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

Pali Textile Cluster

Baseline Energy Audit Report
Vijay Anand Textiles

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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 Vijay Anand Textiles.

Executive Summary

1. Unit Details

Unit Name	:	**Vijay Anand Textiles**
Address	:	E-28, Mandia Road, Pali, Rajasthan- 306401
Contact Person	:	Mr. Rajmal Kawar, Proprietor (Cell no: 9414122086)
Products	:	Cloth processing (cotton & polyester)
Production		60,000 to 1,20,000 meters of processed cloth per day
DIC Number		RJSE/03902/17/21/PMT/SSI
Bank Details		The Pali Co-operative Bank Ltd., Suraj Pole, Pali, A/c No.: 29009401130000222, IFSC Code: RSCB0029009
TIN / PAN No.	:	TIN: NA PAN: ABIPK1152A
Contract demand		240 KVA

2. Existing Major Energy Consuming Technology

Jet Dyeing Machine and Zero-Zero Machine

- 5 Nos of Jet Dyeing machine and 1 Nos. of zero-zero machine with no provision for condensate recovery.
- Each jet machine uses steam at 250 kg/hr and each zero-zero machine uses steam at 200 kg/hr, with a production of 1100-1200 mtrs of processed cloth per batch from jet dyeing machines (2-3 hrs time required for one batch) and 30,000 mtrs of processed cloth per day from zero-zero machine respectively.

Jigger Machine

- A total of 32 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.

3. Proposed Energy Saving Technologies with Cost Economics

Proposed Energy Saving Measures

- Installation of float traps in jet dyeing machine and zero-zero machine
- Installation of RO system for treatment of feed water to boiler.
- Installation of condensate recovery system for jet dyeing and zero-zero machines.
- 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)
Float Traps in Jet Dyeing Machine	24	2,91,246	2,75,000	11
Float Traps in Zero-Zero Machine	10	2,07,108	1,00,000	6
Reverse Osmosis (RO) system in steam boiler	3	3,56,108	2,00,000	7

Technology	Estimated Energy Savings (%)	Savings (in Rs)	Investment (in Rs)	Simple Payback period (Months)
Condensate Recovery System (CRS) in Jet Dyeing Machine	41.67	7,59,075	5,00,000	8
Condensate Recovery System (CRS) in Zero-Zero Machine	13.33	3,50,207	5,00,000	17
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 resources that are 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 Vijay Anand Textiles, Pali, was established in the year 2001 and is engaged in processing of cloth (both cotton and polyester) which includes raw cloth (grey) processing, dyeing and finishing operations. The manufacturing unit is located at E-28, Mandia Road, Pali. The unit operation is overseen by Mr. Rajmal Kawar, Proprietor.

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 60,000 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 1,07,170 kgs. The average monthly electricity consumption (derived from reported date of last one year) is 65,995 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.

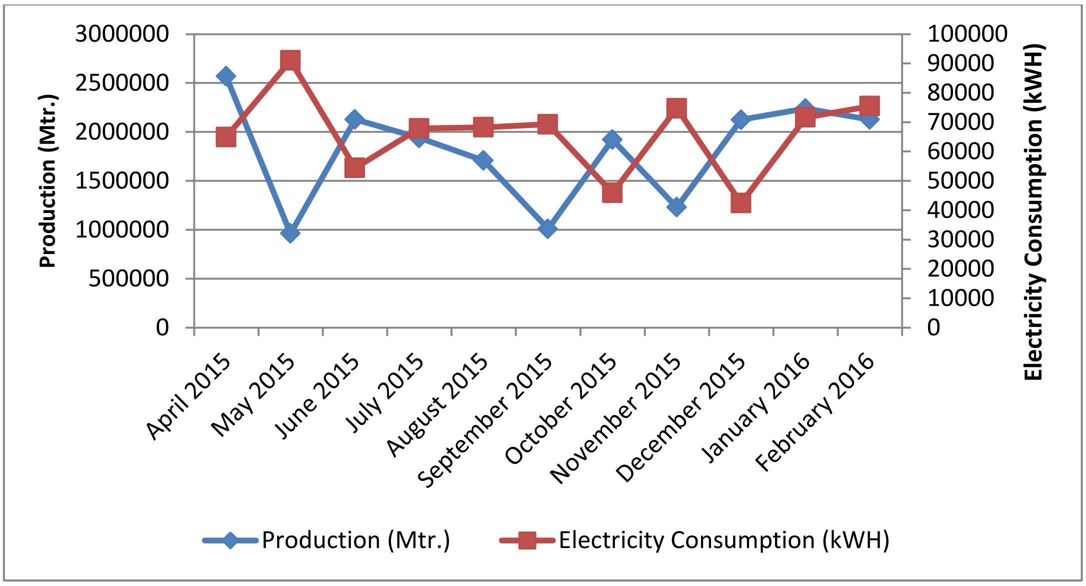


Figure 1.1: ***Monthly variation of production and electricity consumption***

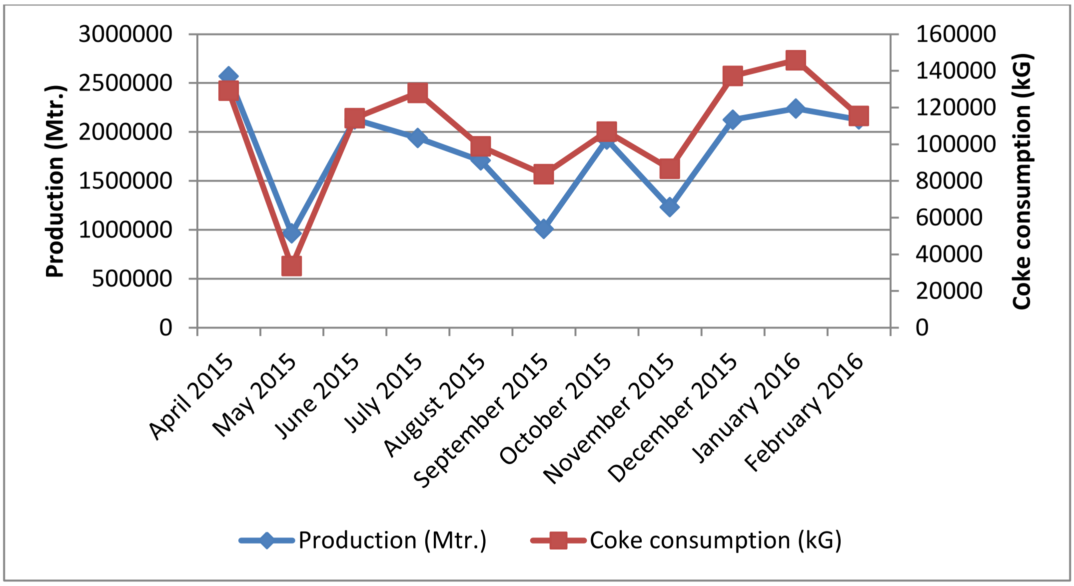


Figure 1.2***: Monthly variation of production and coke cosumption***

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.

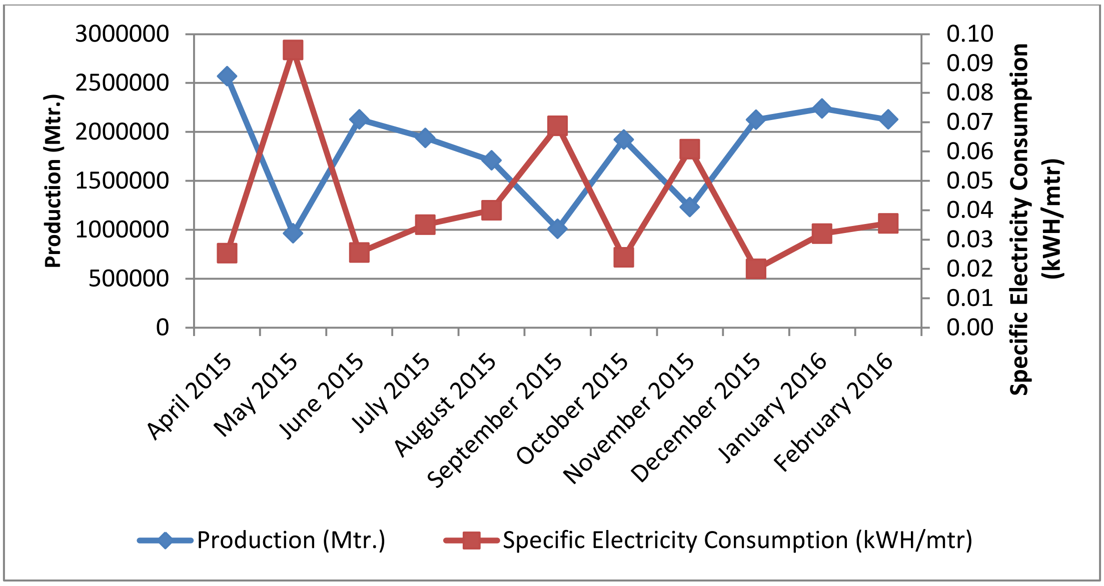


Figure 1.3: ***Variation in specific electrical energy consumption and monthly production***

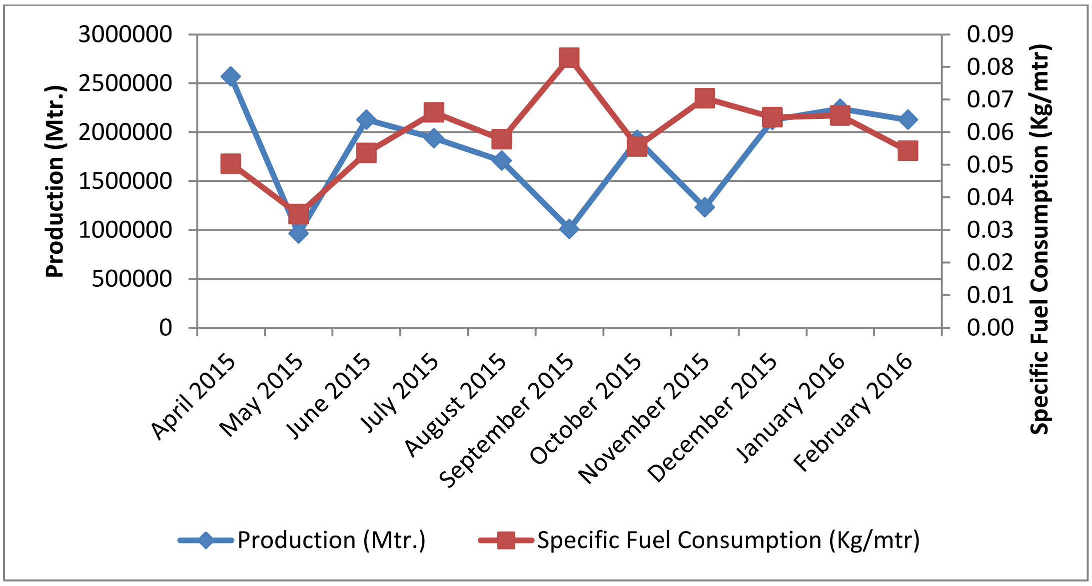


Figure 1.4: ***Variation in specific fuel consumption (coke) and monthly production***

