power)	m^3	321,060	4,999,580	0.06	-	liters/kg

Observations and Recommendations for improvement in wet process area

- IFL has about 70 % dark shades dyeing, 15 % medium shade, 5 % light shade and 5 % white as per normal average production routine
- Dyeing liquor and wash liquor is drained to ETP at 80 deg C after cooling. The cooling water is collected with reserve tank and reused for hot water requirement.
- Lab to bulk first time right percentage are good (80 -85 %) as per data available.
- From dyeing production, 5-10 % reprocess/correction is required which is also higher as process performance
- The dyeing installed capacity is @ 17 TPD but since the finishing department has one Stenter which can process 10 TPD only, the dyeing productivity is used up to only 65 % which is big production loss.
- The finishing Stenter is a bottle neck for production as well as NG fuel availability is another limitation, but as discussed with MD Mr. Rahim, Gas fuel supply is already approved, so Stenter remains now only requirement to achieve increased productivity
- The table: shows below summary of observation and recommendations for improvement in processing area.

Table 26: Process area recommendations for improvement

Sr. No.	Process area	Observations	Recommendations / Remarks

1	Dyeing department	• 3 Nos. Brazzoli with LR 1:4.5 • 3 Nos. Fongs machines- LR 1: 6, CMS make 6 Nos. + 6 sample m/c, 1 No. Tonzing machine. • Lab to Bulk RFT – 80-85 %, • Manual weighing and dozing of colour chemicals • Instruments sensors and water level are not calibrated on machine • Liquor cooling is done up to 80 deg C before draining to ETP • Cooling water from dyeing machines is collected in soft water reserve tank • Routine cleaning of dyeing machines is carried out once in 15 days	• Liquor cooling can be further increased to bring down temp to 50 deg C before draining • Reprocess lots are investigated for diff reasons like finish feel, shade, visual look, GSM variation etc. • Condensate recovery is done and sent to Boiler feed tank but no meter and quantification • Heat exchanger on dyeing machines should be cleaned once in six months to save heating and cooling time • Black and dark colour batch time is 8 Hrs. due to direct scouring • Light and medium shades takes more time up to 11 Hrs • Cold soaping is tried but not successful.
2	Dye &Colour Stores	Weighing scale of colour-chemicals store are found calibrated, lab scale also found calibrated	Dyes weighing scales can be frequently calibrated to avoid human errors
3	Light box of laboratory and Dyeing office	Light box of laboratory & dyeing office are calibrated	For proper judgment it is necessary.
4	Sampling Laboratory	• Colour and chemicals are added manually. • Soda dosing is not done in single bath but separately. • Sample checking in normal D-65 or as per buyer `s requirement. • Delta passing ratio is below 1.0	Auto Colour dispense and auto dosing systems give more accuracy and better Lab to bulk ratio
5	Finishing machines	- Slitting machine-Alcan -1, turkey. - Dewatering machine – calator-1 - Dewatering machine Banks –Turkey - Dryer -1- Turkey - Open compactor- lafer-1 - Stenter -1, Bruckner –Germany - Stenter - Alkam – Turkey - Tube compactor- 1- Tubetex	- Stenter & dryer, there is no system to measure moisture content There is no heat recovery on Stenter.

6	Moisture level in fabric and garment before drying	No practice of checking moisture level after centrifuge	• Intermittent moisture level should be checked before sending garment for drying after centrifuge and before Stenter drying to reduce time and energy • Resurfacing/regrinding of rubber mangle rollers is recommended once in a year
7	Dewatering machines	On Corino dewatering machine squeezed water is going to drain	Squeezing water can be re utilized by simple filtrations, Thus huge amount of water can be saved
8	Dyeing and Pre treatment	Overall high water consumption due to pretreatment washing for dyed fabric	Pretreatment washing can be done as per requirement and recipe. Excess washing should be avoided. Reuse of clean water can reduce the water consumption
9	Heat recovery from Hot liquor drained at higher temperature	Hot liquor after dyeing process is drained at 80-84 deg c which is thermal loss and increases energy requirement at ETP for cooling the effluent	• Waste heat recovery from hot liquor for making hot process water which can be used for pretreatment /washing purpose
10	Planned programmed timing for process as per program sheet	There are variations in programmed cycle time by 13-15 % higher than actual process time.	Monitor actual process times against programmed and identify the reasons if over-running is caused due to machine problems, maintenance issues, utility reasons, individual operators, any special processes or due corrections and reprocess to match the quality
11	Dye liquor left over percentage after dyeing /rinsing	• Dyeing liquor left over percentage should be tested after every batch by dyeing small strip in lab to calculate actual dye pick up and if found more, better quality dye should be used to reduce ETP load	• The scope of reusing the mother dye bath for the repeat dyeing process in subsequent batches in the same or different machines • The better pick up dyes can be tried to reduce dyes consumption if residue % are found more.
12	Report generated -1	Volume parameter Re checking	This will change liquor to

<table>
<tr><td></td><td></td><td><table><tr><td>m/c no</td><td>Required volume as per sheet</td><td>Actual volume On glass Gauge pipe</td><td>remarks</td><td></td></tr><tr><td>16</td><td>2916</td><td>2750</td><td>166 litres more</td><td></td></tr><tr><td>10</td><td>2700</td><td>3100</td><td>400 litres more</td><td></td></tr><tr><td>19</td><td>5430</td><td>6900</td><td>1470 litres more</td><td></td></tr></table></td><td>material ratio and lead to correction of shade. Calibration of machine parameter required</td></tr>
<tr><td>13</td><td>Report generated -2</td><td>Rechecking dyes and chemicals on weight basis.<table><tr><td>m/c no-/chemicals</td><td>Actual Required</td><td>Actual Found</td><td>difference</td></tr><tr><td>10 Caustic soda</td><td>8.1 kg</td><td>12.0 kg</td><td>3900 grams more</td></tr><tr><td>3 dye</td><td>1200 grams</td><td>979 grams</td><td>221 grams less</td></tr></table></td><td>This type of mistakes leads more addition of colors and chemicals, and reprocess</td></tr>
<tr><td>14</td><td>Report generated -3</td><td>Analyzed 7 machines' work sheets of dt. 9/4/16
- Five black colors batches has taken 12.0 hrs each
- For medium shade process cycle time 10 hrs</td><td>Peroxide bleaching can be avoided In black shade which can reduce process time and chemical consumption with water saving</td></tr>
<tr><td>15</td><td>Colour -Chemical s store room</td><td>For all colors only one spoon was there in working which can create dye mixing</td><td>This will result the contamination of colors which more problematic for bright and light shades
- Separate spoon is required in all colour box</td></tr>
<tr><td>16</td><td>General</td><td>Chemicals like Caustic soda are lying near the machine side which can get moisture from wet floor</td><td>If soda and salt are kept nearer to chemical room. In big plastic boxes wastage will be less and accuracy in weight will be there,</td></tr>
</table>

17	For Development	- Value adding chemicals are just introduced in the market for sports garment and uniforms . Bio minerals chemicals, which increases the blood circulations	- For the market it is new , so better scope for introduced in marketing Sportswear, uniform garment - To evaluate in lab for better functions

3.4 Wet Processing section CP measures action plan

3.4.1 CP measures no 1:

Project

Heat recovery from dyeing machine drained liquor at higher temperature.

Observation during audit

It is observed during the visit that the liquor from dyeing machines are drained at higher temperature in the range of 80 deg C which is heat loss and creates problem at ETP treatment consuming higher chemicals for desired results.

