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

Ludhiana Forging Cluster

Baseline Energy Audit Report
Dhand Industrial Corporation

Submitted to

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About The Project

The project BEE's National Program on "Energy Efficiency and Technology Up gradation in SMEs - Ludhiana Forging Cluster" supported by Bureau of Energy Efficiency (BEE), Ministry of MSME and Ludhiana Auto Parts Manufacturers Association aims to bring down the energy demand of forging industries located at Ludhiana by supporting them to implement Energy Efficient Technologies in the SME units.

Executive Summary

1. Unit Details

Unit Name	:	**Dhand Industrial Corporation**
Address	:	425/5, Street No. 22, Janta Nagar, Ludhiana - 141003
Contact Person	:	Mr. Ravinder Dhand (Cell No: 9814027217)
Products	:	Various types of bolts
Production	:	1 ton /day
DIC Number	:	030091102989 (Part-II)
Bank Details	:	Bank of Baroda; Account No - 01040100010586
TAN/PAN No.	:	TAN: 03311152679, PAN: ABKPD2944B
Contract demand	:	38.81 kVA

2. Existing Major Energy Consuming Technology

LPG Based Re-heating furnace

- Conventional Technology with higher losses
- Prevailing LPG consumption 0.095 kg of LPG per kg of the production

Lathe Machine

- Manually operated lathe machines for machining job work including threading, turning, grinding, drilling etc.
- Electrical motor rating of 3 HP with production of around 90 pieces per hour per set of lathe machine.

3. Proposed Energy Saving Technologies with Cost Economics

Proposed Energy Measures

- Replacement of LPG based re-heating furnace with two 30 kW induction re-heating furnaces
- Replacement of manual lathe machines by one Special Purpose Machine (SPM) for turning operation

Table 1: *Cost Economic Analysis*

Proposed Technology	Estimated Energy Savings (%)	Savings (in Rs.)	Investment (in Rs.)	Simple Payback period (Years)
Induction re-heating furnace 30 kW (2 Numbers)	69	962,756	1,454,775	1.5
SPM - Turning Machine	79	117,664	550,000	4.7
Total		**1,080,420**	**2,004,775**	

Introduction

1.1 ABOUT THE UNIT

M/s Dhand Industrial Corporation engaged in manufacturing of different types of bolts as per the customer requirement. The manufacturing unit is located at 425/5, Street No. 22, Janta Nagar, Ludhiana - 141003

The raw material procured by the unit for making various types of bolts etc.

The daily production lies in the range of 1000 kgs per day (or 25 tons per month with 25 working days). M/s Dhand Industrial Corporation is using primary energy, namely, LPG and Electricity supply from SEBs for various process and utility applications in premises. The average monthly LPG consumption in the unit is 383 kgs. It was observed that the average monthly electricity consumption is 2729 kWh.

According to the assessment of the energy consumption data collected, the specific thermal energy consumption and specific electrical energy consumption is 0.024 L/kg (245.7 kcal/kg) of product and 0.15 kWh/kg (129.67) of product respectively. The total specific energy consumption (in kCal) is 375.4 kCal/ kg of product. Details of annual electrical and thermal energy consumption and specific energy consumption details in Dhand Industrial Corporation are presented in table below:

Table 1.1: ***Details of Dhand Industrial Corporation***

SN	Parameter	Value	Unit
1	Name and address of unit	M/s Dhand Industrial Corporation, 425/5, Street No. 22, Janta Nagar, Ludhiana	
2	Contact person	Mr. Ravinder Dhand - 9814027217	
3	Manufacturing product	Various types of bolts	
4	Daily Production	1 ton/day	
	Energy utilization		
5	Average monthly electrical energy consumption	2729	kWh per month
6	Average monthly thermal (LPG) energy consumption	383	Liters per month
7	Average thermal specific energy consumption	0.015	Liter /kg of product
		175.6	kCal/kg of product
8	Electrical specific energy consumption	0.11	kWh/Kg of product
		90.56	kCal/kg of product
9	Specific energy consumption	266.2	kCal/kg of product
10	Electrical energy cost	0.47	Rs/Kg of product
11	Thermal energy cost	0.7	Rs/kg of product
12	Total energy cost	1.17	Rs/kg of product

Note:

^1: Specific gross calorific value of LPG is considered as 11,900 kcal / kg

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

The unit operates for 25 days a month (1 shift of 10 effective hours per day).