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 195 kCal/mtr to 775 kCal/mtr over a period of one year with an average of 343 kCal/mtr. The specific electrical energy consumption of the unit varies from 0.02 kWh/mtr to 0.09 kWh/mtr over a period of one year with an average of 0.04 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 **379.87 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 Vijay Anand Textiles*

SN	Parameter	Unit	Value
1	Name and address of unit	Vijay Anand Textiles, E-28, Mandia Road, Pali, Rajasthan-306401	
2	Contact person	Mr. Rajmal Kawar, Proprietor	
3	Manufacturing product	Processed cloth (Cotton/ Polyester)	
4	Daily Production	70,000 to 1,20,000 mtr per day	
Energy utilization			
5	Average monthly electrical energy consumption	kWh	65,995
6	Average monthly fuel (coke) energy consumption	kg	1,07,170
7	Average specific thermal energy consumption	kCal/mtr	343.81
8	Specific electrical energy consumption	kWh/mtr	0.04
9	Specific energy consumption[1,2]	kCal/mtr	379.87
10	Electrical energy cost[3]	Rs/mtr	0.27
11	Thermal energy cost[3]	Rs/mtr	0.30

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 Vijay Anand Textiles:

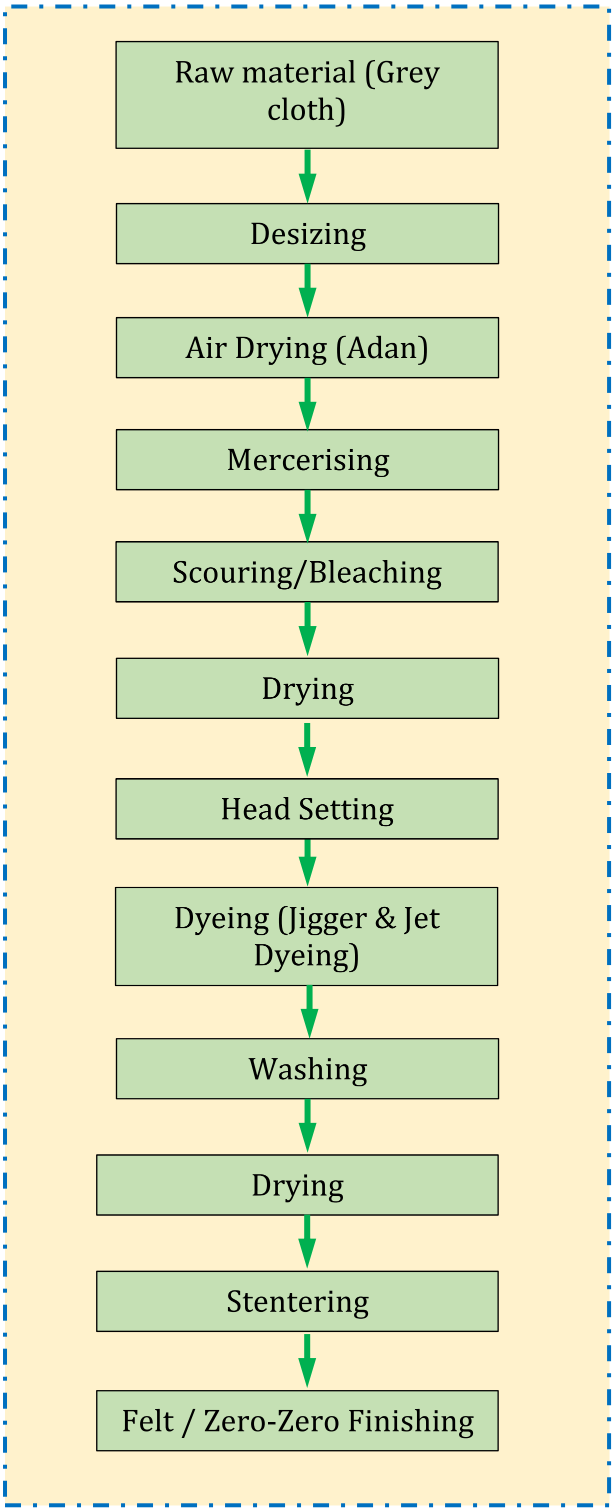


Figure 1.5: ***Production process at Vijay Anand Textiles***

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:

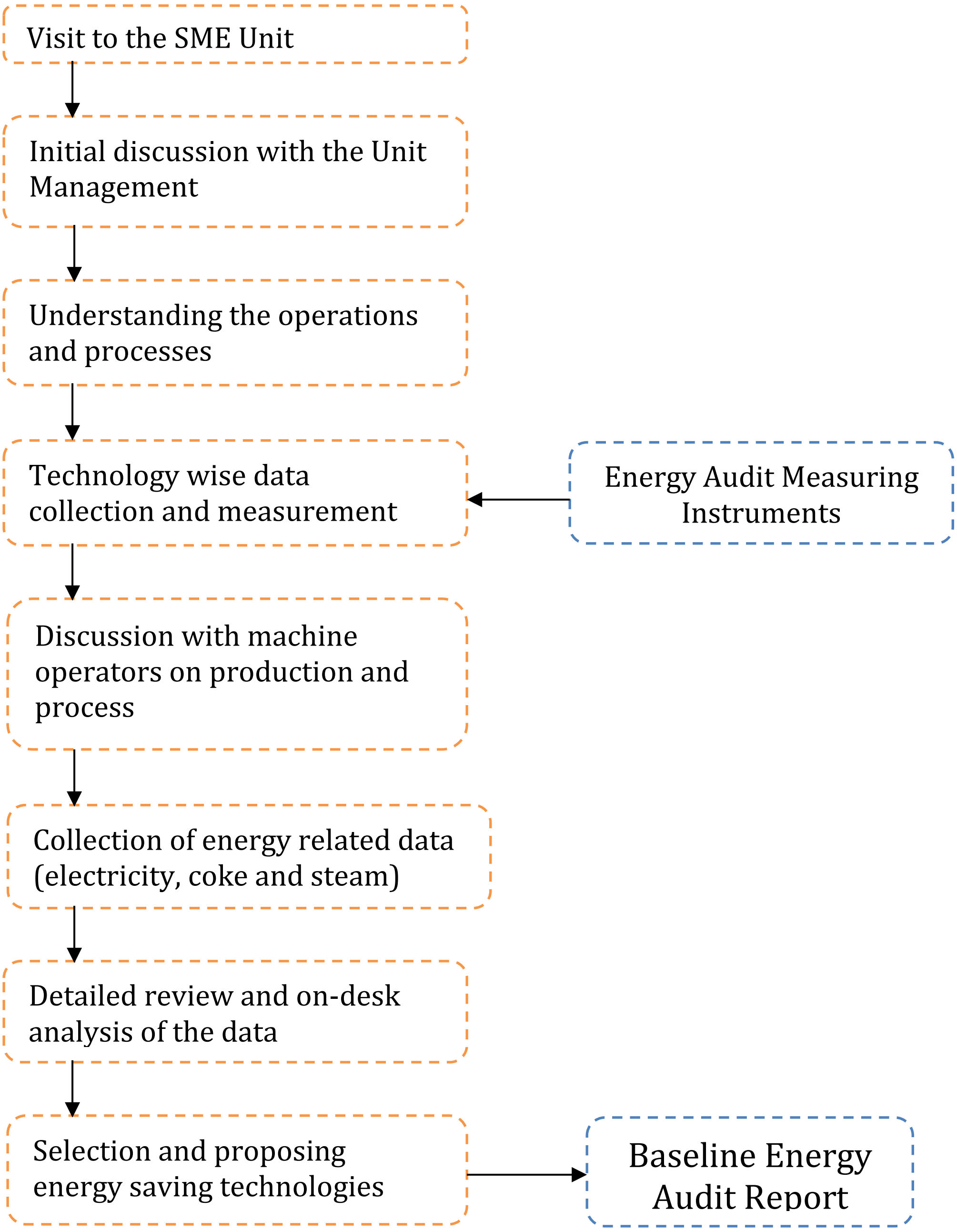


Figure 1.6: *Energy audit methodology*

1.5 UNIT PHOTOGRAPHS

Caption: Natural drying of fabric at Vijay Anand

Caption: Cotton fabric dyeing using Jigger Machines

Caption: Polyester dyeing using Jet dyeing machine

Caption: Finishing operation using Stenter

Caption: Caustic processing unit

Caption: Boiler unit at Vijay Anand

CHAPTER 2:

Present Process, Observations and Proposed Technology

2.1 INSTALLATION OF FLOAT TRAPS IN JET DYEING MACHINE

2.1.1 Present Process

Vijay Anand Textile has installed 5 nos. of jet dyeing machines having a capacity of 250 kgs each. The unit has 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 in the jet dyeing machines. In the condensate outlet, 25 NB thermodynamic (TD) traps are installed in all 5 nos. of jet dyeing machine.

2.1.2 Observations

Thermodynamic traps work on the difference in dynamic response to velocity change in the flow of compressible and incompressible fluids. As steam enters, static pressure above the disk forces the disk against the valve seat. The static pressure over a large area overcomes the high inlet pressure of the steam. As the steam starts to condense, the pressure against the disk lessens and the trap cycles. This essentially makes a TD trap a "time cycle" device: it will open even if there is only steam present, this can cause premature wear. If non-condensable gas is trapped on top of the disc, it can cause the trap to be locked shut. However, the efficiency of TD traps is low in comparative to float traps. In the current process, it was observed that the TD traps are not being able to remove condensate properly. As a result, the operator by-pass the valve to remove the condensate in the heating cycle. Thus, a significant amount of steam is lost in each heating cycle.

2.1.3 Conclusion

As per the study conducted in the unit, it is suggested to install pneumatically operated float traps in steam unit of jet dyeing machine in place of TD traps. These float traps will be able to filter out condensate in the machine exit and allow steam to pass through the line. The amount of steam being discharged along with the condensate can be saved in the process.

The installation of the float-traps in the steam utilizing units will lead to following benefits:

- Higher capacity turndown trap
- Complete Space Optimization – Area required for installation is less

- No welding required
- No Inline leakages
- Lesser Radiation losses
- Reduced transportation costs

2.1.4 Cost Economics Analysis

The section below provides a cost benefit analysis for installation of float traps in the existing steam line of the jet dyeing machine in place of the existing TD traps:

Table 2.1: *Cost Economic Analysis of installation of float traps in jet dyeing machine*

SN	Parameter	Unit	Value
1	Bypass Valve size	mm	25
2	Percentage opening of bypass valve	%	20
3	Orifice size of opened valve	mm	5
4	Operating pressure	kg/cm^2	4
5	Steam leakage per batch per jet dyeing machine (considering 45 min heating cycle/jet dyeing	kg/batch/jet dyeing m/c	27
6	No. of batches	no.	5
7	Total steam leakage /day/jet dyeing	kg/day/jet dyeing m/c	135
8	No. of jet dyeing machine	no.	5
9	Quantity of steam saved	kg/day	675
10	Energy saved	%	24
11	Quantity of fuel saved daily	kg/day	118
12	Annual fuel saving	kg/yr	38833
13	Annual cost saving	Rs/yr	291246
14	Investment	Rs	275000
15	Pay back	months	11

* Cost of fuel taken as Rs 7.5/kg

As per the detailed calculations done, it is proposed to install float traps in place of existing thermodynamic traps in the steam line of the jet dyeing machine. The estimated fuel saving with the installation is 38,833 kgs annually which can save an amount of Rs. 2,91,246 per year. Thus the cost of the 5 nos. of float traps (estimated to be Rs. 2,75,000) can be recouped in less than 11 months.