Recommendation Action

To reduce the liquor temperature upto 50 deg C before draining using cooling water. This cooling water should be stored in a separate insulated hot storage water tank in the department which can be used for hot water requirement for washing / bleaching / rinsing etc in dyeing machines

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 27: Saving & Cost benefit for heat recovery

Parameter	Unit	Values
Total dyeing production - Jan-Mar 2016	kg	1,792,603
Pro-rata annual production	kgs/year	7,170,412
Baseline Water consumption	Liters/kg	114
Assuming 60 % of total water used for hot process	Liters/kg	68
Present Drained water temperature	Deg C	80
Suggested drained water temperature	Deg C	60
Differential temperature of heat recovery	Deg C	20
Heat gained by cooling water from 30 deg C	Deg C	15
Heat gained by cooling water per kg	Kcal/kg	15
Total heat gained by cooling water	Kcal	7,342,238,006
Equivalent saving of Gas fuel at 8930 Kcal/nm^3 and 80% boiler efficiency	nm3/year	1,027,749
Annual saving of Gas fuel cost for heating @ BDT 6.04 / nm3	Million BDT	6.21

Parameter	Unit	Values
Reduced GHG emission per year	T CO2e/year	2,214
Investment for heat recovery process equipment, storage tank, pipes and insulation	Million BDT	2.5
Simple Payback	Months	5

Action Plan

Item	Action
Initial trials	Initial trail can be taken one one/two machine to reduce the drain temperature from PLC and collecting hot water to insulated storage tank
Replacement	None
Procurement	From local vendors / fabricators
Construction	As per vendor's instruction
Costing	To collect from local vendor
Project Specific Baseline Parameters	Present Sp. Water consumption per kg of production as 114 Ltrs /kg and considering 60 % of water used in high temp process which is drained at 80 Deg C, Jan-Mar 2016 Production -1,792,603 kg. Heat gained by cold water - 15 kCal /kg
Baseline Implication, If any & precaution	None
Social Benefits	Reduced NG fuel, reduced CO2 emission, reduced effluent load and treatment cost

3.4.2 CP measures no 2: Recovery of water from Corino Slitting machines

Project

Corino slitting machines for tubular knitted fabric is using water balloon. This water can be reused and circulated instead of draining to ETP

Observation during audit

- 1 No. Corino slitting machine use water balloon for tubular fabric to open
- The water is drained after slitting the fabric which can be collected, filtered and reused
- This can save significant amount of water without much efforts.

Recommendation Action

- Drained water to be collected in a tank and filtered.
- With a small circulating pump, this water can be reused for this application and @ 5 m3/hr water can be saved on each machine
- Suitable trial can be taken for one machines first and record the water consumption

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 28: Benefits for water recovery from dewatering machine

Parameter	Unit	Values
Total Number of Tubular fabric slitting machines	Numbers	1
Present water Consumption per hour	M3/hour	5
Average operating hours for each machine	hours	20
Saving Potential with each machine	m3/day	100
Total Saving Potential per day	m3	100
Annual operating Days	days	300
Total Water saving potential per year	m^3/year	30,000
Annual water cost saving potential	Million BDT	0.27
Estimated investment for 3 machines	Million BDT	0.3
Simple Payback period	Months	13

Action Plan

Item	Action
Initial trials	Initial trials can be taken on machine from local vendors available in Dhaka
Retrofit	Collection tank, water filter and circulation pump
Procurement	From Local vendors
Construction	As per vendor's instruction and design
Costing	Estimate : 300,000 BDT for three machines
Project Specific	No. of slitting machines -1
Baseline Parameters	Operating days – 300, Average operating hours per day -20
Baseline	Present water consumption per hour on each machine – 5 m3/hr
Implication, If any & precaution	None
Social Benefits	Reduced water consumption, reduced effluent load

3.4.3 CP measures no 3: Reducing moisture in fabric before drying on Stenter machines

Project

Recoating/regrinding of rubber padding mangles for reducing moisture percentage in Stenter drying

Observation during audit

- For Stenter drying process of fabric, no information of moisture content in fabric before entry to Stenter is available; there is no measurement / metering of moisture also before and after drying.
- Fabric seems to have higher percentage of moisture which can consume higher thermal energy

Recommendation Action

- Recoating/regrinding of rubber mangle rollers to squeeze the fabric to reduce moisture before the fabric enters to Stenter
- Suitable moisture meter to be installed on Stenter entry

Saving Assessment

The cost-benefit analysis of the project is as shown in the table below:

Table 29: Reducing moisture before drying in mangle

Parameter	Unit	Values
Total Number of Stenter machines	Numbers	1
Machines operational	Numbers	1
Assuming moisture content before drying	%	80
Estimated reduction in moisture	%	60
Total production capacity of Stenter	Tons /day	10
Estimated reduction in moisture	Tons/day	2
Reduction in thermal energy required to evaporate the moisture	M kcal /day	1.1
Reduction in Equivalent NG fuel consumption @ 8930 Kcal and 80 % eff.	nm^3/day	154
Operating Days	Days	300
Savings of annual NG fuel	nm^3/annum	46,193
Monetary saving in fuel cost @ 6.04 BDT	Million BDT/annum	0.279
Estimated Investment for replacing rubber rollers and moisture indicator	M BDT	0.4
Simple payback	Months	17
Annual reduction of GHG emission	Tons/annum	99.5

Action Plan

Item	Action
Initial trials	Initial trials can be taken on machine by checking performance of rubber roller by regrinding/ recoating and then replacing by new
Maintenance	Existing rubber mangles need annual maintenance by regrinding
Procurement	From local service providers / vendors
Installation	As per vendor's instruction
Costing	Estimated : 300,000 BDT for rubber rollers Estimated: 100,000 BDT for moisture meter
Project Specific	No of Stenter machines -1
Baseline Parameters	Operating days – 300, Present production capacity of one Stenter – 10 Tons/day

Baseline

Implication, If any & precaution	None
Social Benefits	Reduced NG fuel consumption, reduced CO2 emission

3.5 Water & Watertreatment Scenario

Water balance diagram for IFL is shown in **Annexure3**

3.5.1 Water and WTP (Water Treatment Plant) - Installation

Four submersible pumps are installed by IFL to meet water requirement of process, boilers and domestic use. Installation details of submersible pumps are tabulated hereunder.

Table 30: Submersible Pump Details

Parameters	Unit	Submersible Pump-1	Submersible Pump-2	Submersible Pump-3	Submersible Pump-4
Make	-	SIGMA (India)	SIGMA (India)	ZAEDA (India)	ZAEDA (India)
Model	-	-	-	-	-
Flow Rate	m^3/hr	150	150	-	-
Head	m	21.3	21.3	21.3	21.3
Motor Rating	kW	30	30	4	4
RPM	rpm	2845	2845	-	-

Water treatment plant details are summarized hereunder.

Table 31: WTP Plant Details

Parameters	Unit	WTP-1	WTP-2
Make	-	SIGMA (India)	SIGMA (India)
Model	-	Mega G 65-160	Mega G 65-160
Production Capacity	m^3/hr	150	150
Storage Capacity	m^3	-	-
Number of Storage Tanks	Number	1	

Apart from the above pumps IFL has also installed pumps for the water distribution system. Details of the water distribution pumps are tabulated hereunder.

Table 32: Water Distribution Pumps

Parameters	Unit	Booster Pumps	Boiler Feed Water Pumps	Generator Cooling Water Pumps
Make	-	SIGMA (India)	Ground Foss	-
Model	-	DPVF 65-30	-	-
Flow Rate	m^3/hr	-	-	-
Head	m	27.6	-	-
Motor Rating	kW	7.5	11	15
RPM	Rpm	2850	-	-
Quantity	number	6	2	3

Observations:

a. Performances of some of the pumps were evaluated by simultaneous measurement of flow, head & power.
b. Measured parameters and the derived efficiency of the pumps are mentioned hereunder;

Table 33: Pump Performance

Parameters	Unit	WTP Raw Water Pumps	Submersible Pump (Garden)	Submersible Pump#1	Submersible Pump#2
Design Flow	m^3/hr	100	-	150	150
Design Pressure	M	35	-	21.3	21.3
Motor RPM	Rpm	2900	-	2845	2845
Motor	kW	18.5	-	30	30
Measured Flow	m^3/hr	143	12	144	168
Measured Head	M	53	25.1	24.2	24.1
Measured Power	kW	32.9 (3 pumps)	3.0	24.4	26.1
Efficiency	%	73.7	32.1	45.8	49.6

c. Efficiency of submersible pumps is poor.
d. Efficiency of WTP pumps are satisfactory.

Recommendation:

a. Replacement of existing submersible pumps by energy efficient pump.
b. New submersible pumps shall have efficiency of 65%.

3.5.2 Water generation, distribution – Consumption

Water generation data for raw water and soft water for last one year is collected and summarized in annexure. Ground water generation data, soft water generation data and water consumption data are shown in**Annexure4**.

4 Effluent Treatment Plant (ETP)

The treatment system is based on biological oxidation. The scheme comprises of manual screen, lifting sump, mechanical fine screen, storage tank, neutralization, distribution chamber, oxidation tank & secondary clarifier and sludge management in the form of sludge thickener& filter press. The design capacity of the plant is 1600 m3/day. Considering future expansion management has planned to install addition new ETP of capacity 2800 m3/day.

Schematic block diagram of ETP is shown hereunder for simple understanding.

