Case Studies on Financing Energy Efficiency Projects

भारतीय लघु उद्योग विकास बैंक

Small Industries Development Bank of India

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Content

Introduction

Micro, Small and Medium Enterprises (MSME) sector has emerged as a highly vibrant and dynamic sector of the Indian economy over the last six decades. MSMEs not only play crucial role in providing large employment opportunities at comparatively lower capital cost than large industries but also help in industrialization of rural & backward areas, thereby, reducing regional imbalances, assuring more equitable distribution of national income and wealth. MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country.

With the Mission "To facilitate and strengthen credit flow to MSMEs and address both financial and developmental gaps in the MSME eco-system" Small Industries Development Bank of India (SIDBI), was set up on April 2, 1990 under an Act of Indian Parliament, acts as the Principal Financial Institution for the Promotion, Financing and Development of the Micro, Small and Medium Enterprise (MSME) sector and for Co-ordination of the functions of the institutions engaged in similar activities.

SIDBI's Vision is "To emerge as a single window for meeting the financial and developmental needs of the MSME sector tomake it strong, vibrant and globally competitive, to position SIDBI Brand as the preferred and customer - friendly institution and for enhancement of share - holder wealth and highest corporate values through modern technology platform"

The business domain of SIDBI consists of Micro, Small and Medium Enterprises (MSMEs), which contribute significantly to the national economy in terms of production, employment and exports. MSME sector is an important pillar of Indian economy as it contributes greatly to the growth of Indian economy with a vast network of around 4.6 crore units, creating employment of about 11 crore, manufacturing more than 6,000 products, contributing about 45% to manufacturing output and about 40% of exports in terms of value, about 37% of GDP, directly and indirectly.

The business strategy of SIDBI is to address the financial and non-financial gaps in MSME eco-system. Financial support to MSMEs is provided by way of (a) Indirect refinance to banks / Financial Institutions for onward lending to MSMEs and (b) direct finance in the niche areas like risk capital/equity, sustainable finance, receivable financing, service sector financing, etc.

In order to promote and develop the MSME sector, SIDBI adopts a 'Credit+' approach, under which, besides credit, SIDBI supports enterprise development, skill upgradation, marketing support, cluster development, technology modernisation, etc., in the MSME sector through its promotional and developmental support to MSMEs. Majority of the MSMEs are energy-intensive employing primitive and inefficient technologies and processes that endanger their competitiveness and future growth.

Industrial sector contributes to more than 45 % of country's energy demand and offers great potential to

Introduction

save 49 billion kWh of energy per year. It is estimated that about 48 % of the total energy consumed in the industrial sector is from MSMEs and by adopting energy conservation measures, at least 25% of it could be potentially saved. MSMEs, especially those for whom energy costs represent a large portion of total production costs, can reap high direct economic benefits from improving efficiency of energy conversion and reduction of energy losses.

Recognizing the need for encouraging Energy Efficiency (EE) and sustainable development in the MSME sector for their survival and growth in long run, SIDBI has taken various initiatives through dedicated loan products and other promotional activities. SIDBI has been operating focused concessional lending schemes for energy efficiency and cleaner production from various multilateral/ bilateral agencies viz., WB, JICA, KfW, AfD etc.

SIDBI is also providing risk capital and equity support for innovation projects related to energy efficiency, cleaner technologies, renewable energy etc. As part of WB-GEF project, SIDBI is also implementing energy efficiency measures in energy intensive MSME clusters. This has resulted in a total investment of more than Rs. 100 crore with a payback period of upto 36 months, achieving upto 25% energy savings.

This case study booklet is prepared to showcase SIDBI's success in Energy Efficiency Financing which would enhance the confidence of other financial institutions also for the promotion of EE projects.

इंडिया एसएमई टेक्नोलॉजी सर्विसेस लिमिटेड

INDIA SME TECHNOLOGY SERVICES LIMITED

Joint Venture

SIDBI
भारतीय लघु उद्योग विकास बैंक
Small Industries Development Bank of India

इण्डियन ओवरसीज़ बैंक
Indian Overseas Bank
आपकी प्रगति का सच्चा साथी
Good people to grow with

भारतीय स्टेट बैंक
State Bank of India

इंडियन बैंक
Indian Bank

ओरियन्टल बैंक ऑफ़ कॉमर्स
Oriental Bank of Commerce

Journey

2016 Grade- 2 ESCO

2015 Renewable Energy & Consulting Services

2014 4E (End to End Energy Efficiency) Solutions

2010 Energy Efficiency

2009 Clean Development Mechanism (CDM) advisory

2005 Technology Bank

Services

- End to End Energy Efficiency (4E) Solutions
- Renewable Energy (Solar Power & Heating)
- TEQUP M&V Audit
- ConsultancyServices
- FinancialSyndication

End-to-End Energy Efficiency (4E) Programme

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INDIA SME TECHNOLOGY SERVICES LIMITED
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SIDBI
भारतीय लघु उद्योग विकास बैंक
Small Industries Development Bank of India

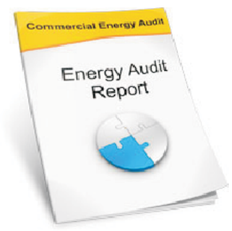
TECHNICAL SUPPORT

- Detailed Energy Audit
- Preparation of DPR
- Implementation Support
- Post implementation M&V audit

FINANCIAL ASSISTANCE

- Loan- Rs. 10 Lakh to Rs. 150 Lakh
  Max. loan upto 90% of total project cost
- Repayment - 60 months "Including moratorium period of 6 months"
- Interest - 8.10% - 9.90% p.a. presently
- Eligibility Criteria
  - 3 years Operation and
  - Last 2 years Operational profit
- Project Coverage after DEA
  - EE Retrofit Projects
  - RE Projects,
  - Technology upgradation Projects

4E Application Process



Finance from SIDBI

Detailed Project Report

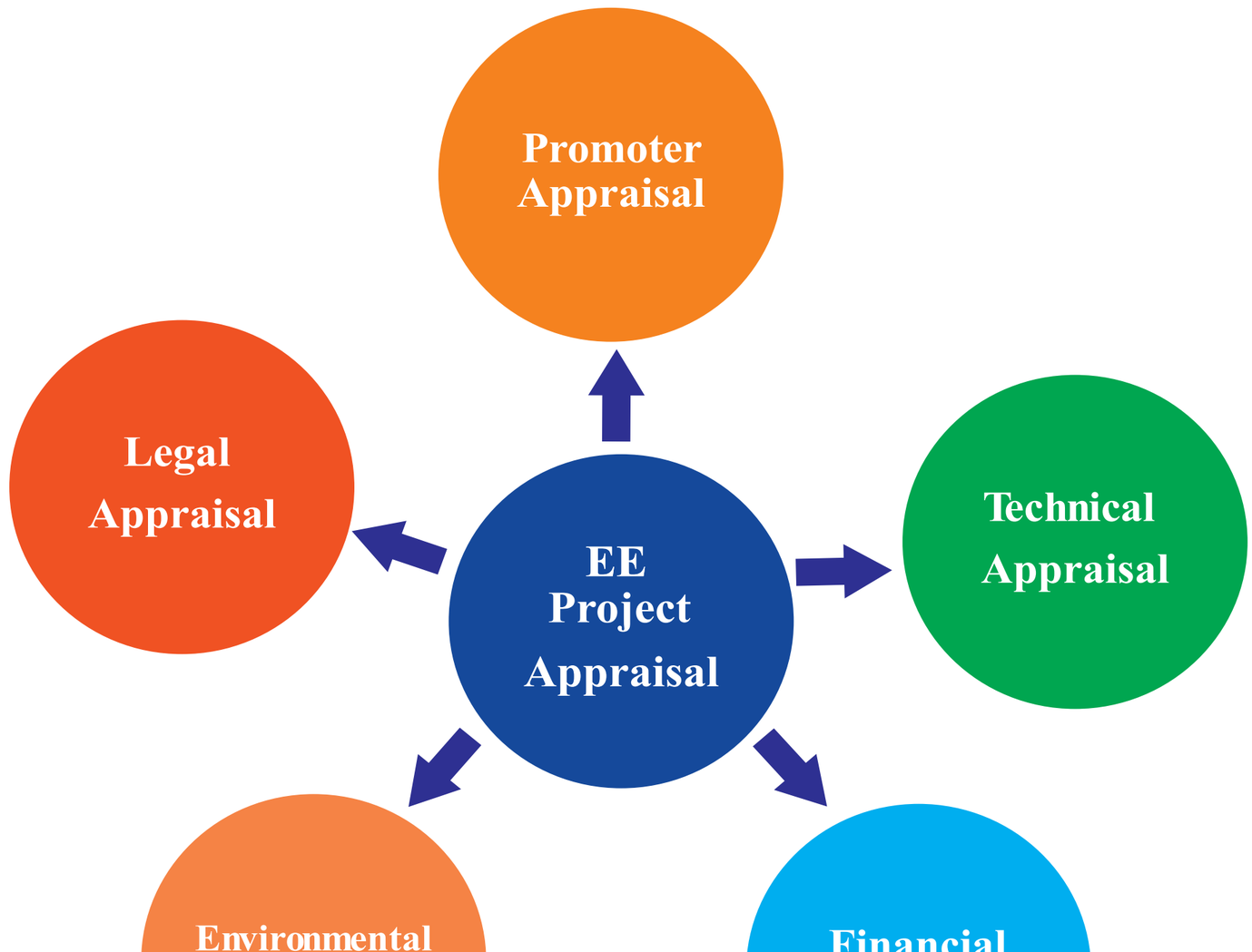
Detailed Energy Audit

(Detailed investigation and analysis)

Submission of

1. Application Form
2. Questionnaire
3. DIC/Udhyog Adhaar
4. Audit Fee

ENERGY EFFICIENCY PROJECT APPRAISAL



Partial Risk Sharing Facility

For
Financing Energy Efficiency Projects

To empower ESCOs to undertake EE projects through performance contracting route

SIDBI shall provide partial risk guarantee to selected Banks & NBFCs for their loans sanctioned for energy efficiency projects Implemented through ESCOs.

PRSF – Guarantee Product Details

Eligible Hosts / Sectors	Eligible EE Loans	Eligible ESCOs
• Large industries (excluding thermal power plants) • MSMEs • Municipalities • Buildings	• Loan to ESCO or host entity falling under Micro & Small Category • Min. 75% of loan towards EE investment	• BEE Empaneled ESCO • JV / Consortium of ESCOs allowed • Other entities are also eligible subject to grading by a rating agency
Extent of Coverage	**Guarantee Tenure**	**Guarantee Fee**
• **75%** of loan • Min. loan – **Rs.10 Lakh** • Max. loan – **Rs.15 cr.** • **Max. exposure** to a single Host / ESCO – **Rs. 45 cr.**	• **5 Years** or loan tenure, whichever is lower	• Slab-Wise & based on the grading of ESCO

PRSF – Guarantee Fee Structure

Guaranteed Loan Amount or outstanding, which-ever is lower (INR)	*Non-Refundable Annual Guarantee Fee*		
	For Grade 1 to Grade 3 ESCO	*For Grade 4 ESCO*	*For Grade 5 ESCO*
Upto Rs. 500 Lakhs	*1.00% subject to a maximum of Rs. 5.00 Lakh*	*1.00% subject to a maximum of Rs. 5.00 Lakh*	*1% subject to maximum of Rs. 15.00 lakhs*
Above Rs. 500 lakhs and upto Rs. 1000 lakhs	*Rs. 5.00 lakhs plus 0.50% on the amount above 500 Lakhs subject to a maximum of Rs. 7.50 lakh*	*Rs. 5.00 lakhs plus 0.75% on the amount above 500 Lakhs subject to a maximum of Rs. 8.75 lakh*	
Above Rs. 1000 lakhs and upto Rs. 1500 lakhs	*Rs. 7.50 lakhs plus 0.25% on the amount above 1000 lakhs subject to a maximum of Rs. 8.75 lakh*	*Rs. 8.75 lakhs plus 0.50% on the amount above 1000 lakhs subject to a maximum of Rs. 11.25 lakh*	

PRSF – Guarantee Claim Options

Option 1: **Gaurantee claim in the event of laon default and the PFI proceed for legal action for recovery.**

- **75% of guaranteed amount shall be paid upon submission of claim upon satisfying with regard**
- **to the**
- **Remaining 25% shall be paid on completion of recovery process and closure of account**
- **Any recoveries by the PFI from the Borrower Subsequent to lodgement of the Guarantee claim to be**

Option 2: **In the event of Restructing of loan**

- **If actual energy savings are lower than the estimated saving and PFI is of the opinion that by**
- **restructuring the loan, the loan repayment may become regular / timely.**
- **After restructuring the loan with or without writing off apart restructured EE Loan, PFI may lodge the claim to the extent of unsustainable portion of the restructured EE loan, and without going through any proceeding for recovery of such EE loan against the Borrower.**
- **The claim amount to be paid to PFI shall be lowest of following:**

***75% of the Maximum Guaranteed Amont**
or
***The unsustainable portion of the restructured EE loan**

Note: By exercising Option 2, the Guarantee under the Programme for such EE Loan shall come to an end.

Role of PFIs (Banks/NBFCs)

- Sign MoU with SIDBI and fulfill preparatory activities
- Sign Master Guarantee Agreement
- Sanction the loan
- Apply for Guarantee through PRSF Website
- Sign TRA / ESCROW Agreement
- Submit information on periodic basis to PEA
- M&V exercise through a third party agency hired by SIDBI
- Ensure compliance with the ERMF guidelines

Benefits to PFIs (Banks/NBFCs)

- Partial coverage of credit risk
- Flexibility to take collateral security
- Risk weight for the loan guaranteed under PRSF is 20% and hence:
  - Lower provisioning required
  - Lesser capital requirement for CRAR.
- Capacity building support under the project
- Contribute to climate change mitigation action

Role of ESCOs

- Conduct detailed energy audit in the Host facility
- Conduct Environmental Safeguards due diligence as per ERMF guidelines.
- Prepare the detailed ESPC in consultation with the Host
- Develop the M&V plan in consultation with the Host
- Prepare Investment-grade energy audit report
- Submit loan application to PFI
- Sign the TRA along with the PFI, the Host and the Trustee Bank
- Undertake installation, commissioning, operation, maintenance of energy savings projects
- Measure and verify energy savings

Benifits to ESCOs

- Capacity building support under the project
- Improved availability of finance
- Standard templates of IGDPR, ESPC, TRA etc.
- Matchmaking and loan syndication support
- Build confidence amongst various parties.
- Increased business activity

List of Abbreviation

AAC	Autoclaved Aerated Concrete
BEE	Bureau of Energy Efficiency
BTK	Bull's Trench kiln
CNG	Compressed Natural Gas
CFR	Coke Feed Ratio
DBC	Divided Blast Cupola
DM	De-Mineralization
ECBC	Energy Conservation Building Code
EE	Energy Efficiency
ETP	Effluent Treatment Plant
ESCO	Energy Service Company
GHG	Green House Gas
ISTSL	India SME Technology Services Limited
JICA	Japan International Cooperation Agency
LED	Light Emitting Diode
LDPE	Low-density polyethylene
LLDPE	Linear low density polyethylene
MSME	Micro, Small & Medium Enterprise
MTPA	Million Tons per Annum
MVD	Medium Voltage Drives
RO	Reverse Osmosis
SIDBI	Small Industries Development Bank of India
SEC	Specific Energy Consumption
TMT	Thermo-Mechanical Treatment
TFO	Two-For-One Twisting
VSBK	Vertical Shaft Brick Kiln
VFD	Variable Frequency Drive

CS-1

A CASE STUDY FROM LUDHIANA CLUSTER

MSME Textile unit invests 101 lakh on energy efficiency measures, saves 62 lakh every year!