2.2 INSTALLATION OF FLOAT TRAPS IN ZERO-ZERO MACHINE

2.2.1 Present Process

Vijay Anand Textile has installed 1 no. of zero-zero machines having a capacity of 200 kgs each. The unit has 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 in the jet dyeing machines. In the condensate outlet, thermodynamic (TD) traps are installed in blanket cylinder and rubber cylinder.

2.2.2 Observations

Thermodynamic traps work on the difference in dynamic response to velocity change in the flow of compressible and incompressible fluids. As steam enters, static pressure above the disk forces the disk against the valve seat. The static pressure over a large area overcomes the high inlet pressure of the steam. As the steam starts to condense, the pressure against the disk lessens and the trap cycles. This essentially makes a TD trap a "time cycle" device: it will open even if there is only steam present, this can cause premature wear. If non-condensable gas is trapped on top of the disc, it can cause the trap to be locked shut. However, the efficiency of TD traps is low in comparative to float traps. In the current process, it was observed that the TD traps are not being able to remove condensate properly. As a result, the operator by-pass the valve to remove the condensate in the heating cycle. Thus, a significant amount of steam is lost in each heating cycle.

2.2.3 Conclusion

As per the study conducted in the unit, it is suggested to install pneumatically operated float traps in steam unit of zero-zero machine in place of TD traps. These float traps will be able to filter out condensate in the machine exit and allow steam to pass through the line. The amount of steam being discharged along with the condensate can be saved in the process.

The installation of the float-traps in the steam utilizing units will lead to following benefits:

- Higher capacity turndown trap
- Complete Space Optimization – Area required for installation is less
- No welding required
- No Inline leakages
- Lesser Radiation losses
- Reduced transportation costs

2.2.4 Cost Economics Analysis

The section below provides a cost benefit analysis for installation of float traps in the existing steam line of the zero-zero machine in place of the existing TD traps:

Table 2.2: *Cost Economic Analysis of proposed float traps in zero-zero machine*

SN	Parameter	Unit	Value
1	Bypass Valve size	mm	25
2	Percentage opening of bypass valve	%	15
3	Orifice size of opened valve	mm	4
4	Operating pressure	kg/cm^2	4
5	Steam loss through opened by pass valve	kg/hr	20
6	Total steam leakage /day (considering 50% live steam leakage loss)	kg/day	240
7	No. of cylinders in zero- zero machine	no.	2
8	No. of zero-zero machine	no.	1
9	Quantity of steam saved	kg/day	480

SN	Parameter	Unit	Value
10	Energy saved	%	10
11	Quantity of fuel saved daily	kg/day	84
12	Annual fuel saving	kg/yr	27614
13	Annual cost saving	Rs/yr	207108
14	Investment	Rs	100000
15	Pay back	months	6

* Cost of fuel taken as Rs 7500/MT

As per the detailed calculations done, it is proposed to install float traps in place of existing thermodynamic traps in the steam line of the zero-zero machine. The estimated fuel saving with the installation is 27,614 kgs annually which can save an amount of Rs. 2,07,198 per year. Thus the cost of the float traps (estimated to be Rs. 1, 00,000) can be recouped in less than 6 months.

2.3 CONDENSATE RECOVERY SYSTEM IN JET DRYING MACHINE

2.3.1 Present Process:

Vijay Anand Textiles has installed 5 numbers of jet dyeing machines. These machines are used for pressurized dyeing (Colouring) process, used mainly for polyester based fabric. Steam at a working pressure of 4-5 kg/cm^2 along with water is used in the jet dyeing process. A significant amount of steam is lost during the heating operation of the jet dyeing process, as the portion of the latent heat is transferred to the equipment line resulting in condensate formation. Also, a significant amount of steam is transformed to condensate during the cooling cycle of the jet dyeing process. In addition to these, heat available in exit water generated during the process is wasted during the water recycling process. The unit has 5 numbers of jet dyeing machines, each having a capacity to use steam at 200 to 250 kg/hour. The jet dyeing operation is done in 3 batches in a day, each batch having a capacity of dyeing 2000-2500 meters of cloth per jet machine.

2.3.2 Observations

The jet dyeing process is a batch dyeing process in which dyeing is accomplished in a close tabular system, basically composed of an impeller pump and a shallow dye bath. The fabric to be dyed is loosely collapsed in the form of a rope, and tied into a loop. The impeller pump supplies a jet of dye solution, propelled by water which transports the fabric into the dyeing system, surrounded by dye liquor, under optimum conditions. Turbulence created by the jet aids in dye penetration and prevents the fabric from touching from touching the walls of the tube, thus minimizing mechanical impact in the fabric. Steam is supplied during the heating process for better heat penetration and to create optimum dyeing conditions. Each operational cycle lasts for 2-3 hours which includes heating process, dyeing process and cooling operations. The cloths are dyed in pressurized conditions with the help of steam and water. A significant portion of steam is converted into water droplets due to condensation. When steam condenses, at the threshold or instant of phase change, the condensate temperature is the same as steam because only the latent heat has been lost, and the full amount of sensible heat remains. This condition is known as "Saturated Water". Not wasting, but rather recovering and reusing as much of this sensible heat as possible through installation of condensate recovery system.

2.3.3 Conclusion

In order to recover heat lost through condensate, it is proposed to install a condensate recovery system in the jet dyeing machines. Condensate recovery is a process to reuse the water and sensible heat contained in the discharged condensate. Recovering condensate instead of throwing it away can lead to significant savings of energy, chemical treatment and make-up water. Condensate can be reused in many different ways, for example:

- As heated feed water, by sending hot condensate back to the boiler's deaerator
- As pre-heat, for any applicable heating system
- As steam, by reusing flash steam
- As hot water, for cleaning equipment or other cleaning applications

The system includes a positive displacement condensate pump which can recover (suck) hot condensate and flash steam from the steam pipeline and feed the same into the boiler feed water tank. The pump may also be equipped with an in-built receiver for condensate which eliminates the need for a separate storage tank. The installation of the system will allow 100% recovery of condensate formed during the jet dyeing process. The technology can be suitably modified for mechanical or sensor based control.

Benefits of the condensate 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 condensate recovery system (CRS) in the jet dyeing machine.

Table 2.3: *Cost Economic Analysis of proposed condensate recovery system in jet dyeing machine*

SN	Particular	Unit	Value
1	No. of Jet Dyeing Machine	no	5
2	Steam Consumption of Jet Dyeing M/c per hr	kg/hr	250
3	No.of Batches per day	no	5
4	Condensate recovery potential (considering heating cycle of 45 mins)	kg/day	4687.5

SN	Particular	Unit	Value
5	operating days	days	330
6	Sensible heat @ 4kg/cm^2	kcal/kg	144
7	Sensible heat @ 0.5 kg/cm^2	kcal/kg	111
8	Latent heat @ 0.5 kg/cm^2	kcal/kg	532
9	Flash steam quantity saved	kg/day	291
10	Savings with flash stem (A)	Rs	95953
11	Balance condensate stem	kg/day	4397
12	Temperature of condensate	°C	95
13	Make up water temperature	°C	35
14	Gain in enthalpy	kcal/d	263804
15	GCV of fuel	kCal/kg	8200
16	Cost of fuel	Rs/kg	7.5
17	Savings with condensate stem	Rs	199059
18	Total quantity of RO water generated per day	Ltr/day	4687.5
19	Cost of RO water per liter	Rs	0.3
20	Savings from Ro water per year (B)	Rs	464062.5
21	Total Saving (A+B)	Rs	759075
22	Cost of condensate recovery system	Rs	500000
23	Simple pay back	months	8
24	Fuel saving	kg/hr	218
25	Energy saving	%	41.67

*Cost of fuel taken as Rs 7.5/kg

The proposed condensate recovery system will lead to an annual saving of Rs 7,59,075. Thus the estimated investment of Rs 5, 00, 000 can be recouped in a period of less than a year.

2.4 CONDENSATE RECOVERY SYSTEM IN ZERO-ZERO (FELT) MACHINE

2.4.1 Present Process:

Vijay Anand Textiles has installed 1 numbers of zero-zero (felt) machines. These machines are used for finishing operations wherein the fabric is rotated in circular rubber drum with blanket of steam rotating around it. Steam at a working pressure of 4-5 kg/cm^2 is used in the process. A significant amount of steam is lost during the operation, as the portion of the latent heat is transferred to the equipment line resulting in condensate formation. The unit has 1 number of zero-zero (felt) machines, each having a capacity to use steam at 200 to 250 kg/hour. Around 30,000 meters of cloth is processed in zero-zero machine every day

2.4.2 Observations

The felting or zero-zero process is carried through controlled compression shrinkage or pre-shrinking of the fabric by passing the fabric into rubber unit. This process forces the yarns closer together and the fabric becomes thicker and heavier and the dimensional stability of the fabric improves. This process is also called “sanforization”.

In the zero-zero finishing operation, fabric is passed between hot cylinder with steam in the inner line and endless rubber, heating of the cylinder takes place by steaming arrangements. Pressure is applied on the fabric between the rubber and cylinder by pressure roll. During this above operation shrinkage takes place on the fabric. During drying of fabric in the felt unit, the moisture is uniformly absorbed from the fabric by the felt blanket. And the shrinkage of the fabric is set. The unit also has a cooling cylinder which is used to further cool the fabric to normal temperature.

A significant portion of steam is converted into water droplets due to condensation in the zero-zero and felt operations. When steam condenses, at the threshold or instant of phase change, the condensate temperature is the same as steam because only the latent heat has been lost, and the full amount of sensible heat remains. This condition is known as "Saturated Water". Not wasting, but rather recovering and reusing as much of this sensible heat as possible through installation of condensate recovery system.

2.4.3 Conclusion

In order to recover heat lost through condensate, it is proposed to install a condensate recovery system in the zero-zero machines. Condensate recovery is a process to reuse the water and sensible heat contained in the discharged condensate. Recovering condensate instead of throwing it away can lead to significant savings of energy, chemical treatment and make-up water. Condensate can be reused in many different ways, for example:

- As heated feed water, by sending hot condensate back to the boiler's deaerator
- As pre-heat, for any applicable heating system
- As steam, by reusing flash steam
- As hot water, for cleaning equipment or other cleaning applications

The system includes a positive displacement condensate pump which can recover (suck) hot condensate and flash steam from the steam pipeline and feed the same into the boiler feed water tank. The pump may also be equipped with an in-built receiver for condensate which eliminates the need for a separate storage tank. The installation of the system will allow 100% recovery of condensate formed during the jet dyeing process. The technology can be suitably modified for mechanical or sensor based control.