1.2 PRODUCTION PROCESS OF PLANT

The following figure shows the typical process employed at manufacturing of forged products at Dhand Industrial Corporation are presented below:

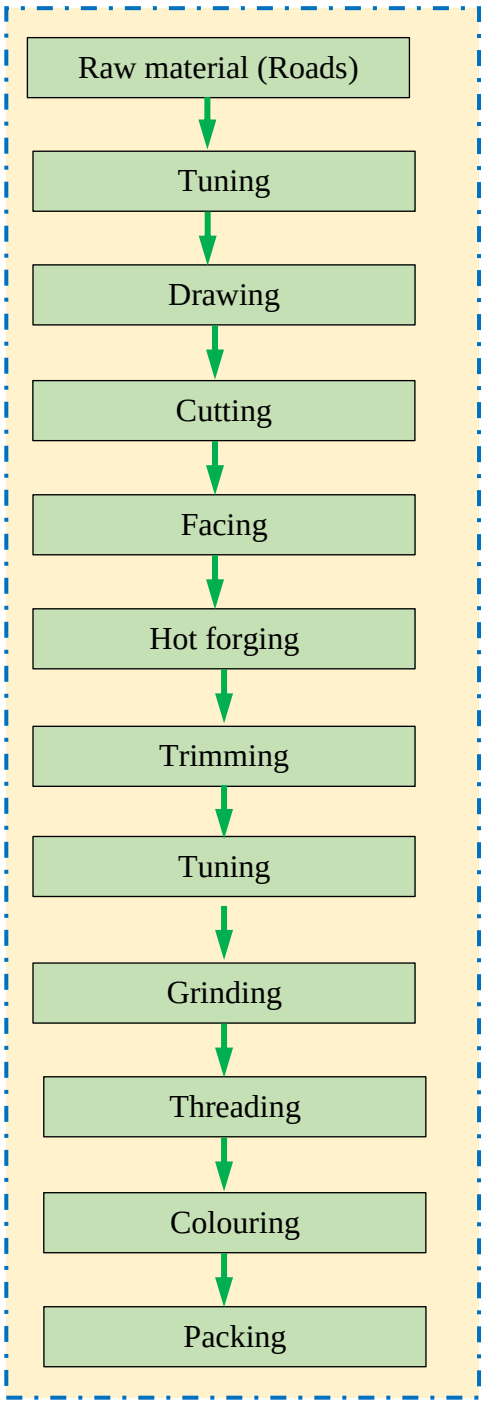


Figure 1.1: ***Production process of the unit***

1.3 ENERGY AUDIT METHODOLOGY

The primary objective of the energy audit was to quantify the existing fuel consumption pattern and to determine the operating efficiencies of existing systems. The key points targeted through energy audits were determination of specific fuel consumption, various losses, operation practices like hot metal temperature, production, fuel consumption, scale formation etc. Pre – planned methodology was followed to conduct the energy audits. Data collected at all above steps was used to calculate various other operating parameters like material feeding rate (Kg/hr), fuel firing rate, specific fuel consumption (kg/tonne), etc.