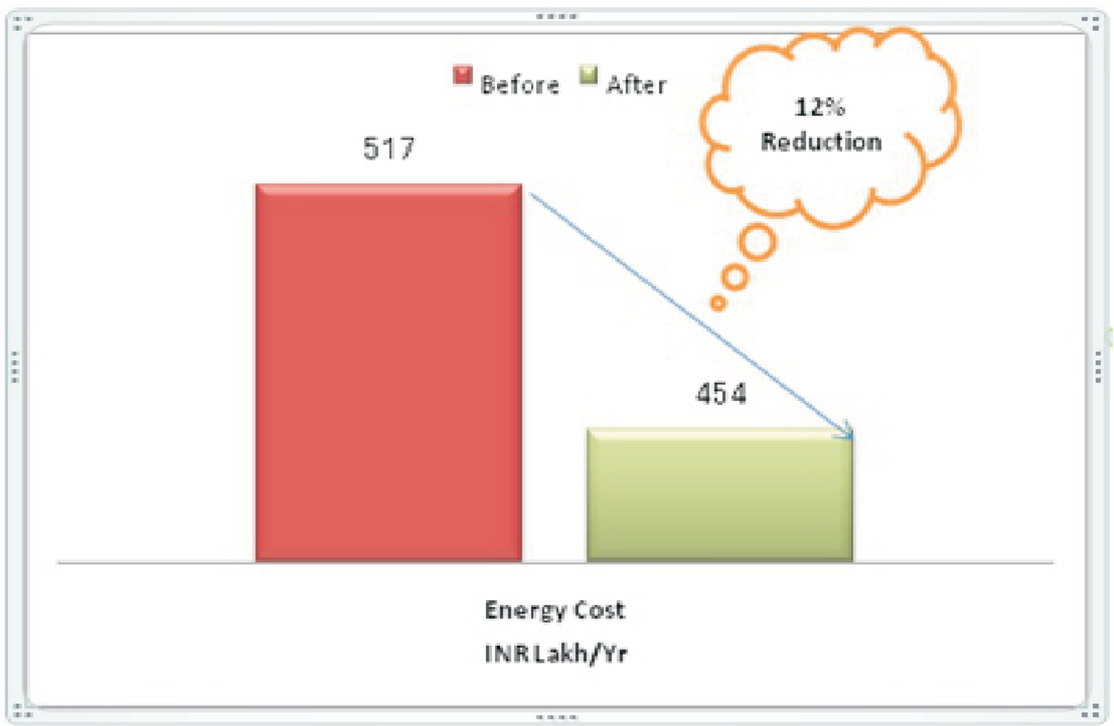
Unit profile

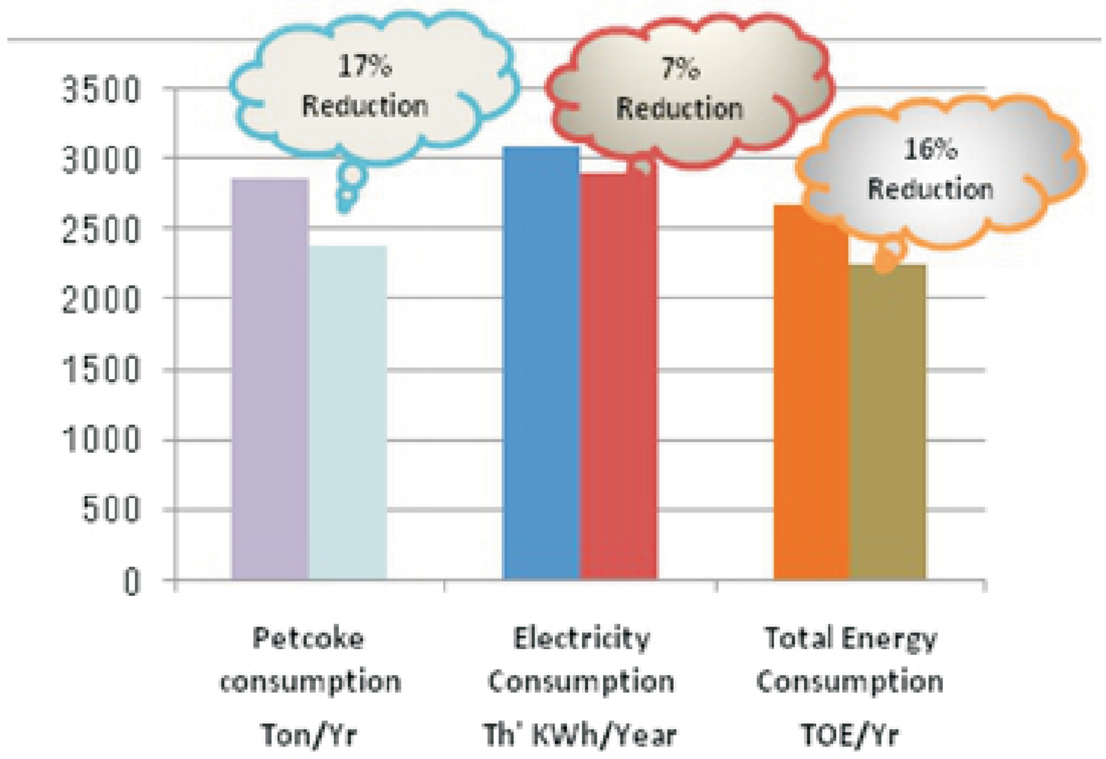
The unit is located at Focal Point Industrial Area, Ludhiana, Punjab. The total annual energy bill of the unit was INR 517 lakh. The total annual energy consumption was 2667 toe, of which pet coke accounted for 49% (1307 toe), grid electricity 46% (1227 toe) and HSD 5% (133 toe).

Process description

The unit is involved in the manufacturing of Knitted Yarn, Dyed Yarn, customised clothing. The unit is manufacturing around 16 lakh pieces per annum of such kind of products. Due to product mix industry, there are number of different processes adopted for processing, dying & knitting of the variety of products. Different Processes in this industry requires huge quantity of steam as an indirect heating media. The unit is using petcoke based boiler that is main energy intensive equipment in any processing & dying industry. Apart from this, some of other energy consuming equipments are Thermo Pac, Air Compressors, Cone Dyeing, Fabric Dyeing, Relax Dryer, Stenter etc.

The main energy consuming equipment used by the unit comprised One steam boiler (Pet coke based, 5000 kg/hour steam generation capacity), and One Thermopac (pet coke based, 15 lakh kCal/hr heat generation capacity) and Two Air Compressors (192 CFM & 126 CFM capacities).





INTERVENTIONS

Replacement of One existing inefficient boiler with Energy Efficient boiler with automation

Baseline Scenario

Observation

The existing boiler with steam generation capacity of 5000 kg/hour, had operational efficiencies of around 65% (Pet Coke-fired). This efficiency level was low as compared to boiler of similar categories. The lower efficiency was due to incomplete combustion, CO level was 4500-5000 ppm, O_2in flue gas was around 14%, flue gas temperature was very low: 100^{0}C, which shows abnormal operation of boiler, will affect life of chimney also, defective nozzles, faulty VFDs on ID & FD fans and poor insulation. Performance of the Boiler is poor and needs corrective steps on top priority. Apart from its low efficiency, life the boiler has also been degraded drastically due to internal design changes by the unit, increased operational risk.

Implemented Scenario

Recommendation

The unit was advised to replace the existing boiler with a new energy efficient boiler with automation of same capacity. Based on the project's recommendation, the unit replaced the existing boiler, with an efficiency of 84%.

This investment of INR 80 lakh is saving about INR 30 lakh annually in energy cost, with simple payback period of 2.67 years.

PLC Controlled Automation of Thermo Pac

The unit is using one Thermo Pac unit with 15 Lakh kCal capacity to provide hot oil for process heating applications like in stenters etc. The O_2 level in flue gas was very high upto 15%. Auditor suggested to Install PLC based control system for auto tuning of O_2as per requirement for complete combustion with an investment of INR 8 lakh and savings of 65000 kg of pet coke annually, equivalent to INR 5.4 lakhs. The simple payback period is 1.5 years.

To Improve Power Factor to Unity

Analysis of electricity bills showed an average power factor of 0.97 at main incomer. A power factor controller was installed to improve the power factor to about 0.995. This investment of INR 3.2 lakh is saving INR 6.16 lakh annually. The simple payback period is 6 months.

Other Implemented EE Measures

Energy Saving Measures	Estimated Annual Energy Savings		Estimated Investment (Rs. lakh)	Cost Savings (Rs. Lakhs /Yr)	Simple Payback (Months)	Emission Reduction (Tons of CO_2)	Eq. Energy Saving (TOE/yr)
	Electricity (KWh) Lac	Pet Coke (MT)					
Installation of VFD for I.D. Fan in Boiler	0.45		1.50	3.47	5	40.0	3.9
Replacement of smaller size air receivers by large capacity Air Receiver	0.14		1.50	1.06	17	12.5	1.2
Rectification of Leakage of Compressed Air – regularly.	0.25		Routine Maint.	1.92	-	22.3	2.1
Replacement of 742 nos. Tube Light by 18 Watt, LED	1.22		7.50	9.40	9.6	109.6	10.5
Steam Line Insulation		30.8	0.45	2.55	2.2	90.2	25.3
Oil Distribution Line Insulation		34.2	0.26	2.83	1.1	100.2	28.0
Condensate Line Insulation		2.8	0.07	0.23	3.7	8.2	2.3

Unit has also upgraded their technology through advanced automatic Energy Efficient machines viz. PLC Based Compacting Machine, Squeezer for Tubular Fabric MOD. X-PRESS, Industrial Sewing Machine (Direct Drive), Circular Knitting machine, Oil Type Double Rollers Two Touch Polishing Machine (PLC), RN 312 Shearing Machine, RN230 high speed Brushing Machine etc.

CS-2

A CASE STUDY FROM MANESAR CLUSTER

MSME Auto Ancillary and Engineering invests 201 lakh on energy efficiency measures, 18% reduction in total energy bill!

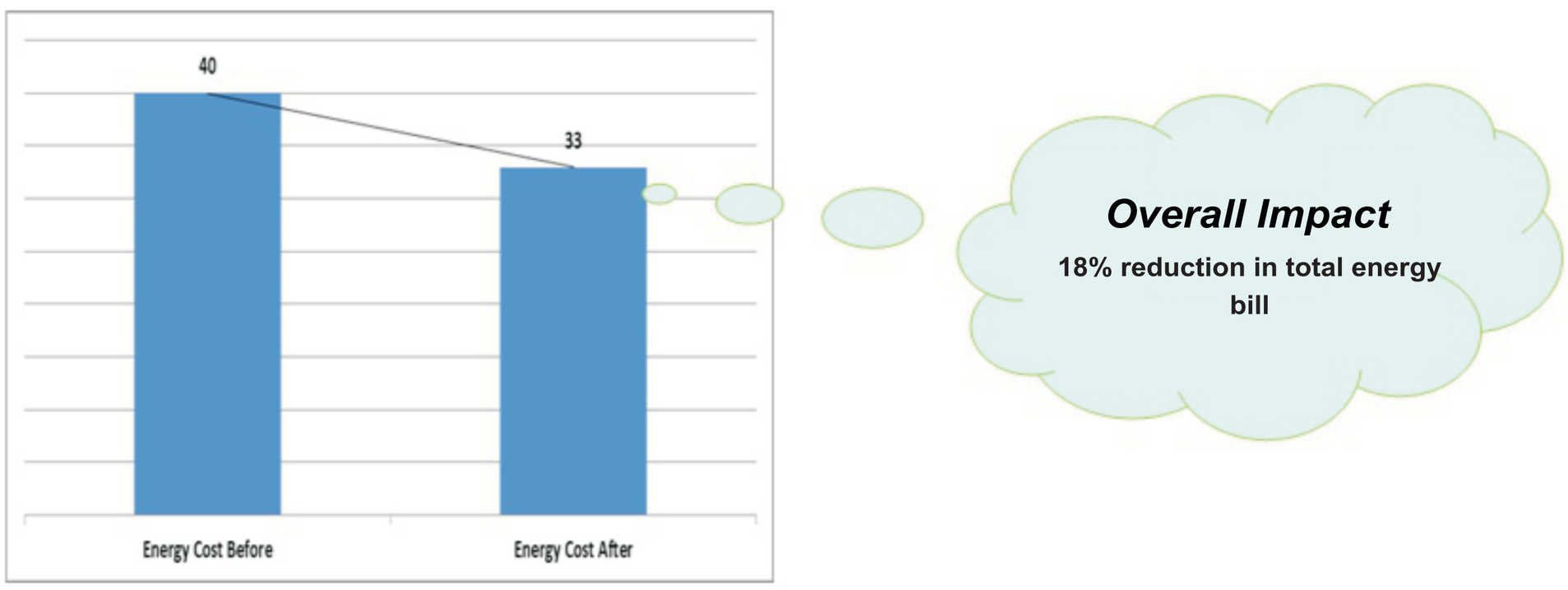
Unit profile

The unit is located at IMT Manesar, Haryana. The total annual energy bill of the unit wasINR 50.5 lakh. The total annual energy consumption was 52 toe, of whichgrid electricity 92% (48 toe) andHSD 8% (4 toe).

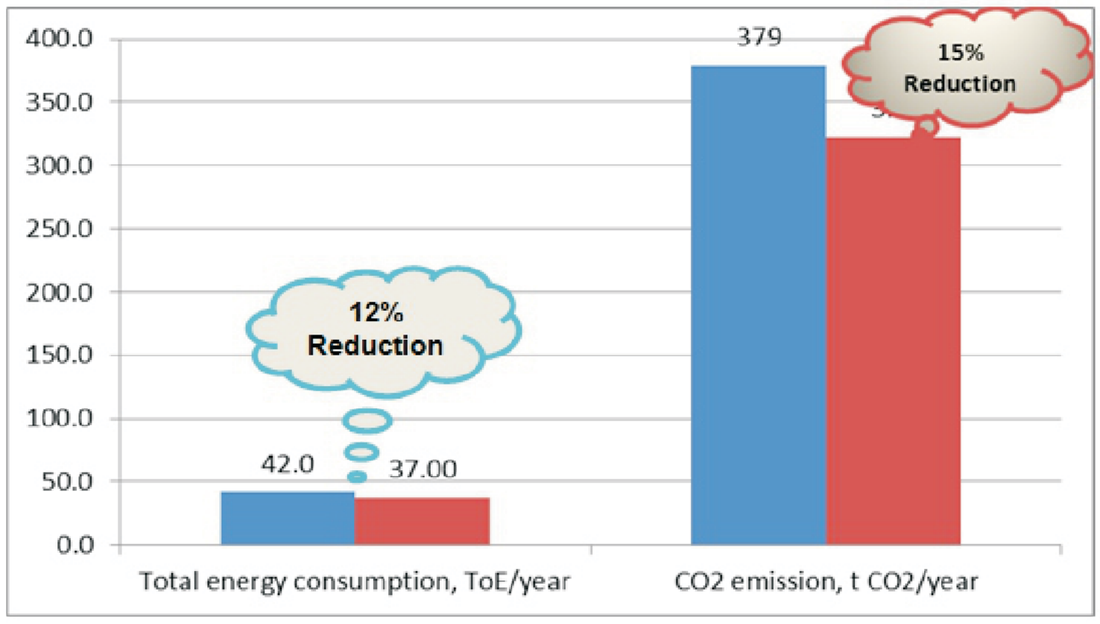
Process description

The unit is involved in the manufacturing of automobile components and its precision parts. The unit is manufacturing around 126.2 lakh pieces per annum of such kind of products. Due to product mix industry, there are number of different processes adopted for processing, cutting and finishing of the variety of products. Different Processes in this industry requires huge quantity of electricity as direct energy and compress air as an indirect energy media. The unit is using grid electricityfor all the main energy intensive equipment/machines in product processing and as power backup unit has HSD based diesel.