Benefits of the condensate recovery system are:

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

2.4.4 Cost Economics Analysis

The section below provides cost benefit analysis for the installation of condensate recovery system in the zero-zero machine.

Table 2.4: *Cost Economic Analysis of proposed condensate recovery system in zero-zero machine*

SN	Particular	Unit	Value
1	No. of zero-zero machine	No	1
2	Steam consumption for zero- zero machine	kg/hr	200
3	Operating hours per day	hrs.	12
4	Condensate recovery potential	kg/day	2400
5	Operating days	days	330
6	Sensible heat @ 4kg/cm^2	kcal/kg	144
7	Sensible heat @ 0.5 kg/cm^2	kcal/kg	111
8	Latent heat @ 0.5 kg/cm^2	kcal/kg	532
9	Flash steam quantity saved	kg/day	149
10	Savings with flash stem (A)	Rs	44662
11	Balance condensate stem	kg/day	2251
12	Temperature of condensate	°C	95
13	Inlet temperature	°C	35
14	Gain in enthalpy	kcal/d	135068
15	GCV of fuel	kCal/kg	8200
16	Cost of fuel	Rs/kg	7.5
17	Savings with condensate stem	Rs	67946
18	Total quantity of RO water generated per day	Ltr/day	2400
19	Cost of RO water per liter	Rs	0.30
20	Savings from Ro water per year (B)	Rs	237600
21	Total Saving (A +B)	Rs	350207
22	Cost of condensate recovery system	Rs	500000
23	Simple pay back	months	17.13
24	Fuel saving	kg/hr	70
25	Energy saving	%	13.33

*Cost of fuel taken as Rs 7.5/kg

The proposed system can lead to a annual saving of Rs 3,50,207. Thus the estimated investment of Rs 5,00,000 can be recouped in 17 months period.

2.5 BOILER FEED WATER TREATMENT

2.5.1 Present Process

Vijay Anand Textiles 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 Vijay Anand, 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.

2.5.2 Observations

The TDS level of the feed water used for the steam boiler at Vijay Anand Textiles 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 Vijay Anand, 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.

2.5.3 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

2.5.4 Cost Economics Analysis

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

Table 2.5: *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	430
3	Quantity of fuel used to generate 1 kg of steam	kg/kg	0.143
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	68800
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	22919
16	Annual saving in fuel	kg	45881
17	Percentage saving in fuel consumption	%	3.0
18	Annual cost saving in fuel	Rs	344107.5
19	Annual cost saving in terms of make-up water and boiler maintenance	Rs	12000
20	Annual cost savings	Rs	356108
21	Equipment cost	Rs	200000
22	Pay back	months	7

*Cost of fuel taken as Rs 7.5/kg

The proposed RO system can lead to a saving of 45,881 kgs of coke annual leading to a monetary saving of Rs 3,56,108. Thus the investment (estimated as Rs 2,00,000) can be recouped in a period of 7 months.

2.6 TEMPERATURE MONITORING AND CONTROL IN JIGGER MACHINES

2.6.1 Present Process

Vijay Anand Textiles has installed a total of 24 Jigger machines, 18 small jiggers running with 3 HP motor each and 6 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.

2.6.2 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 Vijay Anand, 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.

2.6.3 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.

2.6.4 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 2.6: *Cost Economic Analysis of jigger water temperature monitoring and control system*

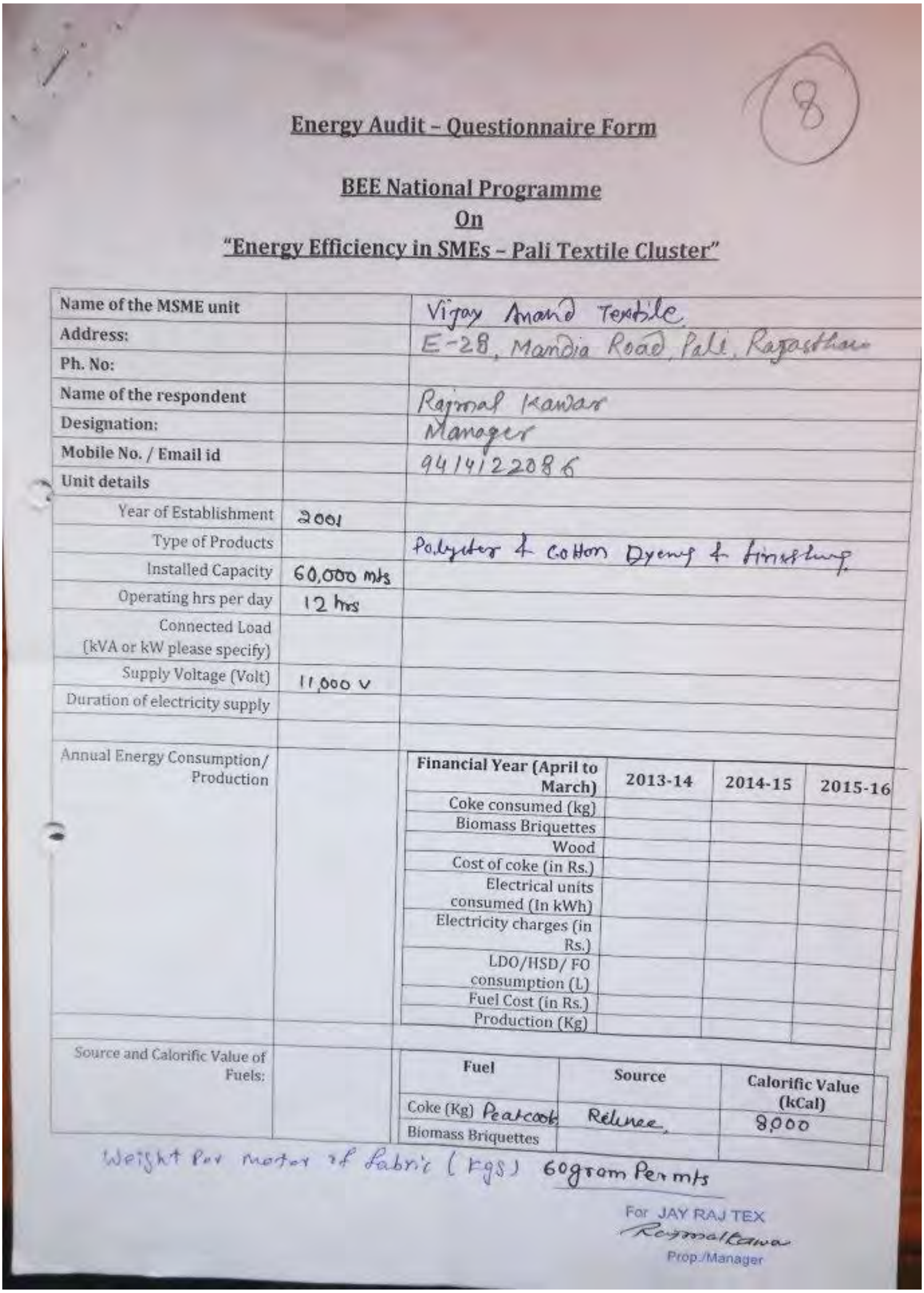
SN	Particulars	Units	Value
1	Temperature observed in Jigger	°C	95
2	Temperature to be maintained	°C	80
3	Machine Capacity	kg	200
4	Steam pressure	kg/cm^2	4
5	Steam Enthalpy @ 4 Kg /cm^2 pressure	kCal/kg	657
6	Liquor Ratio		0
7	Water Capacity	Kg	400
8	Specific heat coefficient (Cp)-water	kCal/kg °C	1
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
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

The proposed system will lead to a saving of 65,634 kgs of coal annually leading to a savings of Rs 4,92,252 annually. The estimated investment of Rs 2,50,000 for 10 nos. of jigger machines can be recouped in a period of 6 months.

Annexure 1

Questionnaire



8

Energy Audit – Questionnaire Form

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

Name of the MSME unit		Vijay Anand Textile
Address:		E-28, Mandia Road, Pali, Rajasthan
Ph. No:		
Name of the respondent		Rajmal Kawar
Designation:		Manager
Mobile No. / Email id		9414122086
Unit details		
Year of Establishment	2001	
Type of Products		Polyster & cotton Dyeing & finishing
Installed Capacity	60,000 mts	
Operating hrs per day	12 hrs	
Connected Load (kVA or kW please specify)		
Supply Voltage (Volt)	11,000 V	
Duration of electricity supply		
Annual Energy Consumption/ Production		

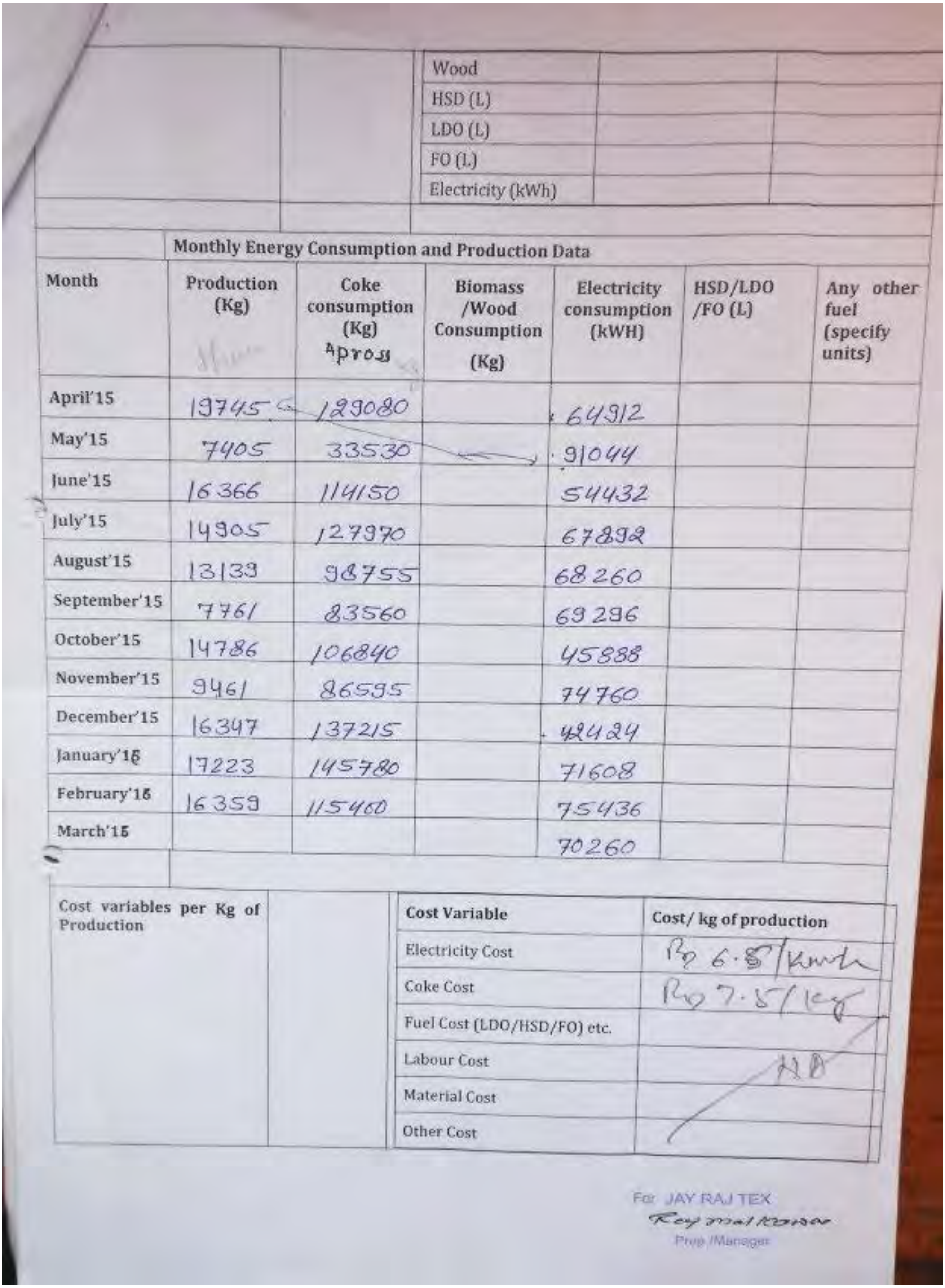
Financial Year (April to March)	2013-14	2014-15	2015-16
Coke consumed (kg)			
Biomass Briquettes			
Wood			
Cost of coke (in Rs.)			
Electrical units consumed (In kWh)			
Electricity charges (in Rs.)			
LDO/HSD/ FO consumption (L)			
Fuel Cost (in Rs.)			
Production (Kg)			

