BEE's National Program
on
Energy Efficiency and Technology Up-gradation in SMEs

Pali Textile Cluster

Baseline Energy Audit Report
Shree Rajaram Prints (P) Ltd.




Submitted to

ENERGY IS LIFE
BEE
CONSERVE IT

Submitted by

InsPIRE

InsPIRE Network for Environment

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APH	Air-preheater
BEE	Bureau of Energy Efficiency
BD	Blow Down
BOP	Best Operating Practice
BFW	Boiler Feed Water
CETP	Common Effluent Treatment Plant
CSE	Center for Science and Environment
CRS	Condensate Recovery System
FD	Forced Draft
HP	Horse Power
ID	Induced Draft
kcal	Kilo Calories
kg	Kilogram
kVA	Kilo Volt Ampere
kW	Kilo Watts
MSME	Ministry of Micro Small and Medium Enterprises
RTHPA	Rajasthan Textile and Hand Processors Association
RO	Reverse Osmosis
SEC	Specific Energy Consumption
SFC	Specific Fuel Consumption
SPC	Specific Power Consumption
SME	Small and Medium Enterprise
SO	Sulphur Oxide
TDS	Total Dissolved Solids
TFH	Thermic Fluid Heater
VFD	Variable Frequency Drive

About The Project

The project titled "BEE's National Program on Energy Efficiency and Technology Up-gradation in SMEs" supported by Bureau of Energy Efficiency (BEE), Ministry of MSME and Rajasthan Textile and Hand Processors Association (RTHPA) aims to bring down the energy demand of MSME industries located at different clusters around the country. Pali Textile Processing cluster located at Pali, Rajasthan is one such cluster, which has been selected under the program. The project aims to support the MSME units in Pali to implement Energy Efficient Technologies in the SME units.

There are more than 400 Small and Medium Enterprise (SME) textile processing units operating in the various industrial pockets of Pali. The project aims to initially diffuse energy efficient technologies in selected units in the cluster. These units will act as demonstration units for long term and sustainable penetration of energy efficient technologies in the entire cluster. InsPIRE Network for Environment, New Delhi has been appointed as the executing agency to carry out the following activities in the cluster:

- Conducting pre-activity cluster workshop in the cluster.
- Conducting initial walk through audits in 5 representative units of the cluster.
- Identify and propose BEE on energy efficient process technologies, relevant to the cluster, with highest energy saving and replication potential, and their cost benefit analysis.
- Identify local technology/service providers (LSP) for the above technologies in the cluster
- Identify SME units willing to implement and demonstrate the energy efficient technologies
- Assist BEE to enter into a contract with each of the shortlisted SME units to enable implementation and showcasing of Energy Efficient technology.
- Conduct comprehensive Baseline Energy Audits in the shortlisted SME units wherein these technologies can be implemented and document the findings in the form of a report.
- Develop technology specific case studies (Audio-Visual and print) for each technology
- Prepare Best Operating Practices (BOP) document for the top 5 energy using equipment / process in the industry cluster
- Enumeration of common regularly monitorable parameter at the process level which have impact on energy performance, and listing of appropriate instrumentation for the same with options including make, supplier, indicative cost specifications and accuracy of measurements.
- Carry out post implementation energy audit in the implemented units to verify energy savings as a result of EE technology implementation.
- Verify and submit to BEE all the relevant documents of each participating unit owner indicating his complete credentials, proof of purchasing the equipment, evidence of implementation and commissioning of the EE technology in the unit.

As part of the activities conducted under the energy efficiency program in Pali Textile cluster, detailed energy audits in 11 Textile units in Pali was conducted in the month of March and April'2016. This specific audit report details the findings of the energy audit study carried out at Shree Rajaram Prints (P) Ltd.

Executive Summary

1. Unit Details

Unit Name	:	**Shree Rajaram Prints (P) Ltd.**
Address	:	E-226 to 229, Punayata Industrial Area, Pali, Rajasthan- 306401
Contact Person	:	Mr. Rahul Gupta, Manager (Cell no: 8003291297)
Products	:	Cloth processing including printing and dyeing
Production		20,000 to 40,000 meters of processed cloth per day
DIC Number		RJ26B0000079
Bank Details		Bank of Baroda, Suraj Pole, Pali, A/c No.: 09790500015049, IFSC Code: BARB0PALIXX
TIN / PAN No.	:	TIN: 08173260629 PAN: AAICS0464M
Contract demand		400 KVA

2. Existing Major Energy Consuming Technology

Coke Based Steam Boiler & Thermopac

- Steam boiler and thermopac with no provision of monitoring and control.
- Prevailing specific fuel consumption is 0.09 kgs of coke per meter of processed cloth. High TDS in the feed water leads to frequent blow-down of boiler.

Washing range

- One no. of washing range for washing of printed fabrics with no provision for temperature monitoring and control.

Washing range

- One no. of Desizing machine along with Desizing washing range running with DC motors of 3 HP and 7.5 HP capacity.

3. Proposed Energy Saving Technologies with Cost Economics

Proposed Energy Saving Measures

- Installation of temperature based automation system in thermopac
- Installation of oxygen based automation system in steam boiler
- Installation of RO system for treatment of feed water to boiler.
- Installation of temperature monitoring and control system in washing range
- Installation of energy efficient AC motors with VFD in Desizing unit

Table 1: ***Cost Economic Analysis***

Technology	Estimated Energy Savings (%)	Savings (in Rs)	Investment (in Rs)	Simple Payback period (Months)
Installation of temperature based automation system in thermopac	1	75,732	3,00,000	48
Installation of oxygen based automation system in steam boiler	18.8	5,08,846	7,00,000	17
Reverse Osmosis (RO) system in steam boiler	3	1,26,436	2,00,000	19
Temperature monitoring and control system in washing range	69.4	1,42,912	50,000	4
Energy efficient AC motors with VFD in Desizing unit	30	1,63,150	2,00,000	14.71

Introduction

1.1 ABOUT THE CLUSTER

The Pali textile cluster is one of the biggest SME clusters in Rajasthan having over 350 member industries. The units in the cluster are mainly located in industrial areas namely Industrial Area Phase I & Phase II, Mandia Road Industrial Area and Punayata Industrial Area. Balotra and Bhilwara are other textile clusters in Rajasthan. These clusters also have similar processes and any intervention in Pali would benefit entrepreneurs in these clusters as well. Pollution of nearby river was a significant environmental issue. Center for Science and Environment (CSE) conducted a study to assess the situation behind the environmental issues. The units faced closure for a long time due to legal actions and decided to set up a Common Effluent Treatment Plant (CETP) for redressal the waste water related issues. The CETP is being operational under a trust managed by the entrepreneurs themselves.

Ironically, even though none of the resources required for textile processing is available locally, the textile cluster at Pali has grown despite the odds. The industrial area has no water and all the water required is transported from a distance of over 20 KM. The labour working in the cluster is mostly from outside Pali, at times from as far as Eastern UP and Bihar. Equipment suppliers are all based in Gujarat and Pali does not have enough local service providers or consultants. Even the grey (raw) cloth, dye and chemicals are brought mostly from Maharashtra and Gujarat. Coal or residual pet coke is also not available locally.

Only resource that is available locally is the entrepreneurship of the people, availability of clear sky for over 340 days in a year and good power availability. Presence of a pool of dye masters to process over 400 shades through colour recipe based on experience is another plus for Pali. Initially, Surat used to be the largest processing center for dyeing but a large portion of the job there got outsourced to Pali due to problems like Pollution, Flood, Plague etc.