The main energy consuming equipment used by the unit comprised of CNC, VMC machines and one air compressor (110 capacity).



Overall Impact - Post implementation



INTERVENTIONS

Installation of Energy Efficient High Speed CNC Turning Machine

Baseline Scenario

Observation

The unit produces precision components as per the required specifications. Unit is presently using low speed CNC machine for processing of the components.

Implemented Scenario

Recommendation

Based on the recommendations, the unit installed energy efficient high speed CNC turning machine which can yield high production with material savings and less manpower and energy cost per unit of product.

The resulting annual energy savings , accounting for the reduction in manpower cost and material cost, total monetary savings of INR 9.5 lakh. The investment made was INR 71.30 lakh with average payback period of 7.5 year.

Replacement of existing lighting scheme with energy efficient lighting in plant premises

Baseline Scenario

Observation

The unit has installed 54 numbers of FTL of 44 W, 36 numbers of FTL of 36W, 120 numbers of FTL and 51 CLF of 36 W in the plant.

Implemented Scenario

Recommendation

Based on the recommendation, the unit replaced with suitable energy efficient LED lamps in phase-wise manner.Resulting energy saving is 21131 kWh per year equivalent to a monetary saving of Rs. 1.73 lakh. The investment requirement is Rs. 2.14 lakh with a simple payback period of 15 months.

Other Implemented EE Measures

S. No	Energy Saving Measures	Estimated Annual Energy Savings		Estimated Investment	Monetary Savings	Simple Payback	Emission Reduction	Eq. Energy Saving
		Electricity (kWh)	Electricity (kVAh)	(Rs.lakh)	(Rs. Lakhs /Yr)	(Months)	(Tons of CO2)	(TOE/yr)
1	Demand Reduction from 260 KVA to 200 KVA	-	-	-	1.22	-	-	-
2	Power Factor Improvement from 0.975 to 0.999		8664.77	1.00	0.71	17	-	-
3	Reduction in Pressure Setting of Current Compressor	11357		0	0.93	Immediate	9.31	0.98
4	Leakage Arrest in Compress Air System	42855		0.50	3.51	1.71	35.14	3.69
5	Installation of Variable Frequency Drive (VFD) at Compressor	10541		0.75	0.86	10.43	8.64	0.91
6	Replacement of Current Lighting Appliances with Suitable LED lighting Appliances	21132		2.14	1.73	14.84	17.33	1.82
7	Power Generation from Solar rooftop PV System	21024	21236	12.5	1.74	66	17.41	1.83

CS-3

A CASE STUDY FROM DEHRADUN CLUSTER

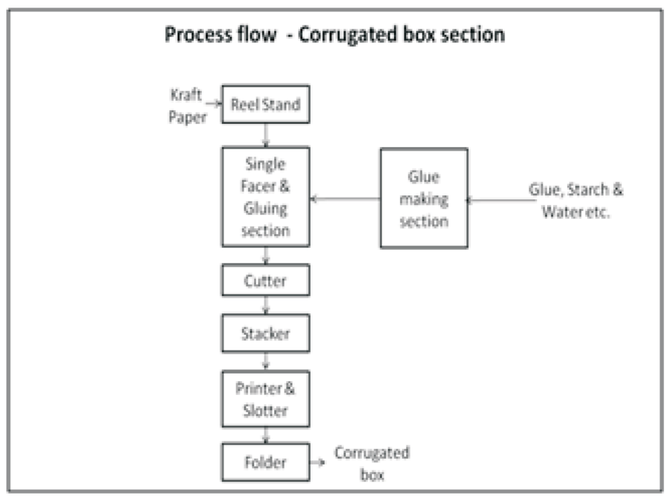
MSME Packaging unit invests 288.89 lakh on energy efficiency measures, saves 51.77 lakh every year!

Unit profile

The unit is located at Madhopur Hazratpur Village of Haridwar Dist, Uttarakhand. The total annual energy bill of the unit was INR 137.28 lakh. The total annual energy consumption was 605 toe, of which Biomasss briquetts accounted for 87.7% (532 toe), grid electricity 4.19% (25.4 toe) and HSD 8.01% (48.5 toe).

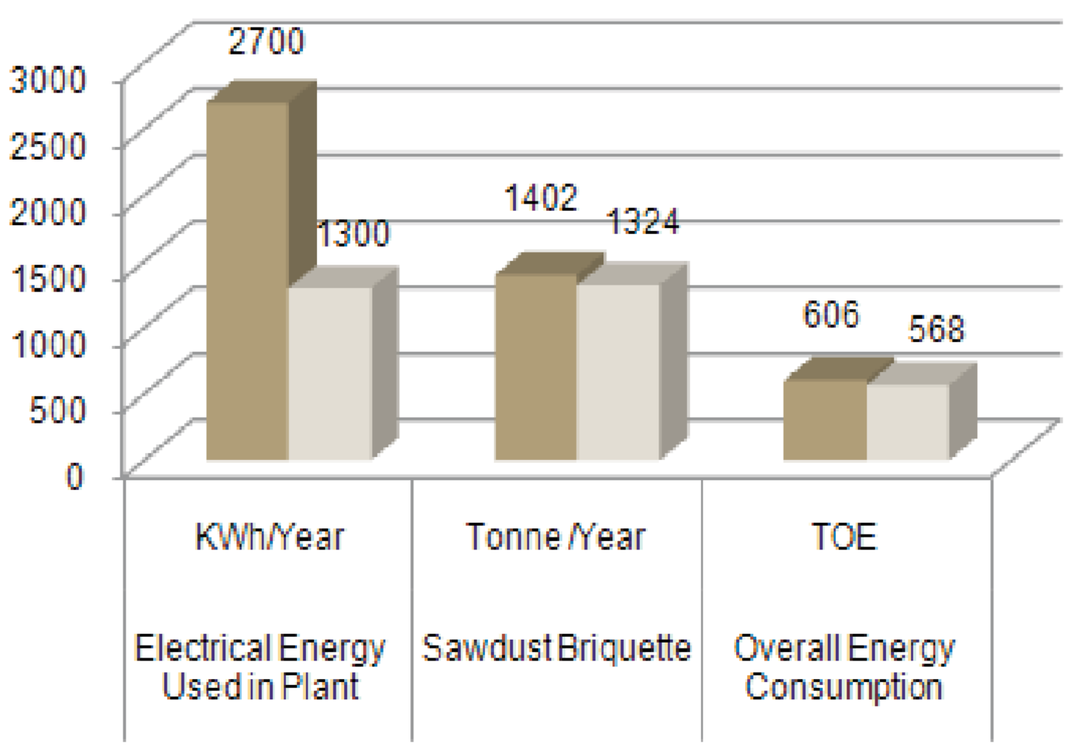
Process description

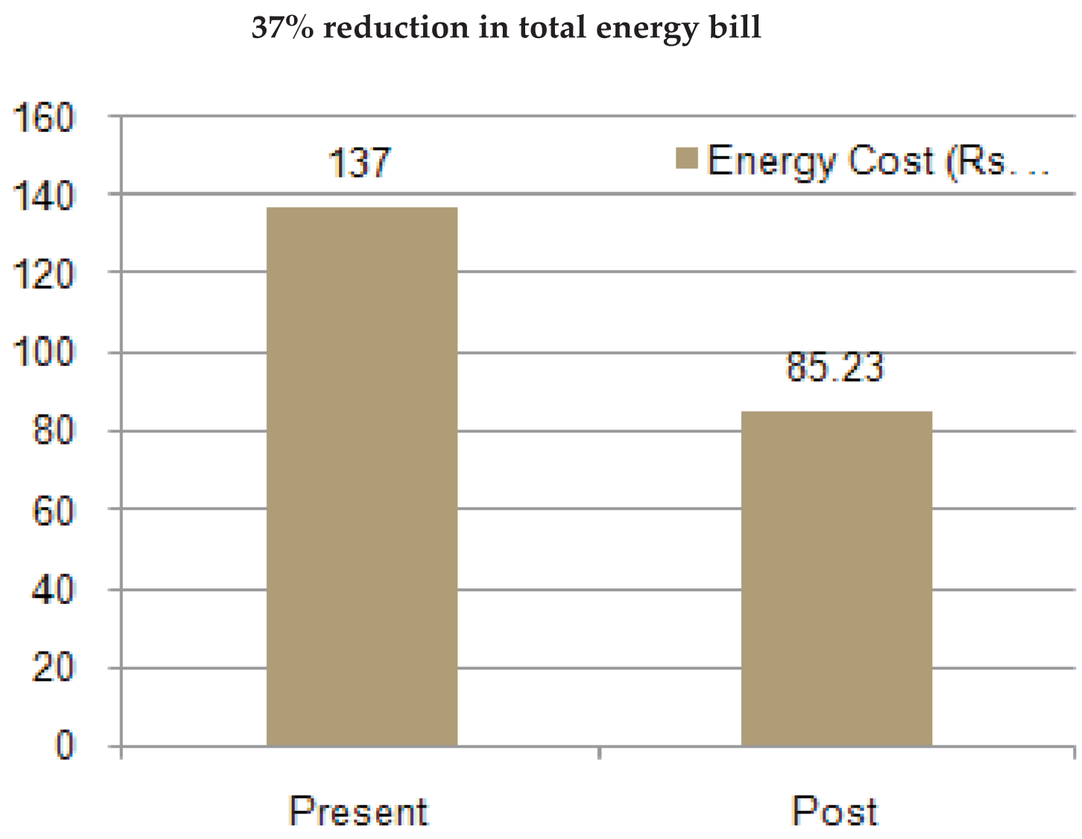
The unit is involved in the manufacturing of Corrugated Boxes for Packaging purposes. The unit installed capacity was around 1,200 tons /month with various sizes of Boxes. The common process for manufacturing of the corrugated boxes is provided below. The unit required steam and electrical energy for different process involved during the manufacturing. The unit is uses biomass as fuel for steam generation which consumes major energy consumption in the unit. Apart from this, some of other energy consuming Equipments are Air Compressors, Motors, pumps etc.



The main energy consuming equipment used by unit Boiler (Biomass Briquette based, 3000 kg/hour steam generation capacity), and Air Compressor and DG Sets.

Overall Impact - Post implementation





INTERVENTIONS

Replacement of Auto Gluer Machine with Auto Gluer Machine

Baseline Scenario

Observation

The unit is using one Gluer Machine for drying the flute (the middle layer of the corrugated sheet) in between the layers of corrugated sheet. The present gluer machine operates with 440 V with 20KW load. The capacity of the machine is 2000 Boxes/hr and the wastages from the gluer machine are about 5%.

Implemented Scenario

Recommendation

The auditor suggested to Install Auto Gluer Machine which will operate 200 V and 13.75 kW load requirement. The machine capacity is 15000 boxes/hr and the wastages is about only 1% Max. The investment required is 253.63 Lakhs and Annual monetary savings of Rs. 40 Lakhs. The simple payback] period is 6 years

Replacement of existing smaller capacity inefficient Air compressor with higher capacity energy efficient compressor

Observation

The existing compressor having 85 CFM with 7.5 bar. The compressor draws more power than the rated power due to higher production levels and inefficiency. The SEC of the existing Air compressor was higher than other available efficient compressors in the market. Considering the fact that the performance of compressor was very poor and future demand, It was suggested to replace with higher capacity energy efficient Air Compressor.

Recommendation

The unit was advised to replace the existing Compressor 85 CFM with new Energy Efficient Compressor of 170 CFM to meet the proposed demand of the entire plant. This required an investment of INR 10 lakh with savings of about INR 3.19 lakh annually in energy cost, with simple payback period of 3 years.

Air to fuel ratio optimization, Insulation on condensate recovery lines and Flue gas duct system in Boiler

Observation

The Unit is using the 3 TPH boiler to generate steam for drying the flute and other processes. It was observed that installed condensate recovery system was not mounted properly and condensate recovery lines were not insulated which was resulted the surface heat loss. It was also observed that the actual flue gas duct was damaged which result fresh air gets in to the flue gas stream and ashes from the boiler escapes from the chimney without being separated in the dust collector. The O_2 level in the flue gas was 15% which is higher than recommended value of 5%. Overall It was resulted into increased pollution level, increased ID Fan load and inefficient combustion.

Recommendation

The auditor advised to Install O_2 sensor/ Flue gas analyzer at the flue gas outlet and replacement of flue gas duct system, Insulation of condensate recovery pipelines, exposed steam distribution pipe lines at inlet of Gluing machine, reel stand and single facer etc.
This required an investment of INR 6.56 lakh with savings of about INR 4.68 lakh annually in energy cost, with simple payback period with in 2 years.

Unit have also procured energy efficient duplex gluer, Down Stacker, Shredder Blower, Auto folder Gluer, Toyota forklift with Clamp etc machines to meet the addition capacity of the plant.