Source and Calorific Value of Fuels:

Fuel	Source	Calorific Value (kCal)
Coke (Kg) Peatcoke	Relince.	8,000
Biomass Briquettes		

Weight Per meter of fabric (kgs) 60gram Per mts

For JAY RAJ TEX
Rajmal Kawar
Prop./Manager



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

Monthly Energy Consumption and Production Data

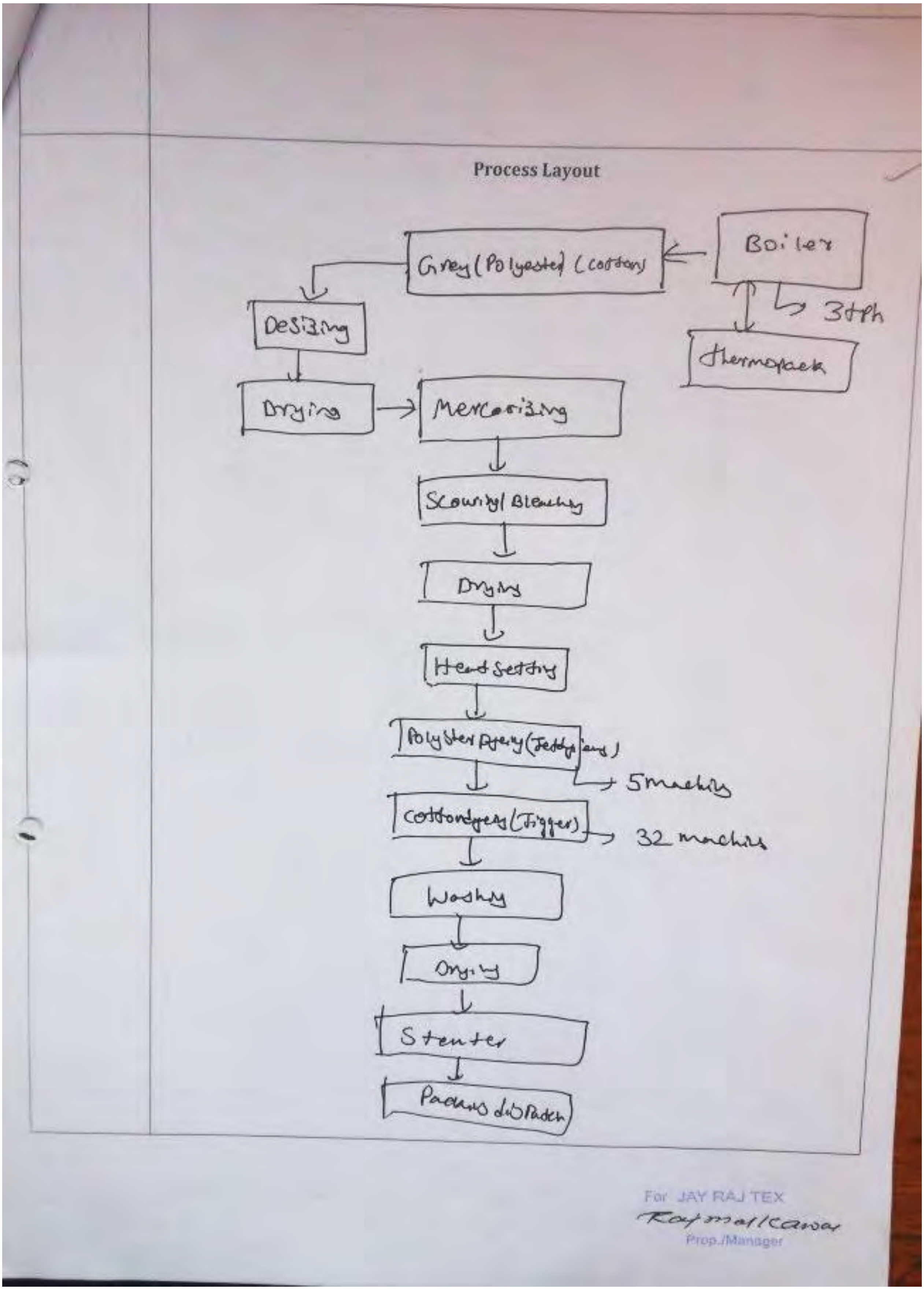
Month	Production (Kg)	Coke consumption (Kg) Aprox	Biomass /Wood Consumption (Kg)	Electricity consumption (kWH)	HSD/LDO /FO (L)	Any other fuel (specify units)
April'15	19745	129080		64912		
May'15	7405	33530		91044		
June'15	16366	114150		54432		
July'15	14905	127970		67892		
August'15	13139	98755		68260		
September'15	7761	83560		69296		
October'15	14786	106840		45888		
November'15	9461	86595		74760		
December'15	16347	137215		42424		
January'16	17223	145780		71608		
February'16	16359	115460		75436		
March'16				70260		

Cost variables per Kg of Production

Cost Variable	Cost/ kg of production
Electricity Cost	Rs 6.8/Kwh
Coke Cost	Rs 7.5/kg
Fuel Cost (LDO/HSD/FO) etc.	
Labour Cost	
Material Cost	
Other Cost	

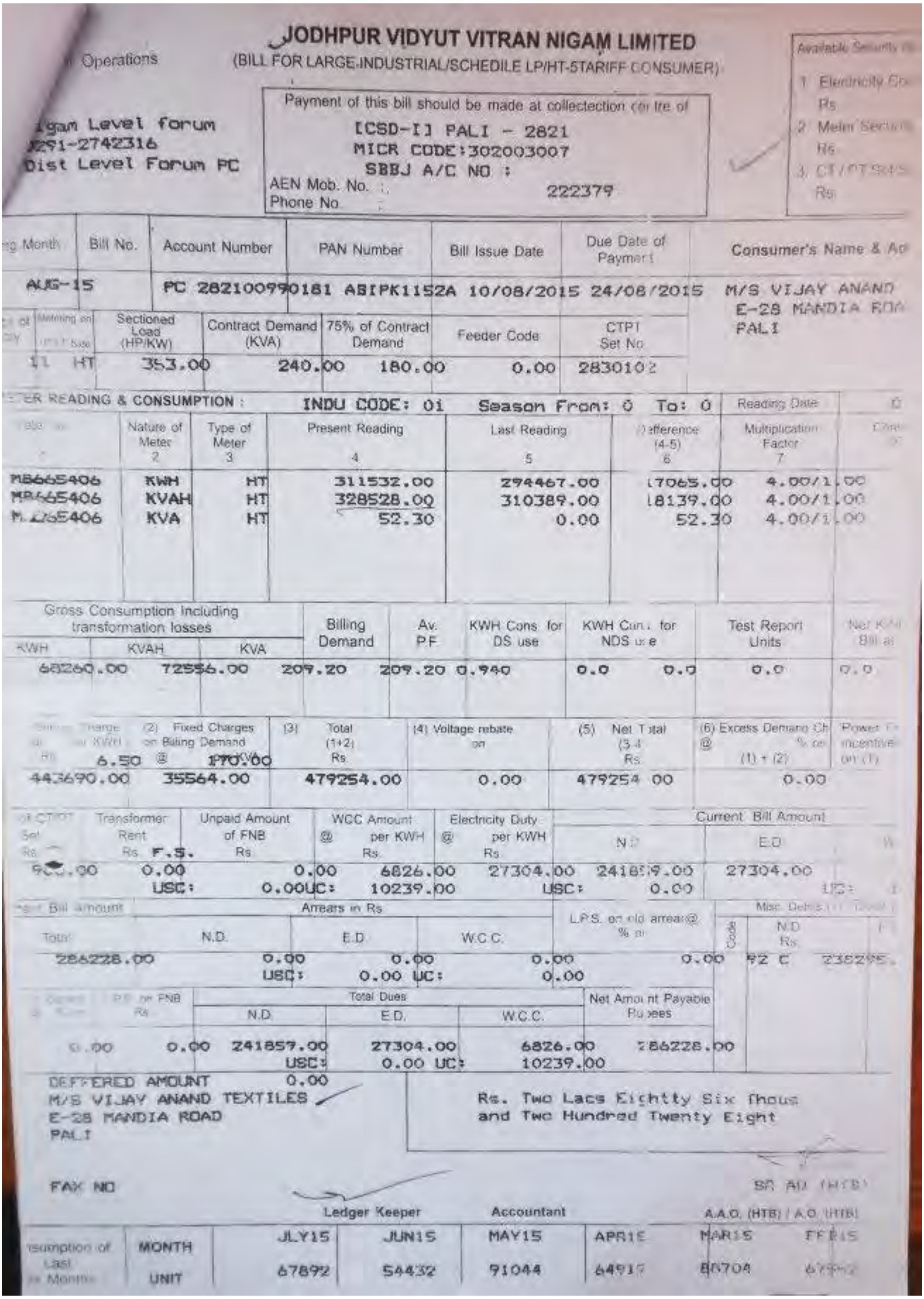
For JAY RAJ TEX

Prop./Manager



Process Layout

For JAY RAJ TEX
Rajmalkawar
Prop./Manager



JODHPUR VIDYUT VITRAN NIGAM LIMITED

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

Operations

igam Level forum
291-2742316
Dist Level Forum PC

Payment of this bill should be made at collectection centre of
[CSD-I] PALI - 2821
MICR CODE:302003007
SBBJ A/C NO :
AEN Mob. No.
Phone No. 222379