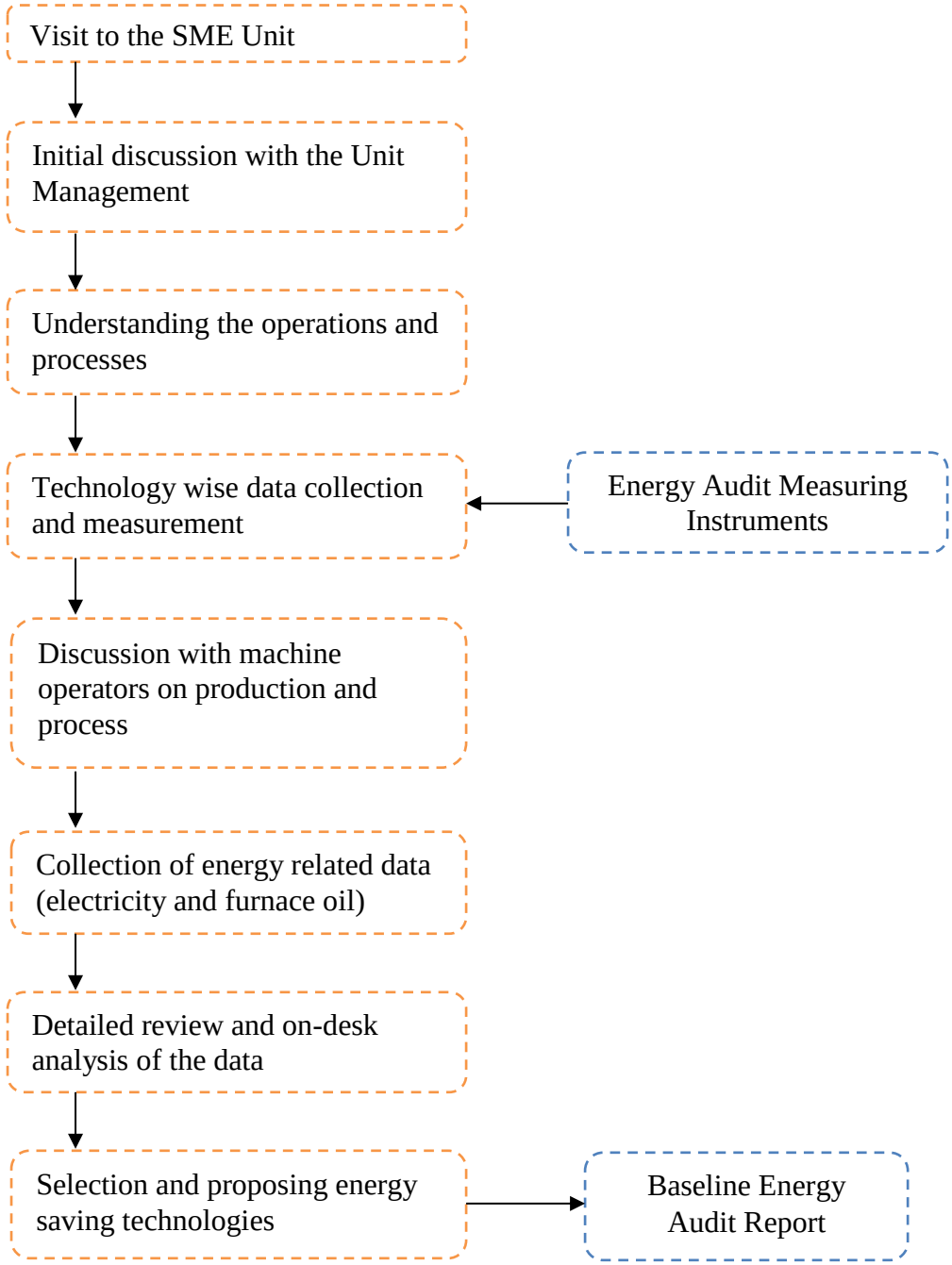


Figure 1.2: ***Energy audit process of the unit***

Present Process, Observations and Proposed Technology

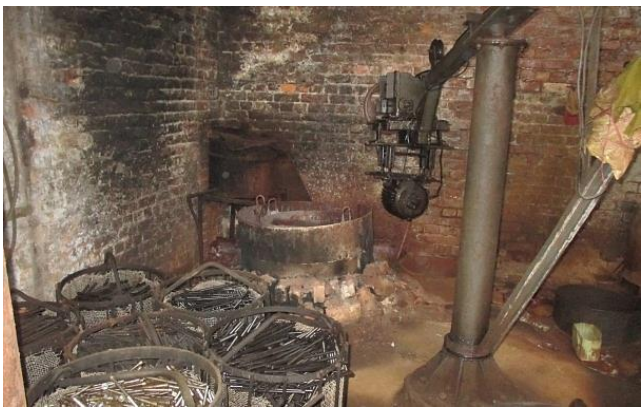
2.1 RE HEATING FURNACE (LPG FIRED)

2.1.1 Present Process

Dhand Industrial Corporation has installed three LPG fired heating furnace, to heat the metal pieces for forging process. The metal pieces to be forged are heated to a temperature of 1150 - 1200 ◦ C. After that, the heated metal piece is then kept on the forging die having the cavity of the product to be formed. The hot metal piece then forged on the forging press into the product.