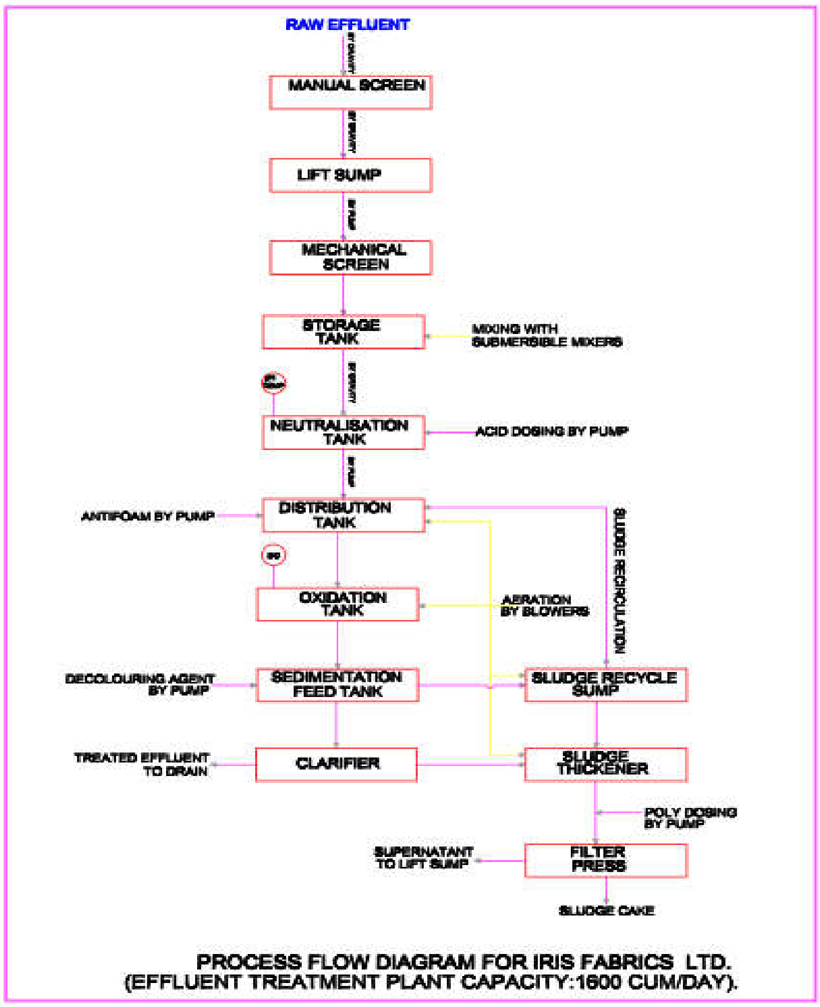


Figure 10: Schematic diagram of ETP plant

4.1 ETP design detail

Design capacity of effluent treatment plant: 1600 m3/day

Present operational load: 1440 m3/day

FIELD OBSERVATIONS:

- Overall condition of plant is good.
- Chemical dosing maintained properly.
- Proper log sheet & records has been maintained.
- It is recommended to use nutrients for better growth of microorganism in the biological treatment system.

Design details of ETP plant is attached as **Annexure5.**

4.2 Inlet and outlet effluent quantity and quality test certificate records

Outlet effluent quantity and quality parameters tested by IFL on different days along with standard norms for effluent in Bangladesh –ECR (Environment Conservation Rules) 1997 mandated by Government of People's Republic of Bangladesh, Ministry of Environment & Forest.

Table 34: ETP quantity & quality test report

Sl. No.	Parameters	Inlet to ETP	Treated effluent
1	PH	9.0-10.3	7.87-8.12
2	Colour	Various	Slightly coloured
3	Temperature (deg. C)	35	30-33
4	Suspended solids (mg/lit)	NA	30
5	Dissolved solids (mg/lit)	2700-2930	1500
6	COD (mg/lit)	530-925	22-85
7	BOD (mg/lit)	174-300	7-28

4.3 Metering facility for effluent inlet and outlet

One electromagnetic flow meter is installed at neutralized effluent pumping line& another mechanical flow meter at outlet discharge point. Metering details of ETP plant are mentioned hereunder.

Table 35: ETP water flow meters

Sl. No.	Location	Type
1	Inlet(neutralized effluent out)	Electromagnetic flow meter
2	Outlet	Mechanical flow meter
3	Any other location	No flow meter

4.4 Metering facility at other location

All major users of fresh water should be having water flow meter e.g. Dyeing, Washing, Boiler, Administrative office block, toilet and wash lines etc. to have proper control of ETP operation and chemical dosing.

It is also recommended to install the air flow meter at various locations to monitor air flow quantity to respective units.

4.5 Segregation of effluent steam

There is no segregation of effluent from various sections like softening plant, boiler blow down and effluent generated from various wet process.

It is recommended to segregate the effluent with high contamination like dyeing process can be treated biologically. Other less contaminated effluent can be treated with minimum chemicals and tertiary treatments to reduce ETP chemical used.

4.6 Sewage generation &treatment facility

There is no record of exact quantity of sewage generated. It is recommended to bring the waste water from toilet flushing, canteen etc. at ETP and can be treated in the biological system. This will save the addition of nutrient for biological system.

4.7 Chemicals dosing practices in ETP

Various chemicals dosing in ETP along with quantity is summarized hereunder.

Table 36: Chemical Dosing in ETP

Chemicals	Location	Quantity (kg/day)
Acid	Neutralization tank	225
De-foaming agent	Oxidation tank	4.5
De-coloring agent	Lamella Clarifier	100
Urea	Oxidation tank	Not used
DAP	Oxidation tank	Not used
Dewatering polyelectrolyte	Sludge management	Not used

Recommendations:

1. It is recommended to check day to day basis incoming effluent parameters like temperature, pH, color, COD, BOD &DO etc to decide the required chemical dosage.
2. Dosing of Nutrient like DAP & Urea for healthy growth of microorganism.

4.8 Recovery of Salt and Reuse of water

There is no salt recovery from effluent water at present. It is recommended to have a salt recovery at source; it can reduce additional chemical consumption at ETP.

The treated effluent can be reused for certain applications like primary washing, car washing & gardening purpose etc. It can reduce use of fresh water consumption and overall reduction of hydraulic load on ETP.

4.9 Disposal of sludge and hazardous chemicals

The ETP biological dewatered sludge is stored in storage area and disposed to nearby open land. It is also recommended to maintain sludge generation record on day to day basis.

4.10 Critical findings and recommendations

Table 37: ETP Findings

Equipment	Findings	Details
Bar Screen	Observation	Coarse type manual screen has been provided

Equipment	Findings	Details
		before the lift sump & lots of floating materials are passing through bar racks.
	Impact	Larger particles not filtered out which creates problem in frequent choking of pumps.
	Recommendations	Adequate size SS fine manual bar to be installed.
Storage tank& neutralization tank	Observation	a) Mixing is not proper. b) Out of two submersible mixers, one mixer is under maintenance.
	Impact	Settlement of suspended solids and un-uniform quality of effluent to the downstream treatment process during maintenance period.
	Recommendations	Under maintenance mixer to be repaired & made operational.
Oxidation tank	Observation	a) Air distribution& mixing not proper. b) DO meter installed near the entry point of oxidation tank. c) There is no Nutrient's used for biological system.
	Impact	a) Affect the healthy growth of biomass.
	Recommendations	b) Working condition of air diffusers to be checked & if required new to be installed. c) Location of the DO meter to be changed, preferably at the outlet point of oxidation tank. d) Urea/DAP dosing system to be provided.
Sludge recirculation sump	Observation	Only One No. of sludge recirculation pump is provided.
	Impact	It can hamper the biological system due to inadequate biomass in the aeration tank if there is break down of pump.
	Recommendations	Standby sludge recirculation pumps to be provided.
Sludge Management	Observation	Only one No. of sludge feed pump is provided.
	Impact	Can smoothen sludge management and handling.
	Recommendations	Additional standby sludge feed pump to be provided.

4.10.1 Issues discussed with client

All the operational issues of existing ETP , problematic areas, action to be taken at each stage, importance of record keeping has been discussed in detailed with top management and supporting staff of each section.

1. Importance of mechanical screen at the inlet point.
2. Importance of proper mixing instorage tank.
3. Importance of location of online DO monitoring system for aerobic system.

4. Importance & requirement of additional sludge recirculation pump for aerobic system.
5. Importance & Requirement of Nutrient dosing system for biological system.