CS-4

A CASE STUDY FROM DEHRADUN CLUSTER

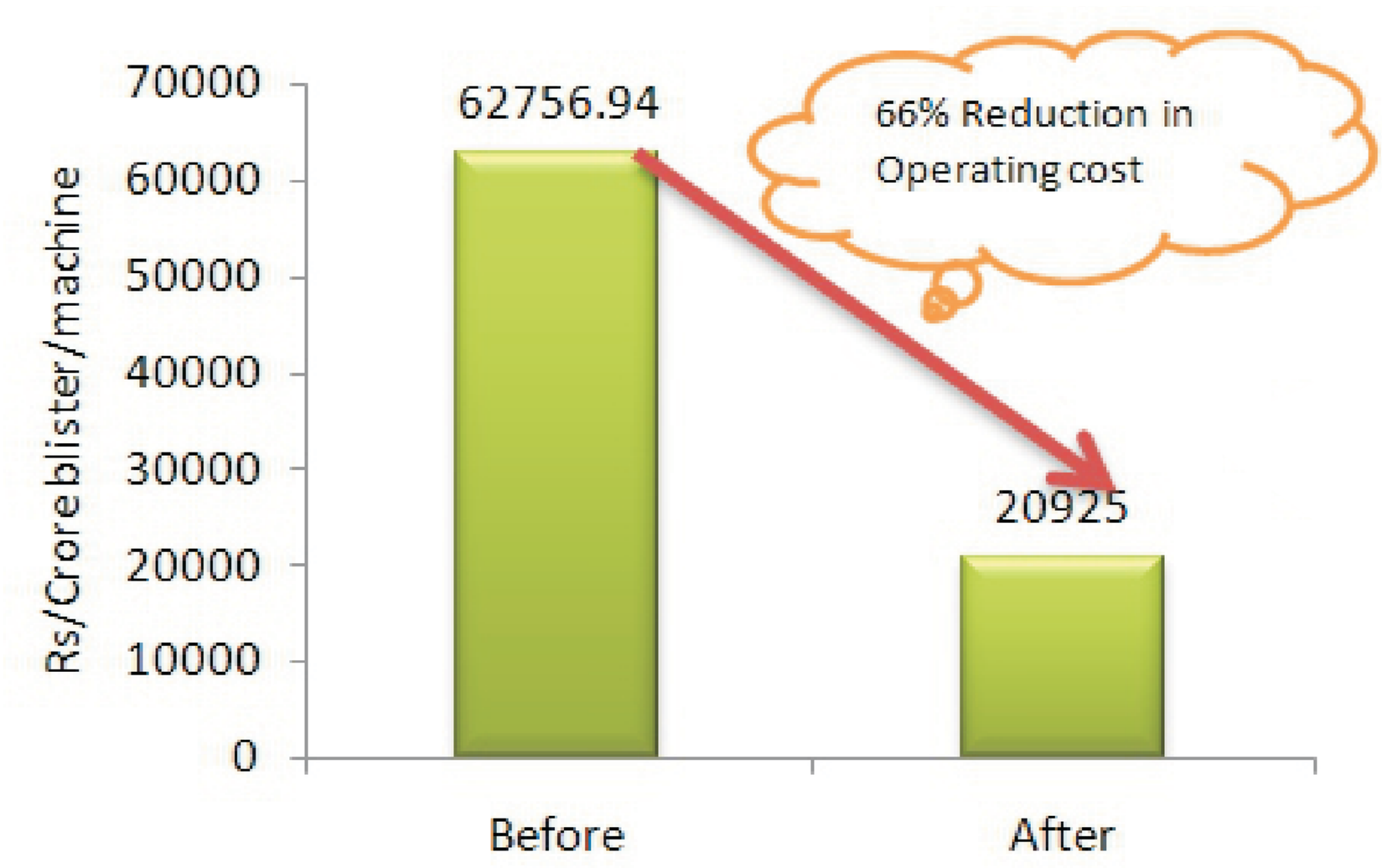
MSME Pharmaceutical unit invests 627 lakhs on energy efficiency measures, saves 298 lakhs every year!

Unit profile

The unit is a contract manufacturer and it also manufactures and markets medicines across a wide range of therapeutic areas under its own brand. Annual production of the unit is estimated to be equal to 216 crore blister.

Process description

The Company manufactures and markets medicines across a wide range of therapeutic areas under its own brand. For the manufacturing of medicines, the Company makes use of modern tools and equipment. Highly qualified staff and detailed scheduling processes ensure that the products are of high quality and cost effective as well. The Company exports its formulations to many countries in Asia, Africa and Latin America apart from meeting the domestic requirements. Due to product mix industry, there are number of different processes adopted in the unit. Different Processes in this industry requires huge quantity of steam as an indirect heating media. The unit is using diesel & briquette in the boiler that is main energy intensive equipment in any processing industry. Apart from this, some of other energy consuming equipments are air compressor, hot water generator, chiller, air handling units, diesel generator, electric motors, pumps, lighting etc.



Overall Impact - Post implementation

INTERVENTIONS

Replacement of existing secondary packing with latest PLC based automatic Cartoning Machine

Baseline Scenario

Observation

Secondary packagings of blisters / bottles / vials/ ampoules / tubes are being carried out manually at the unit. The unit is facing many problems with regard to less capacity utilization of the plant which resulting into less productivity and also labour intensive work. Hence, in order to increase the productivity and to reduce the operating costs and dependency on labour. Unit has been suggested to installing “PLC Based Automatic Cartoning Machine”

Implemented Scenario

Recommendation

The unit was advised to replace the existing secondary packaging system with a new latest and energy efficient, PLC based automatic cartooning machine. Based on the project's recommendation, the unit replaced with PLC system. This required an investment of 587 lakhs with an annual savings about INR 141 lakhs reduction in operating cost, with simple payback period of 4.16 years.

Fuel conversion from HSD to Briquette in boiler

The unit is using one steam boiler with 1.2TPH capacity to meet the steam requirement. Efficiency of the boiler is 70%. Auditor suggested to Install Briquette fired boiler to reduce the operating cost. This requires an investment of INR 10 lakhs and savings of 133 lakhs annually,. The simple payback period is < 1month. The cost savings is mainly due to change in the fuel. Due to change in fuel the unit was able to reduce 766T CO_2/year.

Installation of EE motors

Analysis of electric motors indicates many motors are rewound motors. The dip in efficiency ranges between 0.8 to 3%. It is better to replace rewound motors and reduce power consumption. Replacement of rewound motors with EE motors requires an investment of INR 0.6 lakh is saving INR 0.3 lakh annually. The simple payback period is 6 months.

Other Implemented EE Measures

Energy Saving Measures	Estimated Annual Energy Savings		Estimated Investment (Rs. lakh)	Cost Savings (Rs. lakh /Yr)	Simple Payback (Months)	Emission Reduction (Tons of CO_2)	Eq. Energy Saving (TOE/yr)
	Electricity (KWh) Lakh	Pet Coke (MT)					
Replacement of leaked steam traps with new 10 nos. to avoid leakage of steam		97.20	5.00	6.90	0.72		36.9
Waste heat recovery from exhaust air to fresh air by incorporating air to air heat exchanger and one steam coil in fresh air to recover sensible heat of existing coil		87.24	8.00	6.15	1.30		33.2
Installation of vortex tube to supply cold air for sealing roller, so requirement of air will be low i.e. wastage is low	27273		3.00	1.50	2.00	24	2.3
Solar based LED Street Lighting for Plant-2 & Expansion	8610		5.00	0.51	9.80	8	0.7
Electric heater with steam coil on FBD and Autocoater to operate in night time so that electricity can be saved of off-peak hours operation (Units shifted to off-peak hours is 77160 kWh/ year)			5.00	1.67	3.00		
Installation of VFD on 5HP & above motors of AHUs	45456		5.00	2.00	2.50	40	3.9
Insulation of retarding chamber to avoid heat loss on FBD		7.04	0.50	0.50	1.00		2.7
Installation of VFD on Air Compressor	60000		7.00	3.30	2.12	53	5.2
LED Lighting for Administration Building	9100		1.45	0.50	2.90	8	0.8

Unit have also procured energy efficient duplex gluer, Down Stacker, Shredder Blower, Auto folder Gluer, Toyota forklift with Clamp etc machines to meet the addition capacity of the plant.

CS-5

A CASE STUDY FROM THANE CLUSTER

MSME Precision component manufacturing unit invests Rs. 225.8 lakh on energy efficiency measures, saves Rs. 46.6 lakh every year!

Unit profile

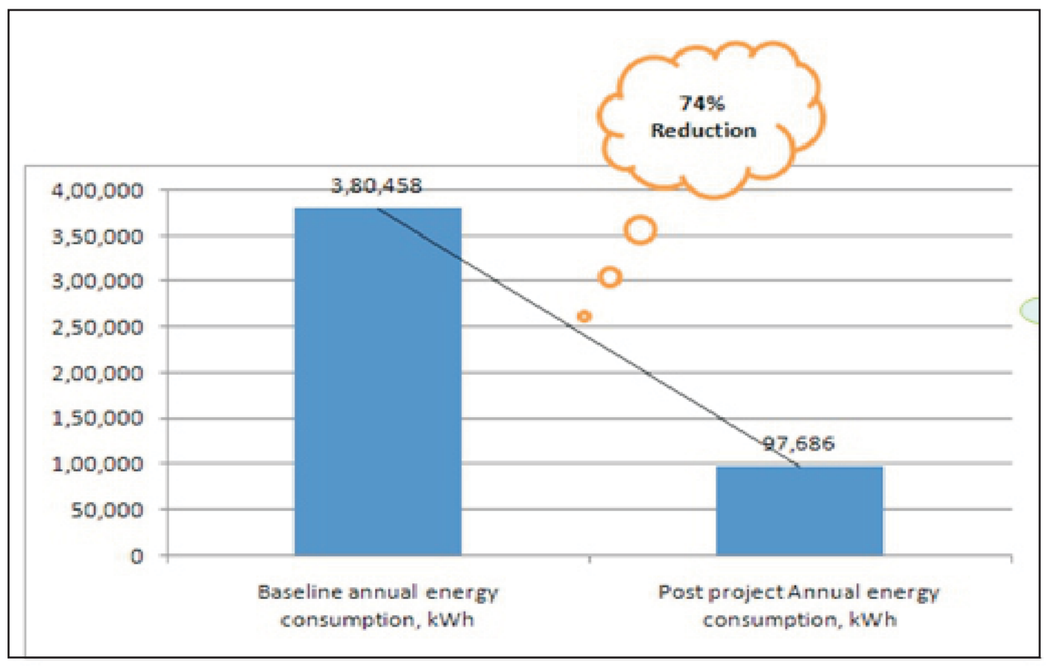
The unit is located at TTC Industrial area, MIDC, Khairane, Navi Mumbai, Maharashtra. Plant consumes only electricity as its fuel. The total energy consumption of the unit during last 12 months was 32.7 TOE which is equivalent to 35.3 lakh rupees. The total CO2 emission during this period is estimated to be 373 tonnes.

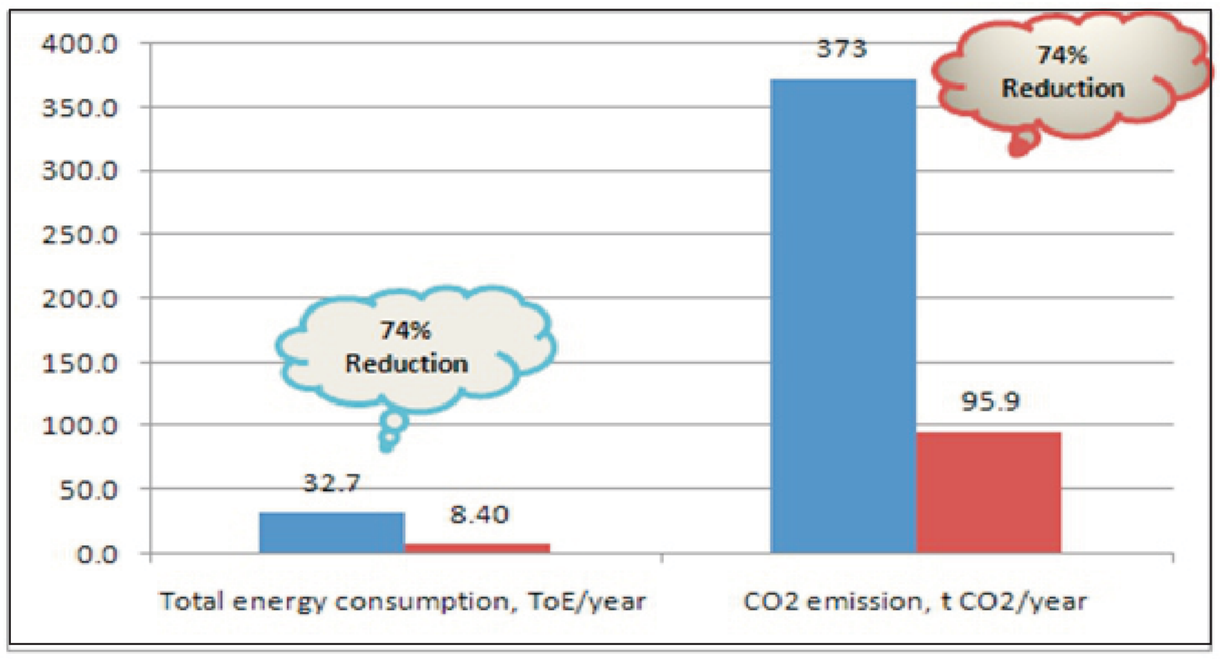
Process description

The unit manufactures precision components and threaded fittings as per customer's drawings and specifications. The total production of the unit during 2014–15 was 39,980 products.

The major steps involved are designing job as per the requirement, raw material procurement, Design & Cutting, Machining & Finishing, Quality testing and inspection and finally Packing and despatch. The major energy consuming areas in the unit are electrical motors associated with process equipment such, CNC machines, air compressors, lathe machines, milling machines, grinding machines and other associated utility equipment.

The unit uses grid electricity as a source of energy. DG set is installed and used only during power failure, which is very insignificant in the cluster.





INTERVENTIONS

Replacement of low speed CNC with high speed CNC turning

Baseline Scenario

Observation

The unit produces precision components as per the required specifications. Unit is presently using low speed CNC machine for processing of the components.

Implemented Scenario

Recommendation

Based on the recommendations, the unit installed high speed CNC turning machine which can yield high production with material savings and less manpower and energy cost per unit of product. The resulting annual energy savings is 262,800 kWh per year and accounting for the reduction in manpower cost and material cost, total monetary savings of INR 40.96 lakh. The investment made was INR 220 lakh with payback period of 5.4 year.

Replacement of 3 reciprocating air compressors with new energy efficient screw air compressor

Observation

The unit was having three reciprocating air compressor of rating 3.7 kW (5 HP), 3.7 kW (5 HP) and 2.2 kW (3 HP) and design capacity 16.8 CFM, 16.8 CFM and 8.8 CFM respectively to cater the compressed air requirement of processes.

During audit study it was observed that there are many leakage points, compressed air generation pressure setting is more than required and on time of different compressors varying as per the plant air requirement.

Recommendation

Based on the recommendation, the unit installed new energy efficient screw air compressors. Running this air compressor result in less energy consumption compared to reciprocating air compressors consumption for providing the same air requirement.

The energy saving is 13,348 kWh per year equivalent to a monetary saving of Rs. 1.24 lakh. The investment requirement was Rs. 3.66 lakh with a simple payback period of 3.0 years.

Replacement of existing lighting scheme with energy efficient lighting in plant premises

Observation

The unit has installed 6 numbers of MVL lamps of 400 W and 20 numbers of T8 FTL□s of 36 W in the plant.

Recommendation

Based on the recommendation, the unit replaced MVL's with energy efficient LED lamps of 120W and T8 FTLs lights with energy efficient T5 FTLs of 28W each in phase-wise manner.

Resulting energy saving is 6,624 kWh per year equivalent to a monetary saving of Rs. 0.61 lakh. The investment requirement is Rs. 0.81 lakh with a simple payback period of 1.3 year.

Improvement of power factor to unity by installation of APFC panel

Observation

The average power factor of plant was observed 0.88 in the last one year. PF was less than 0.9 in 4 months leading to payment of penalty, while for remaining months the unit has availed less incentive in the electricity bills. The power factor was not maintained unity at the main panel due to less and in-appropriate capacitors.

Recommendation

Based on the recommendation, the unit installed APFC panel of appropriate rating total 100 kVAr at the main panel to maintain the PF at unity and avail the PF incentive of about 7%
on energy charges.
Resulting monetary saving is around Rs 3.8 lakh per year. The investment made was Rs. 1.3 with a simple payback period of 4 months.

CS-6

A CASE STUDY FROM THANE CLUSTER

MSME Paper unit invests Rs.102 lakhs on energy efficiency measures saves Rs.60 lakhs every year!