1.2 ABOUT THE UNIT

M/s Shree Rajaram Prints (P) Ltd., Pali, was established in the year 2015 and is engaged in processing of cloth (both cotton and polyester) which includes raw cloth (grey) processing, dyeing, printing and finishing operations. The manufacturing unit is located at E-226 to 229, Punayata, Pali. The unit operation is overseen by Mr. Rahul Gupta, Manager.

The raw material procured by the unit includes grey (raw cloth) purchased from various sources predominantly from Gujarat and Maharashtra. The unit operates for 12 hours per day, presently.

The daily production lies in the range of 20,000 to 40,000 meters of processed cloth per day. The major energy usage in the unit includes wet steam (generated from coke fired boiler) and electricity. The average monthly coke consumption (derived from reported date of last one year) in the unit is 86,000 Kgs. The average monthly electricity consumption (derived from reported date of last one year) is 31,485 kWh. ***Figure 1.1*** depicts monthly electricity consumption vis-à-vis total monthly production of the unit for last one year. ***Figure 1.2*** depicts monthly coke consumption vis-à-vis total monthly production for last one year.

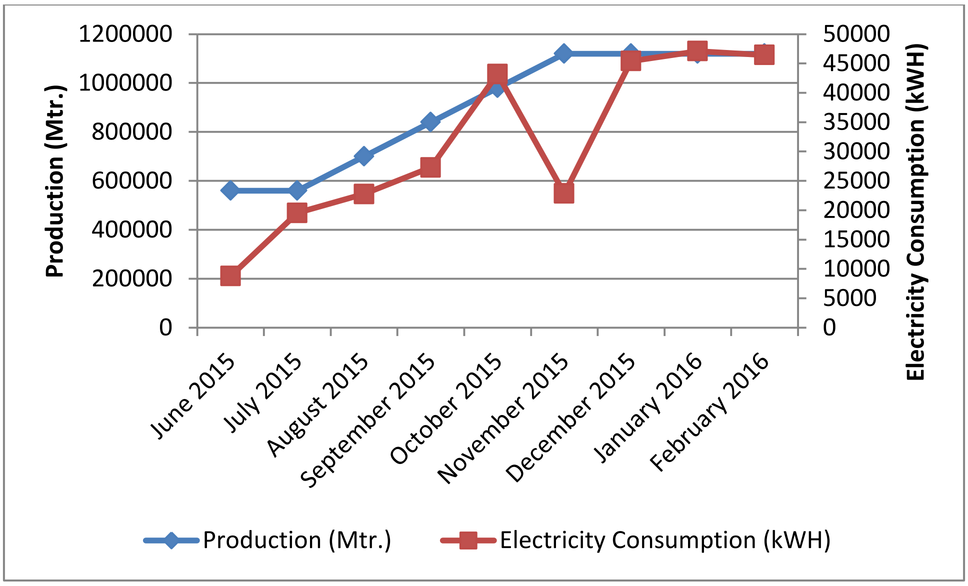


Figure 1.1: ***Monthly variation of production and electricity consumption***

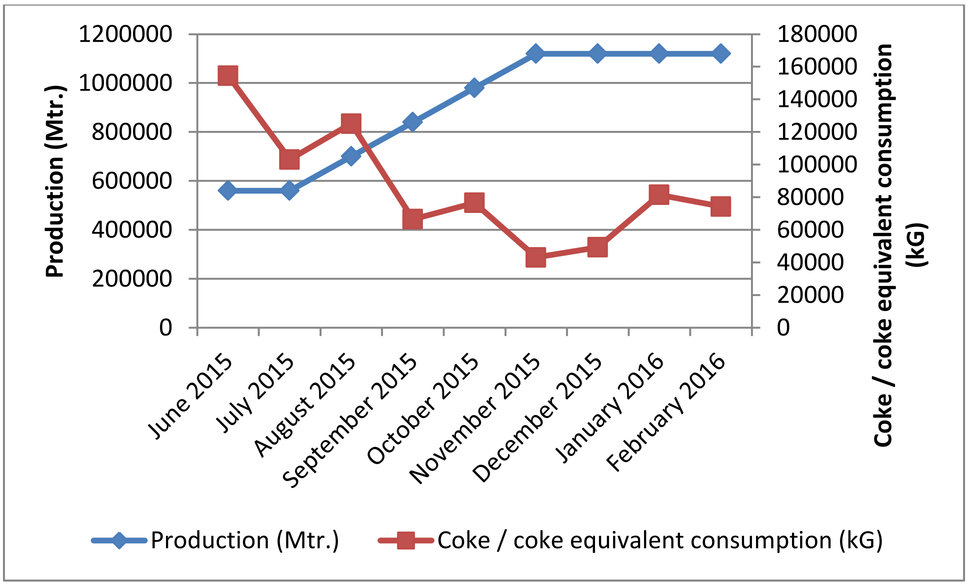


Figure 1.2: ***Monthly variation of production and coke cosumption***

Figure 1.3 and ***Figure 1.4*** below respectively depicts the variation in specific electrical energy consumption and specific thermal energy consumption vis-à-vis the monthly production for last one year.

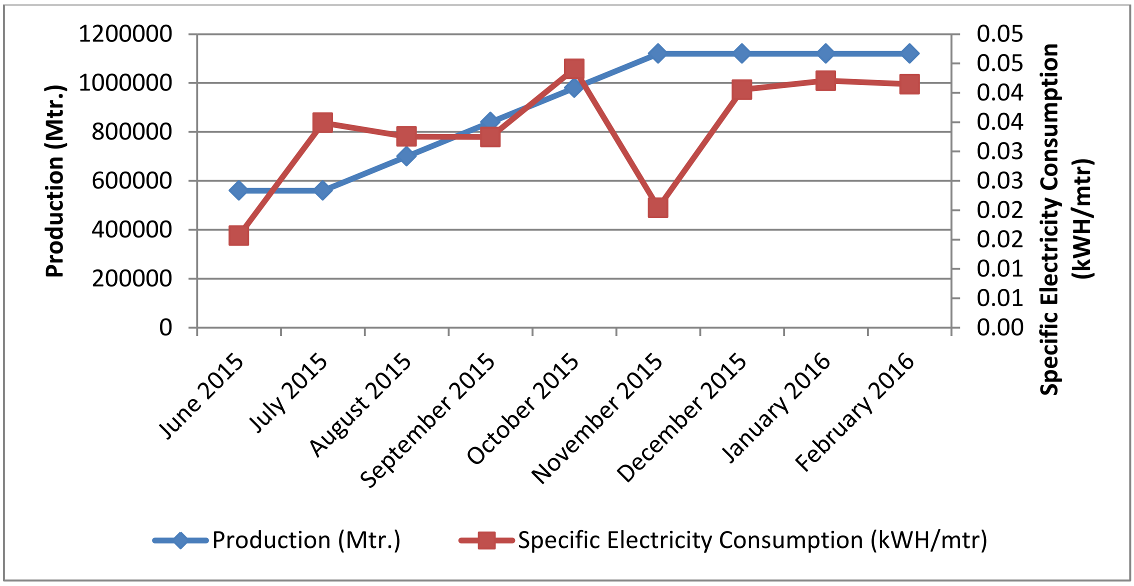


Figure 1.3: ***Variation in specific electrical energy consumption and monthly production***