4.11 Factory Specific baseline key indicators

Table 38: ETP effluent water characteristics

Parameters	UOM	Baseline Condition
Waste water parameters PH Temp Dissolved Oxygen Total Suspended Solids COD BOD	 Deg C mg/L mg/L mg/L mg/L	 9.0-10.3 35 2700-2930 NA 530-925 174-300
GHG reduction	T/Y	
Investment Facilitated	M BDT/USD	1.6 (20,513)
Water & Energy Management System		Not available
Production Process		Mechanical Chemical dispersion
ETP functionality / Operation		Can be improved with suggested measures

4.12 Summary of CP action with proposed investment (ETP section)

Table 39: Summary of CP actions in ETP

Present Set-up	Observations during field Study & measurements	Proposed Cleaner production action	Proposed Investment or Costing (BDT)
Bar screen	Manual type coarse screen at inlet.	Manual SS Fine bar screen to be provided.	250,000/-
Storage tank	Submersible mixer under maintenance.	Repaired/ replacement.	750,000/-
Biological treatment	There is No nutrient used. Only one sludge recirculation pump is running. There is no standby pump.	Nutrient dosing system to be provided. Standby sludge recirculation pump to be provided.	100,000/- 300,000/-
Sludge Management	There is no standby pump.	Standby pumps to be provided.	200,000/-

<u>**Note: The above proposed investments are tentative and can be verified with PaCT TTBC.**</u>

List of venders:

1. Online pH & DO meter : Forbes Marshall/ E& H

2. Manual bar screen: Local
3. Metering pumps: Asia LMI/ prominent/ positive metering (India)

4.13 Design details of ETP & Adequacy

Table 40: Design Adequacy

Sr. No.	Unit/ Equipment's	Capacity/ specifications	Adequacy for present load
1	Manual screen	Manual coarse bar screen	Not adequate
2	Lift sump	31.20 m^3	Adequate
3	Raw effluent pumps	3.1 kW (2 Nos.)	Adequate
4	Storage tank& Neutralization tank	1400 m^3	Adequate
4	Mixers	5.9 kW (1No.), 2.5 KW (1No.)	Adequate
7	Neutralized effluent pump	3.1 KW (2 Nos.)	Adequate
8	Distribution chamber	Volume included in oxidation tank	-----------
8	Oxidation tank	3457 m^3	Adequate
9	Air blower for oxidation tank	1090 m^3/hr. (2w+1s)	Adequate
10	Lamella clarifier	237 m^3	Adequate
11	Sludge recirculation sump	33 m^3	Adequate
12	Sludge recirculation pumps	3.1 kW (1 Nos.)	Additional pump required.
13	Sludge thickener	78.6 m^3	Adequate
14	Thickened sludge pump	------ m^3/hr. (1 No.)	Additional pump required.
15	Filter press	1000 x 1000 , 35 plates	Adequate
16	Dewatering poly dosing system Tank Pump	 2000 Lit 8.0 LPH,1 No.	 Additional pump required.
17	Acid dosing system Tank Pump	 3000 Lit. 1 No.	 Additional pump required.
18	De-coloring dosing system Tank Pump	 2000 Lit. 1 No.	 Additional pump required.
19	Antifoam dosing system Tank Pump	 1000 Lit. 1 No.	 Additional pump required.
20	Instruments	Electromagnetic flower meter PH meter DO meter	Adequate

5 Conclusions and Recommendations

The study has helped successfully identify these areas and cleaner production actions which when implemented will help bring down

a. The total GHG reduction of the unit is estimated at **38.1%**.
b. These measures have an estimated investment of **16.2 Million BDT** and can yield a savings of **14.2 Million BDT.**
c. Energy cost reduction of **14.2 Million BDT,** which is **25.1%** of present energy bill.
d. Investment for metering is estimated at **0.4 Million BDT.**
e. Water savings are about **4.3%** of present consumption.
f. Natural gas saving is about **47.8%** of present consumption.

Annexure1 – Plant and Machinery Details

Table 41: Machines & Equipment Details

Sr. No	Machine	Capacity per batch	Brand	Model	Quantity
1	DYEING MECHINE	10 kg	CANLAR	H.T. TECH sof-H	1
2	DYEING MECHINE	25 kg	CANLAR	H.T. TECH sof-H	1
3	DYEING MECHINE	25 kg	CANLAR	H.T. TECH sof-H	1
4	DYEING MECHINE	25 kg	CANLAR	H.T. TECH sof-H	1
5	DYEING MECHINE	50 kg	CANLAR	H.T. TECH sof-H	1
6	DYEING MECHINE	50 kg	CANLAR	H.T. TECH sof-H	1
7	DYEING MECHINE	150 kg	CANLAR	H.T. TECH sof-H	1
8	DYEING MECHINE	300 kg	CANLAR	H.T. TECH sof-H	1
9	DYEING MECHINE	300 kg	CANLAR	H.T. TECH sof-H	1
10	DYEING MECHINE	450 kg	CANLAR	H.T. TECH sof-H	1
11	DYEING MECHINE	450 kg	CANLAR	H.T. TECH sof-H	1
12	DYEING MECHINE	900 kg	CANLAR	H.T. TECH sof-H	1
13	DYEING MECHINE	750 kg	CANLAR	H.T. TECH sof-H	1
14	DYEING MECHINE	800 kg	FONGS	ECO-38-4T	1
15	DYEING MECHINE	600 kg	FONGS	ECO-38-3T	1
16	DYEING MECHINE	200 kg	FONGS	ECO-38-1T	1
17	DYEING MECHINE	2400 kg	TONG ZENG	-	1
18	DYEING MECHINE	1800 kg	Brazoli	-	1
19	DYEING MECHINE	1800 kg	Brazoli	-	1
20	DYEING MECHINE	1800 kg	Brazoli	-	1
21	DYEING MECHINE	20 kg	STARTEX	-	1
22	DYEING MECHINE	20 kg	STARTEX	-	1
23	Turning Machine (Color)	-	CANLAR		1
24	Turning Machine (Grey)	-	CANLAR		1
25	Slitting Machine	-	ALKAN	-	1
26	Slitting Machine	-	CORINO	-	1
27	Squeezing Machine	-	CALATOR	142	1
28	OpenCompacting Machine	-	HAS	-	1
29	Tubular Compacting Machine	-	TUBE TEX	BM10188	1
30	Santex Machine	-	ALKAN	-	1
31	Stenter Machine	-	BRUCNER	-	1
32	Open Width Compactor Machine	-	LAFAR	KSA500	1
33	Open Width Compactor	-	HAS	-	1

Sr. No	Machine	Capacity per batch	Brand	Model	Quantity
	Machine				
34	Tumble Dryer	-	Gold Dragon	-	1
35	Soft Setting Machine	-	HSING CHENG	-	1
36	Sueding Machine	-	LAFAR	CSM033-T	1
37	Boiler	10 TPH	MECHMAR	AS2400/150	1
38	Gas Generator	1030 kW	CATERPILLAR	-	2
39	Diesel Generator	220 kW	VOLVO	GSW275V	1
40	Gas Generator Pump	-	SIGMA	MEGA G 100-250	2
41	Compressor	50 kW	BOGE	S-40-2	3
42	Compressor	50 kW	SANLION	-	2
43	Compressor	50 kW	PARISE	-	1
44	Compressor	50 kW	GARDNER DENVER	VS 55	1
45	Compressor	50 kW	GARDNER DENVER	ESM 55	1
46	Submersible Pump	30 kW	SIGMA	-	2
47	Submersible Pump	4 kW	ZAEDA	-	2
48	Water Treatment Plant Pump	150 m^3/hr	SIGMA	MEGA G 65-160	2
49	Booster Pump	7.5 kW	SIGMA	DPVF 65-30	6
50	Hot Water Pump	-	SIGMA	MEGA CH 50-200	1
51	ETP Blower	37 kW	ROBUSHI	RBS 65/F-UNJ/A	3
52	Open Fabric Inspection Machine	-	OSHIMA	OST-150-100	2
53	Tubular Fabric Inspection Machine	-	OZBILIM	K1	2