Available Security
1 Electricity
Rs
2 Meter Securi
Rs
3. CT/PT Se
Rs

g Month	Bill No.	Account Number	PAN Number	Bill Issue Date	Due Date of Payment	Consumer's Name & Ad
AUG-15		PC 282100990181	ABIPK1152A	10/08/2015	24/08/2015	M/S VIJAY ANAND E-28 MANDIA ROA PALI

of	Metering on Side	Sectioned Load (HP/KW)	Contract Demand (KVA)	75% of Contract Demand	Feeder Code	CTPT Set No
11	HT	353.00	240.00	180.00	0.00	2830102

ER READING & CONSUMPTION : INDU CODE: 01 Season From: 0 To: 0 Reading Date

Meter No.	Nature of Meter 2	Type of Meter 3	Present Reading 4	Last Reading 5	Difference (4-5) 6	Multiplication Factor 7	Cons
MB665406	KWH	HT	311532.00	294467.00	17065.00	4.00/1.00	
MB665406	KVAH	HT	328528.00	310389.00	18139.00	4.00/1.00	
M.265406	KVA	HT	52.30	0.00	52.30	4.00/1.00	

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 Bill as
68260.00	72556.00	209.20	209.20	0.940	0.0	0.0	0.0	0.0

Charge @ per KWH Rs 6.50	(2) Fixed Charges on Billing Demand @ per KVA 170.00	(3) Total (1+2) Rs	(4) Voltage rebate on	(5) Net Total (3-4) Rs	(6) Excess Demand Ch @ % on (1) + (2)	Power F incentive on (1)
443690.00	35564.00	479254.00	0.00	479254.00	0.00	

of CT/PT Set Rs	Transformer Rent Rs F.S.	Unpaid Amount of FNB Rs	WCC Amount @ per KWH Rs	Electricity Duty @ per KWH Rs	Current Bill Amount N.D	E.D	W
[illegible].00	0.00	0.00	6826.00	27304.00	2418[illegible]9.00	27304.00	
	USC:	0.00UC:	10239.00	USC:	0.00		UC:

ent Bill Amount Total	Arrears in Rs N.D.	E.D	W.C.C.	L.P.S. on old arrear @ % on	Code	Misc. Debits N.D Rs	
286228.00	0.00	0.00	0.00	0.00	92 C	235295.	
	USC:	0.00 UC:	0.00				

	P.F. on FNB Rs	Total Dues N.D.	E.D.	W.C.C.	Net Amount Payable Rupees
0.00	0.00	241857.00	27304.00	6826.00	286228.00
		USC:	0.00 UC:	10239.00	

DEFFERED AMOUNT 0.00
M/S VIJAY ANAND TEXTILES
E-28 MANDIA ROAD
PALI

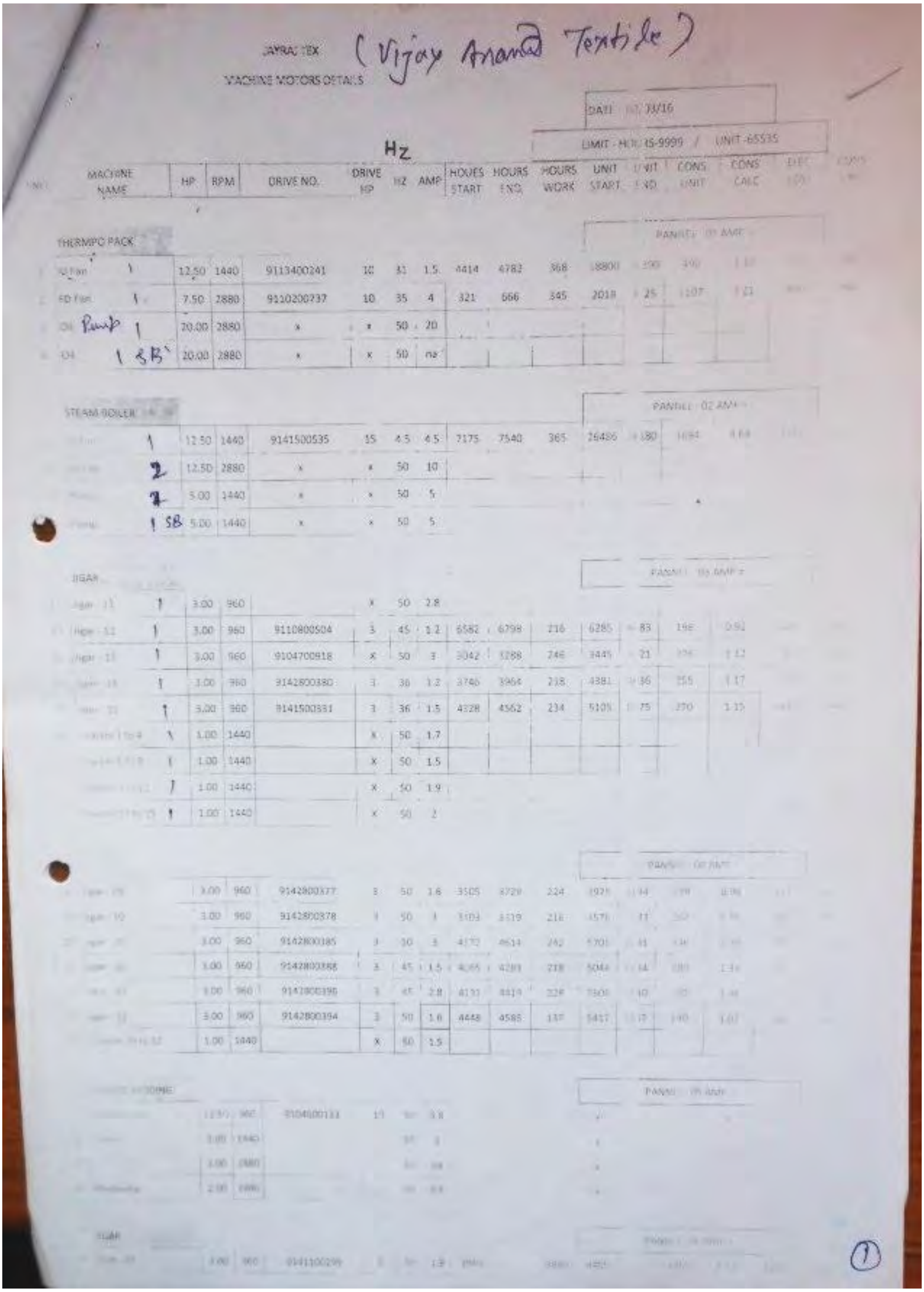
Rs. Two Lacs Eichtty Six Thous
and Two Hundred Twenty Eight

FAX NO

SR AO (HTB)

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

sumption of Last x Months	MONTH	JLY15	JUN15	MAY15	APR15	MAR15	FEB15
	UNIT	67892	54432	91044	6491[illegible]	88704	[illegible]



JAYRAJ TEX (Vijay Anand Textile)

MACHINE MOTORS DETAILS

DATE [illegible]/16

LIMIT - HOURS-9999 / UNIT-65535

Hz

THERMPO PACK — PANNEL 01 AMP

SNO	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOUES START	HOURS END	HOURS WORK	UNIT START	UNIT END	CONS UNIT	CONS CALC
1	ID Fan 1	12.50	1440	9113400241	10	31	1.5	4414	4782	368	18800	[illegible]	[illegible]	[illegible]
2	FD Fan 1	7.50	2880	9110200737	10	35	4	321	666	345	2018	25	[illegible]	[illegible]
3	Oil Pump 1	20.00	2880	x	x	50	20							
4	Oil 1 SB	20.00	2880	x	x	50	na							

STEAM BOILER — PANNEL 02 AMP

SNO	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOUES START	HOURS END	HOURS WORK	UNIT START	UNIT END	CONS UNIT	CONS CALC
[illegible]	[illegible] 1	12.50	1440	9141500535	15	45	4.5	7175	7540	365	26486	180	[illegible]	[illegible]
[illegible]	[illegible] 2	12.50	2880	x	x	50	10							
[illegible]	[illegible] 2	5.00	1440	x	x	50	5							
[illegible]	Pump 1 SB	5.00	1440	x	x	50	5							

JIGAR — PANNEL 03 AMP

SNO	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOUES START	HOURS END	HOURS WORK	UNIT START	UNIT END	CONS UNIT	CONS CALC
1	Jigar - 11 1	3.00	960		x	50	2.8							
[illegible]	Jigar - 12 1	3.00	960	9110800504	3	45	1.2	6582	6798	216	6285	83	198	0.92
[illegible]	Jigar - 13 1	3.00	960	9104700918	x	50	3	3042	3288	246	3445	21	[illegible]	1.12
[illegible]	Jigar - 14 1	3.00	960	9142800380	3	38	1.2	3746	3964	218	4381	36	255	1.17
[illegible]	Jigar - 15 1	3.00	960	9141500331	3	36	1.5	4328	4562	234	5105	75	270	1.15
[illegible]	[illegible] 1 to 4 1	1.00	1440		x	50	1.7							
[illegible]	[illegible] 1	1.00	1440		x	50	1.5							
[illegible]	[illegible] 1	1.00	1440		x	50	1.9							
[illegible]	[illegible] 1	1.00	1440		x	50	2							

PANNEL [illegible] AMP

SNO	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOUES START	HOURS END	HOURS WORK	UNIT START	UNIT END	CONS UNIT	CONS CALC
[illegible]	[illegible]	3.00	960	9142800377	3	50	1.6	3505	[illegible]	224	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3.00	960	9142800378	3	50	3	[illegible]	[illegible]	216	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3.00	960	9142800385	3	50	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3.00	960	9142800388	3	45	1.5	[illegible]	[illegible]	218	5044	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3.00	960	9142800390	3	45	2.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3.00	960	9142800394	3	50	1.6	4448	4585	137	5417	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1.00	1440		x	50	1.5							

[illegible] — PANNEL [illegible] AMP

SNO	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

JIGAR — [illegible]

