BEE's National Program

on

Energy Efficiency and Technology Up-gradation in SMEs

Pali Textile Cluster

Baseline Energy Audit Report
Simandhar Fabtex (P) Ltd.




Submitted to

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InsPIRE Network for Environment

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contents

List of Tables

List of Figures

List of Abbreviations

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 Simandhar Fabtex (P) Ltd.

Executive Summary

1. Unit Details

Unit Name	:	**Simandhar Fabtex (P) Ltd.**
Address	:	F-168/168A, Mandia Road, Pali, Rajasthan- 306401
Contact Person	:	Mr. Arvind Mehta, Director (Cell no: 9414120561)
Products	:	Cloth processing (Cotton)
Production		70,000 to 1,20,000 meters of processed cloth per day
DIC Number		RJSI/09143/21/17/FNL
Bank Details		Bank of Baroda, Suraj Pole, Pali, A/c No.: 09790200007750, IFSC Code: BARB0PALIXX
TIN / PAN No.	:	TIN: 08033260124 PAN: AAQCS1615N
Contract demand		215 KVA

2. Existing Major Energy Consuming Technology

Coke Based Steam Boiler

- Steam boiler with no provision for pre-heating of boiler feed water and combustion air. Also, the unit do not have boiler feed water treatment facility.
- Prevailing specific fuel consumption is 0.02 kgs of coke per meter of processed cloth. High TDS in the feed water leads to frequent blow-down of boiler.

Jigger Machine

- A total of 26 numbers jigger machines used for cotton dyeing at elevated temperature (60-80 ^{0}C). Jiggers are not equipped with temperature monitoring and control system.
- Each jigger machine uses 2000-2500 liters of water in each cycle.

Kier Boiling Machine

- Two nos. of kier boiling unit for scouring job to be performed on fabric.
- The kier boiler uses indirect heating with no provision for waste heat recovery

3. Proposed Energy Saving Technologies with Cost Economics

Proposed Energy Saving Measures

- Installation of economizer in thermic fluid heater for boiler feed-water pre-heating.
- Installation of combustion air pre-heater in steam boiler.
- Installation of RO system for treatment of feed water to boiler.
- Installation of waste heat recovery system in kier boiling unit.
- Installation of temperature monitoring and control system in jigger machines

Table 1: *Cost Economic Analysis*

Technology	Estimated Energy Savings (%)	Savings (in Rs)	Investment (in Rs)	Simple Payback period (Months)
Economizer in Thermic fluid exit	10.43	3,97,385	3,00,000	9
Air-preheater (APH) in steam boiler	2.32	88,509	2,00,000	27
Reverse Osmosis (RO) system in steam boiler	3	181,333	2,00,000	13
Waste heat recovery (WHR) in kier boiling unit	9.47	1,71,665	1,50,000	15
Temperature Monitoring & Control in Jigger Machines (for 10 Jiggers)	5.70	4,92,252	2,50,000	6

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 an 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 Simandhar Fabtex (P) Ltd., Pali, was established in the year 2000 and is engaged in processing of cotton cloth which includes raw cloth (grey) processing, dyeing and finishing operations. The manufacturing unit is located at F-168/168A, Mandia Road, Pali. The unit operation is overseen by Mr. Arvind Mehta, Director.

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 70,000 to 1,20,000 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 52,913 kgs. The average monthly electricity consumption (derived from reported date of last one year) is 46,460 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.

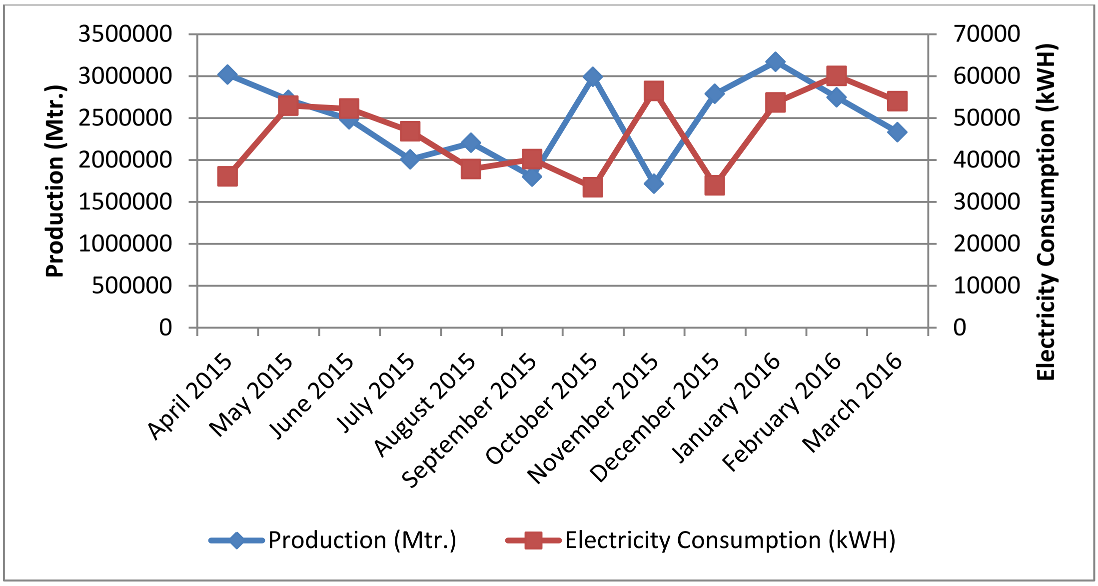


Figure 1.1.*Monthly variation of production and electricity consumption*

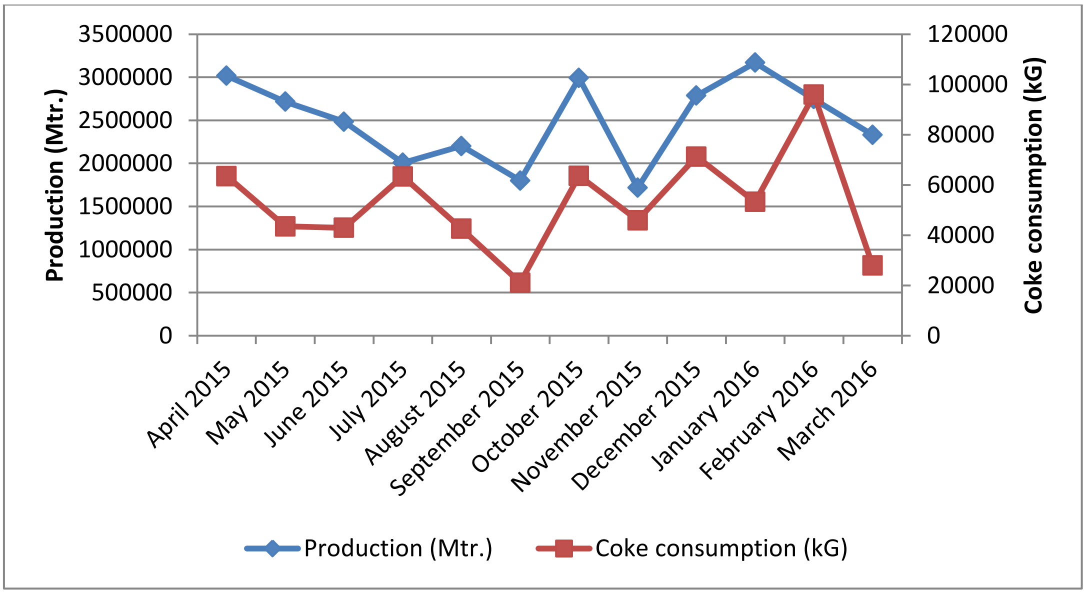


Figure 1.2. ***Monthly variation of production and coke cosumption***

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.