Annexure2 – Process Flow Diagrams

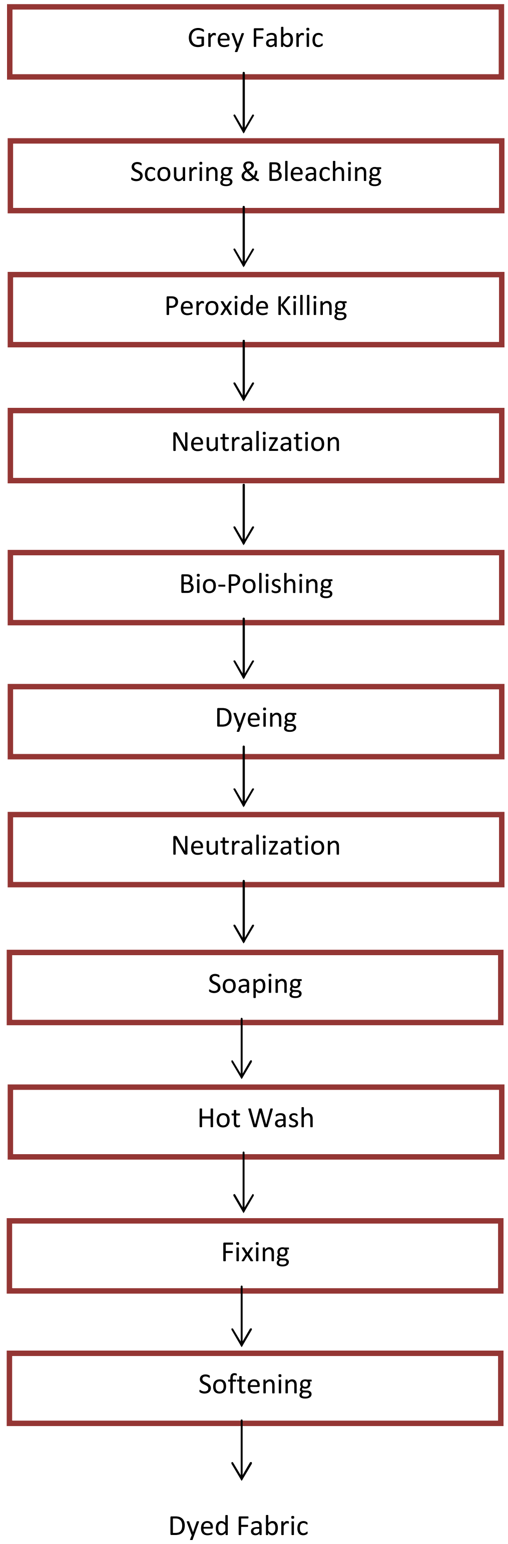


Figure 11: Process flow diagram of 100% cotton (dark) fabric dyeing

Annexure3 – Water Balance Diagrams

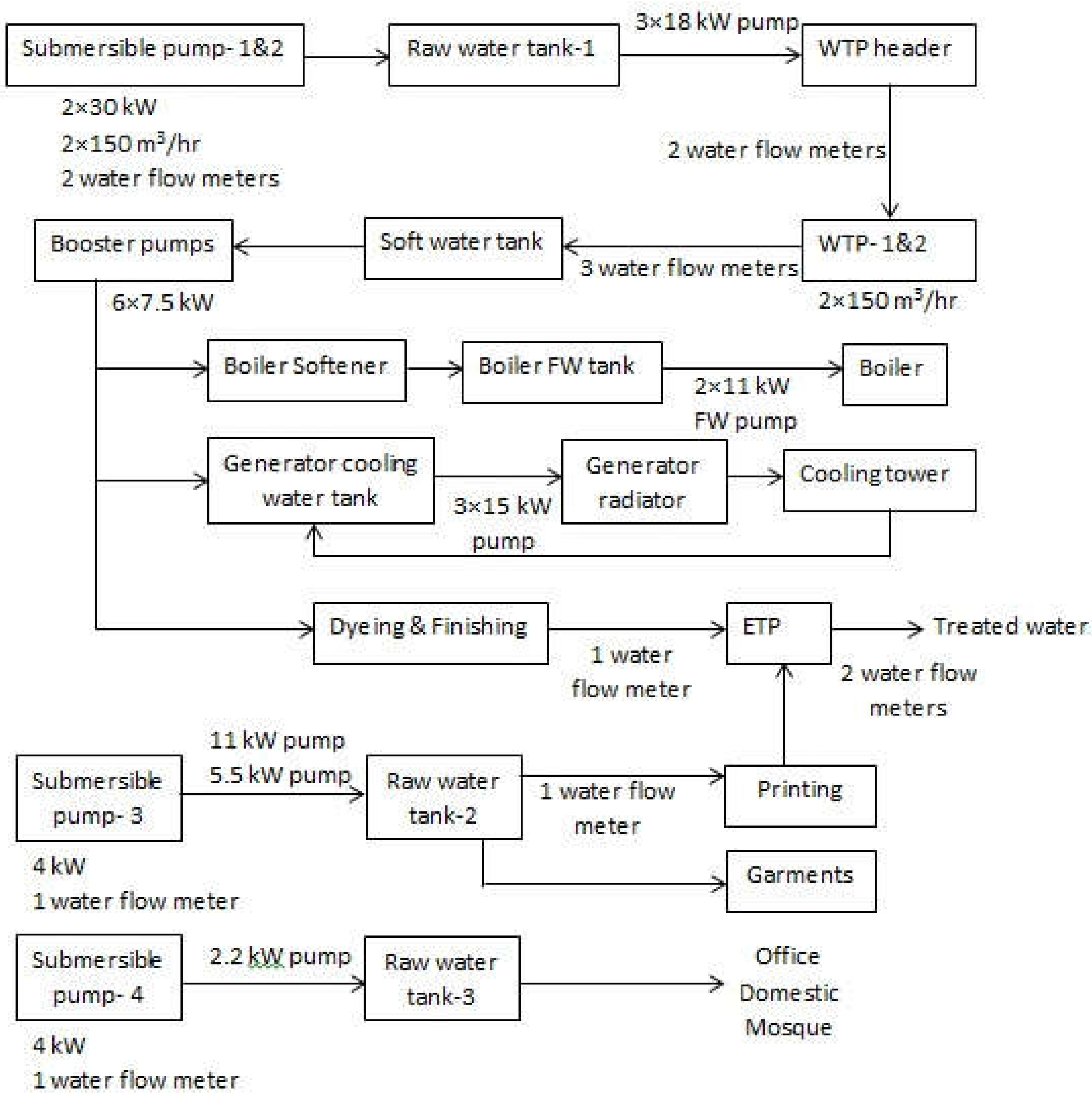


Figure 12: Water balance diagram of IFL

Annexure4 -Waste water data from ETP

Raw water, soft waterdata provided by IFL is summarized hereunder.

Table 42: Rawwater& soft water data

Month	Unit	Raw water	Soft water
Jan’15	m^3	59,583	48,911
Feb’15	m^3	53,917	44,096
Mar’15	m^3	59,803	48,809
Apr’15	m^3	57,216	46,950
May’15	m^3	59,097	48,704
Jun’15	m^3	57,138	46,990
Jul’15	m^3	53,789	43,976
Aug’15	m^3	57,212	48,669
Sep’15	m^3	57,492	47,168
Oct’15	m^3	58,974	48,756
Nov’15	m^3	57,730	47,068
Dec’15	m^3	59,594	48,724
Total (year)	m^3	691,545	568,821

Annexure5 – ETP design details

Table 43: ETP design details

Sr. No	Particular	Details	Unit
1	**Chemical used in the process**	H_2SO_4, Poly electrolyte, Urea, DAP, Decolorant	
2	**Total Industrial water demand**	2305	m^3/day
3	**Waste water generated from various section**	1850	m^3/day
3a	Peak flow and duration	-	m^3/day
3b	Lean flow & duration	-	m^3/day
3c	Avg. flow	77	m^3/hr
4	**Domestic waste water**	0	m^3/day
5	**Total waste water**	1850	m^3/day
6	**Raw waste water characteristics**		
	PH	10.29	
	Color	-	
	Temperature	-	Deg.
	Oil & Grease	-	mg/lit
	Suspended solids	-	mg/lit
	Dissolved solids	2700	mg/lit
	COD	925	mg/lit
	BOD	300	mg/lit
7	**Treated waste water characteristics**		
	PH	8.12	
	Color	-	

Sr. No	Particular	Details	Unit
	Temperature	-	Deg.
	Suspended solids	22	mg/lit
	Dissolved solids	1509	mg/lit
	COD	22	mg/lit
	BOD_5	7	mg/lit
	Effluent treatment plant capacity	1,600	m^3/day
	Sewage treatment	No	
8	**Effluent Treatment scheme Adapted**		
8a	**Physical Separation**		
	Screen (Yes/No)	Yes	
	Type	Bar screen (Mechanical)	
8b	**Equalization**		
	Tank Capacity (Size)	-	m^3
	Type of mixing	Mechanical diffuser	
	Mixer	5.9+2.5	kW
	Primary Treatment		
	Flash mixer (Yes/No)	Yes	
	Capacity/ Size(2000x2000x2000mm)	-	m^3
	Flocculation tank (Yes/No)	No	
	Capacity/ Size(3200x3200x3200mm)	-	m^3
	Primary Clarifier/ plan settling/tube settler/Lamella settler		
	Capacity	-	m^3
	Size	-	
8d	Chemical used		
	H_2SO_4	240	kg/day
	Decolorant	104	kg/day
	Urea/DAP	Not regularly	
	Poly	Not regularly	kg/day
	Type of feeding (Manual/ Pumping)	Pumping	
8e	pH Correction facility (yes/No)	Yes	
	Capacity	-	m^3
	Chemical used	240	kg/day
	Type of feeding (Manual/ Pumping)	Pumping	
9	**Biological Treatment (Yes/No.)**	Yes	
9a	**Type of system**		
	Conventional/ MBBR/ Other	Bio-chemical	
	Feed pump Capacity	-	m^3/hr
	Size / Capacity		m^3
	Performance of aeration system	Diffused aeration	
	Blower capacity/Installed power	37	kW (3 units)
9b	**Secondary settling tank**	Yes	
	Clarifier/ plain settling/ tube settler	Clarifier	
	Size	-	
	Capacity	-	m^3/hr