SNO	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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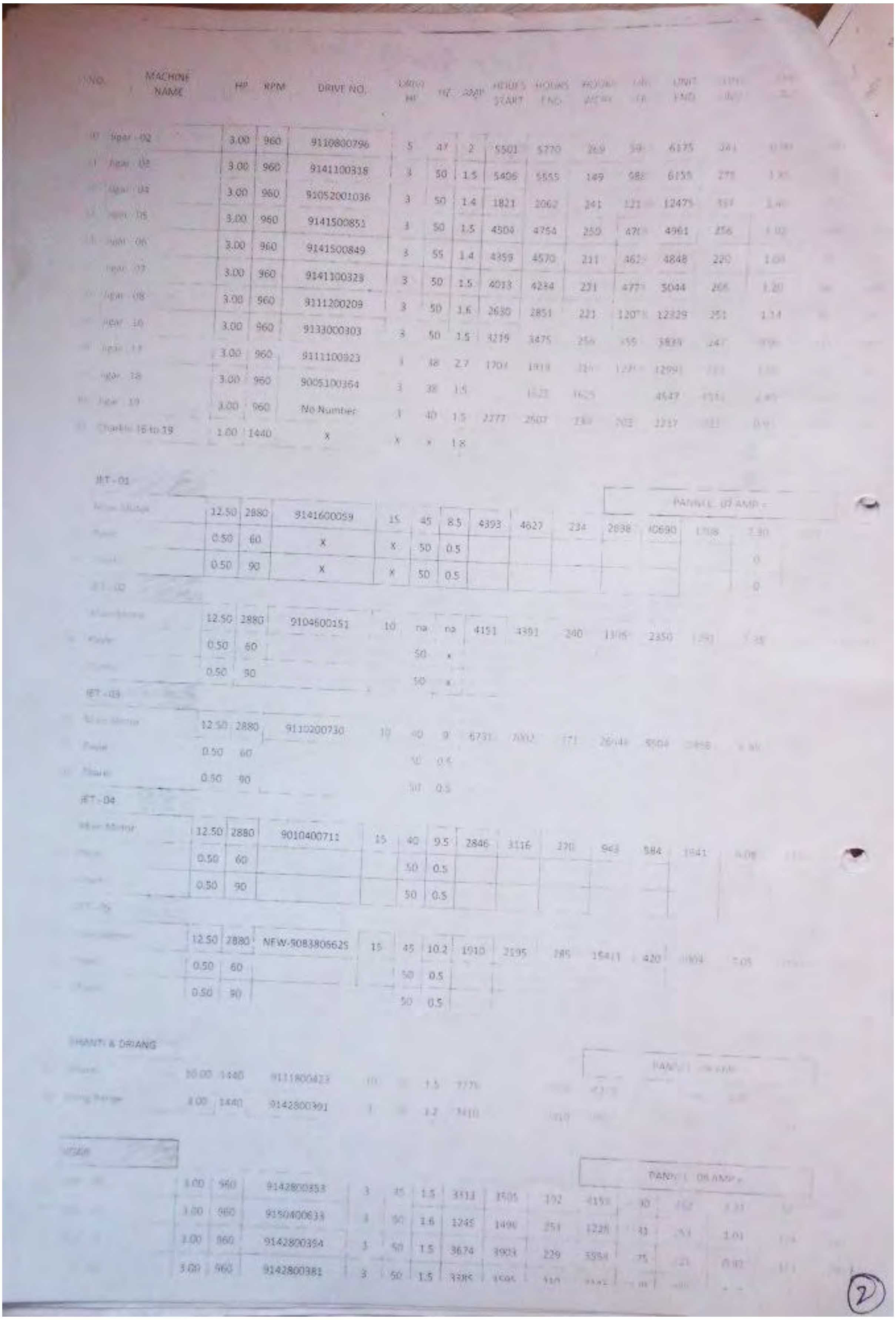

NO.	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOURS START	HOURS END	HOURS WORK	[illegible]	UNIT END	[illegible]	[illegible]
[illegible]	Jigar - 02	3.00	960	9110800796	5	47	2	5501	5770	269	[illegible]	6175	241	[illegible]
[illegible]	Jigar - 03	3.00	960	9141100318	3	50	1.5	5406	5555	149	[illegible]	6155	[illegible]	[illegible]
[illegible]	Jigar - 04	3.00	960	91052001036	3	50	1.4	1821	2062	241	[illegible]	12475	[illegible]	[illegible]
[illegible]	Jigar - 05	3.00	960	9141500851	3	50	1.5	4504	4754	250	[illegible]	4961	256	[illegible]
[illegible]	Jigar - 06	3.00	960	9141500849	3	55	1.4	4359	4570	211	[illegible]	4848	220	[illegible]
[illegible]	Jigar - 07	3.00	960	9141100323	3	50	1.5	4013	4234	221	[illegible]	5044	266	1.20
[illegible]	Jigar - 08	3.00	960	9111200209	3	50	1.6	2630	2851	221	[illegible]	12329	251	1.14
[illegible]	Jigar - 10	3.00	960	9133000303	3	50	1.5	3219	3475	256	[illegible]	3839	247	[illegible]
[illegible]	Jigar - 17	3.00	960	9111100923	3	48	2.7	1704	1919	[illegible]	[illegible]	12991	[illegible]	[illegible]
[illegible]	Jigar - 18	3.00	960	9005100364	3	38	1.5		[illegible]	[illegible]		4547	[illegible]	[illegible]
[illegible]	Jigar - 19	3.00	960	No Number	3	40	1.5	2277	2507	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Charkhi 16 to 19	1.00	1440	x	x	x	1.8							

JET - 01

PANNEL 07 AMP =

MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOURS START	HOURS END	HOURS WORK	[illegible]	UNIT END	[illegible]	[illegible]
Main Motor	12.50	2880	9141600059	15	45	8.5	4393	4627	234	2838	10690	[illegible]	[illegible]
Pump	0.50	60	x	x	50	0.5							0
[illegible]	0.50	90	x	x	50	0.5							0

JET - 02

MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOURS START	HOURS END	HOURS WORK	[illegible]	UNIT END	[illegible]	[illegible]
Main Motor	12.50	2880	9104600151	10	na	na	4151	4391	240	[illegible]	2350	[illegible]	[illegible]
Pump	0.50	60			50	x							
[illegible]	0.50	90			50	x							

JET - 03

MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOURS START	HOURS END	HOURS WORK	[illegible]	UNIT END	[illegible]	[illegible]
Main Motor	12.50	2880	9110200730	10	40	9	6731	7002	271	[illegible]	[illegible]	[illegible]	[illegible]
Pump	0.50	60			50	0.5							
[illegible]	0.50	90			50	0.5							

JET - 04

MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOURS START	HOURS END	HOURS WORK	[illegible]	UNIT END	[illegible]	[illegible]
Main Motor	12.50	2880	9010400711	15	40	9.5	2846	3116	270	[illegible]	584	[illegible]	[illegible]
[illegible]	0.50	60			50	0.5							
[illegible]	0.50	90			50	0.5							

JET - 05

MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOURS START	HOURS END	HOURS WORK	[illegible]	UNIT END	[illegible]	[illegible]
[illegible]	12.50	2880	NEW-9083806625	15	45	10.2	1910	2195	285	15411	420	[illegible]	[illegible]
[illegible]	0.50	60			50	0.5							
[illegible]	0.50	90			50	0.5							

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PANNEL [illegible]

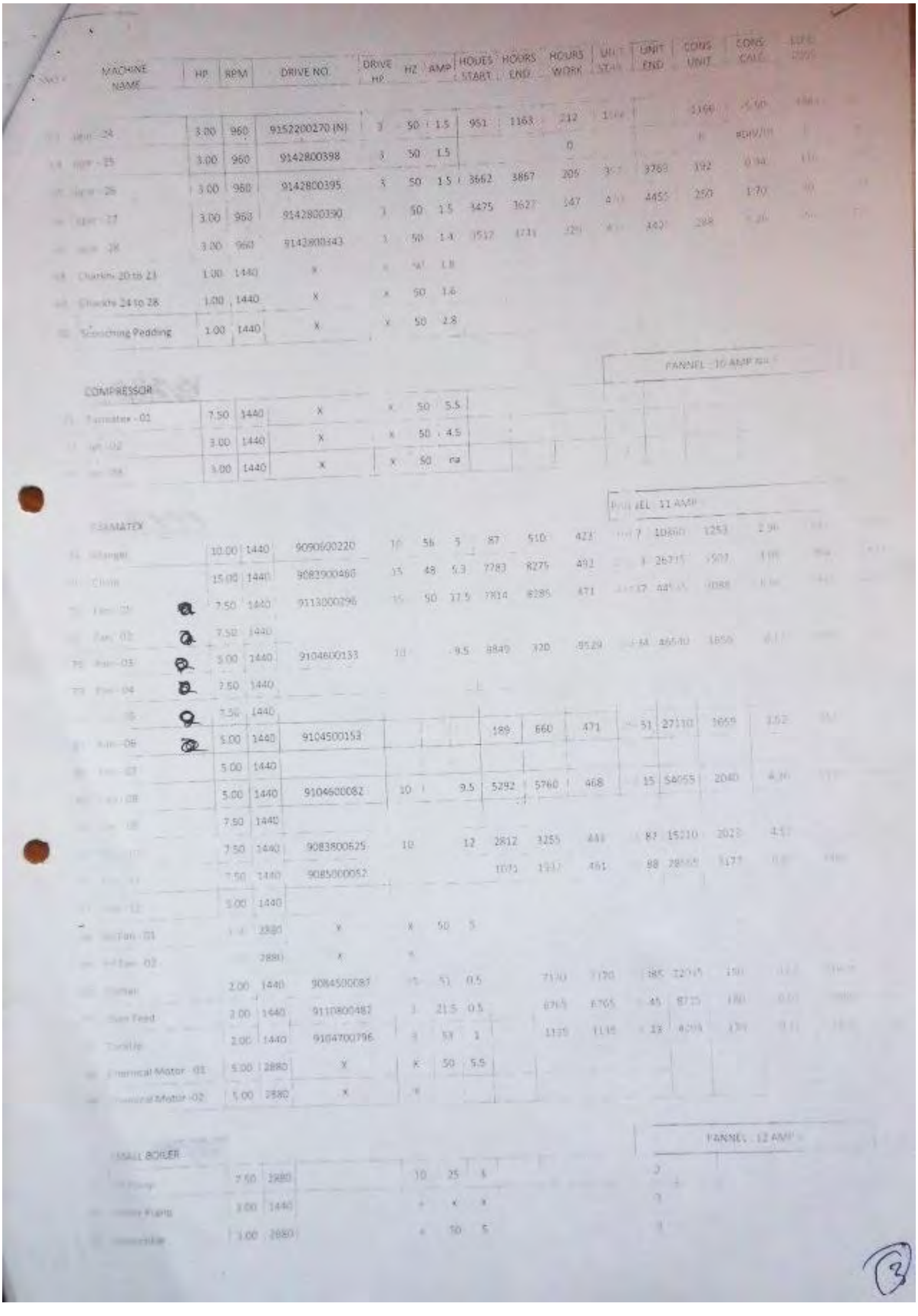
MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOURS START	[illegible]
[illegible]	10.00	1440	9111800423	10	[illegible]	1.5	[illegible]	[illegible]
[illegible] Range	3.00	1440	9142800391	3	[illegible]	1.2	[illegible]	[illegible]

[illegible]

PANNEL 08 AMP =

MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOURS START	HOURS END	HOURS WORK	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	3.00	960	9142800353	3	35	1.5	3313	3505	192	[illegible]	30	[illegible]	[illegible]
[illegible]	3.00	960	9150400633	3	50	1.6	1245	1496	251	[illegible]	31	[illegible]	1.01
[illegible]	3.00	960	9142800354	3	50	1.5	3674	3903	229	[illegible]	75	[illegible]	[illegible]
[illegible]	3.00	960	9142800381	3	50	1.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