2.1.2 Observations

The exiting furnace is old having conventional design with manual control option for fuel firing. Since, the efficiency of such furnace is lower, new technology induction furnaces maybe installed for re-heating process. Further, since the flame of the furnace directly hits the surface of the metal during the heating period varying from 20 – 30 minutes deteriorates the atomic/ grain structure of the piece and also leads to the higher scale formation due the oxidation of the metal at high temperature ultimately leading to material/ production loss. In order to attain the exact temperature profile of the material in less time, 3Ts has to be followed, Time, Turbulence and Temperature, if these three parameters can be followed in a right manner proper temperature can be archive in a minimum time, which would help in reducing the excessive heating of the material and reduction in scale loss.



The specific energy consumption of LPG was observed to be around 0.015 kg LPG per kg of the production which is higher in comparison to the latest technologies available for carrying out the same purpose. During operation, fuel supply was controlled manually without controlling the air flow rate. Further, there was no provision for measuring the temperature inside the furnace and to what time the material should be heated. The judgement regarding completeness of heating was taken by the operator based on the color of the heated material.

In addition, the existing reheating furnace usage LPG as a source of energy to heat the metal pieces. All these factors affect the environment and also the health of the worker handling the furnace and other machineries installed in the factory.

Conclusion:

As per the past studies conducted in forging industries, the replacement of the LPG fired re-heating furnace with an induction re-heating furnace saves up to 60% of the energy cost. The production rate of the furnace observed during study is observed to be low and varies with the product size (Ref Table 2.1). Therefore, it is proposed to replace both these existing re-heating technology (FO Based) with Energy Efficient Induction Reheating furnaces.

This replacement would provide following benefits:

- Environmental cleaner technology
- Reduces Specific Energy Consumption
- Faster operation and reduced scale formation
- User friendly technology
- Improved quality of the product output
- Higher output with fewer crop cuts or short bars

2.1.4 Cost Economics Analysis

The comparison of FO based re-heating technology and induction technology, specific energy consumption, cost savings, investment required and simple payback period of the investment on induction technology is given in Table 2.1. The detailed calculation to finalize the size of induction furnace is provided as ***Annexure 2***.

Table 2.1: *Cost Economic Analysis of proposed induction furnace*

Parameter	Unit	Value
LPG consumption on existing re-heating furnace	Kgs/hr	5.68
Production in terms of Kg	Kg/hour	60
Specific energy consumption on existing LPG based re-heating furnace	Kg/Kg	0.095
Cost of energy consumption using LPG	Rs./Kg	4.47
Power consumed by proposed induction furnace (rated capacity 30 kW operating at 24 kW)	kW	24
Production rate in terms of Kg/hr	Kg/hr	60
Specific energy consumption on induction reheating furnace	kWh/Kg	0.400
Cost of energy consumption using induction furnace	Rs./Kg	1.8
Reduction in cost of energy required	Rs./Kg	2.7
Daily operating hours	Hrs	10
Annual operating days	Days	300
Annual cost savings	Rs	481,378
Investment required for Induction furnace (30 kW)	Rs	727,388
Simple payback period	Years	1.5

As per the detailed calculations done, it is proposed to install an induction re-heating furnace of capacity 30 kW for carrying out heating of heavier metal pieces. Based on the discussion with concerned person in the unit, it came out that maximum weight of the individual piece is around 0.6 kgs. The cycle time required to re-heat the metal piece of 0.6 kgs would be around 20 secs.

The cost of energy saved per Kg of material forged is calculated as Rs.1.8. The investment required for implementing the induction technology is estimated to about Rs 7.27 Lakhs with annual saving of Rs 4.81 Lakhs. The simple payback period of the technology is 1.5 years.

2.2 SPECIAL PURPOSE MACHINES (SPM)

2.2.1 Present Process

M/s Dhand Industrial Corporation has installed manually operated conventional machines for various components machining job work like turning, undercut, threading, Nut threading etc. These machine runs on electrical motors having the capacity varying from 3 HP to 10 HP with production/ machining of 1000- 2000 pcs/day.

Table 2.2: ***List of conventional machine proposed for replacement / modification***

Machine	Numbers	Motor rating
Manual Lathe turning machine	1	3 hp

2.2.2 Observations

Since these machines are manually operated, the process through which components are manufactured is very slow and time consuming. Apart from the slow process, the components manufactured are not very precise and of high quality. Some times what happens that the machine keeps on running even there is no component on the machine or the operator is busy in some other work. All these factors lead to the loss of energy and production of low quality components.