Sr. No	Particular	Details	Unit
	Recirculation Pumps	-	m^3/hr
9c	**Chlorine contact tank (Yes/No)**	No	
	Capacity/Size	-	m^3
9d	**sludge pit**	No	
9e	**Sludge Thickener**	Yes	
10	**Tertiary system (Yes/No)**	No	
	Capacity	-	m^3/hr
	Units involved	-	
	Capacity/size	-	
	Utility point	-	
11	**Sludge Management**	No	
	Type (Sludge drying beds/Mech. De-watering system)	-	
	Capacity/ size	-	m^3/hr
	Chemicals used for dewatering	-	
	Chemical Consumption	-	kg/day

Annexure6 – Energy Consumption Details

Table 44: Energy Consumption

Month	NG Heat (m^3)	NG Power (m^3)	CNG Power (m^3)	Electrical Grid (kWh)
Jan’15	283,040	128,476	7,699	217,565
Feb’15	232,036	100,999	6,152	146,545
Mar’15	260,681	116,227	13,127	207,760
Apr’15	276,652	131,031	21,262	100,700
May’15	281,280	133,445	27,225	212,530
Jun’15	284,186	102,636	34,278	125,875
Jul’15	312,358	148,364	26,378	106,530
Aug’15	237,531	112,132	37,468	155,025
Sep’15	233,137	103,535	31,460	95,135
Oct’15	246,217	131,099	36,858	144,425
Nov’15	306,292	157,688	48,448	100,700
Dec’15	276,639	139,528	30,705	153,170
Total (year)	3,230,050	1,505,160	321,060	1,765,960

Annexure8 – Compressed air distribution schematic

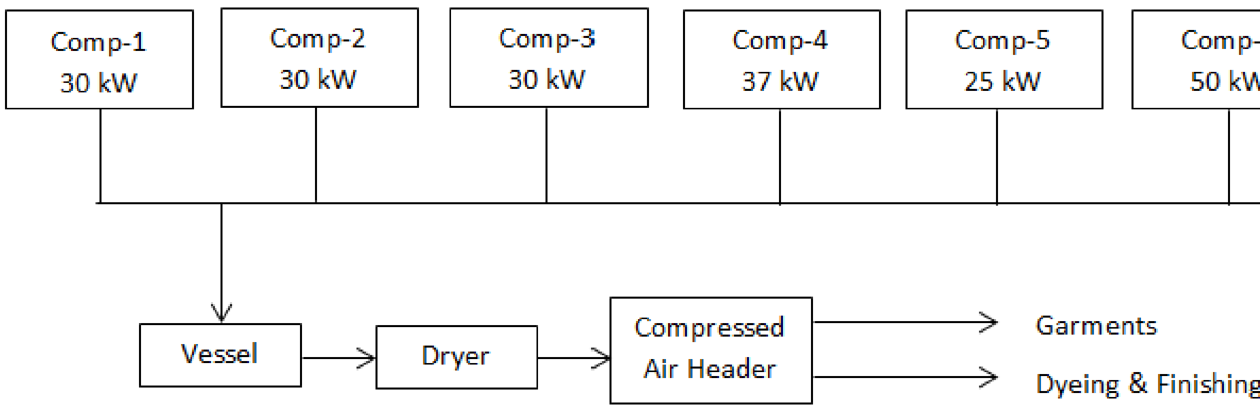


Figure 13: Compressed air distribution schematic

Annexure9- Dyeing Bulk production recipe sheet

Form No : Dyeing Prod'n : 03
Revision : 00

D:\DYEING RECEIPE\H&M\LIGHT COLOR 3/14/2016 2:53 PM

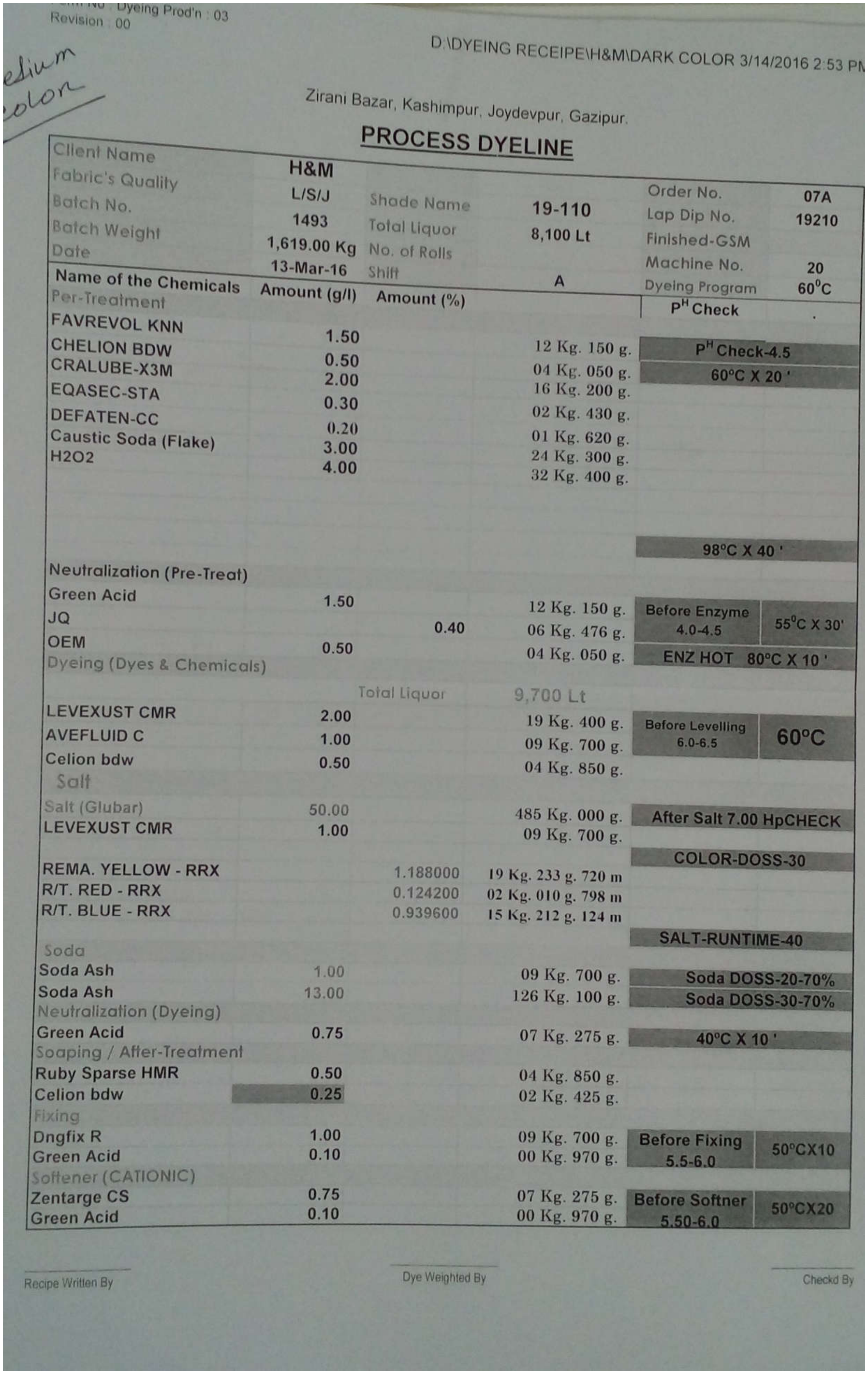
Zirani Bazar, Kashimpur, Joydevpur, Gazipur.