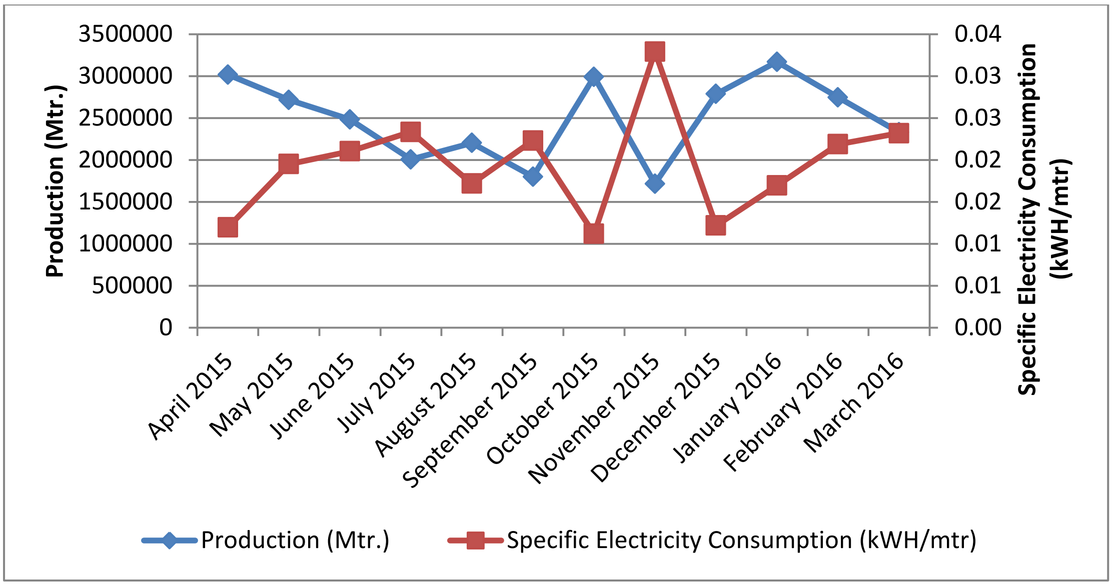


Figure 1.3: ***Variation in specific electrical energy consumption and monthly production***

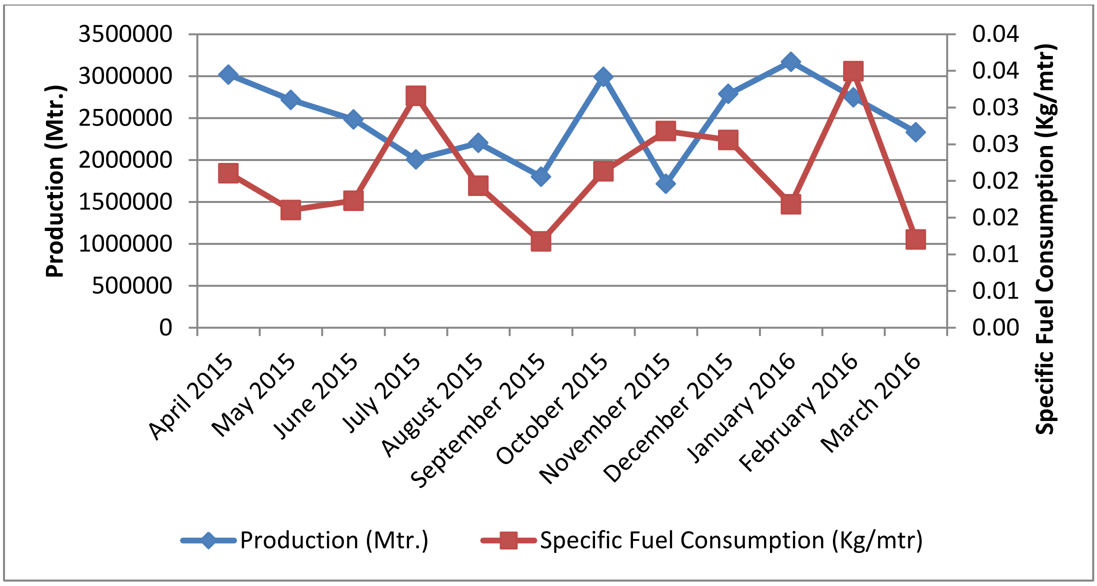


Figure 1.4.: ***Variation in specific fuel consumption (coke) and monthly production.***

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 91 kCal/mtr to 269 kCal/mtr over a period of one year with an average of 159 kCal/mtr. The specific electrical energy consumption of the unit varies from 0.01 kWh/mtr to 0.03 kWh/mtr over a period of one year with an average of 0.02 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 **176.33 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 Simandhar Fabtex (P) Ltd.***

SN	Parameter	Unit	Value
1	Name and address of unit	Simandhar Fabtex (P) Ltd., F-168/168A, Mandia Road, Pali, Rajasthan-306401	
2	Contact person	Mr. Arvind Mehta, Director	
3	Manufacturing product	Processed cloth (Cotton)	
4	Daily Production	70,000 to 1,20,000 mtr per day	
Energy utilization			
5	Average monthly electrical energy consumption	kWh	46.460
6	Average monthly fuel (coke) energy consumption	kg	52,913
7	Average specific thermal energy consumption	kCal/mtr	159.59
8	Specific electrical energy consumption	kWh/mtr	0.02
9	Specific energy consumption[1,2]	kCal/mtr	176.33
10	Electrical energy cost[3]	Rs/mtr	0.13
11	Thermal energy cost[3]	Rs/mtr	0.16