2.2.3 Conclusion

In order to promote the energy efficiency and reduction in the overall energy cost in the factory, it is recommended to covert the existing manual machines into automatic special purpose machine (SPMs) by implementing PLC control mechanism or CNC machines. Since the modified machines will run on the pre-installed programming technique, the consumption of electricity will only happen when there is a function or operation required on the component. In the ideal condition the machine will remain in dead mode/ no operation mode.

Apart from the operation, the machine automatically loads the component for machining. The cycle time of the each component will be fixed in the business logic of the PLC / SPM machine therefore each component will take specific time for processing or machining. The SPM machines results in 30-50% percent of the energy savings depending upon the type of component, operation, material, cycle time etc.

Benefits of the Automatic SPM/ CNC machines:

- Reduced energy consumption
- Faster operation and reduced down time
- Improved product quality and symmetrical product dimensions
- Higher productivity
- Environment friendly technology

2.2.4 Cost Economics Analysis

The comparison of production on old manual/ conventional lathe machine and modified SPM machine, specific energy consumption, cost savings, investment required and simple payback period of the investment on SPM machines is given in Table 2.3.

Table 2.3: ***Energy saving calculation for Automatic SPM Lathe***

Parameter	Unit	Value
Power consumed by old manual lathe machine	kW	8.952
Production on manual lathe machine	Pcs/hr	90
Specific power consumption on manual machine	kWh/Pcs	0.09946667
Power consumed by SPM Lathe Machine (Turning/ undercut operation) (motor capacity 3 hp) @ 70% Loading	kW	2.984
Production on SPM machine (Projected)	Pcs/hr	140
Specific power consumption on SPM machine	kWh/Pcs	0.021
Reduction in specific power consumption	kWh/Pcs	0.078
Percentage savings	%	78.6
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	26,259
Annual cost savings	Rs.	117,664
Investment required	Rs.	550,000
Simple payback period	Years	5

As per the detailed calculations done, it is proposed to convert/ replace existing manual lathe machines to automatic Special Purpose Machines (SPMs). The specific power consumption on a manual machine is 0.021 kWh/ pcs whereas the specific power consumption in SPM machine would be around 0.078 kWh/pcs resulting in 78.6 % savings in electrical energy. The investment required for making an SPM machine would be around Rs 5.5 Lakhs with annual saving of Rs 1.17. The simple payback period of the technology is 5 years.

Annexure 1

Basic Details and Energy Utilization Pattern of M/s Dhand Industrial Corporation

SN	Parameter	Value	Unit
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Note:

^1: Specific gross calorific value of LPG is considered as 11,900 kcal / kg

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

The unit operates for 25 days a month.

Annexure 2

Energy Saving Calculation for Induction Furnace

Parameter	Unit	Value
LPG consumption on existing re-heating furnace	Kgs/hr	5.68
Production in terms of Kg	Kg/hour	60
Specific energy consumption on existing LPG based re-heating furnace	Kg/Kg	0.095
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Reduction in cost of energy required	Rs./Kg	2.7
Daily operating hours	Hrs	10
Annual operating days	Days	300
Annual cost savings	Rs	481,378
Investment required for Induction furnace (30 kW)	Rs	727,388
Simple payback period	Years	1.5

Note:

*** The cost of induction furnace is an indicative value gathered from quotations provided by furnace suppliers. It may vary according to the heating requirement and the material to be heated.*

Annexure 3

Energy saving calculation for Automatic SPM Lathe

Parameter	Unit	Value
Power consumed by old manual lathe machine	kW	8.952
Production on manual lathe machine	Pcs/hr	90
Specific power consumption on manual machine	kWh/Pcs	0.09946667
Power consumed by SPM Lathe Machine (Turning/ undercut operation) (motor capacity 3 hp) @ 70% Loading	kW	2.984
Production on SPM machine (Projected)	Pcs/hr	140
Specific power consumption on SPM machine	kWh/Pcs	0.021
Reduction in specific power consumption	kWh/Pcs	0.078
Percentage savings	%	78.6
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	26,259
Annual cost savings	Rs.	117,664
Investment required	Rs.	550,000
Simple payback period	Years	5