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

Ludhiana Forging Cluster

Baseline Energy Audit Report
Rekofa Small Tools (P) Ltd.

Submitted to

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InsPIRE Network for Environment

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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	:	**Rekofa Small Tools (P) Ltd.**
Address	:	D-227, Phase-VII, Focal Point, Ludhiana-10
Contact Person	:	Mr. Jaspal Singh (Cell No.: 9814021475)
Products	:	Various types of auto parts
Production	:	2-3 Ton per day
DIC Number	:	030091100729
Bank Details	:	HDFC Bank; Branch: GT Road, Ludhiana; Account No.: 02598020000431
TAN / PAN No.	:	PAN: AACR7850A
Contract demand	:	450 kVA

2. Existing Major Energy Consuming Technology

FO Based re-heating technology

- Conventional Technology with higher losses
- Prevailing energy consumption 0.02 liters of FO per kg of the production

3. Proposed Energy Saving Technologies with Cost Economics

Proposed Energy Measures

- Replacement of FO fired re-heating furnace with one 150 kW induction re-heating furnace

Table 1: *Cost Economic Analysis*

Technology	Estimated Energy Savings (%)	Savings	Investment	Simple Payback period (Years)
Induction re-heating furnace 150 kW	79	2,841,600	1,753,521	0.62
Total		**2,841,600**	**1,753,521**	

Introduction

1.1 ABOUT THE UNIT

M/s Rekofa Small Tools (P) Ltd. is engaged in manufacturing of different types of auto parts. The manufacturing unit is located at D-227, Phase-VII, Focal Point, Ludhiana-10

The raw material procured by the unit for different types auto parts.

The daily production lies in the range of 2000– 3000 kgs per day (or 75 tons per month with 25 working days). It was observed that the average monthly electricity consumption is 118534 kWh.

According to the assessment of the energy consumption data collected, the specific thermal energy consumption and specific electrical energy consumption is 0.37 L/kg (314.7 kcal/kg) of product and 0.15 kWh/kg (129.67) of product respectively. The total specific energy consumption (in kCal) is 314.7 kCal/ kg of product. Details of annual electrical and thermal energy consumption and specific energy consumption details in Rekofa Small Tools (P) Ltd. are presented in table below:

Table 1.1: ***Details of Rekofa Small Tools (P) Ltd.***

SN	Parameter	Value	Unit
1	Name and address of unit	M/s Rekofa Small Tools (P) Ltd	
2	Contact person	Mr. Jaspal Singh (Cell No.: 9814021475)	
3	Manufacturing product	Various types of auto parts	
4	Daily Production	2-3 tons per day	
	Energy utilization		
5	Average monthly electrical energy consumption	118534	kWh per month
6	Average monthly thermal (FO) energy consumption	19200	Liters per month
7	Average specific thermal energy consumption^1	0.08	Liter /kg of product
		816	kCal/kg of product
8	Specific electrical energy consumption^2	0.47	kWh/Kg of product
		407.76	kCal/kg of product
9	Specific energy consumption	1223.76	kCal/kg of product
10	Electrical energy cost	3.56	Rs/Kg of product
11	Thermal energy cost	4	Rs/kg of product
12	Total energy cost	7.56	Rs/kg of product

^ Note:

^1: Specific gross calorific value of FO is considered as 10,200 kcal / liters

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

^3: The unit operates for 25 days a month.