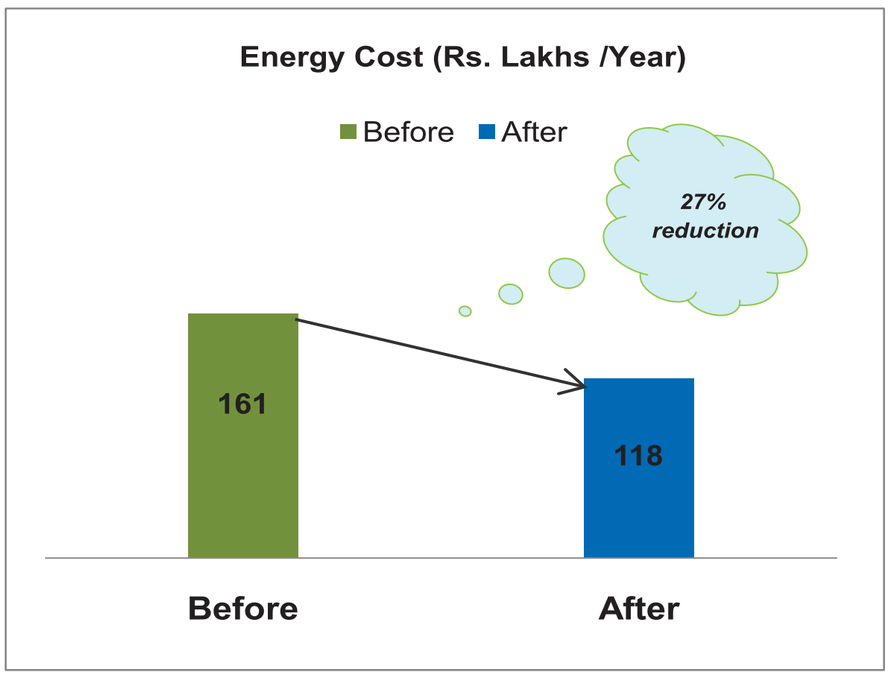
Unit profile

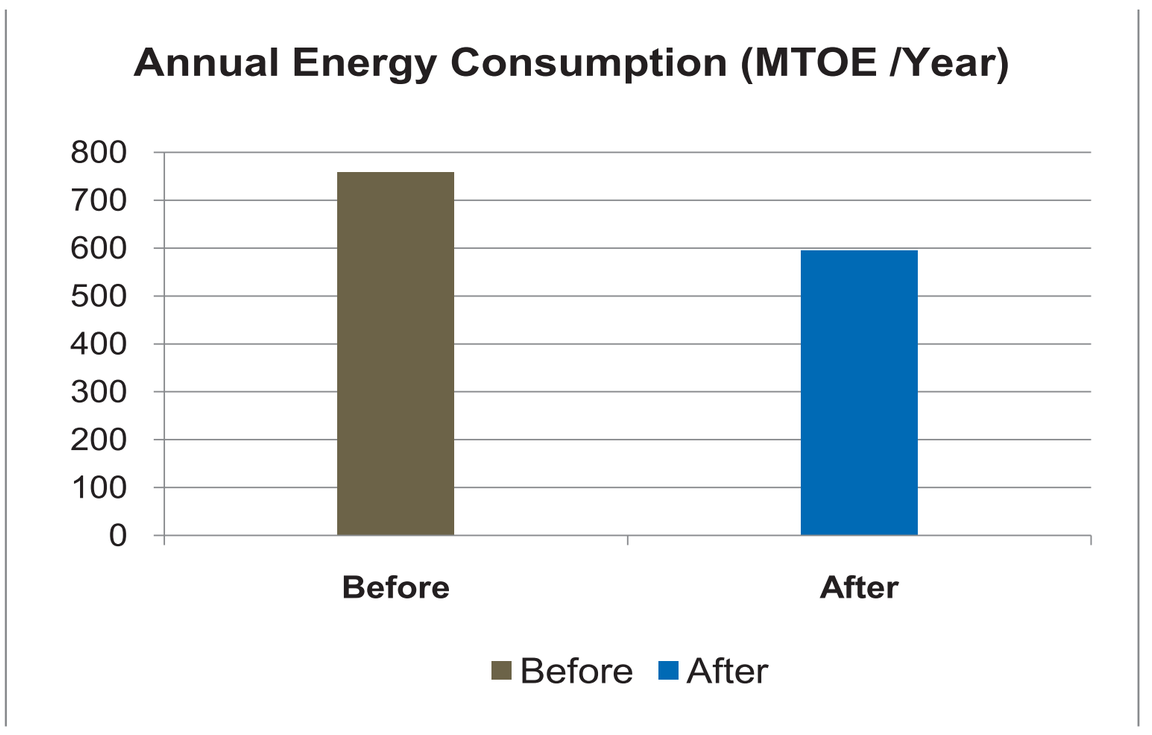
The unit is located at Sahnewal Road in Ludhiana, Punjab. The total annual energy bill of the unit was INR 161 lakhs. The total annual energy consumption was 868 MTOE.

Process description

The unit is involved inmanufacture of assorted Corrugated & Offset Corrugated packaging boxes. The annual production is around 10000 MT. Catering to demands from various segments and categories of industries, the assorted corrugated boxes are manufactured of various sizes and qualities. Few processes in this industry require significant quantity of steam as an indirect heating media. The unit is using briquettes primarily for boiler fuel. Apart from this, some of other energy consuming equipments are Air Compressors, main board machine, etc.

The main energy intensive equipment used by the unit comprised 1 No., 3 TPH steam boiler (briquette fired), 1 No., air cooled Screw Air Compressors of capacity 160 CFM.





INTERVENTIONS

Replacement of One existing inefficient boiler with Energy Efficient boiler with automation

Baseline Scenario

Observation

The existing boiler with steam generation capacity of 1.91 TPH, had operational efficiencies of around 65% (Briquette – fired). This efficiency level was low as compared to standard efficient boiler of similar categories. The lower efficiency was due to incomplete combustion, CO level was2 ppm, O_2 in flue gas was around 14%, flue gas temperature was around 140 ^{0}C, which shows normal operation of boiler , while the excess air was around 202%. There was no automation, despite the boiler was dual fird and capable of operating on Pet Coke as well. Overall performance of the Boiler is poor and needs corrective steps on top priority . Apart from its low efficiency, life the boiler has also been degraded drastically due to internal design changes by the unit, increased operational risk.

Implemented Scenario

Recommendation

The unit was advised to replace thexisting boiler with a new energy efficient boiler with full automation of same capacity. Based on the project's recommendation, the unit replaced the existing boiler, with an efficiency of 84%.

This investment of INR 23 lakh resulting n equivalent saving, with simple payback period of1 years.

Air Compressor

The unit is operating 1 No., Elgi Make, Screw type Air Compressor of 160 CFM capacity. It was observed that the SEC is on the higher side, followed by frequent loading & unloading pattern. Auditor suggested installing new Air Compressor with VFD and lowering SEC. The overall investment required was around INR 2.4 lakhs resulting in monetary saving of INR 2.8 lakhs with simple payback period of around 10 months.

Installation of EnergyEfficient IE3 motor with VFD

The main corrugated machine was being operated using DC motor, requiring change of speed, every now and then. It was suggested during DEA to replace the existing main motor with energy efficient IE3 AC motor with VFD. The overall investment required was around INR 1.5 lakhs with simple payback period of 10 months.

Other Implemented EE Measures

Energy Saving Measures	Estimated Annual Energy Savings		Estimated Investment (Rs. lakh)	Cost Savings (Rs. Lakhs/Yr)	Simple Payback (Months)	Emission Reduction (Tons of CO_2)	Eq. Energy Saving (TOE/yr)
	Electricity (KWh) Lac	Pet Coke (MT)					
Installation of solar roof top PV system - 200 kWh	2.9	-	110	23.4	56	260.33	25.2
Installation of new and high energy efficient motors with VFD	0.97	-	4.3	7.8	7	86.35	8.3
Arresting compressed air leakage	0.18	-	0.3	1.4	2	15.60	1.5

Unit has also upgraded its lighting from conventional one to energy efficient lighting, installed translucent sheet over the shop floor to reduce lighting load during day time and ensure maximum utilization of natural day lighting.

CS-7

A CASE STUDY FROM ANKLESHWAR CHEMICAL CLUSTER

MSME chemical unit invests 17 lakhs in energy efficiency measures, saves 9 lakhs every year!

Background

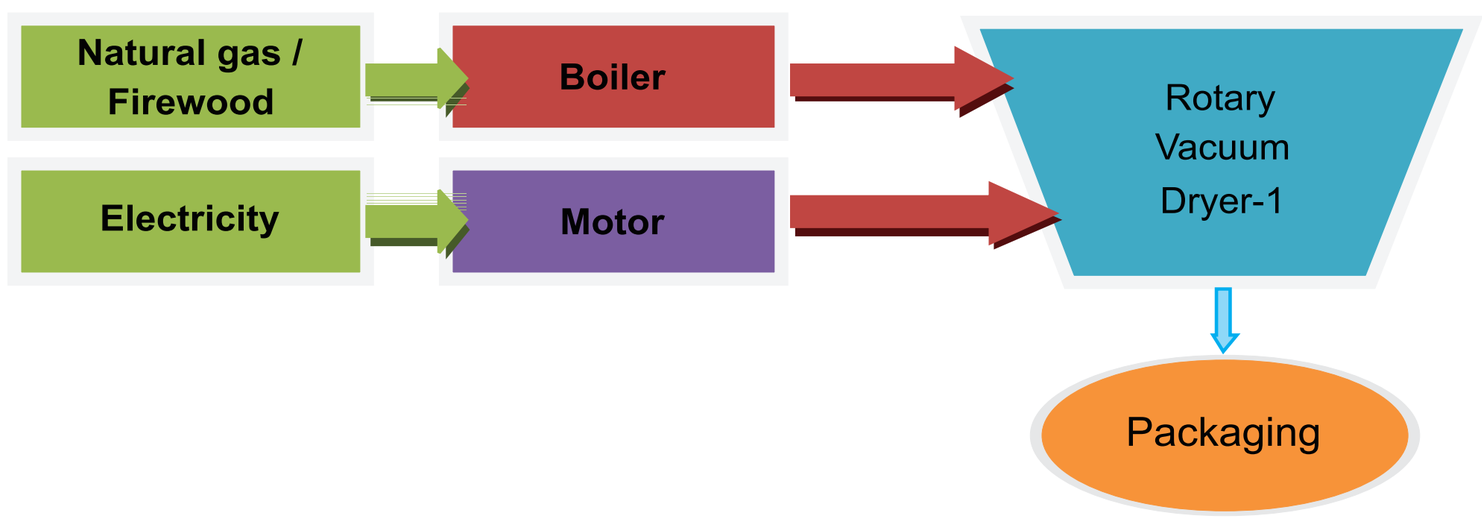
Ankleshwar is a chemical cluster in Gujarat. It has over 700 MSMEs manufacturing various kinds of chemicals (dyes and pigments—67% pharma and pharma intermediates—27%; and pesticides and chlor-alkalis—6%). The production capacity of these units varies from 50 tonnes to over 10,000 tonnes per annum (tpa).

Unit profile

This unit is a MSME unit engaged in the manufacturing of ammonium nitrate, producing about 10,200 tonnes per annum (tpa). The total annual energy bill of the unit was INR 76 lakhs, which was around 40% of total turnover. The total annual energy consumption was 380, of which wood accounted for 76% (288 toe), natural gas (NG) 20% (75 toe), and grid electricity 4% (17 toe).

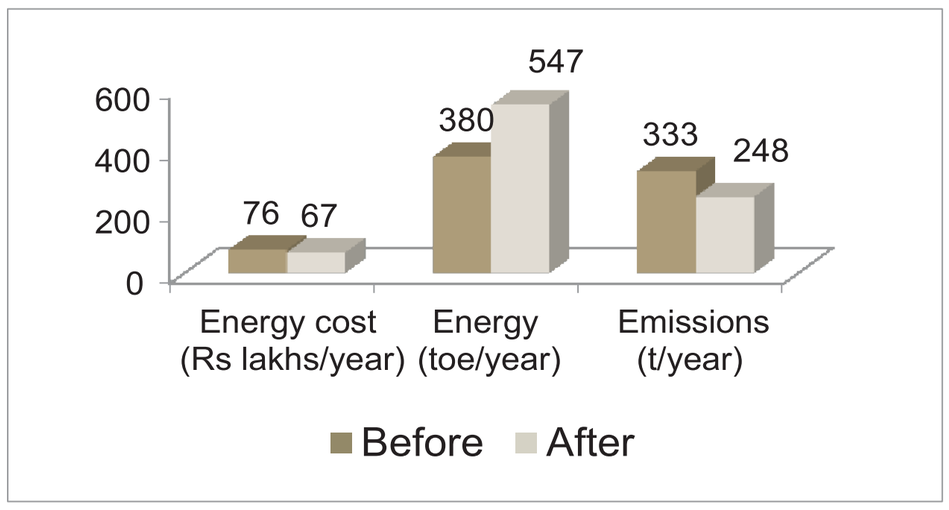
Process description

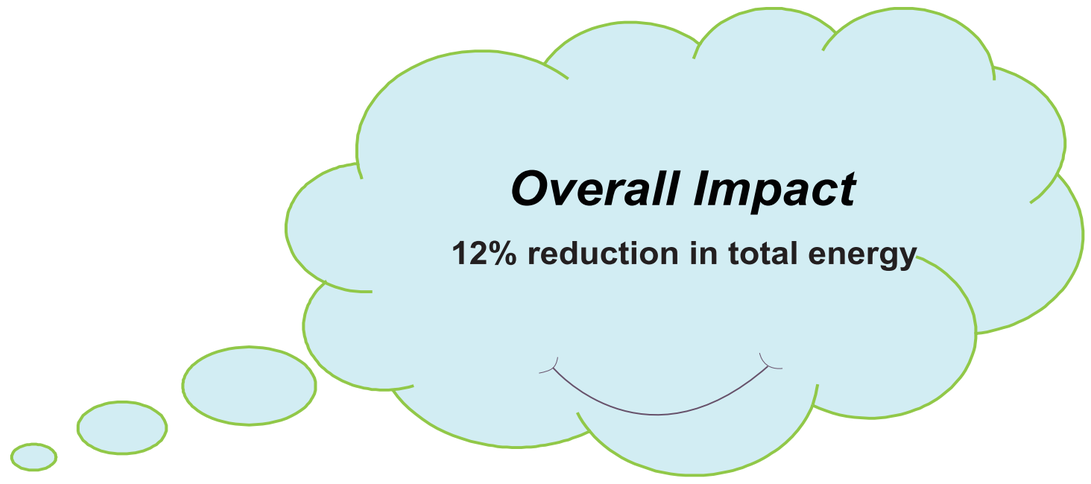
The pre-prepared batch materials are charged in rotary vacuum dryers, where they are heated indirectly, using steam from boilers. The mixture is continuously stirred to ensure uniform heat transfer. The steam is recovered by condensers using water from cooling towers. The product is removed from the rotary vacuum dryers for packaging and dispatch.



