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

Ludhiana Forging Cluster

Baseline Energy Audit Report
Saini Auto Impex

Submitted to

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Brief 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	**:**	**Saini Auto Impex**
Address	:	Plot No. 331-A, Industrial area -A, Near Cheema Chowk, Ludhiana - 141003, Punjab
Contact Person	:	Mrs. Apinder Kaur (Cell No: 9876082701)
Products	:	Centre Bolts, Nuts, Fasteners and Auto parts
Production	:	1.25-1.5 Tons/ day
DIC Number	:	030871108208
Bank Details	:	Bank of Maharashtra, Gill Road Ludhiana – 141003 Account no. 60010228121, IFSC Code: MAHB0000382
TAN / PAN No.	:	TAN: 03601054792, PAN: ACFPS3992J
Contract demand	:	89.97 kVA

2. Existing Major Energy Consuming Technology

FO Based re-heating technology

- Conventional Technology with higher losses
- Prevailing energy consumption is 0.14 liters of FO per kg of the production

Lathe Machine

- Manually operated lathe machines for machining job work including threading, turning, nut cutting etc.
- Electrical motor rating of 1HP to 3 HP with production of 125- 250 pieces per hour per set of lathe machine

3. Proposed Energy Saving Technologies with Cost Economics

Proposed Energy Saving Measures

- Replacement of FO fired re-heating furnace with 50 kW induction re-heating furnace
- Replacement of manual lathe machines by three numbers of CNC based Special Purpose Machine (SPM), one each for turning, cutting and threading operation

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

Technology	Estimated Energy Savings (%)	Annual Savings (In INR)	Investment (In INR)	Simple Payback period
Induction re-heating furnace (50 kW)	75	630,528	936,510	1.5
SPM Lathe Machine (for turning and undercut operation)	81	194,706	550,000	2.8
SPM Nut cutting machine	71	63,664	250,000	3.9
SPM Nut threading machine	81	36,272	100,000	2.8
Total		**925,170**	**1,836,510**	

Introduction

1.1 ABOUT THE UNIT

M/s Saini auto Impex was started in the year 1996 and is engaged in manufacturing of different types of centre bolts, nuts and bolts, centre bolt flat type and auto fasteners in various sizes as per the customer requirement. The manufacturing unit is located at Plot No. 331-A, Industrial area -A, Near Cheema Chowk, Ludhiana - 141003, Punjab.

The raw material procured by the unit for making bolts and other auto components include Mild Steel, EN8, EN15 etc.

The production of M/s Saini Auto Impex lies in the range of 1.25-1.5 tonnes/ day. The unit is using two different forms of energy for various process and utility applications in premises, those are:

- Furnace Oil (FO)
- Electricity

The average monthly FO consumption is 875 liters whereas the average monthly electricity consumption comes around 6762 kWh.

To manufacture the products, the unit has installed a FO based re-heating furnace, forging press, pressing machine, grinding/ facing/ trimming lathes, threading machine, cold forging hammers, nut making machines, drawing machine etc.

According to the assessment of the energy consumption data collected, the specific thermal energy consumption and specific electrical energy consumption is 0.05 L/kg (510 kcal/kg) of product and 0.38 kWh/kg (332.30 kCal/kg) of product respectively. The total specific energy consumption (in kCal) is 842.30 kCal/ kg of product. Details of annual electrical and thermal energy consumption and specific energy consumption details in M/s Saini Auto Impex is presented in table below:

Table 1.1: ***Details of M/s Saini Auto Impex***

SN	Parameter	Value	Unit
1	Name and address of unit	M/s. Saini Auto Impex, Plot No. 331-A, Industrial area -A, Near Cheema Chowk, Ludhiana - 141003, Punjab	
2	Contact person	Ms. Apinder Kaur	
3	Manufacturing product	Centre Bolts, Nuts, Fasteners and Auto parts	
4	Daily Production	1.25- 1.5 Tonnes/ day	
	Energy utilization		
5	Average monthly electrical energy consumption	6762	kWh per month
6	Average monthly thermal (FO) energy consumption	875	Liters per month
7	Average thermal specific energy consumption	0.05	Liter /kg of product
		510	kCal/kg of product
8	Electrical specific energy	0.3864	kWh/Kg of product