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 Rs 7.5 /kg

1.3 PRODUCTION PROCESS OF PLANT

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

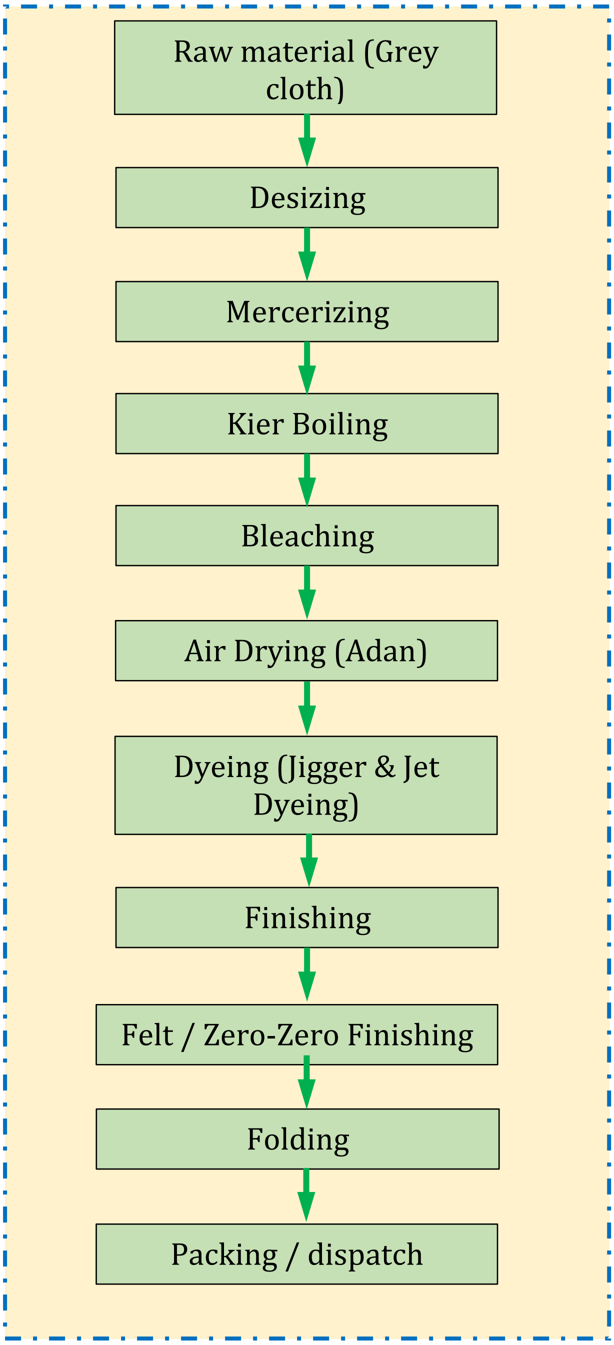


Figure 1.5: ***Production process at Simandhar Fabtex (P) Ltd.***

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:

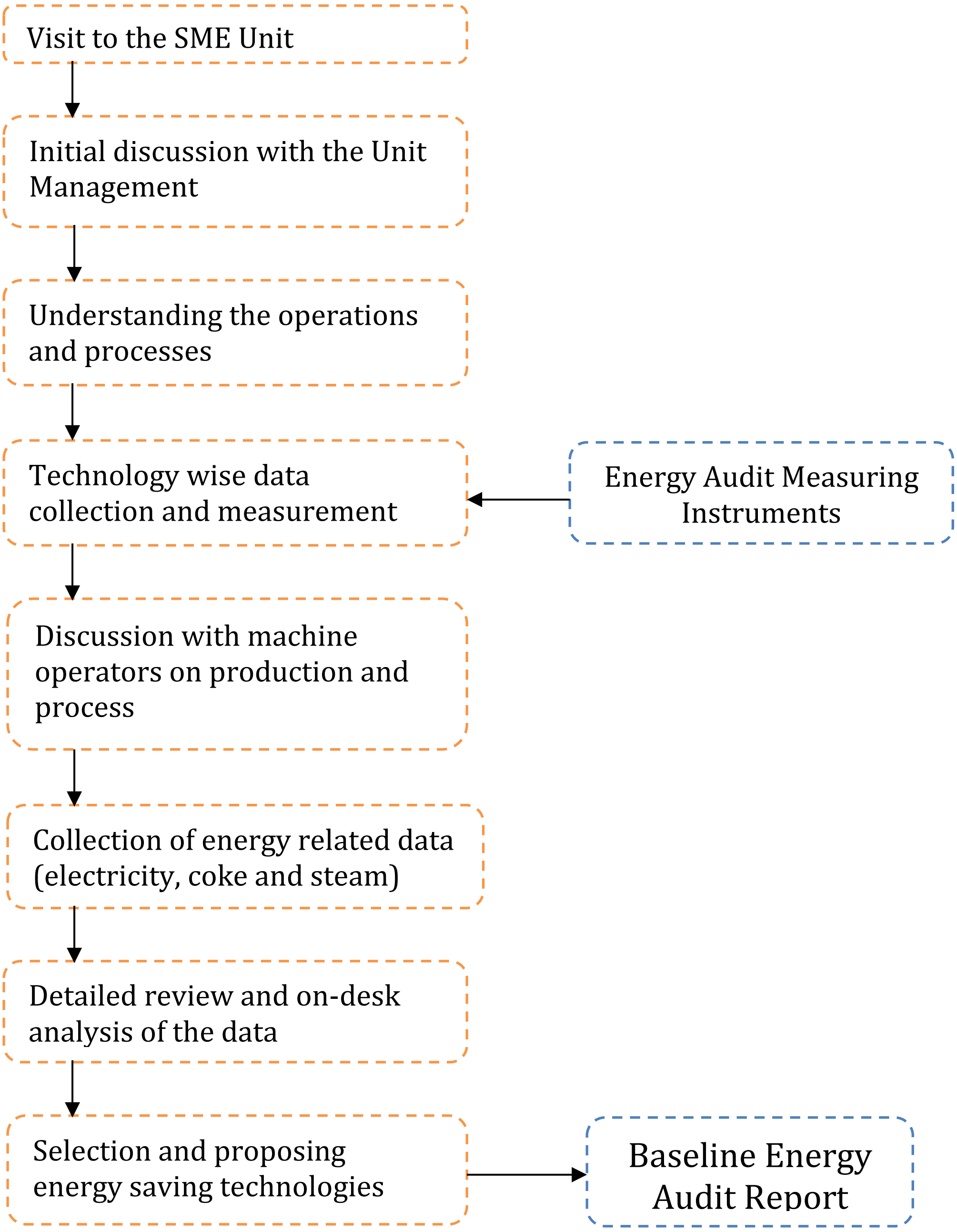


Figure 1.6: ***Energy audit methodology***

1.5 UNIT PHOTOGRAPHS

Caption: Boiler firing chamber at Simandhar Fabtex

Caption: Mercerizing machine

Caption: Kier Boiling unit at Simandhar Fabtex

Caption: Cotton dyeing using jigger machine

Caption: Steam boiler at Simandhar Fabtex

Caption: Finished cloth ready for dispatch

Present Process, Observations and Proposed Technology

2.1 INSTALLATION OF ECONOMIZER IN THERMIC-FLUID HEATER EXIT

2.1.1 Present Process

Simandhar Fabtex (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. The unit also has a thermic-fluid heater (thermo-pack) of 1000 U capacity. 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.

2.1.2 Observations

The steam boiler operating in the unit is a packaged boiler with fire tube design. Steam is the main agent of energy used in the textile processing unit. Thus, the boiler is the major energy utilizing source in the unit. The existing boiler used at Simandhar Fabtex does not have provisions of waste heat recovery. The feed water to the boiler is fed at ambient temperature (35^{0}C) and the stack temperature was observed to be around 180^{0}C. Also, waste heat recovery system is not installed in the thermic-fluid heater. The flue gas temperature leaving the thermic-fluid heater was observed to be 240^{0}C. The combustion air to the boiler firing unit is also being fed at ambient temperature (35^{0}C). No monitoring is being done towards feeding of coke and air into the boiler. In order to analyse the boiler performance, a detailed study was carried out in the unit.

The specific fuel consumption of coke was observed to be around 0.02 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.

The flue gas temperature leaving at 240^{0}C from the thermic-fluid heater provides a potential for waste heat recovery. Stack temperature needs to be maintained above 120^{0}C in order avoid condensation of Sulphur oxides (SO) present in the flue gas which can cause corrosion. The available heat from a temperature difference of 120^{0}C is sufficient to rise the boiler feed water temperature by 60-65^{0}C. The increase in boiler feed water temperature can lead to substantial increase in boiler efficiency thus leading to reduction in specific fuel consumption.

2.1.3 Conclusion

As per the study conducted in the unit, it is suggested to install an economizer (boiler feed water heating system) in the thermic-fluid heater exit. This heat can be utilized to raise the boiler feed water temperature; thus pre-heating the boiler feed water.