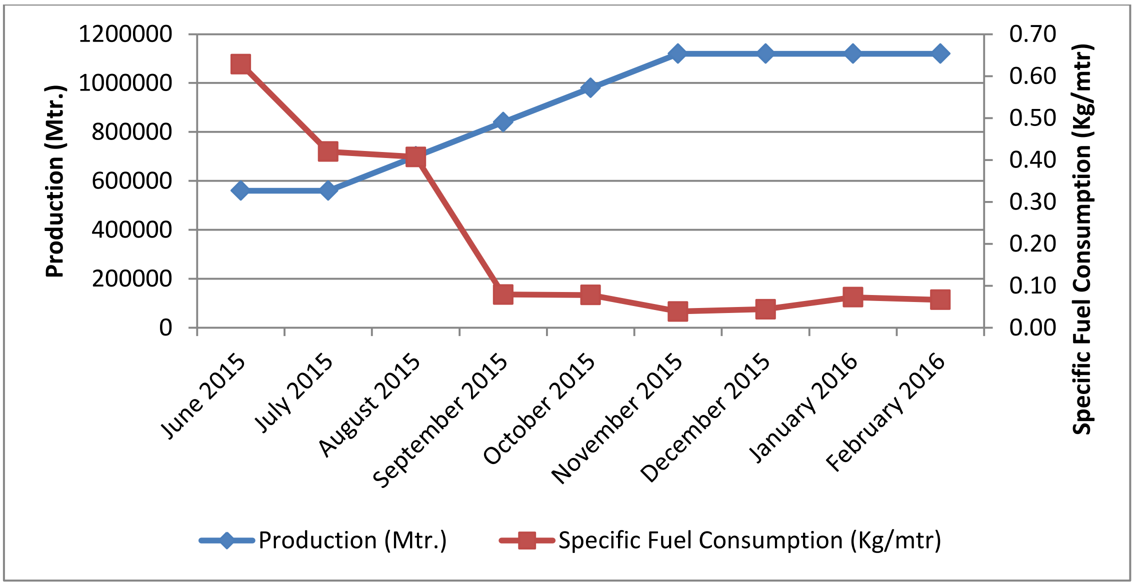


Figure 1.4: ***Variation in specific fuel consumption (coke) and monthly production***

According to the assessment of the energy consumption data as reported by the unit (filled in questionnaire attached), the specific thermal energy consumption of the unit varies from 128 kCal/mtr to 361 kCal/mtr over a period of one year with an average of 277 kCal/mtr. The specific electrical energy consumption of the unit varies from 0.02kWh/mtr to 0.04 kWh/mtr over a period of one year with an average of 0.03 kWh/kg. The unit used coke as fuel with a calorific value of 8200 kCal/mtr. The total average specific energy consumption (in kcal), based on reported data for one year, is estimated as **306.14 kCal/mtr** of product. The energy consumption pattern for the unit has been summarized below at ***Table 1.1***:

Table 1.1: ***Energy consumption details of Shree Rajaram Prints (P) Ltd***

SN	Parameter	Unit	Value
1	Name and address of unit	Shree Rajaram Prints (P) Ltd., E-226 to 229, Punayata, Pali, Rajasthan-306401	
2	Contact person	Mr. Rahul Gupta, Manager	
3	Manufacturing product	Processed cloth (Cotton printed & dyed materials)	
4	Daily Production	20,000 to 40,000 mtr per day	
Energy utilization			
5	Average monthly electrical energy consumption	kWh	31,485
6	Average monthly fuel (coke) energy consumption	kg	86,000
7	Average specific thermal energy consumption	kCal/mtr	277.08
8	Specific electrical energy consumption	kWh/mtr	0.03
9	Specific energy consumption[1,2]	kCal/mtr	306.14
10	Electrical energy cost[3]	Rs/mtr	0.22
11	Thermal energy cost[3]	Rs/mtr	1.53

Note:

[1]: Specific gross calorific value of Coke has been considered as 8200 kCal/kg

[2]: Thermal equivalent for one unit of electricity is 860 kCal/kWh.

[3]: The unit operates for 25 days a month (1 shift of 12 effective hours per day).
Cost of electricity has been taken as Rs 6.50 / kWh
Cost of coke has been taken as Rs7.5 /kg

1.3 PRODUCTION PROCESS OF PLANT

The ***Figure 1.5*** below shows the typical process employed at processing of textile products at Shree Rajaram Prints (P) Ltd.:

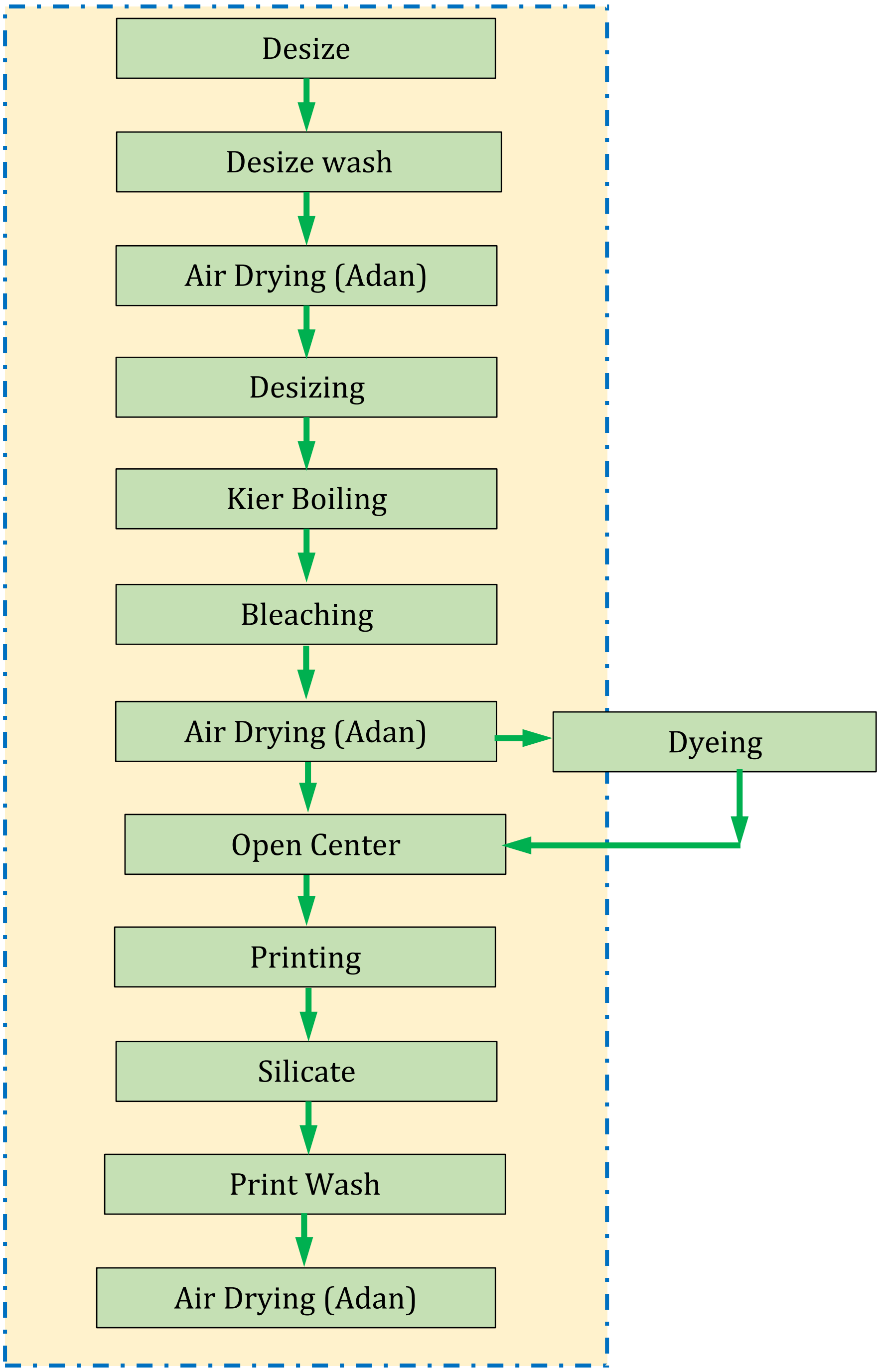


Figure 1.5: ***Production process at Shree Rajaram Prints (P) Ltd.***

1.4 ENERGY AUDIT METHODOLOGY

The primary objective of the energy audit was to quantify the existing energy consumption pattern and to determine the operating efficiencies of key existing systems. The key points targeted through energy audits were determination of specific energy consumption, various losses, operation practices like production, fuel consumption, steam utilization and losses, process temperatures, electrical energy consumptions etc. Pre – planned methodology was followed to conduct the energy audits. Data collected at all above steps were used to calculate various other operating parameters like material processing rate (mtr/hr), specific electricity consumption (kWh/kg), specific steam utilization (kg/kg), etc. The energy audit methodology is depicted in ***Figure 1.6*** below:

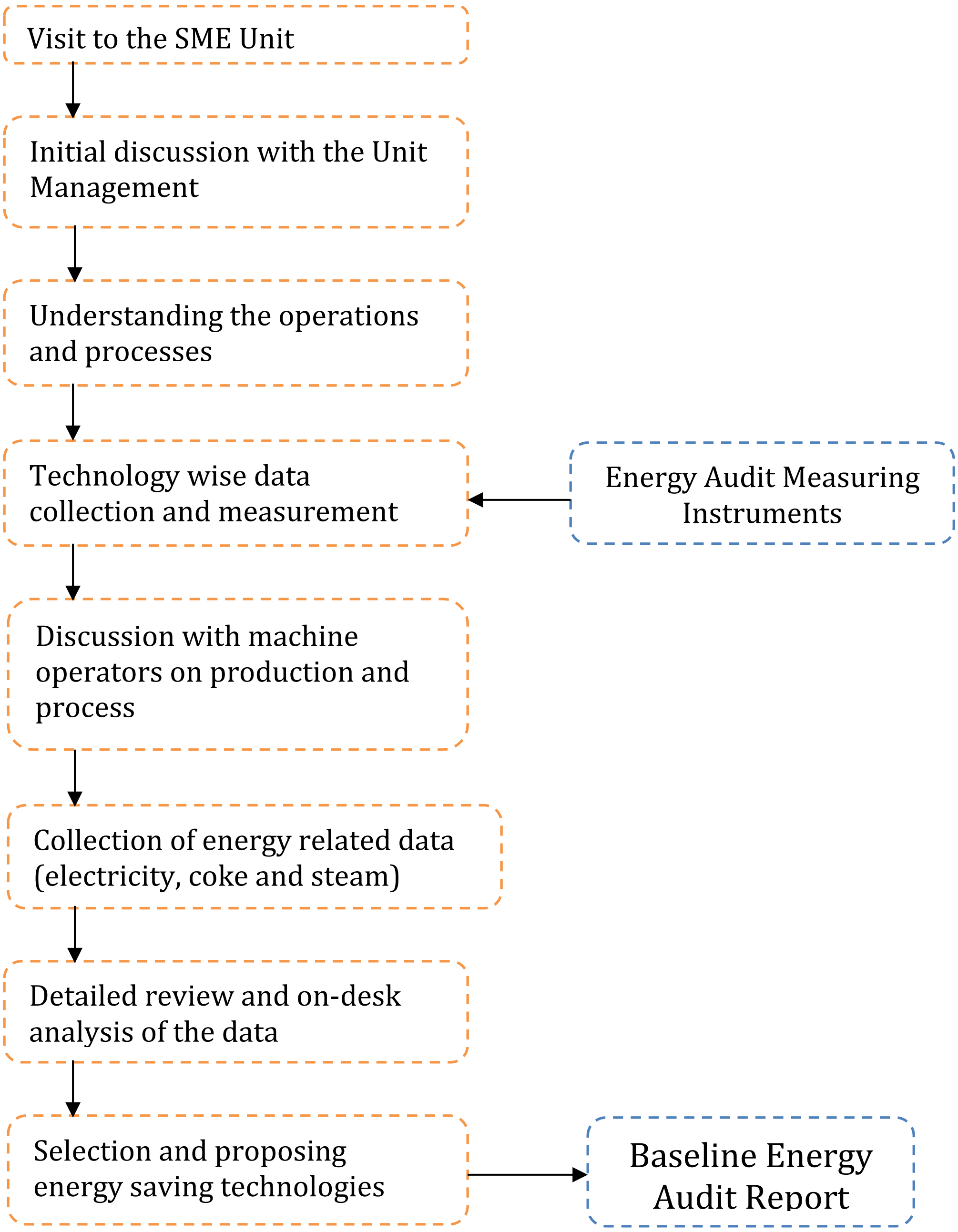


Figure 1.6: *Energy audit methodology*

1.5 UNIT PHOTOGRAPHS

Caption: Natural drying of fabric at Shree Rajaram Prints (P) Ltd.

Caption: Printing of fabric

Caption: Kier Boiling unit

Caption: Finishing operation using Stenter

Caption: Boiler unit at Shree Rajaram Prints (P) Ltd.

Caption: Finishing operation

Present Process, Observations and Proposed Technology

2.1 INSTALLATION OF THERMOPAC AUTOMATION

2.1.1 Present Process

Shree Rajaram Prints Pvt. Ltd. has a thermic-fluid heater (thermo-pac) of 1000 U capacity. Pet-coke is used as the fuel for the thermopac. The heating chamber consists of a fluidized bed of coke wherein air is supplied from bottom. The heat generated by combustion of coke and air is used to heat thermic fluid to required temperature. The heated thermic-fluid generated is used in various processes across the unit. The thermic fluid heater operates for an average of 12 hours daily.

2.1.2 Observations

The Thermic fluid (TF) temperature is dependent primarily on the following factors:

- The amount of fuel fired inside the thermopac furnace for combustion
- The amount of air going to the bed of the furnace for combustion.

Proper combustion of the fuel is very important factor in maintaining good thermopac efficiency, reliability and pollution free environment. To maintain constant thermic fluid outlet temperature the fuel firing rate should also change as per the change in the oil temperature. This leads to the requirement of combustion control system which incorporates the temperature transmitter, the temperature controller and a mechanism to maintain correct air-fuel ratio to meet the varying steam demand. The existing thermopac used at Shree Rajaram Prints does not have provisions of monitoring and control of thermic fluid temperature and thermopac combustion.

Based on the detailed study of the unit, it is proposed to install a temperature based control system for the thermopac. This can be achieved by means of a combustion controller. The combustion controller receives thermopac outlet temperature from temperature transmitter as process variable (PV) input. This input signal is used by the PID controller to control the fuel feed rate using a VFD. Thus, the air-fuel ratio remains fixed at every point during unit operations. Based on the change in forced draught (FD) speed and fuel feeding, the furnace draft will vary. This will be further controlled by secondary draft controlling loop with the help of draft transmitter and draft controller. By this process, the boiler chamber will be maintained at a slightly negative pressure.

2.1.3 Conclusion

As per the study conducted in the unit, it is suggested to install a temperature based PID control in the thermic-fluid heater. This system will be able to maintain the air-fuel ratio based on the thermic-fluid temperature and also control the furnace draught using secondary looping.

The installation of the temperature based automation in the thermic fluid heater and utilizing the same to control air-fuel ratio and furnace draught will lead to following benefits:

- Saving of fuel feed.
- Savings in electrical energy consumption
- Improvement in boiler efficiency
- Lower maintenance
- Improved environment

2.1.4 Cost Economics Analysis

The section below provides a cost benefit analysis for installation of thermopac automation.