SN	Parameter	Value	Unit
	consumption	332.304	kCal/kg of product
9	Specific energy consumption	842.304	kCal/kg of product
10	Electrical energy cost	2.898	Rs/Kg of product
11	Thermal energy cost	2.5	Rs/kg of product
12	Total energy cost	5.398	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 M/s Saini Auto Impex are presented below:

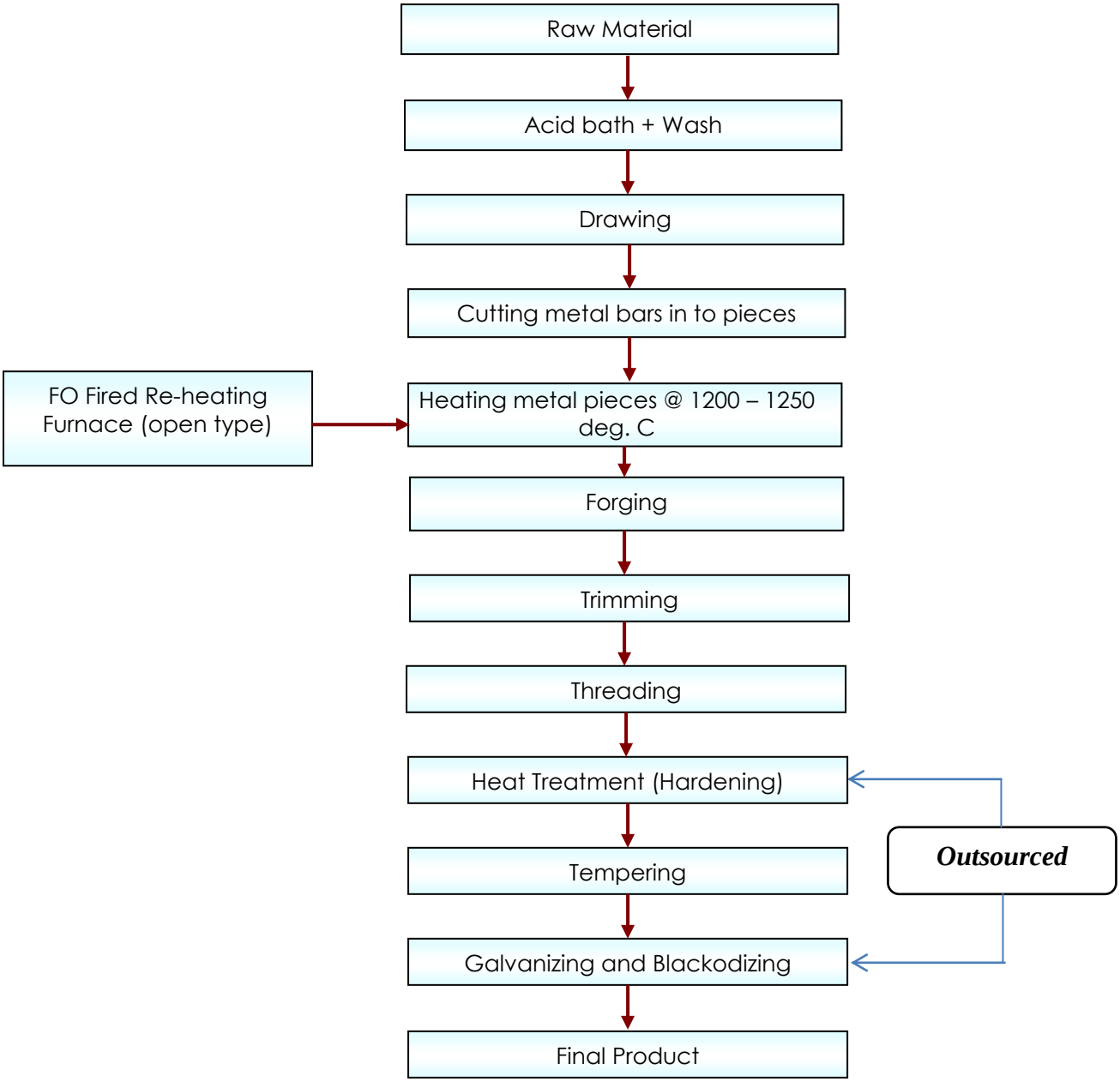

Figure 1.1: ***Production process of the unit***

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.