The installation of the economizer in the thermic fluid heater and utilizing the same for pre-heating boiler feed water will lead to following benefits:

- Waste heat recovery
- Improvement in boiler efficiency
- Reduction in FD/ID fan power usage
- Improved environment

2.1.4 Cost Economics Analysis

The section below provides a cost benefit analysis for installation of economizer in the existing thermic-fluid heater for pre-heating boiler feed water of the unit:

Table 2.1: *Cost Economic Analysis of proposed economizer*

SN	Parameter	Unit	Value
1	Quantity of steam generated per hr (Q)	kg/hr	3000
2	Quantity of fuel used per hr (q)	kg/hr	211.6
3	Working Pressure	kg/cm^2	10
4	Temperature of feed water	°C	35
5	Type of fuel		Coke
6	Calorific Value of fuel		8200
7	Enthalpy of steam	kCal/kg	665
8	Enthalpy of feed water	kCal/kg	35
9	Boiler Efficiency	%	109
10	Flue gas temperature (in thermic fluid heater)	°C	240
11	Steam generation per Kg of fuel	kg/kg	14
12	Flue gas quantity	kg/kg	15
13	Quantity of flue gas	kg/hr	3097
14	Quantity of heat available in flue gas	kCal/hr	85466
15	Rise in feed water temperature	°C	63
16	Savings in terms of fuel from pre-heated boiler feed water	%	10.43
17	Savings in terms of fuel	kg/hr	22
18	Annual operating hrs.	Hrs.	3600
19	Annual savings of fuel	kgs	79477
20	Annual cost savings	Rs/yr.	397385
21	Cost of economizer	Rs	300000
22	Pay-back	Months	9

* Every rise of 6ºC in boiler feed water temperature through waste heat recovery would offer about 1% fuel savings.

** Cost of fuel taken as Rs 7.5/kg

As per the detailed calculations done, it is proposed to install an economizer in the existing thermic-fluid heater outlet and utilizing the heat to pre-heat the boiler feed water. The estimated fuel saving with the installation is 79,477 kgs annually which can save an amount of Rs. 3,97, 385 per year. Thus the cost of the economizer (estimated to be Rs. 3, 00,000) can be recouped in less than a year.

2.2 INSTALLATION OF AIR-PREHEATER FOR BOILER COMBUSTION AIR

2.2.1 Present Process

Simandhar Fabtex (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

The steam boiler operating in the unit is a packaged boiler with fire tube design. Steam is the main agent of energy used in the textile processing unit. Thus, the boiler is the major energy utilizing source in the unit. The existing boiler used at Simandhar Fabtex does not have provisions of waste heat recovery. Combustion air to the boiler is fed at ambient temperature (35^{0}C) and the flue gas exit temperature was observed to be around 180^{0}C. No monitoring is being done towards feeding of coke and air into the boiler. In order to analyse the boiler performance, a detailed study was carried out in the unit.

The specific fuel consumption of coke was observed to be around 0.02 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.

The flue gas temperature leaving at 180^{0}C from the steam boiler provides a potential for waste heat recovery for combustion pre-heating. Stack temperature needs to be maintained above 120^{0}C in order avoid condensation of Sulphur oxides present in the flue gas which can cause corrosion. The available heat from a temperature difference of 60^{0}C is sufficient to rise the combustion air temperature by 100-120^{0}C. The increase in combustion air temperature can lead to substantial increase in combustion efficiency in the boiler heating chamber thus leading to reduction in specific fuel consumption.

2.2.3 Conclusion

As per the study conducted in the unit, it is suggested to install an air pre-heater (boiler combustion air pre-heat system) in the steam boiler exit. This heat can be utilized to raise the combustion air temperature.

The installation of the air preheater in the steam boiler and utilizing the same for pre-heating combustion air will lead to following benefits:

- Waste heat recovery
- Improvement in boiler efficiency
- Reduction in FD/ID fan power usage
- Improved environment

2.2.4 Cost Economics Analysis

The section below provides a cost benefit analysis for installation of air-preheater in the existing steam boiler of the unit.

Table 2.2: ***Cost Economic Analysis of proposed combustion air-preheater***

SN	Parameter	Unit	Value
1	Exit flue gas temperature	°C	180
2	Stack dew temperature	°C	120
3	Available temperature for heat transfer	°C	60
4	Quantity of steam generated per hour	kg/hr	3000
5	Quantity of fuel in the boiler	kg/hr	211.6
6	Specific heat of water	kCal/ kg °C	1
7	Steam generation per Kg of fuel	kg/kg	14.18
8	Flue gas quantity	kg/kg	20.69
9	Quantity of flue gas	kg/hr	4378
10	Quantity of heat available in flue gas	kCal/hr	60415
11	Rise in combustion pre-heat temperature	°C	48.8
12	Savings in terms of fuel from pre-heated combustion air	%	2.32
13	Savings in terms of fuel	kg/hr	4.92
14	Annual operating hrs.	Hrs.	3600
15	Annual savings of fuel	kgs	17702
16	Annual cost savings	Rs/yr.	88509
17	Cost of air pre-heater	Rs	200000
18	Pay-back	months	27.1

* Every rise of 21°C in combustion air pre-heat temperature through waste heat recovery would offer about 1% fuel savings.

It is therefore proposed to install an economizer in the existing thermic-fluid heater outlet and utilizing the heat to pre-heat the boiler feed water. The estimated fuel saving with the installation is 17,702 kgs annually which can save an amount of Rs. 88,509 per year. Thus the cost of the economizer (estimated to be Rs. 2, 00,000) can be recouped in 27 months period.

2.3 INSTALLATION OF WASTE HEAT RECOVERY IN KIER BOILER UNIT

2.3.1 Present Process:

Simandhar Fabtex (P) Ltd. has installed 2 numbers of kier boiling unit to perform scouring operations in the fabric. The term 'scouring' applies to the removal of impurities such as oils, was, gums, soluble impurities and sold dirt commonly found in textile material and produce a hydrophilic and clean cloth. The Kier boiler is a long cast iron cylindrical vessel provided with two perforated tube sheets (disc with a number of holes). One is placed at the bottom and another in top. These discs are connected by a number of tubes which carry the liquor from the bottom compartment to the upper one. In the middle compartment steam is passed. Thus the tubes carrying the liquor are surrounded by steam which heats them.

The hot liquor from the multi-tubular heater is sprayed over the cloth, packed in the kier, through a hollow perforated ring. The liquid passes slowly over the packed cloth, collects below the false bottom, from where it is pumped into the auxiliary heater by a centrifugal pump and the cycle repeats.

At Simandhar Fabrics, Kier boiling operation is carried out by indirect heating. Hot water at temperature of around 90^{0}C is fed into the boiler. After the heating operation, water is drained out. A significant amount of heat energy present in the water is wasted in the process.

2.3.2 Observations

The Kier Boiling process is a batch process which last for a period of approximately 2 days, which including heating and cooling cycle for the fabrics. Both water and steam is fed into the boiler unit. Approximately 30,000 to 40,000 meters of cloth is processed per batch in the kier boiling unit. Steam at a working pressure of 3-4 kg/cm^2 is used along with hot water at around 120 ^{0}C. Around 4000-5000 liters of water is used in each kier boiling process. A significant amount of energy is lost when hot water utilized in the process is drained out. A waste heat recovery unit installed at the outlet of the kier boiling unit can save a significant amount of energy.

2.3.3 Conclusion

In order to recover heat lost through hot water discharge from the kier boiling unit, it is proposed to install a waste heat recovery system at the outlet of the kier boiling unit. The waste heat recovered can be re-utilized in the system thus leading to significant energy saving.