1.2 PRODUCTION PROCESS OF PLANT

The following figure shows the typical process employed at manufacturing of forged products at Rekofa Small Tools (P) Ltd. are presented below:

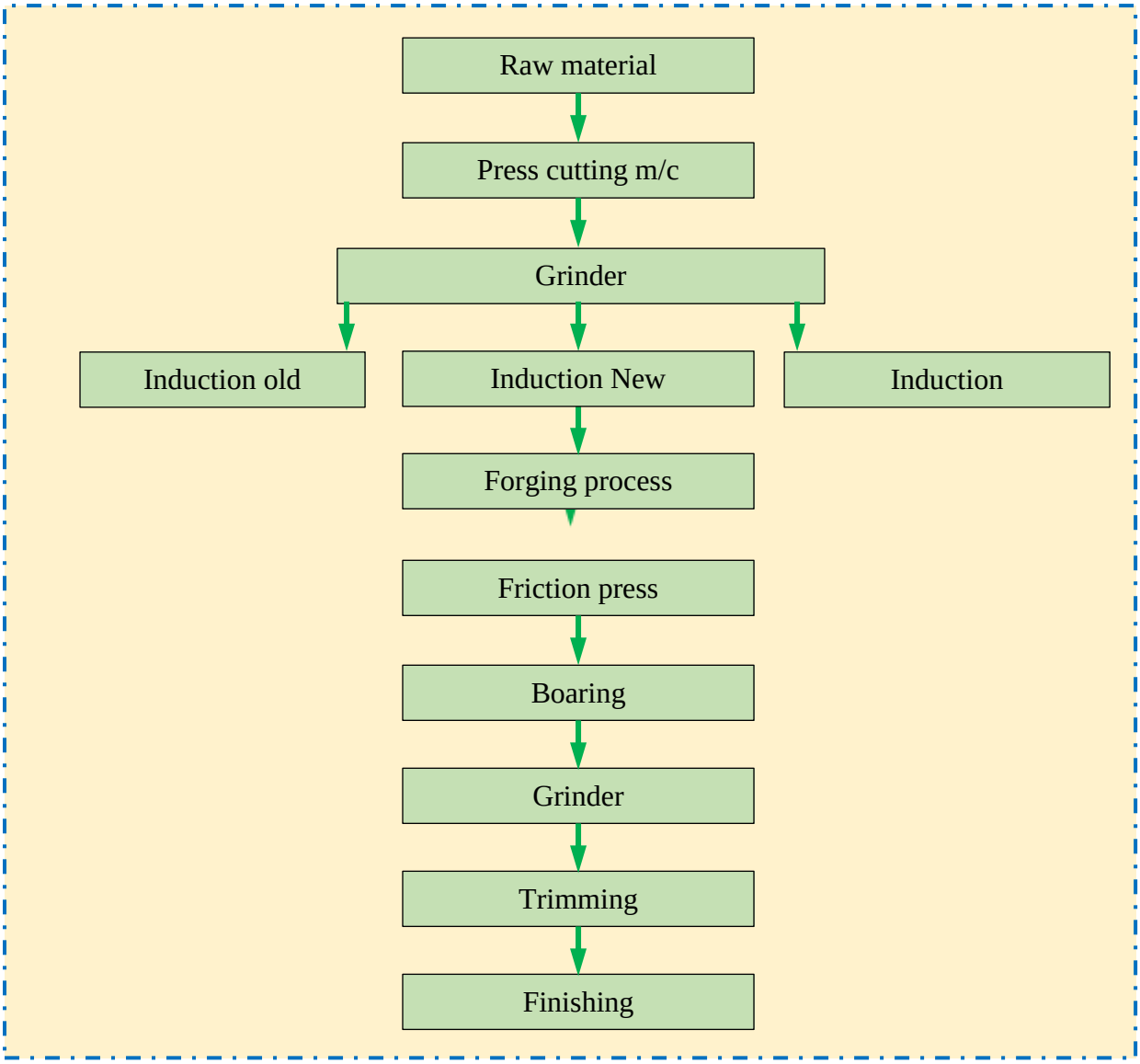

Figure 1.1: ***Flow chart of production process***

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/tons), etc.