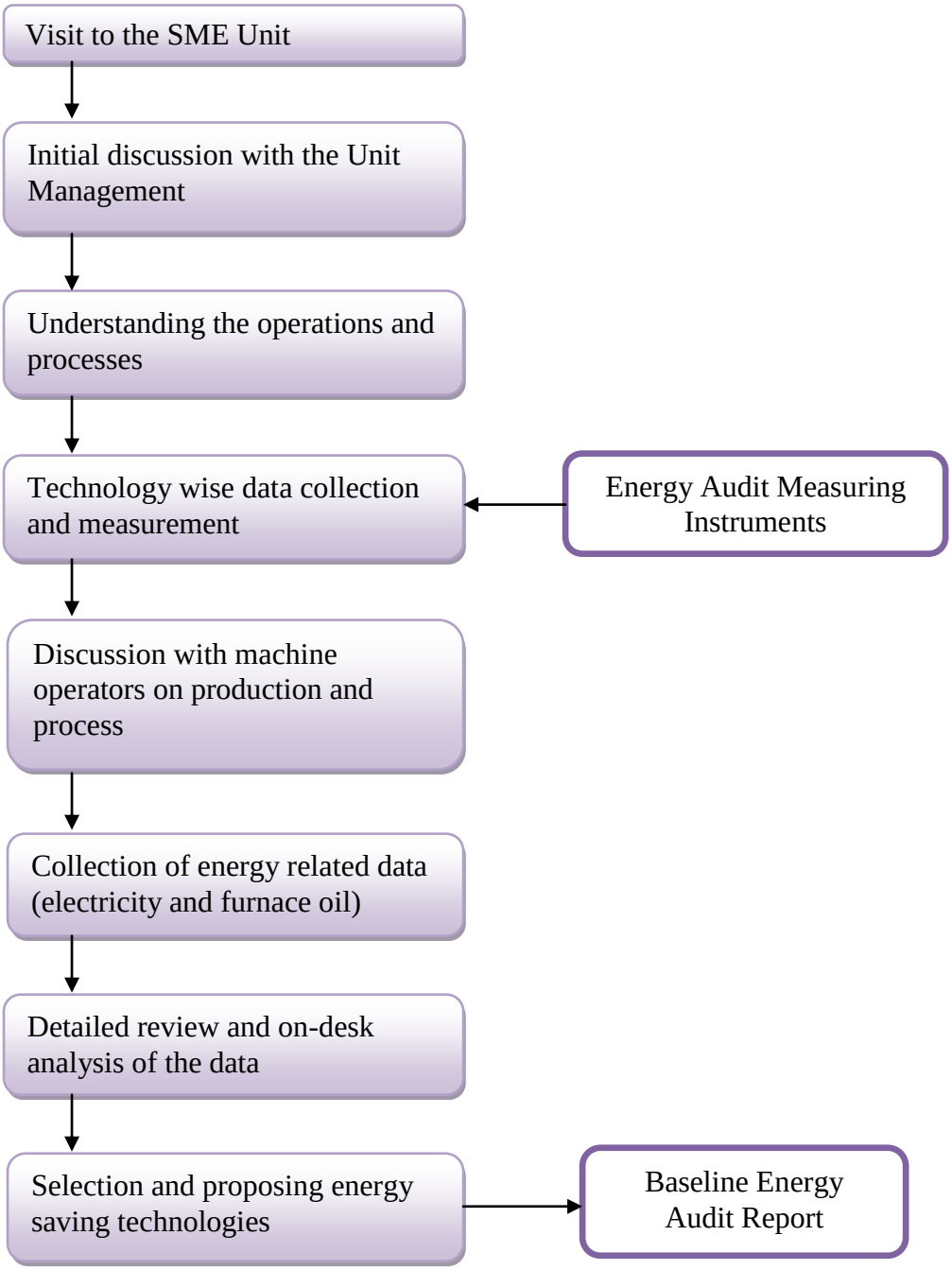

Figure 1.2: ***Energy audit process of the unit***

1.4 PRESENT TECHNOLOGIES ADOPTED

The list of energy consuming equipment's installed in Saini Auto Impex and used for forging process are as follows:

Table 1.2: ***List of energy consuming equipment's installed of the unit***

SN	Equipment	Energy Source	Energy consumption	Year of Installation
1	Drawing Machine	Electricity	10 hp	1996
2	Threading machine (3 Nos.)	Electricity	7 hp, 5 hp x 2	2011
3	Cold forge headers (2 Nos.)	Electricity	10 hp each	2011
4	Induction Re-heating Furnace	Electricity	25 kW	2014
5	FO Re-heating Furnace	Furnace Oil	40-45 L	1996
6	Forging Press (1 Nos.)	Electricity	10 hp	1996
7	Trimming Press	Electricity	5 hp	2011
8	Nut cutting machine (4 Nos.)	Electricity	3 hp x 2, 2 hp x 2	2011
9	Manual Lathes (4 Nos.)	Electricity	3 hp x 2, 2 hp x 2	2000
10	Nut threading machine (2 Nos.)	Electricity	1 hp x 2	2010

Study and Observations

2.1 RE HEATING FURNACE (FURNACE OIL FIRED)

2.1.1 Present Process

M/s Saini Auto Impex has installed a Furnace Oil (FO) fired reheating furnace to heat the metal pieces for forging process. The metal pieces are kept inside the furnace and heated for a period of 15-25 mins. depending upon the size of the raw material and product to be formed. The metal piece to be forged is 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.

Table 2.1: ***Fuel consumption and Production data of Furnace Oil based re-heating furnace***

Time	Input (No. of Pcs.)	Output (No. of Pcs.)	FO consumption (L)	Remarks
9:30 – 10:00	30	0		Pre-heating of the furnace with Tank level measurement
10:00 – 11:00	32	62	4.2	Forging started at 10:00 AM and completed at 11:00 AM for Lot-1 with tank level measurement
11:00 – 12:00	58	58	3.2	Forging started at 11:00 AM and completed at 12:00 AM for Lot-2 with tank level measurement
Total	**120**	**120**	**7.4**	**FO consumption is 7.4 liters for 120 nos. of pieces forged**

The energy consumption and production data related to detailed study conducted for the furnace oil based re-heating furnace installed at Saini Auto Impex is shown in Table 2.1. Initially, before start of the forging of the metal pieces, the re-heating furnace was pre-heated for about 30 minutes from 9:30 AM to 10:00 AM along with the material to be heated/ forged. The oil level in the fuel tank was measured with "Dip-Measurement" technique and it was noted that 1.2 liters of FO was consumed for pre-heating of re-heating furnace. The forging of (Lot-1) 62 metal pieces was started at around 10:00 AM and completed at around 11:00 AM. After Lot-1, another batch of 58 pieces (Lot-2) was feed to the re-heating furnace. The forging of Lot-2 started at 11:00 AM and completed 12:00 noon. The number of pieces forged during the study was 120 with fuel consumption of 7.4 liters. Here in this case, only head portion of the metal pieces was heated (wt. 200g per pieces). The Specific Energy Consumption comes around 0.3 L/ Kg of product. The cost of furnace oil noted as Rs. 50 per liter.

2.1.2 Observations

Some observations and drawbacks of the present re-heating FO technology:

- **Conventional Technology:**

The exiting furnace is very old installed in year 1996 and was fabricated by the local manufacturer without following any design standards. The burner used in the furnace is also based on the conventional design having manual control option for fuel firing rate.

- **Material deterioration:**

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.

- **High energy consumption:**

As per the data collected during the energy audit activity, the reheating furnace consumes around 0.3 liters of FO per kg of the production which higher if we compare the same with the latest technologies available in the market like induction heating furnace.

- **Low production rate:**

Since the existing furnace is open type and most of the heat of the flame goes out of the furnace leading to higher heating time and more fuel consumption. Because of this the material under heating takes time to attain the desired temperature profile and thus leads to the lower production rate. Apart from the open heating, labor handling the furnace also responsible for slower production rate due to their own unorganized pattern of working.