The system includes a heat exchanger unit which can recover energy from hot water being discharged from the boiler. In the process, pre-heated water can be achieved for boiler feeding.

Benefits of the waste heat recovery system are:

- Reduced fuel cost
- Lower water related expenses
- Positive impact on safety and environment

2.3.4 Cost Economics Analysis

The section below provides cost benefit analysis for the installation of waste heat recovery unit in the kier boiling unit.

Table 2.3: *Cost Economic Analysis of proposed waste heat recovery unit in kier boiling unit*

SN	Particular	Unit	Value
1	Capacity of kier boiling unit	mtr/batch	32500
2	Water used in each batch	kg	5000
3	Process for one batch	days	2
4	Input water temperature (ambient temperature)	°C	35
5	Required temperature for kier boiling	°C	120
6	Output temperature of drained water	°C	100
7	Heat available in water	kCal / batch	325000
8	Quantity of fuel saved for 100% recovery of waste heat	kg / batch	99
9	Annual fuel saving	kg/yr.	16349
10	Annual monetary saving due to fuel saving	Rs/yr.	122618
11	Annual monetary saving due to water saving	Rs/yr.	49047
12	Total annual cost saving	Rs/yr.	171665
13	Investment	Rs/yr.	150000
14	Pay-back	months	15
15	Energy saving	%	9.47

*Cost of fuel has been taken as Rs 7.5/kg

The installation of the proposed waste heat recovery unit in the kier boiler unit will lead to an energy saving of 16,349 kgs of coke thus leading to an annual saving of Rs 1,71,665 per year. Thus the estimated investment of Rs 1,50,000 can be recouped in a period of 15 months.

2.4 BOILER FEED WATER TREATMENT

2.4.1 Present Process:

Simandhar Fabtex (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 Simandhar Fabtex, 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.

2.4.2 Observations

The TDS level of the feed water used for the steam boiler at Simandhar Fabtex (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 Simandhar Fabtex, 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.

2.4.3 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

2.4.4 Cost Economics Analysis

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

Table 2.4: *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	211.6
3	Quantity of fuel used to generate 1 kg of steam	kg/kg	0.071
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	33856
10	**With RO**		
11	Frequency of blow down	no.	25

SN	Parameter	Unit	Value
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	11278.28
16	Annual saving in fuel	kg	22577.72
17	Percentage saving in fuel consumption	%	3.0
18	Annual cost saving in fuel	Rs	169332.9
19	Annual cost saving in terms of make-up water and boiler maintenance	Rs	12000
20	Annual cost savings	Rs	181333
21	Equipment cost	Rs	200000
22	Pay back	months	13

*Cost of fuel taken as Rs 7.5/kg

The installation of reverse osmosis system for boiler feed water treatment will lead to an annual fuel saving of 22,577 kg of coal implying to a monetary saving of Rs 1,81,333 per year. Thus, the estimated cost of the system i.e. Rs 2,00,000 can be recouped in 13 months period.

2.5 TEMPERATURE MONITORING AND CONTROL IN JIGGER MACHINES

2.5.1 Present Process:

Simandhar Fabtex (P) Ltd. has installed a total of 26 Jigger machines, 24 small jiggers running with 3 HP motor each and 2 jumbo jiggers, each running with 7.5 HP motor. These jigger machines are used for dyeing of cotton cloth at elevated temperature of 60-80 ^{0}C depending on the type of fabric and the dye used. Steam is fed into the system for the required amount of elevated temperature. Once the dyeing process is over, the hot water is drained out of the factory. The temperature requirement for water is different for different grades of dyes and quality of fabric. However, no temperature monitoring system has been installed in the jigger machines. Monitoring and control of temperature of water is done purely based on manual interference.

2.5.2 Observations

Dyeing of cotton fabric is done with the help of a jigger machine. In this process the fabric is rotated in a shallow dip containing hot water. The temperature of the water depends on the type of dyeing agent and the quality of the fabric. Typically a temperature range between 60 ^{0}C to 80 ^{0}C is adopted based on different fabric quality and dye. Steam is used to bring amount the required temperature in the process. In case of Simandhar Fabtex, no temperature monitors is being installed in any of the jiggers. The monitoring of water temperature and its control is purely done by manual interference. A study of the jigger water temperature showed off-shooting of temperature at certain places. Thus, a significant amount of energy in the form of steam required to heat water is being lost due to the absence of temperature monitoring and control system. It is suggested for installation of sensor based automatic temperature control and monitoring system in the jiggers.

2.5.3 Conclusion

In order to maintain the correct temperature profile in the jigger 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 jiggers and control the flow of steam by a pneumatically operated valve. This will be lead to optimum utilization of steam in the jiggers 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.

2.5.4 Cost Economics Analysis

The section below provides cost benefit analysis for the installation of temperature monitoring and control system in jiggers. For calculation purpose, it has been assumed that the system is installed in 10 nos. of jiggers.

Table 2.5: *Cost Economic Analysis of jigger water temperature monitoring and control system*

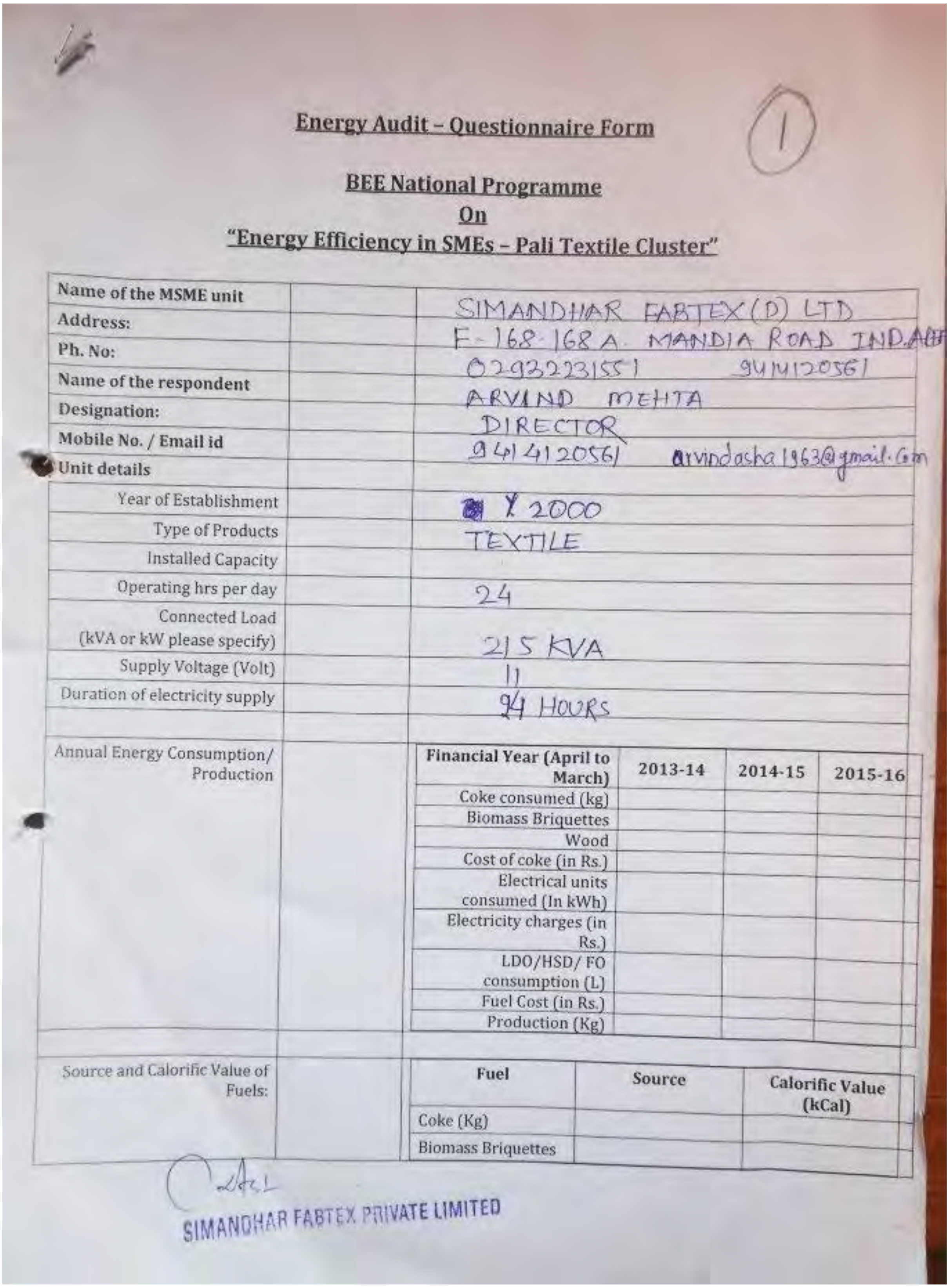
SN	Particulars	Units	Value
1	Temperature observed in Jigger	°C	95
2	Temperature to be maintained	°C	80
3	Machine Capacity	kg	200
4	Steam pressure	kg/cm²	4
5	Steam Enthalpy @ 4 Kg /cm² pressure	kCal/kg	657
6	Liquor Ratio		0
7	Water Capacity	Kg	400
8	Specific heat coefficient (Cp)-water	kCal/kg °C	1
9	Specific heat coefficient (Cp)-fabric	kCal/kg °C	0.5
10	No. of batches per day	nos.	2
11	Saving of steam per batch	kg / hr	11
12	Saving of steam per day (considering 10 hrs heating period in 2 batch)	kg/day	114
13	Savings of steam per annum	kgs/annum	37648
14	Annual fuel savings	kgs	6563
15	Annual monetary savings	Rs	49225
16	Investment per jigger	Rs	25000