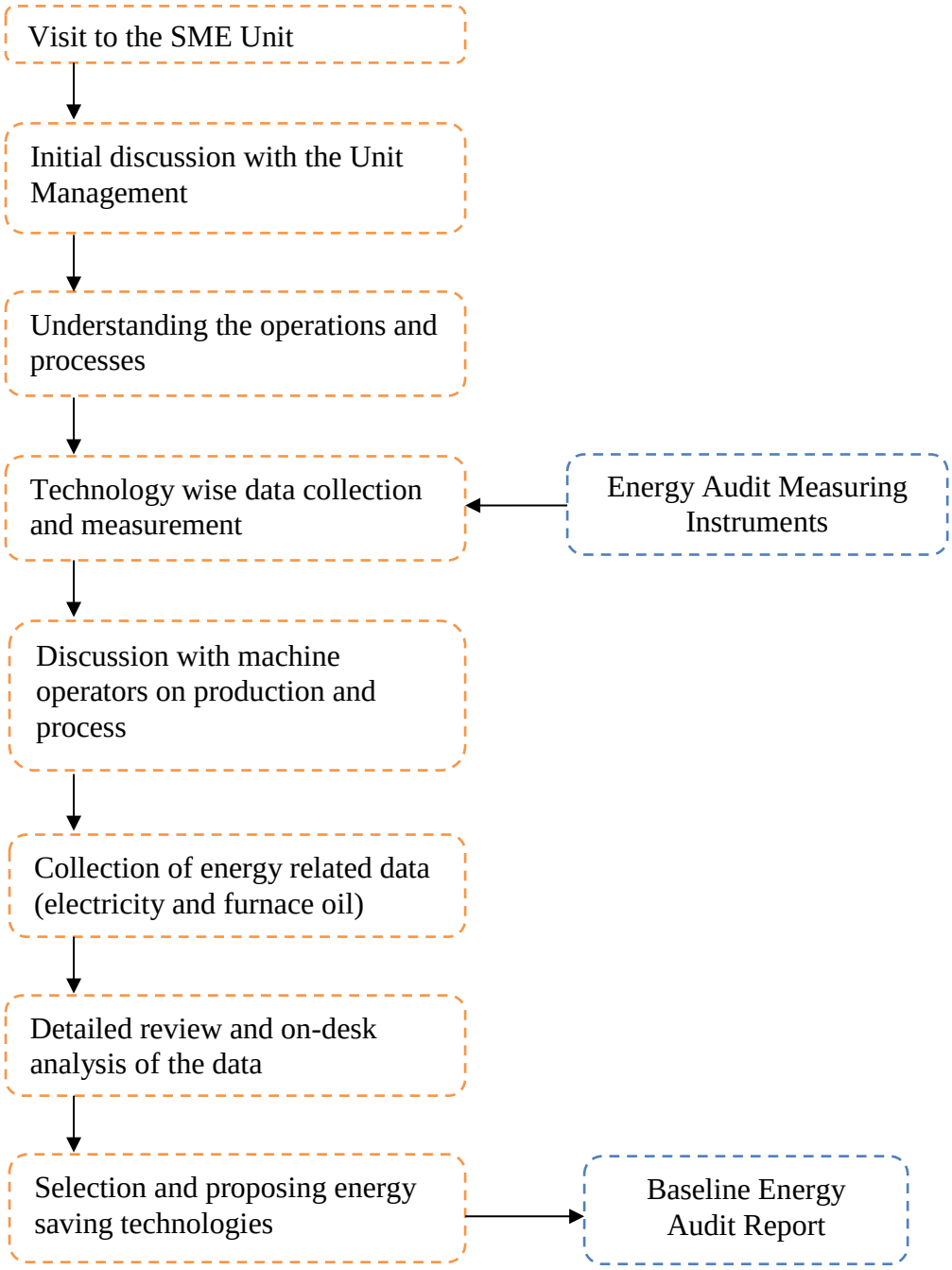

Figure 1.2: ***Energy audit process***

Present Process, Observations and Proposed Technology

2.1 RE HEATING FURNACE (FURNACE OIL FIRED)

2.1.1 Present Process

Rekofa Small Tools (P) Ltd. has installed three furnaces, Oil (FO) 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 ^{o}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 furnace oil was observed to be around 0.12 liters of FO 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 judgment regarding completeness of heating was taken by the operator based on the color of the heated material.