Table 2.1: *Cost Economic Analysis Thermopac Automation*

SN	Parameter	Unit	Value
1	Temperature in thermopac chamber	°C	850
2	Temperature required	°C	800
3	Saving in energy	Kcal/h	11500
4	Saving in fuel (considering thermopac efficiency of 50%)	kg/hr	3
5	Saving in specific fuel consumption	%	1
6	Annual saving in fuel	kg/annum	10098
7	Annual cost saving	Rs/yr.	75732
8	Investment	Rs/yr.	300000
9	Pay back	months	48

*Cost of fuel taken as Rs 7.5/kg

As per the detailed calculations done, it is proposed to install a temperature based automation system in the existing thermic-fluid heater. The estimated fuel saving with the installation is 10,098 kgs annually which can save an amount of Rs. 75,732 per year. Thus the cost of the system (estimated to be Rs. 3, 00,000) can be recouped in 48 months.

2.2 INSTALLATION OF BOILER AUTOMATION

2.2.1 Present Process

Shree Rajaram Prints (P) Ltd. has installed a steam boiler of 3 tonnes capacity to generate wet steam required for the process. Steam is used at a working pressure of 4-5 kg/cm^2. Pet-coke is used as the fuel for the steam boiler. The heating chamber consists of a fluidized bed of coke wherein air is supplied from bottom. The heat generated by combustion of coke and air is used to heat water to form steam. The steam generated is used in various processes across the unit. The boiler operates for an average of 12 hours daily.

2.2.2 Observations

Combustion efficiency is an important parameter to determine the boiler efficiency. Combustion efficiency depends on 3 'Ts" i.e. temperature, turbulence and time. In case of Rajaram Prints, there is not control on the fuel feeding rate and air supply to the boiler combustion chamber. Also, the unit does not have monitoring system for measuring the chamber temperature and free oxygen in the flue gas. In order to determine the combustion efficiency in the boiler chamber, oxygen percentage in the flue gas outlet was monitored in the unit using a flue gas analyzer. The oxygen percentage was observed to be 15% instead of the required level of 8%. This led to high amount of excess air in the boiler chamber thus leading to poor efficiency of the boiler.

The specific fuel consumption of coke was observed to be around 0.09 kgs of coke per meter of the processed cloth which is higher in comparison to the values for other units. It was observed that during operation, fuel supply was controlled manually without controlling the air flow rate. Further, there was no provision for measuring the temperature inside the boiler heating chamber.

Based on the detailed study of the unit, it is proposed to install an oxygen based control system in the steam boiler of the unit. The system will work based on the oxygen percentage in the flue gas, which will automatically control the forced draught (FD) and the induced draught (ID) fan. The fuel flow rate can also be monitored using an integrating a temperature based control system with the same. The correct amount of excess air maintained will lead to significant improvement in the combustion efficiency of the unit.

2.2.3 Conclusion

As per the study conducted in the unit, it is suggested to install an oxygen based automation control system in the steam boiler. This system will be able to maintain the correct oxygen and excess air percentage thus improving the boiler efficiency.

The installation of the oxygen based automation in the steam boiler will lead to following benefits:

- Saving of fuel feed.
- Savings in electrical energy consumption
- Improvement in boiler efficiency
- Lower maintenance
- Improved environment

2.2.4 Cost Economics Analysis

The section below provides a cost benefit analysis for installation of oxygen based control system in the existing steam boiler of the unit.

Table 2.2: *Cost Economic Analysis of proposed oxygen based automation system*

SN	Parameter	Unit	Value
1	Present O_2 level	% age	15
2	Theoretical air requirement	kg of air/kg of fuel	10.8
3	Excess air supply at present condition	% age	250
4	Actual mass of air supplied at present condition	kg of air/kg of fuel	37.8
5	Proposed O_2 level required	% age	8
6	Excess air supply after implementation of technology	% age	61.5
7	Reduction in sensible excess air		188.5
8	Reduction in fuel consumption	%	18.8
9	Hourly fuel consumption (present)	kg/hr	143
10	Hourly fuel consumption after installation	kg/hr	116
11	Annual fuel saving	kg/yr.	67846
12	Annual monetary saving	Rs/yr.	508846
13	Investment	Rs	700000
14	Payback	months	17

* With every 10% reduction in excess air leads to a saving in specific fuel consumption by 1%

It is therefore proposed to install an oxygen based automation control system in the existing steam boiler the estimated fuel saving with the installation is 67,846 kgs annually which can save an amount of Rs. 508846 per year. Thus the cost of the economizer (estimated to be Rs. 7, 00,000) can be recouped in 17 months period.

2.3 BOILER FEED WATER TREATMENT

2.3.1 Present Process

Shree Rajaram Prints (P) Ltd. has installed 1 number of steam boiler of 3 tonnes capacity. Since, Pali cluster do not have any internal source of water, water to be used in the boiler is sourced from nearby areas. Presently, the unit is not applying any kind of process treatment for the feed water to the boiler. The total dissolved solids (TDS) content in the boiler feed water intends to surplus the maximum permissible TDS of the boiler due to repeated use of water. This leads to frequent boiler blow-down operation of the boiler, where a certain amount of water is blown off and is automatically replaced by feed water thus maintaining the optimum level of total dissolved solids (TDS) in the boiler water. In Shree Rajaram Prints, boiler blow-down is carried out at a frequency of 4 hours every day. The frequency of blow-down is predominantly dependent of the high level of TDS in the boiler feed water. During each Blow-Down (BD) operation, a large quantity of energy in the form of steam is wasted into the atmosphere.

2.3.2 Observations

The TDS level of the feed water used for the steam boiler at Shree Rajaram Prints (P) Ltd. was reported to be 500 ppm, which when continuously used intends to surplus the permissible TDS level which is around 2000-3000 ppm. When feed water enters the boiler, the elevated temperature and pressure cause the components of water to behave differently. Under heat and pressure, most of the soluble components in the feed water come out of the solution as particulate solids, sometime in crystalized forms and other times as amorphous particles. When solubility of a specific component in water is exceeded, scale or deposits develop. Deposit in boilers may result from hardness contamination of feed water and corrosion products from the condensate and feed water system. Deposits and corrosion result in localized heating, efficiency losses and may ultimately result in failure of boiler tube and inability to produce steam. In order to avoid deposits or scale formation in the boiler lining, blow-down operation is carried out in the boiler. The process of blow-down involves blowing off a portion of the water and replacing it with fresh feed water.

In case of Shree Rajaram Prints, intermittent blow-down operation is practiced at frequency of 4 hours. The blow-down is done with the use of a valve fitted to discharge pipe at the lowest point of the boiler. The blow-down process is carried out for a period of 1-2 minutes. Approximately 1500-1700 liters of water is lost every day in the blow-down operation.

In order to reduce the blow-down operation in the boiler and to maintain the permissible level of TDS, it is suggested for pre-treatment of boiler feed water. This external treatment of boiler feed water can be done in a number of ways. One of the most feasible options is the 'Reverse Osmosis' processes.

2.3.3 Conclusion

In order to maintain the TDS of boiler feed water close to the permissible range, it is suggested to install a revise osmosis (RO) plant in the unit. When solution of differing concentration are separated by a semi-permissible membrane, water from less concentrated solution passes through the membrane to dilute the liquid of high concentration, which is called osmosis. If the solution of high concentration is pressurized, the process is reversed and water from the solution of high concentration flows to the weaker solution. This is known as reverse osmosis. The quality of water produced depends upon the concentration of the solution on the high-pressure side and pressure differential across the membrane. The process is suitable for waters with high TDS.

Installation of the RO system of required capacity can lead to considerable reduction in boiler blow-down, thus leading to a saving in steam. The membrane for RO system can be suitably selected based on the TDS level of the unit.