SN	Particulars	Units	Value
17	General payback period	Months	6
18	Annual fuel savings for 10 jiggers	Kgs	65634
19	Annual monetary savings for 10 jiggers	Rs	492252
20	Investment for 10 jiggers	Rs	250000
21	Pay-back	Months	6
22	Energy savings	%	5.70

*Cost of fuel taken as Rs 7.5/kg

Installation of temperature monitoring and control system in jigger machines (estimated for 10 units) will lead to annual saving of 65,634 kgs of coal leading to a monetary saving of Rs 4,92,252. Thus the estimated investment of Rs 2, 50,000 can be recouped in a period of 6 months.

Questionnaire



Energy Audit – Questionnaire Form

1

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

Name of the MSME unit		SIMANDHAR FABTEX (P) LTD
Address:		F-168-168 A MANDIA ROAD IND.AR
Ph. No:		02932231551 9414120561
Name of the respondent		ARVIND MEHTA
Designation:		DIRECTOR
Mobile No. / Email id		9414120561 arvindasha1963@gmail.com
Unit details		
Year of Establishment		Y 2000
Type of Products		TEXTILE
Installed Capacity		
Operating hrs per day		24
Connected Load (kVA or kW please specify)		215 KVA
Supply Voltage (Volt)		11
Duration of electricity supply		24 HOURS

Annual Energy Consumption/ Production

Financial Year (April to March)	2013-14	2014-15	2015-16
Coke consumed (kg)			
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)		
Biomass Briquettes		

SIMANDHAR FABTEX PRIVATE LIMITED

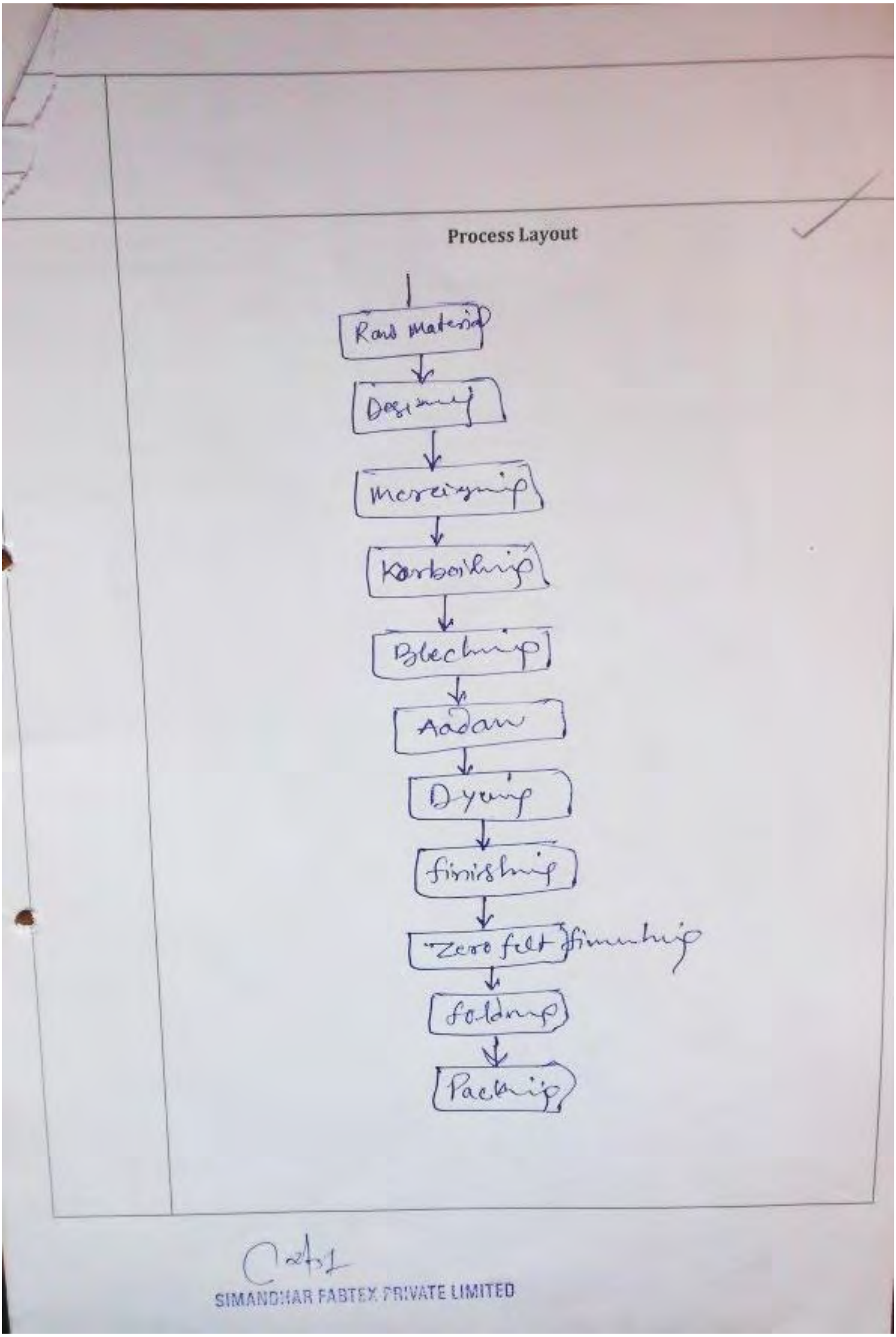
		Wood		
		HSD (L)		
		LDO (L)		
		FO (L)		
		Electricity (kWh)		