In addition, the existing reheating furnace usage furnace oil as a source of energy to heat the metal pieces. The burning of FO releases harmful gases like CO, CO_2, SOX, NOX, smoke etc. During the visit, it was observed that furnace has no exhaust mechanism, ID fan and flue gas pipe, to pass the flue gases out of the factory. 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 FO 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 3***.

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

Parameter	Unit	Value
FO consumption on existing re-heating furnace	Liters/hr	8
Production in terms of Kg	Kg/hour	100
Specific energy consumption on FO based re-heating furnace	Kg/Kg	0
Cost of energy consumption	Rs./Kg	8
Power consumed by proposed induction furnace (rated capacity 150 kW operating at 123.5 kW)	kW	124
Production in terms of Kg	Kg/hr	285
Specific energy consumption on induction reheating furnace	kWh/Kg	0.43
Cost of energy consumption	Rs./Kg	3.25
Reduction in cost of energy required	Rs./Kg	4.36
Operating hours	Hrs	8
Annual operating days	Days	300
Annual cost savings	Rs	2,841,600
Investment required for Induction furnace (150 kW)	Rs	1,753,521
Simple payback period	Years	0.62

As per the detailed calculations done, it is proposed to install an induction re-heating furnace of capacity 150 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 3 kgs. The cycle time required to re-heat the metal piece of 3 kgs would be around 20 secs.

The cost of energy saved per Kg of material forged is calculated as Rs. 3.25. The investment required for implementing the induction technology is estimated to about Rs 1.75 Lakhs with annual saving of Rs 28.41 Lakhs. The simple payback period of the technology is 0.62 years.

Annexure 1

Basic details and energy utilization pattern of M/s Rekofa Small Tools (P) Ltd.

SN	Parameter	Value	Unit
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Note:

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

^3: The unit operates for 25 days a month.

Annexure 2

Induction furnace capacity and heating cycle time calculation

Induction furnace capacity calculations:

Induction furnace design standard: 2.7 – 3 kg/ kW/hr

Hourly material to be heated = 285 Kg

Induction furnace capacity requirement (theoretical) = 285/2.7 kW/hr
= 105.55 kW/hr

As discussed with technology manufacturer, we have taken the lower value 2.7 kg/kW/hr for calculations.

Induction furnace capacity requirement (actual) (efficiency = 90%) = 117.28 kW/hr /0.90
= 117.28 kw/hr
=120 kW approximately

Heating cycle time calculation:

Hourly material to be heated	= 285 kg
Weight of the metal pieces	= 3 kg
No. of pieces to be heated in an hour	= 100 pieces
Heating time required per piece	= 20 seconds approximately

Keeping in mind the variety of products manufactured by Rekofa Small Tools (P) Ltd. having variable weight, size, geometry, composition etc. induction furnace of 150 kW is proposed.

Note:

*** For more accurate capacity options, induction furnace manufacturer should be consulted prior to the implementation*

Annexure 3

Energy saving calculation for Induction furnace

Parameter	Unit	Value
FO consumption on existing re-heating furnace	Liters/hr	8
Production in terms of Kg	Kg/hour	100
Specific energy consumption on FO based re-heating furnace	Kg/Kg	0
Cost of energy consumption	Rs./Kg	8
Power consumed by proposed induction furnace (rated capacity 150 kW operating at 123.5 kW)	kW	124
Production in terms of Kg	Kg/hr	285
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Operating hours	Hrs	8
Annual operating days	Days	300
Annual cost savings	Rs	2,841,600
Investment required for Induction furnace (150 kW)	Rs	1,753,521
Simple payback period	Years	0.62

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.*