- **Environmental and Health Issues:**

The existing reheating furnace requires furnace oil as a source of energy which is burnt to heat the metal pieces. The burning of FO releases harmful gases like CO, CO_2, SO_X, NO_X, smoke etc. During the preliminary visit, it was also noted black soot is coming out of the furnace and getting deposited in the factory itself. The black soot is basically due to the incomplete combustion of the FO, which ageing reduces the efficiency of the furnace and increases the fuel loss. The 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.

- **Lack of skilled labour:**

Another factor which is creating the problem in Ludhiana is shortage of skilled workforce. Present re-heating technology requires 2-3 workers to control the furnace operations and feed in / discharge of material from the furnace.

- **Ideal running of forging press:**

It was noted that there is miss match between the operating capacity of the furnace and forging press. As studied, in a cycle of 5 minutes, the re-heating furnace produces only 10-13 pieces which were being forged in 2 minutes only the remaining 3 minutes the forging press runs ideal. During this ideal running time, the forging press only consumes energy instead of producing any output.

- **Choking at blower suction end:**

While studying the re-heating furnace, it was seen that the suction inlet of the blower is not working properly and there was no suction of the air.

- **Space constrained for storing fuel:**

It was observed during baseline audit, another big issue is fuel storage problem. Saini Auto Impex has space limitations and there for finding problems with maintaining the inventory of the furnace oil in the unit.

2.1.3 Conclusion

Based on the above observations done during the study and discussions with the unit management it is proposed to replace the existing re-heating technology (FO Based) with Energy Efficient Induction Reheating furnace.

Benefits of the EE re-heating technology:

- 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 2.2.

Table 2.2: ***Cost Economics analysis for Induction Furnace***

Parameter	Unit	Value
Furnace oil consumption on existing re-heating furnace	Liters	2.96
Production in terms of Kg	Kg/hour	21
Specific energy consumption on FO based re-heating furnace	Liters/Kg	0.14
Cost of energy consumption	Rs./Kg	7.05

Parameter	Unit	Value
Power consumed by proposed induction furnace (rated capacity 50 kW operating at 26 kW)	kW	26
Production in terms of Kg	Kg/hr	63
Specific energy consumption on induction reheating furnace	kWh/Kg	0.41
Cost of energy consumption	Rs./Kg	2.88
Reduction in cost of energy required	Rs./Kg	4.17
Operating hours	Hrs	8
Annual operating days	Days	300
Annual cost savings	Rs	630,528
Investment required for Induction furnace (50 kW)	Rs	936,510
Simple payback period	Years	1.5

As per the detailed calculations done, it is proposed to install an induction re-heating furnace of capacity 50 kW (proposed for larger products also). On the day of study, the Centre bolt was under process and the data was collected for the same. To reheat the metal pieces, the proposed furnace must be run at 26 kW with production of 63 kg/ hour. The cycle time required to re-heat the metal piece of 200 gram was calculated as 12 seconds.

The cost of energy saved per Kg of material forged is calculated as Rs. 2.88. The investment required for implementing the induction technology estimated as Rs 9.36 Lakhs with annual saving of Rs 6.30 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 Saini Auto Impex 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 2.3: ***List of conventional machine proposed for replacement / modification***

Machine	Numbers	Motor rating
Manual Lathe	4	3 hp
Nut cutting machine	4	3 hp
Nut threading machine	1	1 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 2.4.

Table 2.4 ***Cost Economics analysis for Automatic SPM Lathe machine***

Parameter	Unit	Value
Power consumed by old manual lathe machine	kW	6.714
Production on manual lathe machine	Pcs/hr	150
Specific power consumption on manual machine	kWh/Pcs	0.045
Power consumed by SPM Lathe Machine (Turning/ undercut operation) (motor capacity 3 hp) @ 70% Loading	kW	2.611
Production on SPM machine (Projected)	Pcs/hr	300
Specific power consumption on SPM machine	kWh/Pcs	0.009
Reduction in specific power consumption	kWh/Pcs	0.036
Percentage savings	%	80.6
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	25,961
Annual cost savings	Rs.	194,706
Investment required	Rs.	550,000
Simple payback period	Years	2.8

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 0.009 kWh/ pcs whereas the specific power consumption in SPM machine would be around 0.036 kWh/pcs resulting in 80.6 % savings in electrical energy. The investment required for making an SPM machine would be around Rs 5.5 Lakhs with annual saving of Rs 1.94. The simple payback period of the technology is 2.8 years.