Month	Production (Kg) than	Coke consumption (Kg) Ton	Biomass /Wood Consumption (Kg)	Electricity consumption (kWH)	HSD/LDO /FO (L)	Any other fuel (specify units)
	Monthly Energy Consumption and Production Data					
April'15	25142	63.48		36048		
May'15	22623	43.50		52,928		
June'15	20689	42.95		52,220		
July'15	16715.5	63.39		46820		
August'15	18348	42.56		37816		
September'15	15000.5	21.11		40148		
October'15	24914	63.65		33444		
November'15	14298	45.94		56456		
December'15	23218	71.28		33928		
January'16	26405	53.27		53692		
February'16	22877	95.88		60012		
March'16	19421	27.95		54012		

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.	NA
Labour Cost	NA
Material Cost	NA
Other Cost	NA

SIMANDHAR FABTEX PRIVATE LIMITED


Process Layout
Raw material
Designing
Mercerising
Karboiling
Bleching
Aadan
Dyeing
finishing
Zero felt finishing
folding
Packing
SIMANDHAR FABTEX PRIVATE LIMITED

Any Energy Efficient Technology installed in the unit		

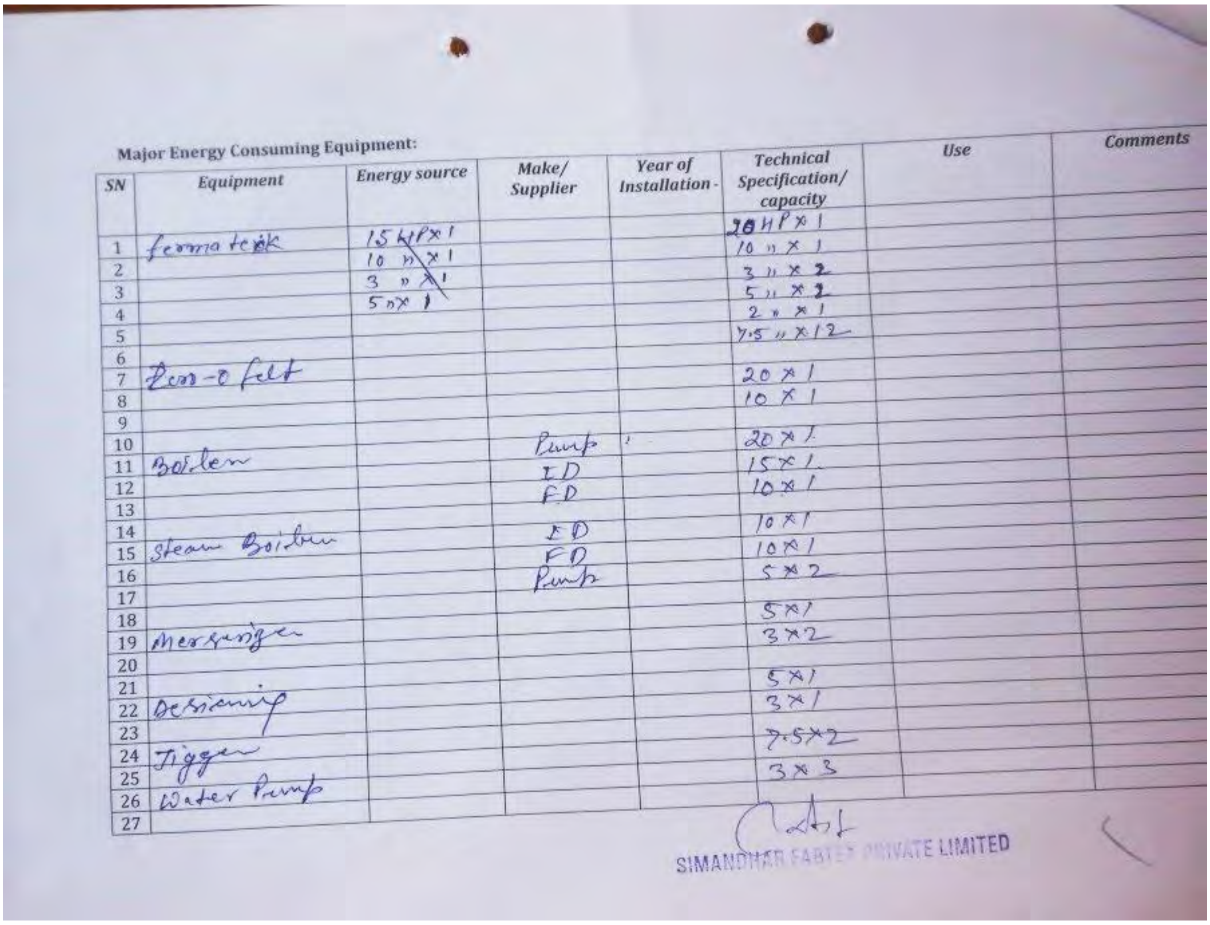
Technology	Specification	Cost	Year of Installation

Any Energy Efficient Technology the management wants to implement in the unit		

Technology	Cost	Use

[illegible]

SIMANDHAR FABTEX PRIVATE LIMITED



Major Energy Consuming Equipment:

SN	Equipment	Energy source	Make/ Supplier	Year of Installation -	Technical Specification/ capacity	Use	Comments
					20 HP × 1		
1	ferma tex	~~15 HP × 1~~			10 " × 1		
2		~~10 " × 1~~			3 " × 2		
3		~~3 " × 1~~			5 " × 2		
4		~~5 " × 1~~			2 " × 1		
5					7.5 " × 12		
6							
7	Zero-o felt				20 × 1		
8					10 × 1		
9							
10			Pump		20 × 1		
11	Boiler		ID		15 × 1		
12			FD		10 × 1		
13							
14			ID		10 × 1		
15	Steam Boiler		FD		10 × 1		
16			Pump		5 × 2		
17							
18					5 × 1		
19	Mercerizer				3 × 2		
20							
21					5 × 1		
22	Desizing				3 × 1		
23					7.5 × 2		
24	Jigger						
25					3 × 3		
26	Water Pump						
27							