The main energy consuming equipments used by the unit were comprised of two steam boilers (one wood-fired, the other NG-fired, each of 600 kg/hour steam generation capacity), and three cooling towers, (each with capacity of 60 tonnes of refrigeration (TR) and operating on electricity)

Overall Impact - Post implementation





INTERVENTIONS

Replacement of two existing non-Independent Business Review boilers with single Independent Business Review boiler of larger capacity

Baseline Scenario

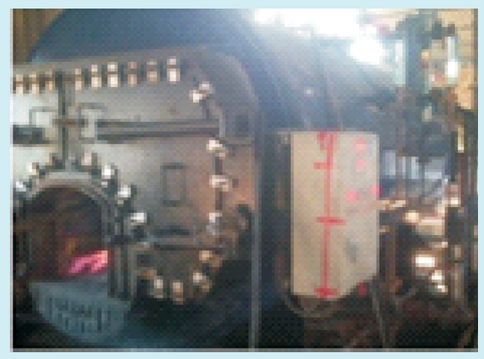
The two existing boilers, each with steam generation capacity of 600 kg/hour, had operational efficiencies of 59% (NG-fired)and 56% (wood-fired). These efficiency levels were low compared to boilers of similar categories. The lower efficiencies were due to lack of waste heat recovery, use of incompatible burner (for NG firing) and poor insulation.

Recommendation

The unit was advised to replace the two existing boilers with a single wood-fired boiler of IBR type having steam generation capacity of 2000 kg per hour.

Implemented Scenario

Based on the project's recommendation, the unit replaced the two existing boilers with a single IBR wood-fired boiler of capacity 2000 kg per hour, with an efficiency of 74%. While electricity and wood consumption have increased by 65,700 kWh and 729 tonnes respectively, about 64,125 SCM of NG being saved annually.



This investment of INR 14.62 lakhs is saving about INR 6.97 lakhs annually in energy cost, with simple payback period of 2.1 years.

Replacement of existing cooling towers

The three existing cooling towers, with individual pumps,were drawing constant power for both high and low loads.As suggested, they were replaced by a single cooling tower of 180 TR capacity. This investment of INR 2.86 lakhs is saving 35,153 kWh of electricity annually, equivalent to INR 2.26 lakhs. The simple payback period is 1.3 years.

Installation of power factor correction system at main incomer

Analysis of electricity bills showed an average power factor of 0.90 at main incomer. A power factor controller was installed to improve the power factor to about 0.95. This investment of INR0.06 lakhs is saving INR 0.06 lakhs annually. The simple payback period is one year.

CS-8

A CASE STUDY FROM ANKLESHWAR CHEMICAL CLUSTER

MSME pharma unit invests 14 lakhs on energy efficiency measures, saves 12 lakhs annually!

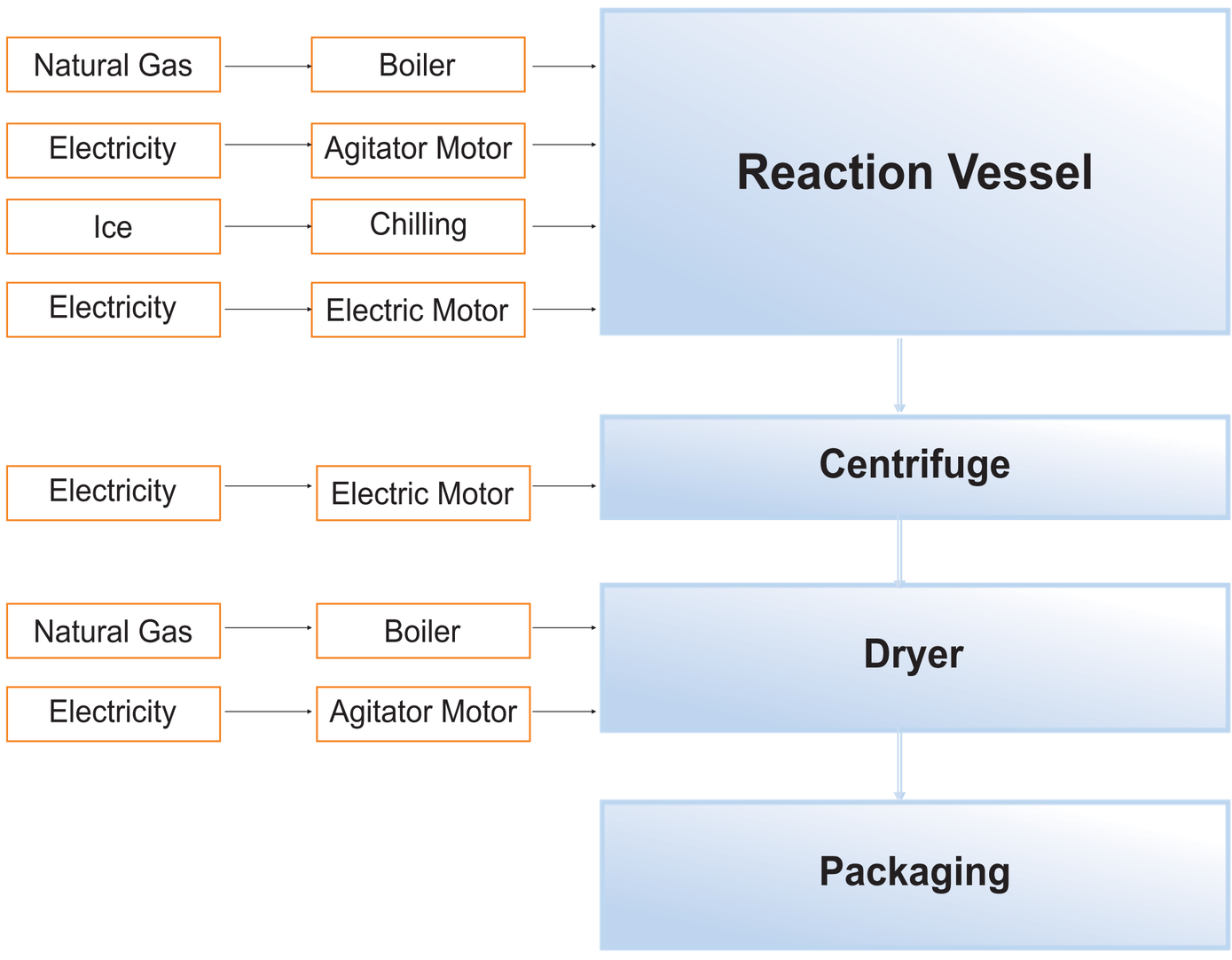
Unit profile

This unit is a MSME unit that manufactures intermediates of gabapentin, lamotrigine, tizadidine, paroxetine, bulk intermediates and pharmaceutical chemicals. The annual production is about 63 tonnes. The total annual energy bill of the unit was INR 83 lakhs, which was around 11% of total turnover. The total annual energy consumption was about 170 tonnes of oil equivalent (toe), of which natural gas (NG) accounted for 81% (137 toe)and grid electricity 19% (33 toe).

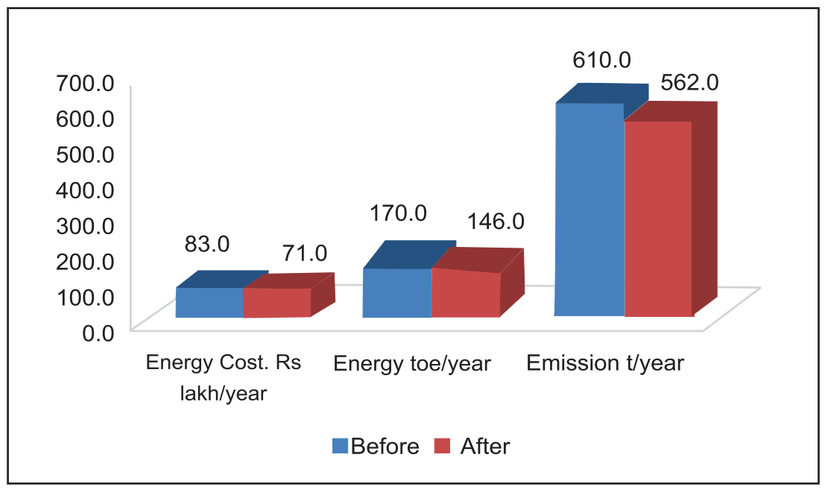
Process description

The pre-prepared batch materials are charged in a reaction vessel with suitable solvent. and made to react at a specific temperature. The batch is heated or cooled as required, using steam/hot oil for heating and ice/chilled water for cooling. This mixture is continuously stirred to ensure uniform heat transfer. After reaction, the output of the primary vessel is filtered, using filter press or centrifuge, and then dried using steam or direct fired hot air generators to give the final product.

The main energy consuming equipments were an NG-fired boiler of capacity 800 kg/hour steam, and electrical motors associated with process equipment such as reaction vessels and centrifuges.



Overall Impact: post- implementation



Overall Impact

14% reduction in total energy bill

INTERVENTIONS

Replacement of existing non-IBR boiler with IBR boiler of larger capacity

Baseline Scenario

The unit was operating a non-IBR type NG-fired boiler with capacity of 800 kg/hour steam. Its efficiency was only about 70%. The low efficiency level was due to lack of waste heat recovery, use of incompatible locally-made burner, poor insulation, leakages in the main furnace shell, etc.

Recommendation

The unit was advised to replace the existing boiler with an energy efficient IBR boiler having steam generation capacity of 1000 kg/hour.

Implemented Scenario

Based on the project's recommendation, the unit replaced the existing boiler with an IBR boiler of capacity 1000 kg/hour steam, with a design efficiency of 88%. The higher capacity meets steam demands of the unit when process heating and drying are carried out together.

This investment of INR 13.5 lakhs is saving about 28,006 SCM of NG annually, equivalent to INR 12.0 lakhs. The simple payback period is 1.1 years.

Installation of power factor controller at main incomer to improve the billing power factor

Analysis of electricity bills showed that the power factor at main incomer varied in the range of 0.913–0.998, and the average power factor during the year was about 0.943. A power factor controller was installed at the main incomer to improve the overall power factor of the unit to about 0.99. This measure has helped the unit in avoiding penalties. This investment of INR 21,250 is bringing an annual saving of INR 17,012. The simple payback period is 1.2 years.

CS-9

A CASE STUDY FROM ANKLESHWAR CHEMICAL CLUSTER

MSME chemical unit invests Rs 16 lakhs in energy efficiency measures—and saves Rs 28 lakhs on annual energy bill!

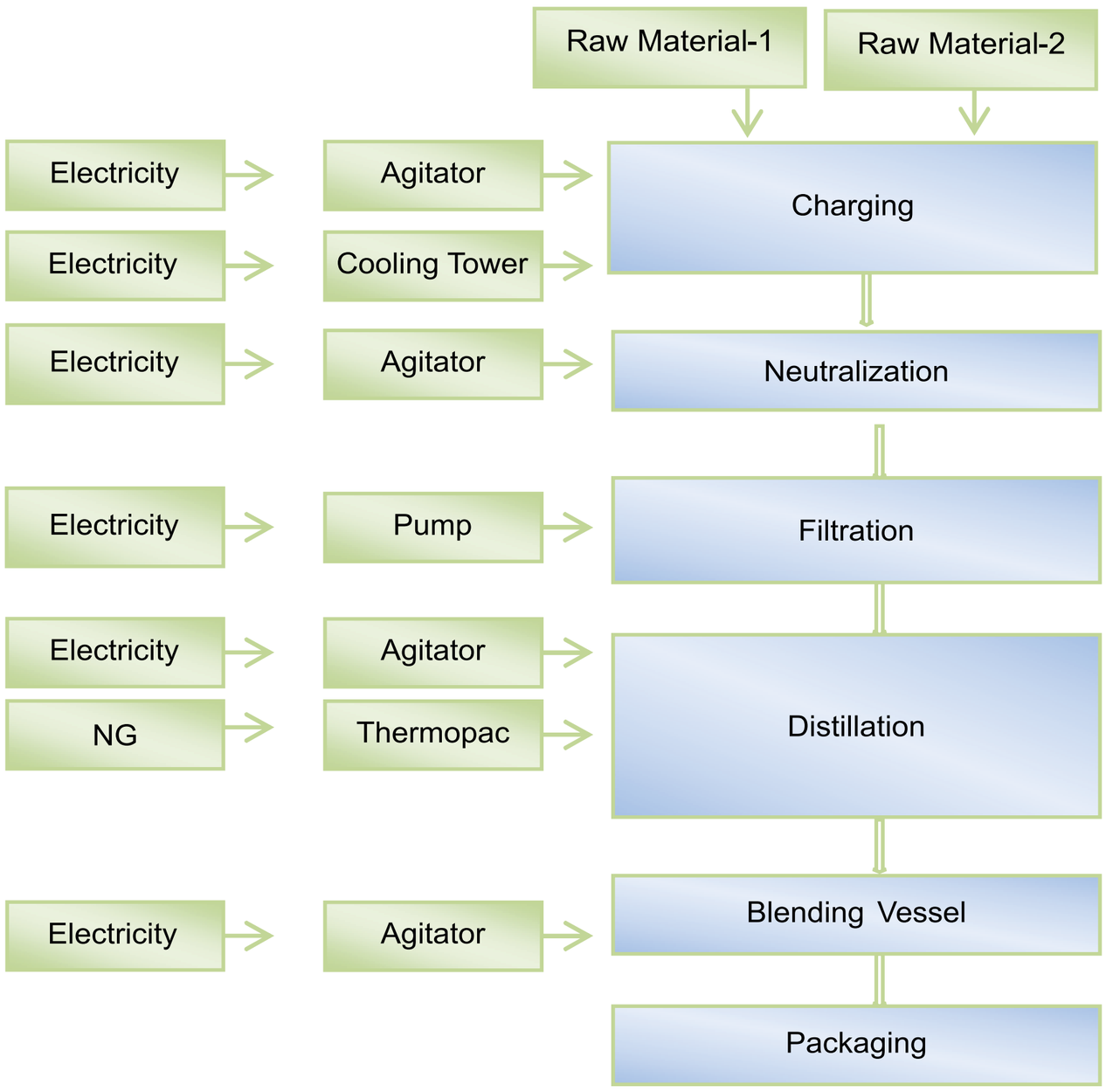
Unit profile

This unit is a MSME unit manufacturing industrial solvents and lubricants. The annual production is about 2600 tonnes. The total annual energy bill of the unit was about INR 98 lakhs, which was around 19% of total turnover. The total annual energy consumption was about 215 tonnes of oil equivalent (toe), of which natural gas (NG) accounted for 94% (201 toe) and grid electricity 6% (14 toe).

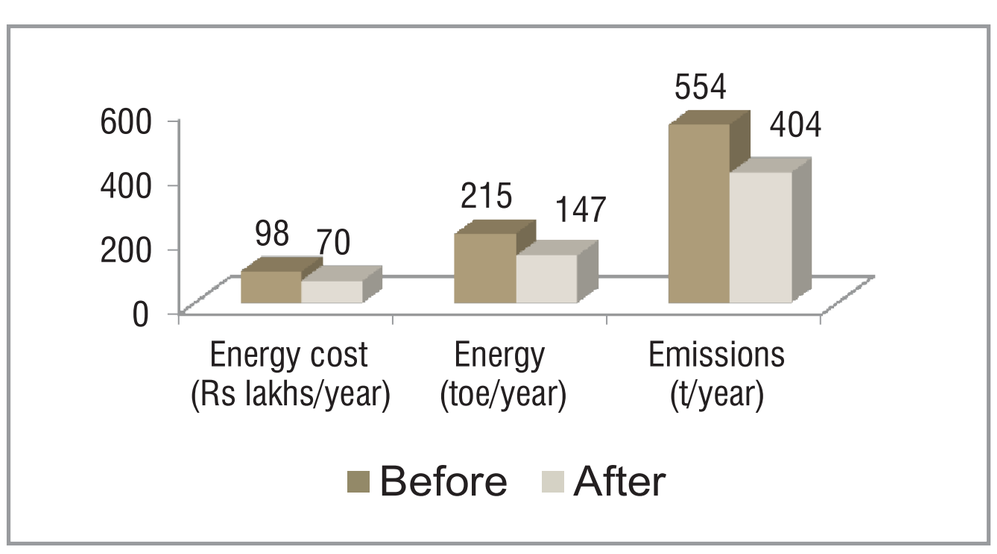
Process description

The manufacturing process involves reaction of the raw materials at a particular temperature, which is maintained through indirect heating by hot oil from a thermic fluid heater (TFH) or cooling by chilled water from a cooling tower. The reaction products are filtered and then the vapours are condensed to the liquid product by passing through a water-cooled condenser.