Benefits of the installation of the RO system are:

- Lower boiler blow-down
- Less make up water consumption
- Steam saving as a result of reduced blow down

- Reduced maintenance downtime
- Increased boiler life
- Reduced fuel cost

2.3.4 Cost Economics Analysis

The section below provides cost benefit analysis for the installation of RO system in the boiler feed water line.

Table 2.3: *Cost Economic Analysis of proposed RO system*

SN	Parameter	Unit	Value
1	Quantity of steam generated per hour	kg/hr	3000
2	Quantity of fuel used per hour	kg/hr	143
3	Quantity of fuel used to generate 1 kg of steam	kg/kg	0.048
4	**Without RO**		
5	Frequency of blow down per month	no.	75
6	No. of blow downs in a year	no.	900
7	Steam lost in each blow down	kg	533
8	Steam lost in year	kg	480000
9	Fuel used to generate lost steam	kg	22880
10	**With RO**		
11	Frequency of blow down	no.	25
12	No. of blow downs in a year	no.	300
13	Steam lost in each blow down	kg	533
14	Steam lost in year	kg	159900
15	Fuel used to generate lost steam	kg	7621.9
16	Annual saving in fuel	kg	15258.1
17	Percentage saving in fuel consumption	%	3.0
18	Annual cost saving in fuel	Rs	114436
19	Annual cost saving in terms of make-up water and boiler maintenance	Rs	12000
20	Annual cost savings	Rs	126436
21	Equipment cost	Rs	200000
22	Pay back	months	19

*Cost of fuel taken as Rs 7.5/kg

The proposed RO system will lead to an annual saving of 15,258 kgs of coke which implies to Rs 1, 26,436 annual monetary benefits. The estimated equipment cost can thus be recouped in 19 months' time.

2.4 TEMPERATURE MONITORING AND CONTROL IN WASHING RANGES

2.4.1 Present Process:

Shree Rajaram Prints (P) Ltd. has one no. of washing range for washing of printed fabrics. This washing operation is done in high temperature, with recommended range between 60-80 ^{0}C. However, the process is manually controlled presently with no control on temperature of water for washing. Thus, a significant portion of energy is lost as hot water is drained out of the system after the process is over.

2.4.2 Observations

A significant amount of heat energy is lost in the washing process of printed fabric. The unit do not have any controlled mechanism for monitoring and controlling the temperature of hot water for washing purpose. Often, there is a over shooting of temperature thus leading to significant loss in terms of energy.

It is proposed to install a pneumatic sensor based temperature monitoring and control system in the washing range of the unit. This is lead to significant savings in terms of energy.

2.4.3 Conclusion

In order to maintain the correct temperature profile in the washing water, it is suggested to install a sensor based temperature monitoring and control system. This system can be used to monitor the temperature level of water in the washing range and control the flow of steam by a pneumatically operated valve. This will be lead to optimum utilization of steam in the washing range thus leading to a substantial energy savings.

Benefits of the installation of the temperature monitoring and control system in Jiggers machines are:

- Precision temperature control
- Reduced energy consumption
- Better quality of production
- Savings in terms of feed water to jiggers.

2.4.4 Cost Economics Analysis

The section below provides cost benefit analysis for the installation of temperature monitoring and control system in washing range.

Table 2.4: *Cost Economic Analysis of washing range water temperature monitoring and control system*

SN	Particulars	Units	Value
1	Temperature observed in washing unit	°C	95
2	Temperature to be maintained	°C	70
3	Quantity of water used	kg	2500
4	Energy being wasted in the process	kCal	62500
5	Heat energy wasted considering boiler efficiency of 60%	kCal	104167
6	Fuel saved	kg/batch	13
7	No. of batches per day	no.	5
8	Daily fuel saving	kg/day	64

SN	Particulars	Units	Value
9	Annual fuel savings	kg/yr.	19054.9
10	Annual monetary savings	Rs/yr.	142912
11	Investment	Rs	50000
12	Pay-back	Months	4

*Cost of fuel taken as Rs 7.5./kg

The proposed temperature monitoring and control system in the washing range of the unit will lead to an annual fuel saving of 19,054 kgs of coal which means a monetary saving of Rs 1,42,912. Thus the estimated investment of Rs 50,000 can be recouped in around 6 months period.

2.5 INSTALLATION OF ENERGY EFFICIENT MOTORS WITH VFD IN DESIZING MACHINE

2.5.1 Present Process

Desizing is an operation carried out to remove loses fiber, hairy fiber, protruding fiber from the surface of the fabric. Desizing, irrespective of what the Desizing agent is, involves impregnation of the fabric with the Desizing agent, allowing the Desizing agent to degrade or solubilise the size material, and finally to wash out the degradation products. Rajaram Prints Pvt. Ltd. has installed a Desizing machine and a Desizing washing unit which is presently run by 2 nos. of DC motors of 3 HP and 7.5 HP rating respectively. Based on the quality of fabric and Desizing required, the speeds of the DC motors are varied.

2.5.2 Observations

In order to analyses the loading of the motors, a detailed study was carried out in the Desizing machine. The respective ampere loading in the motor observed during the study was noted as 1.5 A (for 7.5 HP motor) and 6.5 A (for 7.5 HP motor) respectively. Thus, the motors were observed to be running at less than 50%. Considering the under capacity utilization of the motors during most of the period of operation of Desizing machine, it is suggested to replace the existing DC motors with energy efficient AC motors of lower capacity with variable frequency drives installed with each motor. For the purpose of Desizing operation and washing, 3 nos. of motors of 3 HP rating each is suggested to be installed with VFD drives. The variable frequency drive will allow storage of energy during lean period, thus saving electrical energy used in the system.

2.5.3 Conclusion

As per the study conducted in the unit, it is suggested to replace the existing DC motors in the Desizing machine with AC motors with VFD drives. The current motor ratings are over capacity and needs to be replaced with lower rating motors. VFD needs to be installed in the motor to take of the varying load.

The installation of the energy efficient AC motors with VFD will lead to following benefits:

- Higher efficiency of motors.
- Lower maintenance cost
- Controlled Starting Current
- Reduced Power Line Disturbances
- Lower Power Demand on Start
- Controlled Stopping
- Energy saving

2.5.4 Cost Economics Analysis

The section below provides a cost benefit analysis for installation of energy efficient AC motors with VFD in the existing Desizing machine of the unit.

Table 2.5: *Cost Economic Analysis of proposed energy efficient AC motor with VFD*

SN	Parameter	Unit	Value
1	Power consumed by existing Desizing machine	kWh	10.07
2	Annual consumption	KWh/year	72511
3	Production on existing Desizing machine	mtr/hr	31250
4	Specific power consumption on existing Desizing machine	kWh/mtr	0.0003
5	Power consumed by AC motors with VFD drives	kWh	7.05
6	Annual consumption	KWh/year	50758
7	Projected production on Desizing machine	mtr/hr	31250
8	Specific power consumption (projected)	kWh/mtr	0.0002
9	Reduction in specific power consumption	kWh/Pcs	0.0001
10	Percentage savings	%	30.00
11	Daily operating hours	Hrs.	24
12	Annual operating days	Days	300
13	Annual electricity savings	kWh	21753
14	Annual cost savings	Rs.	163150
15	Investment required	Rs.	200000
16	Simple payback period	months	14.71

It is therefore proposed to replace DC motors with energy efficient AC motor with VFD in the existing Desizing machine. The estimated energy saving with the installation is 21753 kWh annually which can save an amount of Rs. 163150 per year. Thus the cost of the AC motors with VFD (estimated to be Rs. 2, 00,000) can be recouped in period of 14 months.