PROCESS DYELINE

Client Name	H&M			Order No.	R-14 A
Fabric's Quality	S/J	Shade Name	54-107(A.O.P)	Lap Dip No.	18559
Batch No.	OB-624	Total Liquor	4,200 Lt	Finished-GSM	
Batch Weight	700.00 Kg	No. of Rolls		Machine No.	15
Date	13-Mar-16	Shift	B	Dyeing Program	60°C

Name of the Chemicals	Amount (g/l)	Amount (%)		P^H Check
Per-Treatment				
FAVREVOL KNN	0.50		02 Kg. 100 g.	P^H Check-4.5
CHELION BDW	0.25		01 Kg. 050 g.	60°C X 20 '
FAVREVOL KNN	2.00		08 Kg. 400 g.	
CHELION BDW	2.00		08 Kg. 400 g.	
CRALUBE-X3M	1.00		04 Kg. 200 g.	
EQASEC-STA	0.50		02 Kg. 100 g.	
DEFATEN-CC	0.20		00 Kg. 840 g.	
Caustic Soda (Flake)	3.00		12 Kg. 600 g.	
H_2O_2	4.00		16 Kg. 800 g.	98°C X 40 '
Neutralization (Pre-Treat)				
Green Acid	2.00		08 Kg. 400 g.	Before Enzyme 4.0-4.5 / 55°C X 20'
JQ		0.40	02 Kg. 800 g.	
OEM	0.50		02 Kg. 100 g.	ENZ HOT 80°C X 10 '
Dyeing (Dyes & Chemicals)				
		Total Liquor	4,200 Lt	
LEVEXUST CMR	2.00		08 Kg. 400 g.	Before Levelling 6.0-6.5 / 60°C
AVEFLUID C	1.00		04 Kg. 200 g.	
Celion bdw	0.50		02 Kg. 100 g.	
Salt				
Salt (Glubar)	20.00		84 Kg. 000 g.	After Salt 7.00 HpCHECK
LEVEXUST CMR	1.00		04 Kg. 200 g.	
				COLOR-DOSS-30
S/Z. YELLOW - KHL		0.003872	00 Kg. 027 g. 104 m	
S/Z. RED -KHL		0.014250	00 Kg. 099 g. 750 m	
S/Z. BLUE -KHL		0.000345	00 Kg. 002 g. 415 m	
				SALT-RUNTIME-30
Soda				
Soda Ash	1.00		04 Kg. 200 g.	Soda DOSS-20-70%
Soda Ash	4.00		16 Kg. 800 g.	Soda DOSS-30-70%
Neutralization (Dyeing)				
Green Acid	0.75		03 Kg. 150 g.	40°C X 10 '
Soaping / After-Treatment				
Ruby Sparse HMR	0.50		02 Kg. 100 g.	
Celion bdw	0.25		01 Kg. 050 g.	
Fixing				
Dngfix R	1.00		04 Kg. 200 g.	Before Fixing 5.5-6.0 / 50°CX10
Green Acid	0.10		00 Kg. 420 g.	
Softener (CATIONIC)				
Zentarge CS	0.00	A O P	00 Kg. 000 g.	Before Softner 5.50-6.0 / 50°CX20
Green Acid	0.00		00 Kg. 000 g.	

Recipe Written By   Dye Weighted By   Checkd By



... No : Dyeing Prod'n : 03
Revision : 00

edium
color

D:\DYEING RECEIPE\H&M\DARK COLOR 3/14/2016 2:53 PM

Zirani Bazar, Kashimpur, Joydevpur, Gazipur.

PROCESS DYELINE

Client Name	H&M				
Fabric's Quality	L/S/J	Shade Name	19-110	Order No.	07A
Batch No.	1493	Total Liquor	8,100 Lt	Lap Dip No.	19210
Batch Weight	1,619.00 Kg	No. of Rolls		Finished-GSM	
Date	13-Mar-16	Shift	A	Machine No.	20
				Dyeing Program	60°C

Name of the Chemicals	Amount (g/l)	Amount (%)			
Per-Treatment				P^H Check	.
FAVREVOL KNN	1.50		12 Kg. 150 g.	P^H Check-4.5	
CHELION BDW	0.50		04 Kg. 050 g.	60°C X 20 '	
CRALUBE-X3M	2.00		16 Kg. 200 g.		
EQASEC-STA	0.30		02 Kg. 430 g.		
DEFATEN-CC	0.20		01 Kg. 620 g.		
Caustic Soda (Flake)	3.00		24 Kg. 300 g.		
H2O2	4.00		32 Kg. 400 g.		
				98°C X 40 '	
Neutralization (Pre-Treat)					
Green Acid	1.50		12 Kg. 150 g.	Before Enzyme 4.0-4.5	55°C X 30'
JQ		0.40	06 Kg. 476 g.		
OEM	0.50		04 Kg. 050 g.	ENZ HOT 80°C X 10 '	
Dyeing (Dyes & Chemicals)					
		Total Liquor	9,700 Lt		
LEVEXUST CMR	2.00		19 Kg. 400 g.	Before Levelling 6.0-6.5	60°C
AVEFLUID C	1.00		09 Kg. 700 g.		
Celion bdw	0.50		04 Kg. 850 g.		
Salt					
Salt (Glubar)	50.00		485 Kg. 000 g.	After Salt 7.00 HpCHECK	
LEVEXUST CMR	1.00		09 Kg. 700 g.		
				COLOR-DOSS-30	
REMA. YELLOW - RRX		1.188000	19 Kg. 233 g. 720 m		
R/T. RED - RRX		0.124200	02 Kg. 010 g. 798 m		
R/T. BLUE - RRX		0.939600	15 Kg. 212 g. 124 m		
				SALT-RUNTIME-40	
Soda					
Soda Ash	1.00		09 Kg. 700 g.	Soda DOSS-20-70%	
Soda Ash	13.00		126 Kg. 100 g.	Soda DOSS-30-70%	
Neutralization (Dyeing)					
Green Acid	0.75		07 Kg. 275 g.	40°C X 10 '	
Soaping / After-Treatment					
Ruby Sparse HMR	0.50		04 Kg. 850 g.		
Celion bdw	0.25		02 Kg. 425 g.		
Fixing					
Dngfix R	1.00		09 Kg. 700 g.	Before Fixing 5.5-6.0	50°CX10
Green Acid	0.10		00 Kg. 970 g.		
Softener (CATIONIC)					
Zentarge CS	0.75		07 Kg. 275 g.	Before Softner 5.50-6.0	50°CX20
Green Acid	0.10		00 Kg. 970 g.		

Recipe Written By — Dye Weighted By — Checkd By

Form No : Dyeing Prod'n : 03
Revision . 00

D:\DYEING RECEIPE\H&M\DARK COLOR 3/14/2016 2:54 PM

Zirani Bazar, Kashimpur, Joydevpur, Gazipur.