The main energy consuming equipments used were three NG-fired TFHs with heating capacities of 600,000, 400,000 and 200,000 kcal/hour, and electrical motors associated with agitator, cooling tower pumps, and other utilities.



Overall Impact: post- implementation



Overall Impact

28% reduction in total energy bill

INTERVENTIONS

Replacement of existing packing in distillation column with high efficiency packing

Baseline Scenario

The unit was separating methanol and water in a 600 mm diameter distillation column. The existing packing in the column required high energy input to get the desired process parameters.

Recommendation

The unit was advised to replace the existing packing with Sulzer high efficiency structured packing, so as to reduce heat losses and improve heat and mass transfer.

Implemented Scenario

As advised, the unit replaced the existing distillation column packing with Sulzer high efficiency structured packing.

This investment of INR 7.9 lakhs is saving 56,426 SCM of NG annually, equivalent to INR 21 lakhs. The simple payback period is just five months. Annually in energy cost, with simple payback period of 2.1 years.

Replacement of existing agitator system

The existing anchor-type agitator system required heating of batch materials to about 110°°C, consuming about 80 SCM of NG and taking about five hours per batch. As advised, the unit replaced the existing system with a high efficiency EKATO agitator which works at room temperature and reduces batch time to 90 minutes. This investment of INR 4.5 lakhs is saving 16,000 SCM of NG and 750 kWh of electricity annually, equivalent to INR 5 lakhs. The simple payback period is 0.9 year

Installation of VFD enabled process cooling water circulation pump

The existing cooling water circulation pump had a low efficiency (57%), with a rewound motor. As advised, the unit replaced it with an efficient VFD enabled process cooling water system. This investment of INR 3.4 lakhs is saving 15622 kWh of electricity annually, equivalent to INR 1 lakh. The simple payback period is 3.3 years.

Preventive maintenance of TFH burner to optimize oxygen level in flue gas

The TFH of 600,000 kcal/hour capacity showed a high excess air level (49–106%), which indicated energy loss. As advised, the unit adjusted the damper position to reduce the amount of excess air level. This investment of INR 0.1 lakh is saving 12,146 SCM of NG annually, equivalent to INR 1.5 lakhs. The simple payback period is 0.1 year.

CS-10

A CASE STUDY FROM ANKLESHWAR CHEMICAL CLUSTER

MSME chemical unit invests Rs 9 lakhs in energy efficiency measures—and saves Rs 5 lakhs every year!

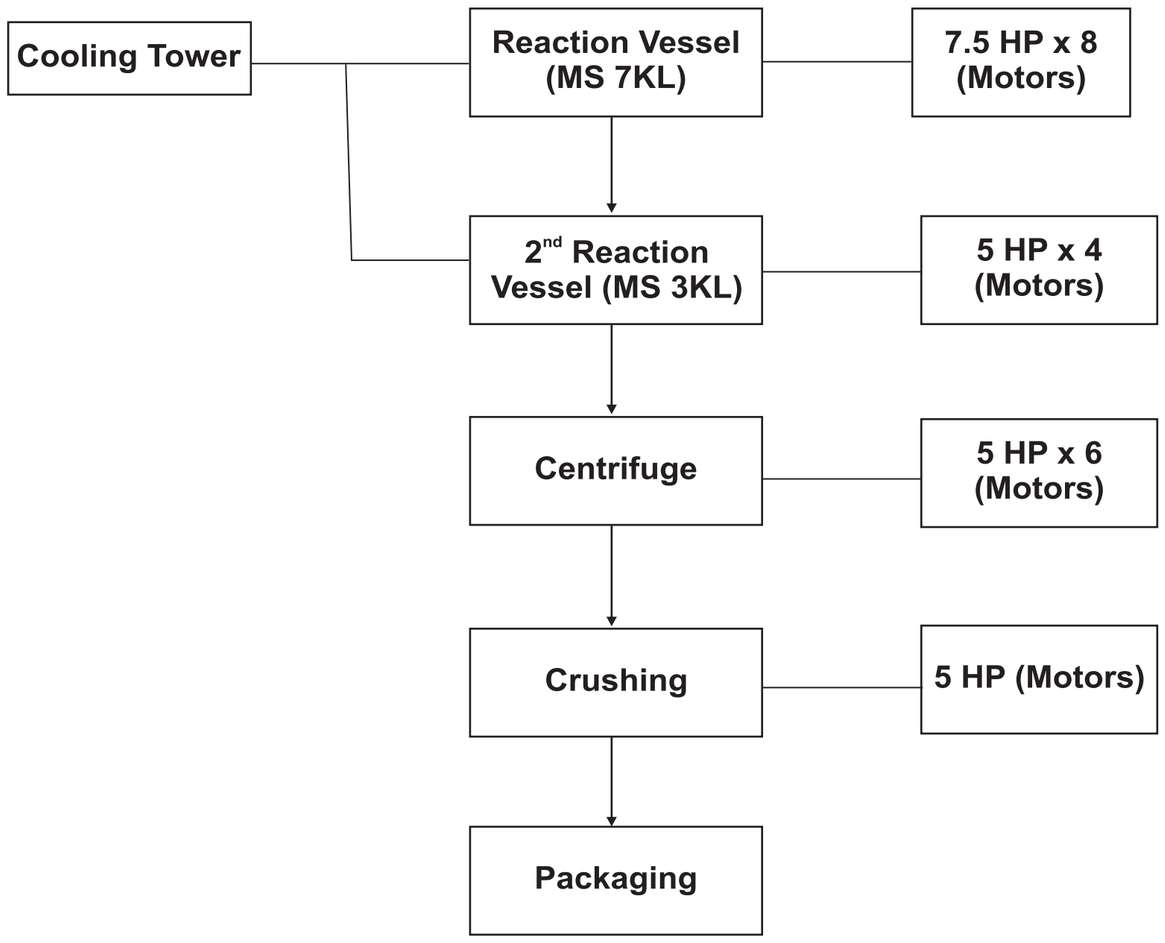
Unit profile

This unit is a MSME unit manufacturing tablets and capsules of sulphamic acid and related compounds. The annual production is about 3600 tonnes. The total annual energy bill of the unit was about INR 28 lakhs, which was around 3% of total turnover. The total annual energy consumption was about 42 tonnes of oil equivalent (toe), of which grid electricity accounted for 72% (30 toe) and natural gas (NG) 28% (12 toe).

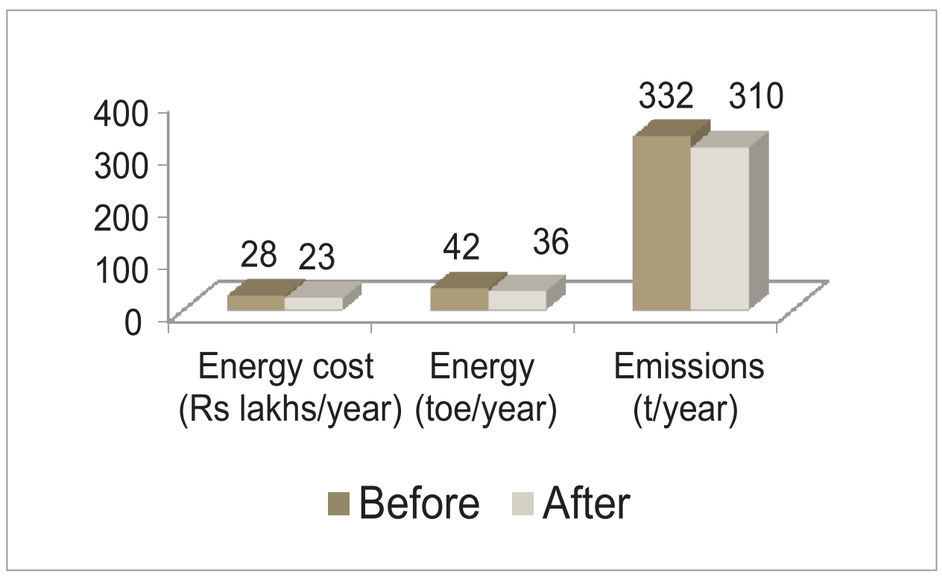
Process description

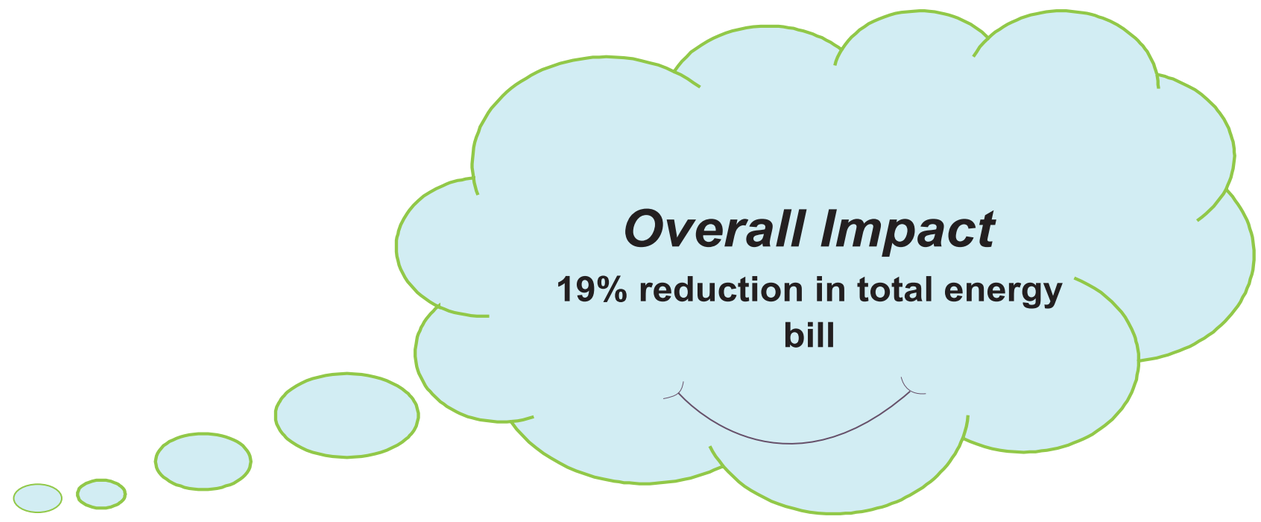
The manufacturing process involves reaction of the raw materials at a particular temperature, which is maintained through indirect heating by steam from an NG-fired boiler, or cooling by chilled water from a cooling tower. The reaction products are centrifuged and powdered to be processed to the final products.

The main energy consuming equipments used were an NG-fired steam boiler with capacity of 600 kg/hour; an NG-based rotary dryer; electrical motors associated with agitator, cooling tower pumps, and other utilities; and lighting.



Overall Impact: post- implementation





INTERVENTIONS

Replacement of damaged wooden cooling tower with an efficient cooling tower

Baseline Scenario

The unit was using a locally fabricated wooden cooling tower of average capacity 25 TR. Its effectiveness was low (about 11%) due to broken wooden fins, resulting in increased cooling cycle time/batch time.

Recommendation

The unit was advised to replace the existing cooling tower with a new natural draft cooling tower of 100 TR capacity.

Implemented Scenario

As advised, the unit replaced the existing cooling tower with a new cooling tower of 100 TR capacity.

This investment of INR 1 lakh is saving 7416 kWh of electricity annually, equivalent to INR 0.5 lakh. The simple payback period is 2 years.

Replacement of cooling tower pump

The operating efficiency of the cooling tower water circulation pump was very low at 13%. As advised, the unit replaced it with an energy efficient pump of the same specifications. This investment of INR 0.21 lakh is saving 5990 kWh of electricity annually, equivalent to INR 0.4 lakh. The simple payback period is 0.5 year.

Replacement of existing vertical type boiler with energy efficient horizontal boiler

The unit was running an NG-fired vertical boiler of 600 kg/hour capacity. Its efficiency was low (69%) due to surface losses and dry flue gas losses. As advised, the unit replaced it with a 3-pass horizontal SIB-type boiler. This investment of INR 7.9 lakhs is saving 10,559 SCM of NG annually, equivalent to INR 3.9 lakhs. The simple payback period is 2 years.

Appropriate Insulation of rotary dryer and hot air generator system

The surface temperatures of the rotary dryer were found to be high, indicating energy losses due to poor insulation. As advised, the unit applied appropriate insulation on the rotary dryer surfaces. This investment of INR 0.2 lakh is saving 1398 SCM of NG annually, equivalent to INR 0.5 lakh. The simple payback period is less than six months.

CS-11

A CASE STUDY FROM FARIDABAD MIXED CLUSTER

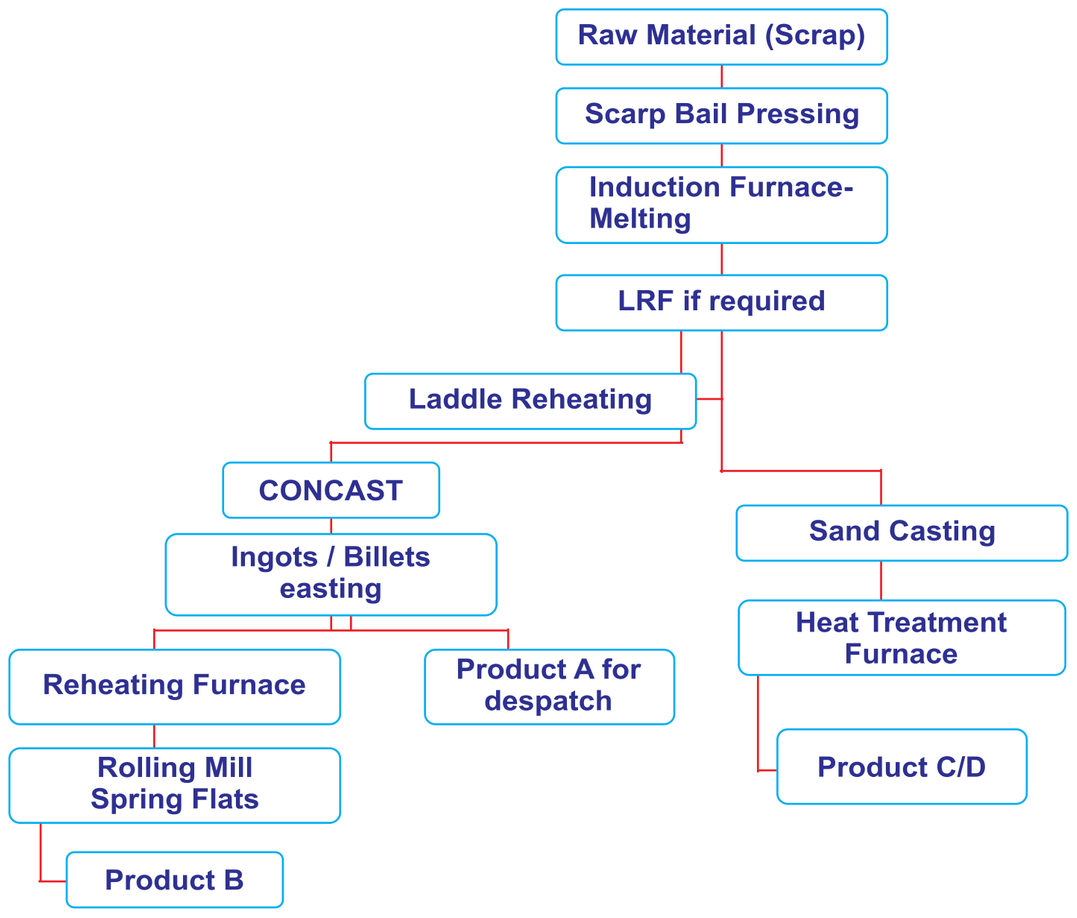
10% reduction in energy bill of a foundry MSME unit through Energy Efficiency

Background

Faridabad is a cluster of mixed industries in Haryana having over 12000 MSMEs majorly manufacturing various kinds of automobile parts, sheet metal components and fabrics. There are majorly 15 industrial segments in the cluster with a high range of products from soaps to tractors.