Questionnaire

6

Energy Audit – Questionnaire Form

BEE National Programme
On
"Energy Efficiency in SMEs – Pali Textile Cluster"

Name of the MSME unit	Shree Rajaram Prints Pvt Ltd.
Address:	E-226 to 229 Punayata Road Ind. Area.
Ph. No:	8003291297
Name of the respondent	RAHUL GUPTA
Designation:	MANAGER
Mobile No. / Email id	8003291297 / rahul.srgindia@gmail.com
Unit details	
Year of Establishment	2015
Type of Products	Cotton Printed & Dyed Materials
Installed Capacity	Apx 1,50,000 mtr per day.
Operating hrs per day	12 hrs.
Connected Load (kVA or kW please specify)	
Supply Voltage (Volt)	440 Volt
Duration of electricity supply	20 to 24 hrs.

Annual Energy Consumption/ Production

Financial Year (April to March)	2013-14	2014-15	2015-16
Coke consumed (kg)	N/A	N/A	
Biomass Briquettes			
Wood			
Cost of coke (in Rs.)			
Electrical units consumed (in kWh)			
Electricity charges (in Rs.)			
LDO/HSD/ FO consumption (L)			
Fuel Cost (in Rs.)			
Production (Kg)			

Source and Calorific Value of Fuels:

Fuel	Source	Calorific Value (kCal)
Coke (Kg)	Petcoke	8000
Biomass Briquettes	Wood waste	4600
	Lignite	5800

For: Shree Rajaram Prints Pvt. Ltd.

Auth./Manager

1 therm =

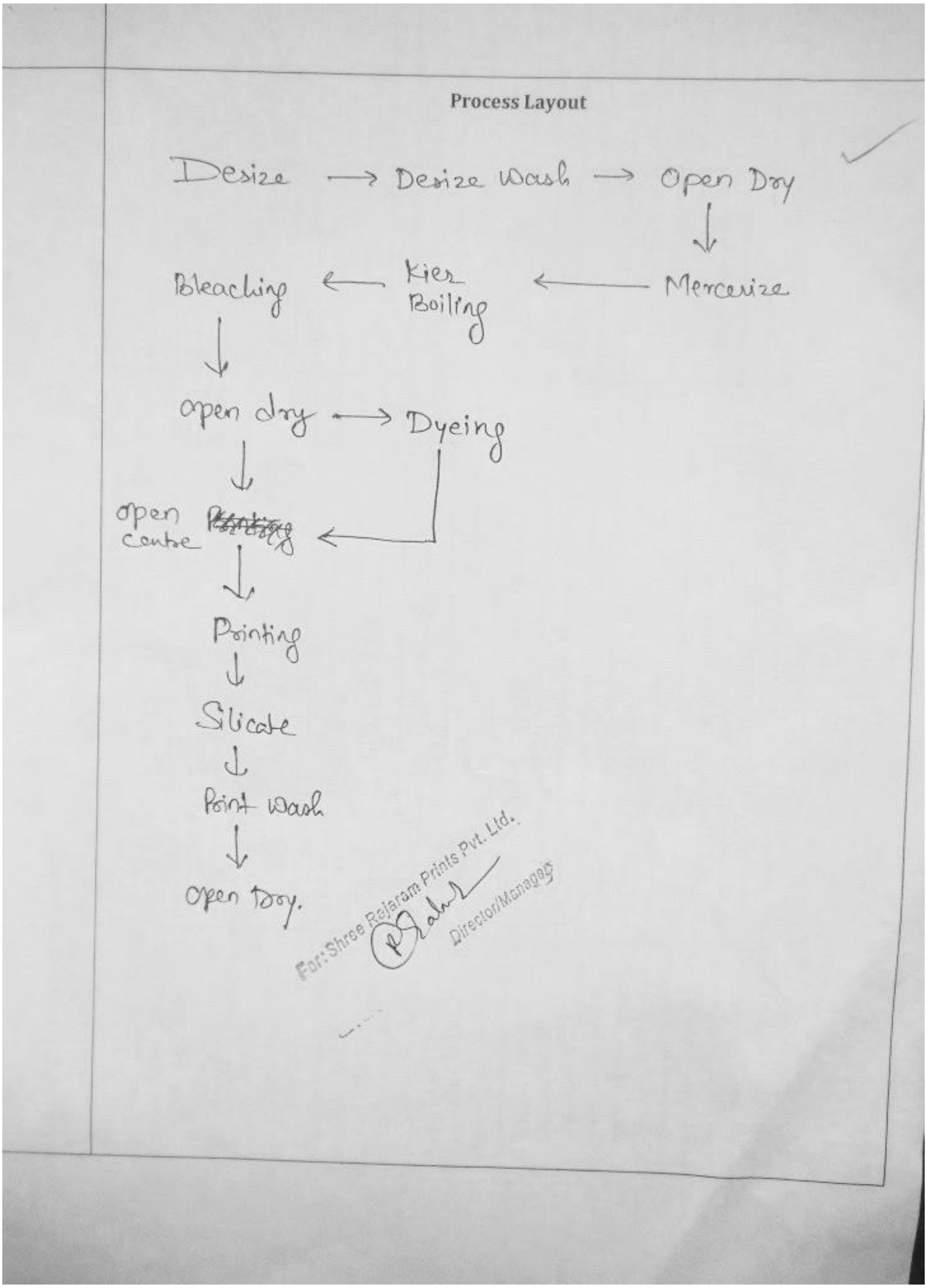
		Wood	–	–
		HSD (L)	–	–
		LDO (L)	–	–
		FO (L)	–	–
		Electricity (kWh)		

Monthly Energy Consumption and Production Data

Month	Production (Kg) (Mtr)	Pet Coke consumption ~~(Kg)~~ (Tons)	Biomass /Wood Consumption ~~(Kg)~~ (Tons)	Electricity consumption (kWH)	HSD/LDO /FO (L)	Any other fuel (specify units) (Tons) Lignite → 5600 kcal/kg
April'15				–		
May'15				–		
June'15	560000	20.56	352.0	8772		
July'15	560000	–	235.0	19536		16.34
August'15	700000	–		22776		16.14
September'15	840000	61.53		27276		
October'15	980000	76.55		43204		
November'15	1120000	43.11		22856		
December'15	1120000	49.28		45408		
January'16	1120000	81.45		47108		
February'16	1120000	74.26		46432		
March'16						

For: Shree Rajaram Prints Pvt. Ltd.
Auth./Manager

Cost variables per Kg of Production		Cost Variable	Cost/ kg of production
		Electricity Cost	Rs 6.5/kwh
		Coke Cost	Rs 7.5/kg
		Fuel Cost (LDO/HSD/FO) etc.	
		Labour Cost	
		Material Cost	
		Other Cost	


Process Layout
Desize
Desize Wash
Open Dry
Mercerize
Kier Boiling
Bleaching
open dry
Dyeing
open Centre
Printing
Slicate
Print wash
Open Dry.
For: Shree Rajaram Prints Pvt. Ltd.
Director/Manager

Major Energy Consuming Equipment:

SN	Equipment	Energy source	Make/ Supplier	Year of Installation	Technical Specification/ capacity	Use	Comments
1	Desize m/c.	3 HP					
2	Desize wash	7.5 HP					
3	Kier	36 HP (12 HP x 3)					
4	Bleach Washer	13 HP (5x2 + 3x1)					
5	Mercerize.	60 HP (50 HP + 10 HP)					
6	Print washer	11 HP (3x2 + 5)					
7	Silicate.	7.5 HP					
8	open Centre	24 HP (12x2)					
9	Printing m/c	11 HP (3x2 + 5)					
10	Jigger	108 HP (3x16 + 5x12)					
11	Thermopac	40 HP					
12	Steam Boiler	40 HP.					
13	Compressor.	30 HP (15x2)					
14	Utility.	25 HP					
15							
16							
17							
18							
19							
20							
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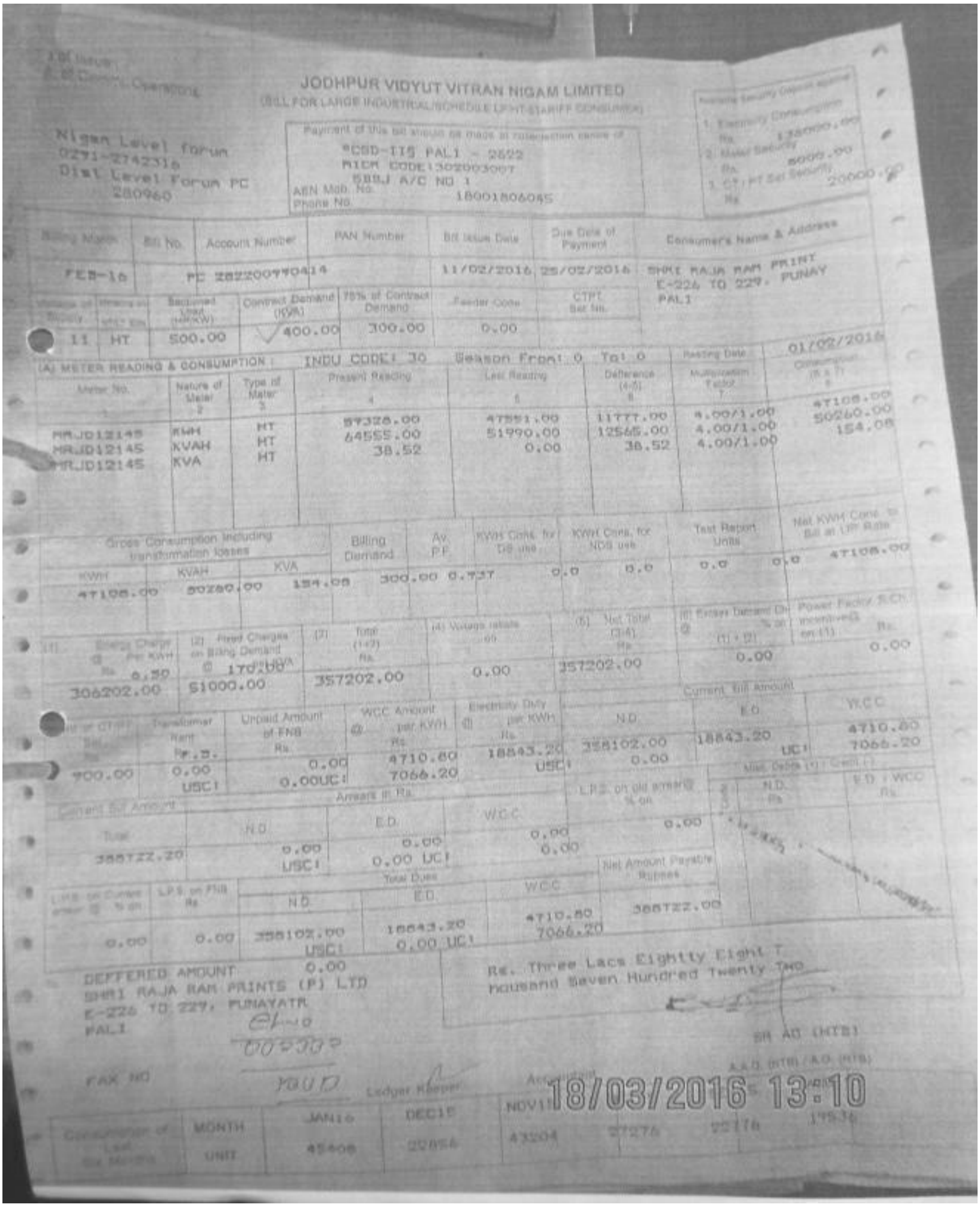
24							
25							
26							
27							

For: Shree Raj[illegible] Prints Pvt. Ltd.

Director/Manager



JODHPUR VIDYUT VITRAN NIGAM LIMITED

(BILL FOR LARGE INDUSTRIAL/SCHEDULE LP HT-5 TARIFF CONSUMER)

Nigam Level Forum
0291-2742316
Dist Level Forum PC
280960

Payment of this bill should be made at collection centre of
*CSD-II5 PALI - 2622
MICR CODE:302003007
SBBJ A/C NO 1
ABN Mob. No.
Phone No. 18001806045

1. Electricity Consumption Rs. 138000.00
2. Meter Security Rs. 5000.00
3. CT/PT Set Security Rs. 20000.00

Billing Month	Bill No.	Account Number	PAN Number	Bill Issue Date	Due Date of Payment	Consumer's Name & Address
FEB-16		PC 2822007704 14		11/02/2016	25/02/2016	SHRI RAJA RAM PRINT E-226 TO 227, PUNAY PALI

Voltage of Supply	Metering on	Sanctioned Load (HP/KW)	Contract Demand (KVA)	75% of Contract Demand	Feeder Code	CTPT Set No.
11	HT	500.00	400.00	300.00	0.00	

(A) METER READING & CONSUMPTION : INDU CODE: 30 Season From: 0 To: 0 Reading Date 01/02/2016

Meter No.	Nature of Meter	Type of Meter	Present Reading	Last Reading	Difference (4-5)	Multiplication Factor	Consumption
MRJD12145	KWH	HT	57328.00	47551.00	11777.00	4.00/1.00	47108.00
MRJD12145	KVAH	HT	64555.00	51990.00	12565.00	4.00/1.00	50260.00
MRJD12145	KVA	HT	38.52	0.00	38.52	4.00/1.00	154.08

Gross Consumption KWH	KVAH	KVA	Billing Demand	Av. P.F.	KWH Cons. for DS use	KWH Cons. for NDS use	Test Report Units		Net KWH Cons. to Bill at LIP Rate
47108.00	50260.00	154.08	300.00	0.937	0.0	0.0	0.0	0.0	47108.00

(1) Energy Charge @ 6.50 Per KWH	(2) Fixed Charges on Billing Demand @ 170.00	(3) Total (1+2) Rs.	(4) Voltage rebate	(5) Net Total (3-4) Rs.	(6) Excess Demand Ch.	Power Factor S.Ch./Incentive
306202.00	51000.00	357202.00	0.00	357202.00	0.00	0.00

Rent of CT/PT Set	Transformer Rent	Unpaid Amount of FNB Rs.	WCC Amount @ per KWH Rs.	Electricity Duty @ per KWH Rs.	N.D.	E.D.	W.C.C
900.00	0.00 USC:	0.00 0.00UC:	4710.80 7066.20	18843.20 USC:	358102.00 0.00	18843.20 UC:	4710.80 7066.20

Current Bill Amount Total	Arrears N.D.	E.D.	W.C.C	L.P.S. on old arrear	
388722.20	0.00 USC:	0.00 0.00 UC:	0.00 0.00	0.00	

L.P.S. on Current arrear	L.P.S. on FNB Rs.	Total Dues N.D.	E.D.	W.C.C	Net Amount Payable Rupees
0.00	0.00	358102.00 USC:	18843.20 0.00 UC:	4710.80 7066.20	388722.00

DEFFERED AMOUNT 0.00
SHRI RAJA RAM PRINTS (P) LTD
E-226 TO 227, PUNAYATA
PALI

Rs. Three Lacs Eightty Eight Thousand Seven Hundred Twenty Two

SR AO (HTB)

FAX NO

Ledger Keeper Accountant A.A.O. (HTB) / A.O. (HTB)

18/03/2016 13:10

Consumption of Last Six Months	MONTH	JAN16	DEC15	NOV15			
	UNIT	45408	22856	43204	27276	25176	17536