②



No.	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOUES START	HOORS END	HOURS WORK	UNIT START	UNIT END	CONS UNIT	CONS CALC	[illegible]
[illegible]	[illegible] - 24	3.00	960	9152200270 (N)	3	50	1.5	951	1163	212	[illegible]		1199	[illegible]	[illegible]
[illegible]	[illegible] - 25	3.00	960	9142800398	3	50	1.5			0			0	#DIV/0!	[illegible]
[illegible]	[illegible] - 26	3.00	960	9142800395	3	50	1.5	3662	3867	205	[illegible]	3769	392	[illegible]	[illegible]
[illegible]	[illegible] - 27	3.00	960	9142800390	3	50	1.5	3475	3627	147	[illegible]	4455	250	1.70	[illegible]
[illegible]	[illegible] - 28	3.00	960	9142800343	3	50	1.4	3517	[illegible]	229	[illegible]	[illegible]	288	[illegible]	[illegible]
[illegible]	Charkhi 20 to 23	1.00	1440	X	x	50	1.8								
[illegible]	Charkhi 24 to 28	1.00	1440	X	x	50	1.6								
[illegible]	Scotching Pedding	1.00	1440	X	x	50	2.8								

FANNEL - 10 AMP [illegible]

COMPRESSOR

No.	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP
[illegible]	Turnatex - 01	7.50	1440	X	x	50	5.5
[illegible]	[illegible] - 02	3.00	1440	X	x	50	4.5
[illegible]	[illegible] - 03	3.00	1440	X	x	50	na

PANNEL 11 AMP

[illegible]MATEX

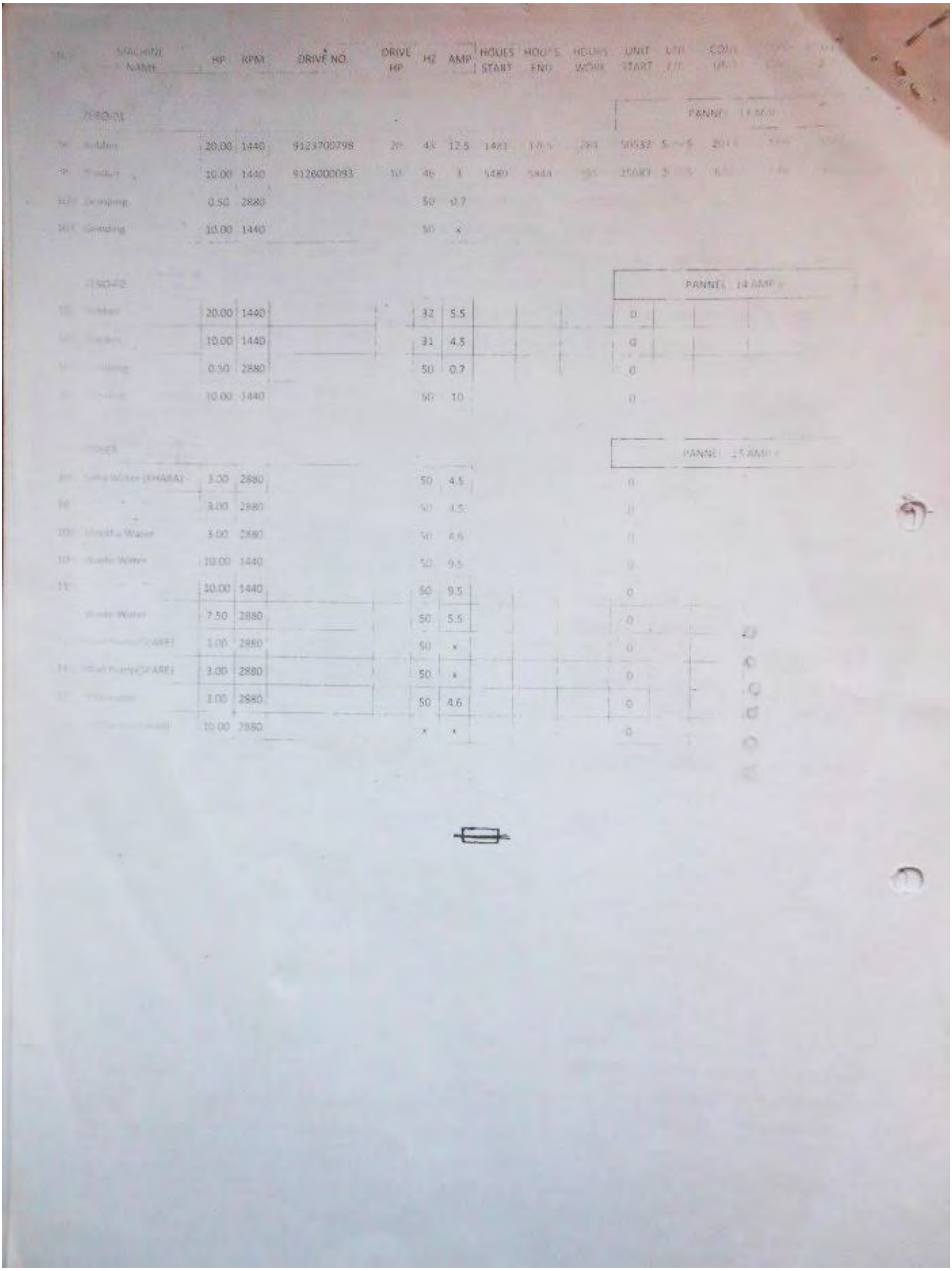
No.	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOUES START	HOORS END	HOURS WORK	UNIT START	UNIT END	CONS UNIT	CONS CALC	[illegible]
[illegible]	[illegible]	10.00	1440	9090600220	10	56	5	87	510	423	[illegible]	10860	1253	2.96	[illegible]
[illegible]	Chain	15.00	1440	9083900460	15	48	5.3	7783	8275	492	[illegible]	26715	[illegible]	[illegible]	[illegible]
[illegible]	Fan - 01	7.50	1440	9113000296	15	50	17.5	7814	8285	471	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Fan - 02	7.50	1440												
75	Fan - 03	5.00	1440	9104600133	10		9.5	8849	320	9529	[illegible]	46540	1650	[illegible]	[illegible]
73	Fan - 04	7.50	1440												
[illegible]	[illegible] - 05	7.50	1440												
[illegible]	Fan - 06	5.00	1440	9104500153				189	660	471	51	27110	[illegible]	3.52	[illegible]
[illegible]	Fan - 07	5.00	1440												
[illegible]	Fan - 08	5.00	1440	9104600082	10		9.5	5292	5760	468	15	56055	2040	[illegible]	[illegible]
[illegible]	Fan - 09	7.50	1440												
[illegible]	[illegible] - 10	7.50	1440	9083800625	10		12	2812	3255	[illegible]	87	15210	[illegible]	[illegible]	
[illegible]	Fan - 11	7.50	1440	9085000052				[illegible]	[illegible]	461	88	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Fan - 12	5.00	1440												
[illegible]	[illegible] Fan - 01	[illegible]	2880	X	X	50	5								
[illegible]	[illegible] Fan - 02		2880	X	X										
[illegible]	[illegible]	2.00	1440	9084500087	[illegible]	51	0.5		[illegible]	[illegible]	[illegible]	[illegible]	150	[illegible]	[illegible]
[illegible]	[illegible] Feed	2.00	1440	9110800482	3	21.5	0.5		[illegible]	[illegible]	45	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	2.00	1440	9104700796	3	53	1		1135	1135	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Chemical Motor - 01	5.00	2880	X	K	50	5.5								
[illegible]	[illegible] Motor - 02	5.00	2880	X	X										

FANNEL - 12 AMP

SMALL BOILER

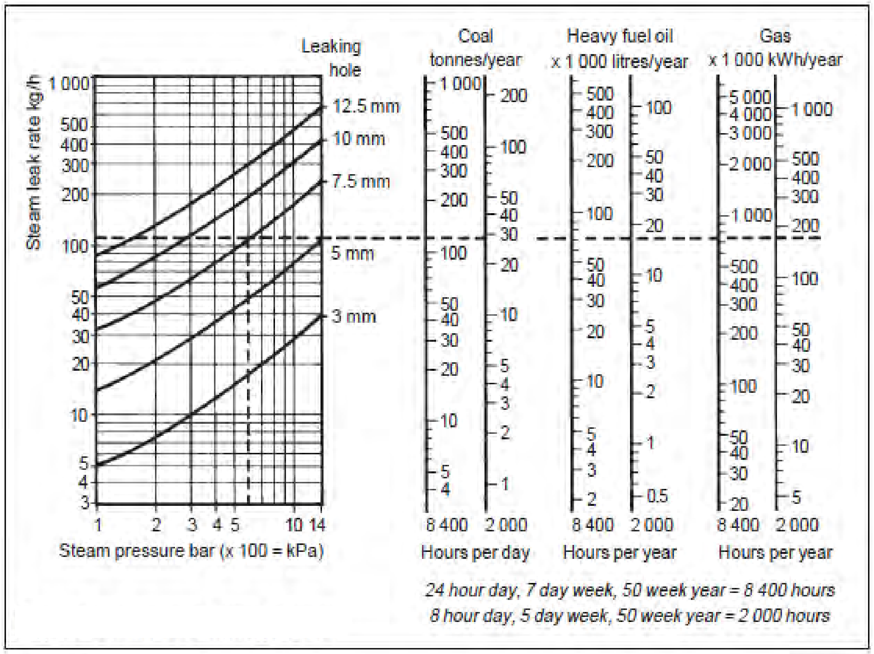
No.	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP		
[illegible]	[illegible] Pump	7.50	2880		10	25	5		3
[illegible]	[illegible] Pump	3.00	1440		x	x	x		3
[illegible]	[illegible]	3.00	2880		x	50	5		3

3



SN	MACHINE NAME	HP	RPM	DRIVE NO.	DRIVE HP	HZ	AMP	HOUES START	HOU'S END	HOURS WORK	UNIT START	[illegible]	CONS UNIT
	ZERO-01										PANNEL 14 AMP		
[illegible]	[illegible]	20.00	1440	9123700798	20	43	12.5	1481	1765	284	50532	[illegible]	[illegible]
[illegible]	[illegible]	10.00	1440	9126000093	10	46	1	5480	5844	[illegible]	15083	[illegible]	[illegible]
[illegible]	[illegible]	0.50	2880			50	0.7						
[illegible]	Grinding	10.00	1440			50	x						
	ZERO-02										PANNEL 14 AMP		
[illegible]	[illegible]	20.00	1440			32	5.5				0		
[illegible]	[illegible]	10.00	1440			31	4.5				0		
[illegible]	[illegible]	0.50	2880			50	0.7				0		
[illegible]	[illegible]	10.00	1440			50	10				0		
	OTHER										PANNEL 13 AMP		
[illegible]	[illegible] Water (KHARA)	3.00	2880			50	4.5				0		
[illegible]		3.00	2880			50	4.5				0		
[illegible]	[illegible] Water	3.00	2880			50	4.6				0		
[illegible]	[illegible] Water	10.00	1440			50	9.5				0		
[illegible]		10.00	1440			50	9.5				0		
	[illegible] Water	7.50	2880			50	5.5				0		
[illegible]	[illegible] Pump(SPARE)	3.00	2880			50	x				0		
[illegible]	[illegible] Pump(SPARE)	3.00	2880			50	x				0		
[illegible]	[illegible]	3.00	2880			50	4.6				0		
	[illegible]	10.00	2880			x	x				0		

Steam Loss Chart



24 hour day, 7 day week, 50 week year = 8 400 hours
8 hour day, 5 day week, 50 week year = 2 000 hours