SIMANDHAR FABTEX PRIVATE LIMITED

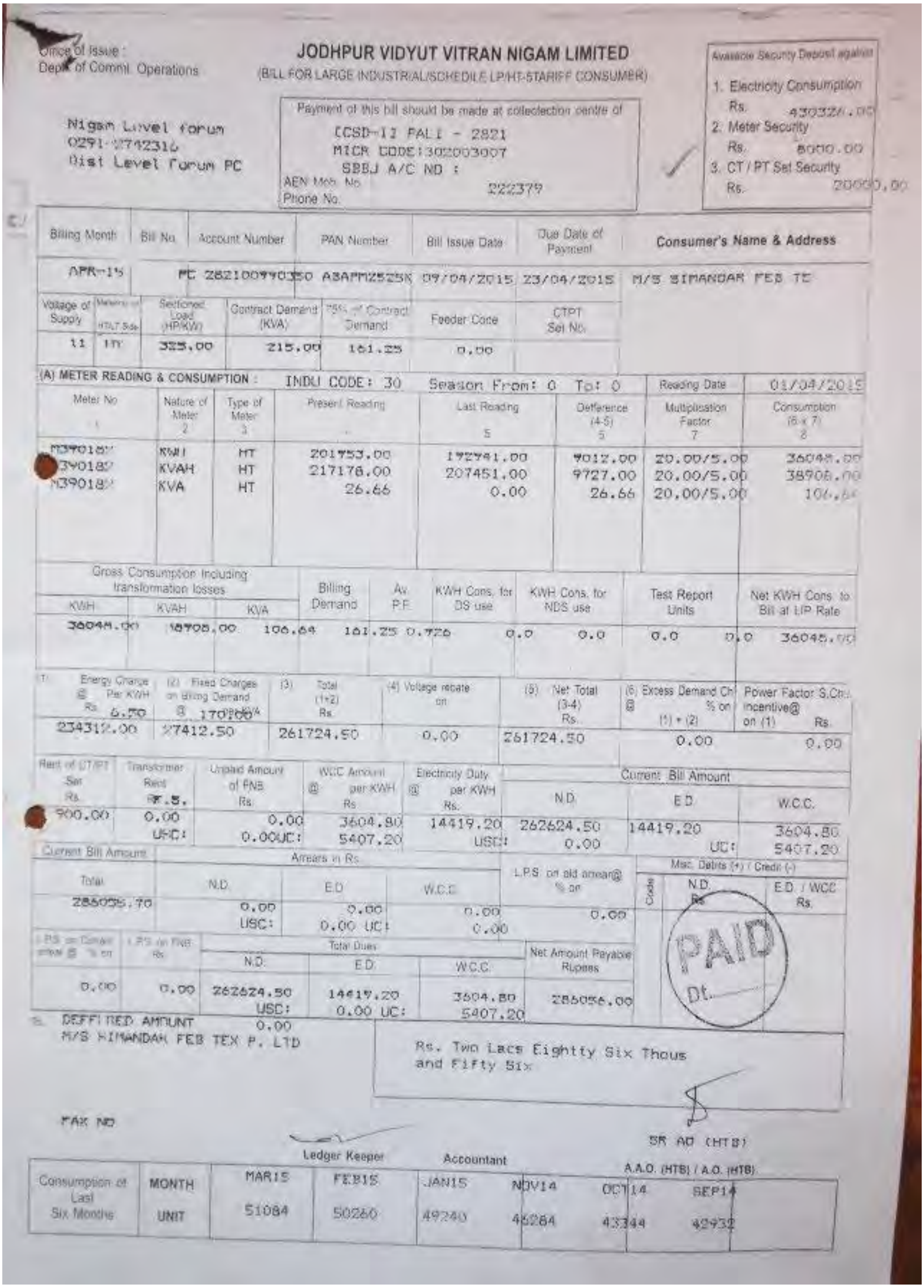
Major Energy Consuming Equipment:

SN	Equipment	Energy source	Make/ Supplier	Year of Installation	Technical Specification/ capacity	Use	Comments
1	ferma tek	~~15 HP×1~~					
2		~~10 " ×1~~			20 HP×1		
3		~~3 " ×1~~			10 " × 1		
4		~~5 " × 1~~			3 " × 2		
5					5 " × 2		
6					2 " × 1		
7	Rem-o felt				7.5 " × 12		
8							
9					20 × 1		
10					10 × 1		
11	Boiler						
12			Pump		20 × 1		
13			ID		15 × 1		
14			FD		10 × 1		
15	Steam Boiler						
16			ID		10 × 1		
17			FD		10 × 1		
18			Pump		5 × 2		
19	Mercerizer						
20					5 × 1		
21					3 × 2		
22	Desizing						
23					5 × 1		
24	Jigger				3 × 1		
25					7.5 × 2		
26	Water Pump						
27					3 × 3		

SIMANDHAR FAB[illegible] PRIVATE LIMITED

SN	Equipment	Energy source	Make/ Supplier	Year of Installation	Technical Specification/ capacity	Use	Comments
28							
29							
30							
31							
32							
33							
34							
35							
36							

SIMANDHAR FABTEX PRIVATE LIMITED



Office of Issue :
Deptt. of Comml. Operations

JODHPUR VIDYUT VITRAN NIGAM LIMITED

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

Nigam Level Forum
0291-2742316
Dist Level Forum PC

Payment of this bill should be made at collection centre of
CCSD-II PALI - 2821
MICR CODE:302003007
SBBJ A/C NO :
AEN Mob. No.
Phone No. 222379

Available Security Deposit against
1. Electricity Consumption Rs. 430326.00
2. Meter Security Rs. 8000.00
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
APR-15		PC 2821007703350	ABAPM2525K	07/04/2015	23/04/2015	M/S SIMANDAR FEB TE

Voltage of Supply	Metering at HT/LT Side	Sanctioned Load (HP/KW)	Contract Demand (KVA)	75% of Contract Demand	Feeder Code	CTPT Set No.
11	HT	325.00	215.00	161.25	0.00	

(A) METER READING & CONSUMPTION : INDU CODE: 30 Season From: 0 To: 0 Reading Date 01/04/2015

Meter No 1	Nature of Meter 2	Type of Meter 3	Present Reading 4	Last Reading 5	Difference (4-5) 6	Multiplication Factor 7	Consumption (6 x 7) 8
M390182	KWH	HT	201753.00	172741.00	7012.00	20.00/5.00	36048.00
M390182	KVAH	HT	217178.00	207451.00	9727.00	20.00/5.00	38908.00
M390182	KVA	HT	26.66	0.00	26.66	20.00/5.00	106.64

Gross Consumption Including transformation losses 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
36048.00	38908.00	106.64	161.25	0.926	0.0	0.0	0.0	0.0	36048.00

(1) Energy Charge @ Per KWH Rs. 6.50	(2) Fixed Charges on Billing Demand @ 170.00/KVA	(3) Total (1+2) Rs.	(4) Voltage rebate on	(5) Net Total (3-4) Rs.	(6) Excess Demand Ch. @ % on (1) + (2)	Power Factor S.Ch./Incentive@ on (1) Rs.
234312.00	27412.50	261724.50	0.00	261724.50	0.00	0.00

Rent of CT/PT Set Rs.	Transformer Rent Rs. 5.	Unpaid Amount of FNB Rs.	WCC Amount @ per KWH Rs.	Electricity Duty @ per KWH Rs.	Current Bill Amount N.D.	E.D.	W.C.C.
900.00	0.00 UHC:	0.00 0.00UC:	3604.80 5407.20	14419.20	262624.50 USC: 0.00	14419.20 UC:	3604.80 5407.20

Current Bill Amount Total	Arrears in Rs. N.D.	E.D.	W.C.C.	L.P.S. on old arrear@ % on	Code	Misc. Debits (+) / Credit (-) N.D. Rs.	E.D. / WCC Rs.
286056.70	0.00 USC:	0.00 0.00 UC:	0.00 0.00	0.00			

L.P.S. on Current arrear @ % on	L.P.S. on FNB Rs.	Total Dues N.D.	E.D.	W.C.C.	Net Amount Payable Rupees
0.00	0.00	262624.50 USC:	14419.20 0.00 UC:	3604.80 5407.20	286056.00

PAID Dt.

DEFFERED AMOUNT 0.00
M/S HIMANDAR FEB TEX P. LTD

Rs. Two Lacs Eightty Six Thous and Fifty Six

FAX NO

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

Consumption of Last Six Months	MONTH	MAR15	FEB15	JAN15	NOV14	OCT14	SEP14
	UNIT	51084	50260	49240	46284	43344	42932