Table 2.5 ***Cost Economics analysis for Automatic SPM Nut cutting machine***

Parameter	Unit	Value
Power consumed by old manual nut cutting machine	kW	6.714
Production on manual nut cutting machine	Pcs/hr	150
Specific power consumption on manual machine	kWh/Pcs	0.045
Power consumed by SPM Nut cutting machine (motor capacity 3 HP) @ 70% Loading	kW	2.611
Production on SPM machine (Projected)	Pcs/hr	300
Specific power consumption on SPM machine	kWh/Pcs	0.009
Reduction in specific power consumption	kWh/Pcs	0.036
Percentage savings	%	80.6
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	25,961
Annual cost savings	Rs.	194,706
Investment required	Rs.	550,000
Simple payback period	Years	2.8

As per the detailed calculations done, it is proposed to convert/ replace existing manual nut cutting machines to automatic SPM nut cutting machines. The specific power consumption on a manual machine is 0.009 kWh/ pcs whereas the specific power consumption in SPM machine would be around 0.036 kWh/pcs resulting in 80.6 % savings in electrical energy. The investment required for making an SPM machine would be around Rs 5.50 Lakhs with annual saving of Rs 1.9 lakhs The simple payback period of the technology is 2.8 years.

Table 2.6 ***Cost Economics analysis for Automatic SPM Nut threading machine***

Parameter	Unit	Value
Power consumed by old manual nut threading machine	kW	2.238
Production on manual nut threading machine	Pcs/hr	125
Specific power consumption on manual machine	kWh/Pcs	0.018
Power consumed by SPM nut threading machine (Turning/ undercut operation) (motor capacity 1 hp) @ 70% Loading	kW	1.5666
Production on SPM machine (Projected)	Pcs/hr	300
Specific power consumption on SPM machine	kWh/Pcs	0.005
Reduction in specific power consumption	kWh/Pcs	0.013
Percentage savings	%	70.8
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	9,131
Annual cost savings	Rs.	63,664
Investment required	Rs.	250,000
Simple payback period	Years	3.9

As per the detailed calculations done, it is proposed to convert/ replace existing nut threading machines to automatic nut threading - Special Purpose Machines (SPMs). The specific power consumption on a manual machine is 0.005 kWh/ pcs whereas the specific power consumption in SPM machine would be around 0.0013 kWh/pcs resulting in 70.8% savings in electrical energy. The investment required for making an SPM machine would be around Rs 2.50 Lakhs with annual saving of Rs 63,664. The simple payback period of the technology is 3.9 years.

Annexure 1

Basic details and energy utilization pattern of Saini Auto Impex

SN	Parameter	Value	Unit
1	Name and address of unit	M/s. Saini Auto Impex, Plot No. 331-A, Industrial area - A, Near Cheema Chowk, Ludhiana - 141003, Punjab	
2	Contact person	Ms. Apinder Kaur	
3	Manufacturing product	Centre Bolts, Nuts, Fasteners and Auto parts	
4	Daily Production	0.6 - 0.8 Tonnes/ day	
	Energy utilization		
5	Average monthly electrical energy consumption	6762	kWh per month
6	Average monthly thermal (FO) energy consumption	875	Liters per month
7	Average thermal specific energy consumption	0.05	Liter /kg of product
		510	kCal/kg of product
8	Electrical specific energy consumption	0.3864	kWh/Kg of product
		332.304	kCal/kg of product
9	Specific energy consumption	842.304	kCal/kg of product
10	Electrical energy cost	2.898	Rs/Kg of product
11	Thermal energy cost	2.5	Rs/kg of product
12	Total energy cost	5.398	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.

Induction furnace capacity and heating cycle time calculation

Induction furnace capacity and heating cycle time calculation

A) Heating cycle time calculation:

No. of pieces to be heated per hour = 315 pieces

Weight of each forging metal pieces = 200 gram

Hourly material to be heated = 63 kg (315 x 0.2)

Heating time required per piece = 12 seconds (60 x 60 / 315)

B) Induction furnace capacity calculations:

The Induction furnace design standard adopted by various Induction manufacturers is in the range of 2.7 ~ 3 kg per kW per hour. This standard was taken as 2.7 kg per kW per hour after consultation with various technology manufacturers.