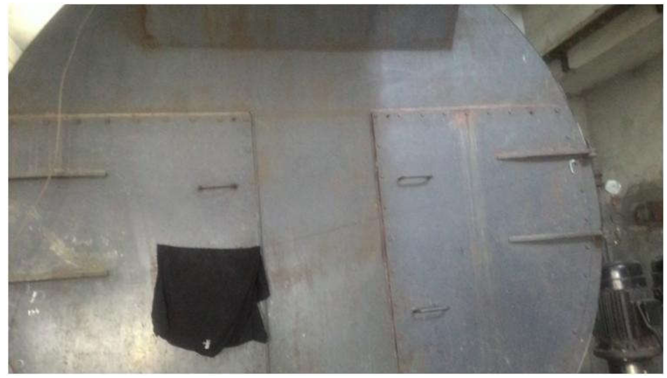
PROCESS DYELINE

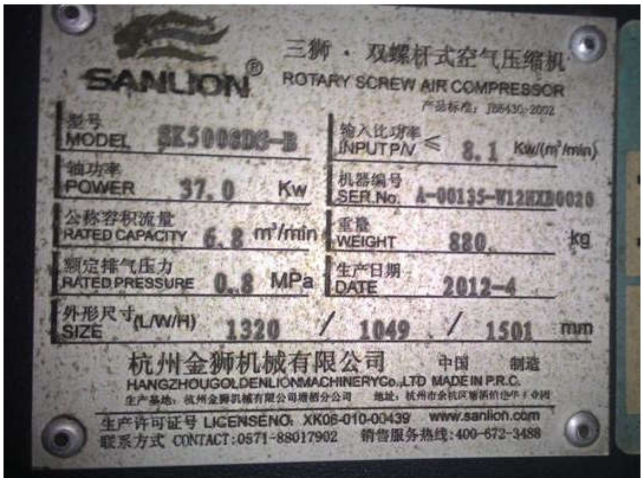
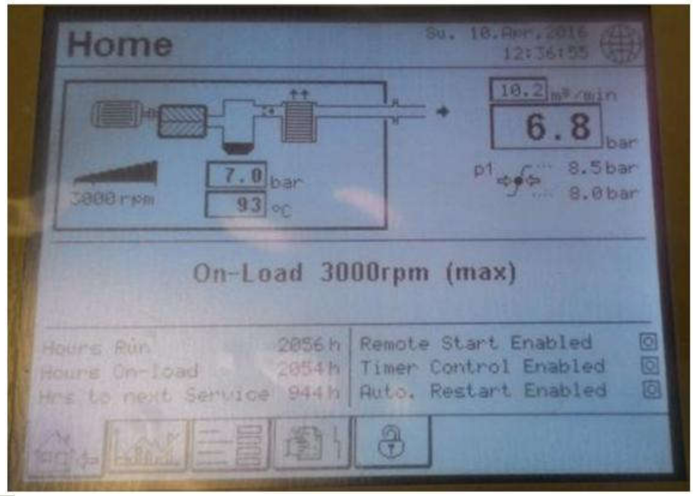
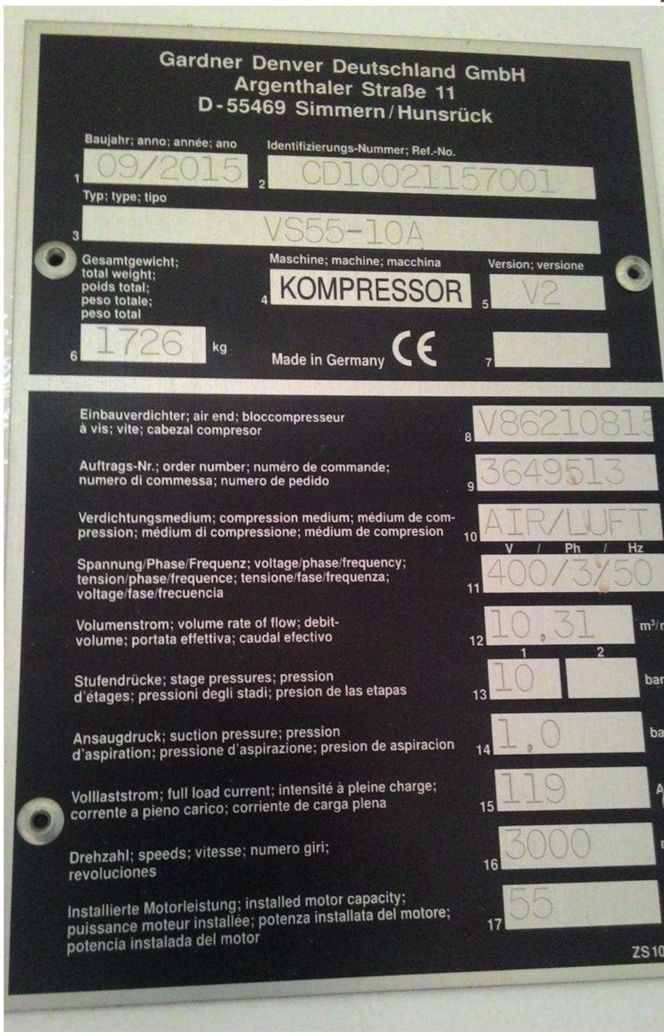
Client Name	H&M		1004	Order No.	21 I
Fabric's Quality	C.V.C L/S/J	Shade Name	08-102	Lap Dip No.	15845
Batch No.	1354	Total Liquor	6,000 Lt	Finished-GSM	
Batch Weight	1,074.00 Kg	No. of Rolls		Machine No.	19
Date	26-Feb-16	Shift	C	Dyeing Program	60°C

Name of the Chemicals	Amount (g/l)	Amount (%)		P^H Check
Per-Treatment				
FAVREVOL KNN	1.50		09 Kg. 000 g.	P^H Check-4.5
CHELION BDW	0.50		03 Kg. 000 g.	60°C X 20 '
CRALUBE-X3M	2.00		12 Kg. 000 g.	
EQASEC-STA	0.30		01 Kg. 800 g.	
DEFATEN-CC	0.20		01 Kg. 200 g.	
Caustic Soda (Flake)	4.00		24 Kg. 000 g.	
H2O2	6.00		36 Kg. 000 g.	
				98°C X 40 '
Neutralization (Pre-Treat)				
Green Acid	1.50		09 Kg. 000 g.	
OEM	0.50		03 Kg. 000 g.	
Dyeing (Dyes & Chemicals)				
		Total Liquor	6,500 Lt	
LEVEXUST CMR	2.00		13 Kg. 000 g.	Before Levelling 6.0-6.5 / 60°C
AVEFLUID C	1.00		06 Kg. 500 g.	
Celion bdw	0.50		03 Kg. 250 g.	
Salt				
Salt (Glubar)	80.00		520 Kg. 000 g.	After Salt 7.00 HpCHECK
LEVEXUST CMR	1.00		06 Kg. 500 g.	
				COLOR-DOSS-30
CORA. YELLOW - GDR		1.080000	11 Kg. 599 g. 200 m	
CORA. RED - GD2B		0.720000	07 Kg. 732 g. 800 m	
BEATIVE. BLACK GED	10%-	5.040000	54 Kg. 129 g. 600 m	
				SALT-RUNTIME-40
Soda				
Soda Ash	0.00		00 Kg. 000 g.	Soda DOSS-20-70%
Soda Ash	20.00		130 Kg. 000 g.	Soda DOSS-30-70%
Neutralization (Dyeing)				
Green Acid	0.75		04 Kg. 875 g.	40°C X 10 '
Soaping / After-Treatment				
Ruby Sparse HMR	0.50		03 Kg. 250 g.	
Celion bdw	0.25 Q		01 Kg. 625 g.	
Fixing				
Dngfix R	1.00		06 Kg. 500 g.	Before Fixing 5.5-6.0 / 50°CX10
Green Acid	0.10		00 Kg. 650 g.	
Softener (CATIONIC)				
Zentarge CS	0.75		04 Kg. 875 g.	Before Softner 5.50-6.0 / 50°CX20
Green Acid	0.10		00 Kg. 650 g.	

Recipe Written By	Dye Weighted By	Checkd By

Annexure10 –Photographs for baseline condition




SANLION®
三狮・双螺杆式空气压缩机
ROTARY SCREW AIR COMPRESSOR
型号 MODEL
输入比功率 INPUT P/V ≤ 8.1 Kw/(m³/min)
轴功率 POWER 37.0 Kw
公称容积流量 RATED CAPACITY 6.8 m³/min
重量 WEIGHT 880 kg
额定排气压力 RATED PRESSURE 0.8 MPa
生产日期 DATE 2012-4
外形尺寸 SIZE (L/W/H) 1320 / 1049 / 1501 mm
杭州金狮机械有限公司 中国 制造
HANGZHOUGOLDENLIONMACHINERYCo.,LTD MADE IN P.R.C.
生产许可证号 LICENSENO. XK06-010-00439 www.sanlion.com
联系方式 CONTACT:0571-88017902 销售服务热线:400-672-3488

Home
10.2 m³/min
6.8 bar
7.0 bar
93 °C
3000 rpm
8.5 bar
8.0 bar
On-Load 3000rpm (max)
Hours Run 2056 h
Hours On-load 2054 h
Hrs to next Service 944 h
Remote Start Enabled
Timer Control Enabled
Auto. Restart Enabled

Gardner Denver Deutschland GmbH
Argenthaler Straße 11
D-55469 Simmern / Hunsrück
Baujahr; anno; année; ano
09/2015
Identifizierungs-Nummer; Ref.-No.
CD10021157001
Typ; type; tipo
VS55-10A
Gesamtgewicht; total weight; poids total; peso totale; peso total
1726 kg
Maschine; machine; macchina
KOMPRESSOR
Version; versione
V2
Made in Germany CE
Einbauverdichter; air end; bloccompresseur à vis; vite; cabezal compresor
V86210815
Auftrags-Nr.; order number; numéro de commande; numero di commessa; numero de pedido
3649513
Verdichtungsmedium; compression medium; médium de compression; medium di compressione; médium de compresion
AIR/LUFT
Spannung/Phase/Frequenz; voltage/phase/frequency; tension/phase/frequence; tensione/fase/frequenza; voltage/fase/frecuencia
V / Ph / Hz
400/3/50
Volumenstrom; volume rate of flow; debit-volume; portata effettiva; caudal efectivo
10,31
Stufendrücke; stage pressures; pression d'étages; pressioni degli stadi; presion de las etapas
10 bar
Ansaugdruck; suction pressure; pression d'aspiration; pressione d'aspirazione; presion de aspiracion
1,0
Volllaststrom; full load current; intensité à pleine charge; corrente a pieno carico; corriente de carga plena
119
Drehzahl; speeds; vitesse; numero giri; revoluciones
3000
Installierte Motorleistung; installed motor capacity; puissance moteur installée; potenza installata del motore; potencia instalada del motor
55