Hourly material to be heated = 63 kg

Theoretical Induction furnace capacity requirement = 63 kg / 2.7 kg / kW/hr
= 23.33 kW/hr

Actual Induction furnace capacity requirement (efficiency = 90%) = 23.33 kW/hr / 0.90
= 25.92 kW/hr
= 26 kW (say)

A variety of products with different weight, size, geometry and material composition is produced by the unit; keeping all the variations which may come across in the future it is proposed to install an electrically operated induction based reheating furnace of 50 kW capacity.

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
Furnace oil consumption on existing re-heating furnace	Liters	2.96
Production in terms of Kg	Kg/hour	21
Specific energy consumption on FO based re-heating furnace	Liters/Kg	0.14
Cost of energy consumption	Rs./Kg	7.05
Power consumed by proposed induction furnace (rated capacity 50 kW operating at 26 kW)	kW	26
Production in terms of Kg	Kg/hr	63
Specific energy consumption on induction reheating furnace	kWh/Kg	0.41
Cost of energy consumption	Rs./Kg	2.88
Reduction in cost of energy required	Rs./Kg	4.17
Operating hours	Hrs	8
Annual operating days	Days	300
Annual cost savings	Rs	630,528
Investment required for Induction furnace (50 kW)	Rs	936,510
Simple payback period	Years	1.5

Note:

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

Annexure 4

Energy Saving Calculation for turning and undercut operation

Parameter	Unit	Value
Power consumed by old manual lathe machine	kW	1.492
Production on manual lathe machine	Pcs/hr	250
Specific power consumption on manual machine	kWh/Pcs	0.006
Power consumed by SPM Lathe Machine (Turning/ undercut opration) (motor capacity 3 HP) @ 70% Loading	kW	0.518
Production on SPM machine (Projected)	Pcs/hr	450
Specific power consumption on SPM machine	kWh/Pcs	0.001
Reduction in specific power consumption	kWh/Pcs	0.005
Percentage savings	%	80.71
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	5,202
Annual cost savings	Rs.	36,272
Investment required	Rs.	100,000
Simple payback period	Years	2.8

Note:

*** The cost of SPM machines is an indicative value gathered from discussions with SPM machine suppliers. It may vary from operation to operation and product to product.*

Energy Saving Calculation for nut cutting operation:

Parameter	Unit	Value
Power consumed by old manual nut cutting machine	kW	6.714
Production on manual nut cutting machine	Pcs/hr	150
Specific power consumption on manual machine	kWh/Pcs	0.045
Power consumed by SPM Nut cutting machine (motor capacity 3 HP) @ 70% Loading	kW	2.611
Production on SPM machine (Projected)	Pcs/hr	300
Specific power consumption on SPM machine	kWh/Pcs	0.009
Reduction in specific power consumption	kWh/Pcs	0.036
Percentage savings	%	80.6
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	25,961
Annual cost savings	Rs.	194,706
Investment required	Rs.	550,000
Simple payback period	Years	2.8

Note:

*** The cost of SPM machines is an indicative value gathered from discussions with SPM machine suppliers. It may vary from operation to operation and product to product.*

Energy Saving Calculation for Nut threading operation:

Parameter	Unit	Value
Power consumed by old manual nut threading machine	kW	2.238
Production on manual nut threading machine	Pcs/hr	125
Specific power consumption on manual machine	kWh/Pcs	0.018
Power consumed by SPM nut threading machine (Turning/ undercut operation) (motor capacity 1 HP) @ 70% Loading	kW	1.5666
Production on SPM machine (Projected)	Pcs/hr	300
Specific power consumption on SPM machine	kWh/Pcs	0.005
Reduction in specific power consumption	kWh/Pcs	0.013
Percentage savings	%	70.8
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	9,131
Annual cost savings	Rs.	63,664
Investment required	Rs.	250,000
Simple payback period	Years	3.9

Note:

*** The cost of SPM machines is an indicative value gathered from discussions with SPM machine suppliers. It may vary from operation to operation and product to product.*