Unit Profile

This unit is a MSME unit engaged in manufacturing of carbon steel and hot rolled steel products producing about 19675 either write tonnes/annum ar tonnes per annum. Total Energy bill of the unit was Rs.1260 lakh per annum which was around 16% of total turnover. About 64% of the unit's energy bill was on account of Grid electricty, 27% accounted for PNG, 5% accounted for DG-Diesel, 4% accounted for Furnace oil and remaining 1% accounted for LPG.

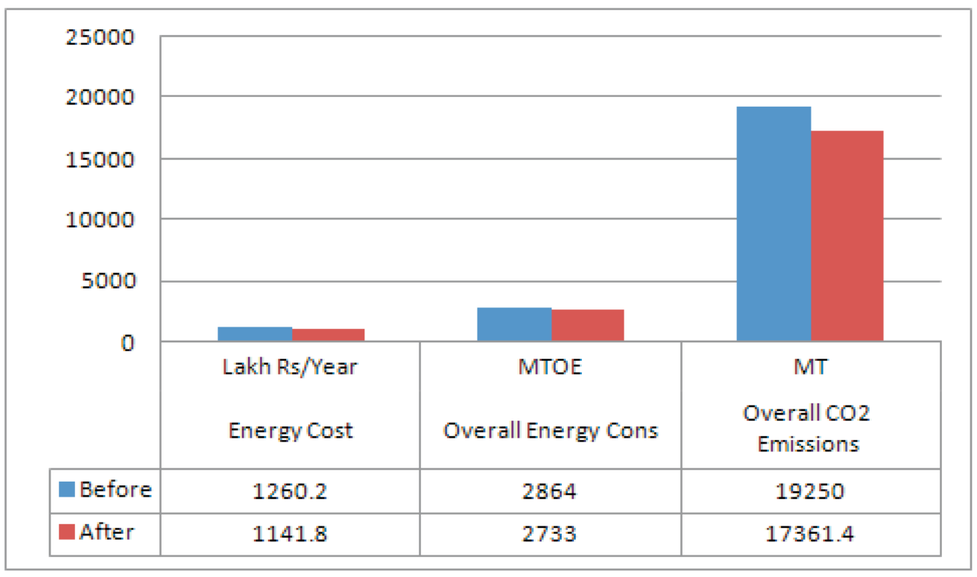


Process description

The manufacturing process involves the separation of turing wastes and sheet metal cuttings from the scrap before its loading into induction furnace. Melting of the metal is done in the furnace till the molten metal is heated to the desired temperature of around 1600^{0}C. Charging is done as per requirement till the desired level of molten metal is reached followed by the removal from the furnace to continuous casting machine by electric hoist for casting billets of required sizes. Moving further, billets are passed through a reheating furnace followed by the rolling process. These flats are removed from rolling stands using mechanized conveyers and cut to the desired size for final inspection and further processing / finishing before dispatch.

Piped natural Gas and Grid Electricity were used to operate major energy consuming equipments in the unit i.e. induction furnace, rolling motor, cooling tower and other utilities like pumps, motors associated with equipments, and lighting.

Overall Impact: post- implementation



	Lakh Rs/Year Energy Cost	MTOE Overall Energy Cons	MT Overall CO2 Emissions
Before	1260.2	2864	19250
After	1141.8	2733	17361.4

Overall Impact

10% reduction in Total Energy bill (i.e. savings of INR 118 lakh p.a.) Simple payback of 16 months

INTERVENTIONS

Replacement of the refractory material of preheating furnace in rolling mill section

Baseline Scenario

The avergae skin temperature on the side walls and top of the furnace was in the range of 70 to 160^{0}C which is very high. Skin losses from the preheating furnace is around 215026 kcal/hr. Inadequate insulation-ead to high heat loss from surfac resulting in poor combustion efficiency.

Recommendation

The unit was advised to improve the furnace refractory to reduce skin losses from 9.5% to 5.3%

Implemented Scenario

Based on the project's recommendation, the unit improved furnace refractory.

Newly replcaed refractory material saves 38198 SCM of fuel per annum.

The Investment of Rs.11 lakh made by the unit has resulted in monetary savings in energy cost of Rs.14 lakh per year with simple payback period of nine months.

Switching Over from furnace are to PNG for Heat Treatment Furnace Application

The performance study was taken during the operational condition of the furnace. As suggested, the unit has switched furnace oil with PNG considering the cost difference. This has helped the unit to reduce overall fuel cost by Rs. 4 lakh per annum

Installation of Oxygen Sensor in Heat Treatment Furnace

The excess air amount in flue gas was very high. With the suggested recommendation, the unit has installed an oxygen sensor with close loop control. This has resulted in an annual fuel saving of 16490 liters/year, equivalent to about Rs. 8 lakh per year with simple payback period of nine months.

CS-12

A CASE STUDY FROM FARIDABAD MIXED CLUSTER

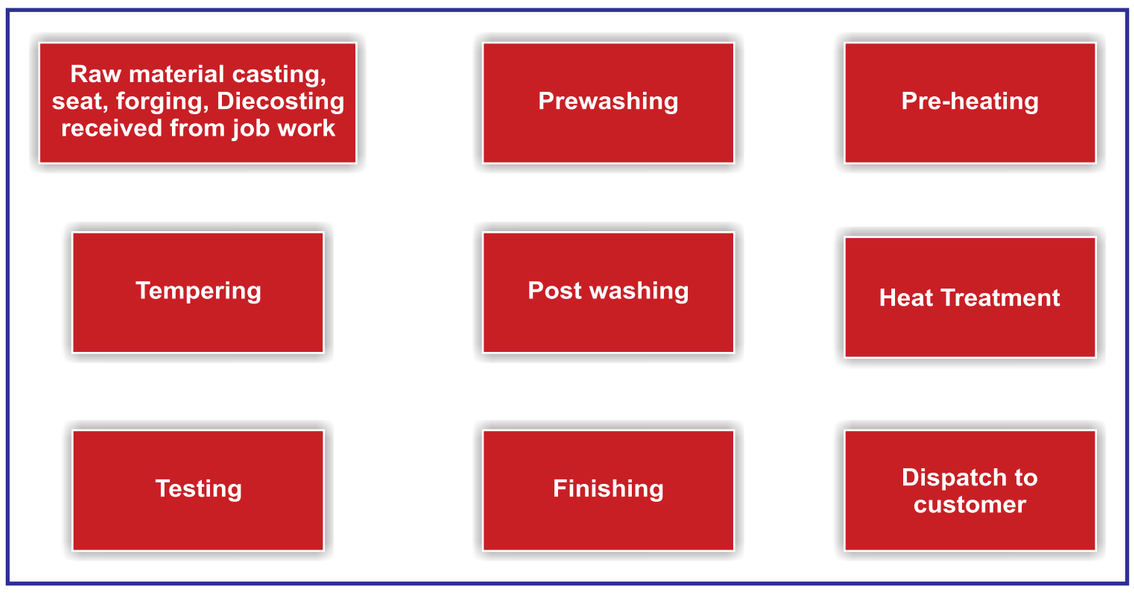
12% reduction in energy bill of a forging MSME unit through Energy Efficiency Measures

Unit Profile

This unit is a MSME unit engaged in manufacturing of heat treatment and forging components producing about 1300 tpa. Total Energy bill of the unit was Rs. 147 lakh per annum which was around 9% of total turnover. About 62% of the unit's energy bill was on account of grid Electricity and remaining 38% accounted for Diesel-DG.

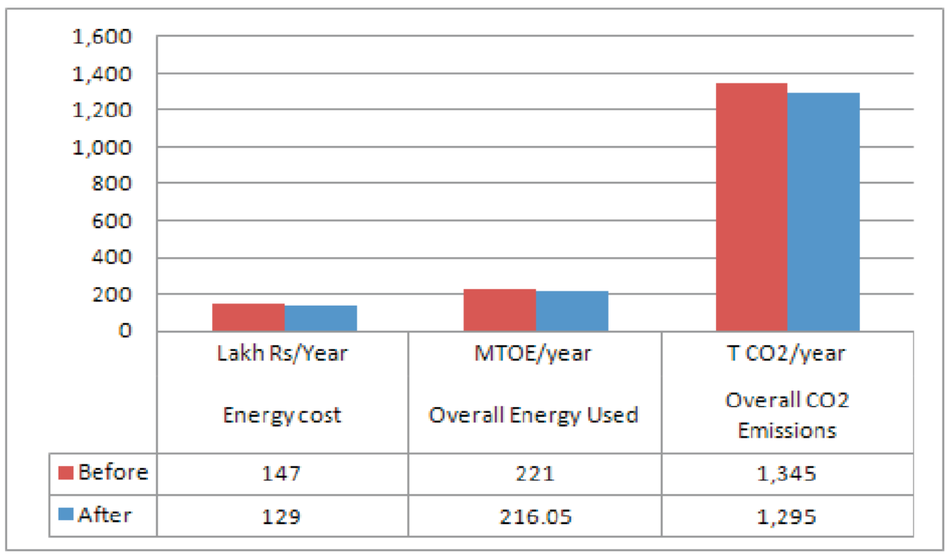
Process description

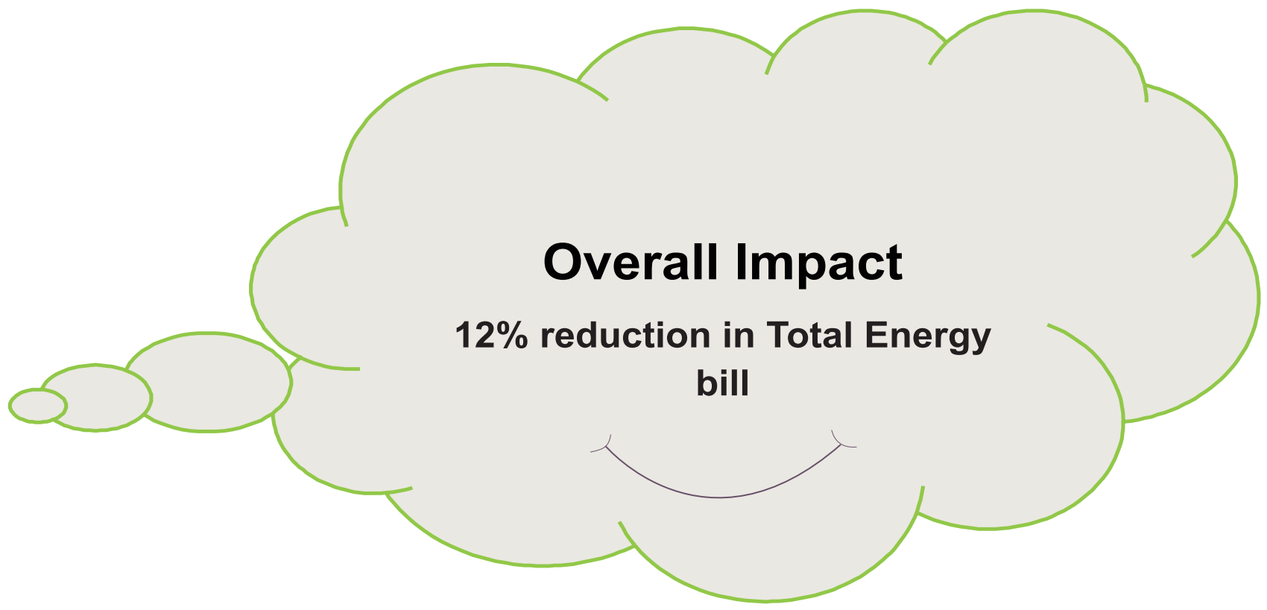
The manufacturing process involves receiving of raw material as forged parts and die casted parts for the pupose of heat treatment. The raw material is pre washed by water at 60°C to remove dust particles from the components. then the raw materials are pre heated in the tempering furnace itself to be fed to quenching furnace. The raw materials are then passed through quenching furnaces where four processes of carburizing, nitriding, hardening and quenching are done. The heat treated products are allowed to pass through water to remove excess oil sticking to the pieces. The pieces are sent to tempering furnace where they are further heat treated to get desired properties. The pieces are finally tested at different parameters and finished using bench grinder and shot blasting machine and finally dispatched.



Diesel and Grid Electricity were used to operate major energy consuming equipments in the unit i.e. furnaces and other utilities i.e. shot blasting machines,pumps, motors and other machines, and lighting.

Overall Impact: post- implementation





INTERVENTIONS

Replacement of the Compressors with Single Screw Compressors

Baseline Scenario

Free air delivery test of both the compressors was done. The SEC of first compressor was found out to be 0.55 kW/CFM, for second compressor it was around 0.22 kW/CFM and for third compressor SEC was 0.32 kW/SCM and the electrcity consumption by the compressors were 42,155 kWh, 39,204 kWh and 81,359 kWh per annum with the average power consumption of 11.71 kW, 10.89 kW and 22.6 kW repectively. High SEC results into high electricity consumption and poor efficiency of the compressor.

Recommendation

The unit was advised to replace the first reciprocating compressor by a single big screw compressor with second compressor as a stand by.

Implemented Scenario

Based on the project's recommendation, the unit replaced first reciprocating compressor by screw compressor.

Newly installed compressor consumes 28,495 kWh of electricity per annum.

The Investment of Rs.13.6 lakh made by the unit has resulted in monetary savings in energy cost of Rs.4.8 lakh per year with simple payback period of 34 months.

Installation of capacitor bank to improve power factor

The average power factor of the unit was low, at 0.840. As suggested, the unit installed an additional capacitor bank to improve the power factor to about 0.99. This helped the unit to reduce distribution losses and voltage fluctuation besides avoiding penalty.

Replacement of Window AC with Star Rated AC

The unit had 1.5 ton window AC in control room having SEC 1.05 kW/Ton. With the suggested recommendation, the unit replaced window AC with 5 star rated AC. This resulted in an annual energy saving of 1620 kWh of electricity, equivalent to about Rs. 15,000 per year with simple payback period of 25 months.

CS-13

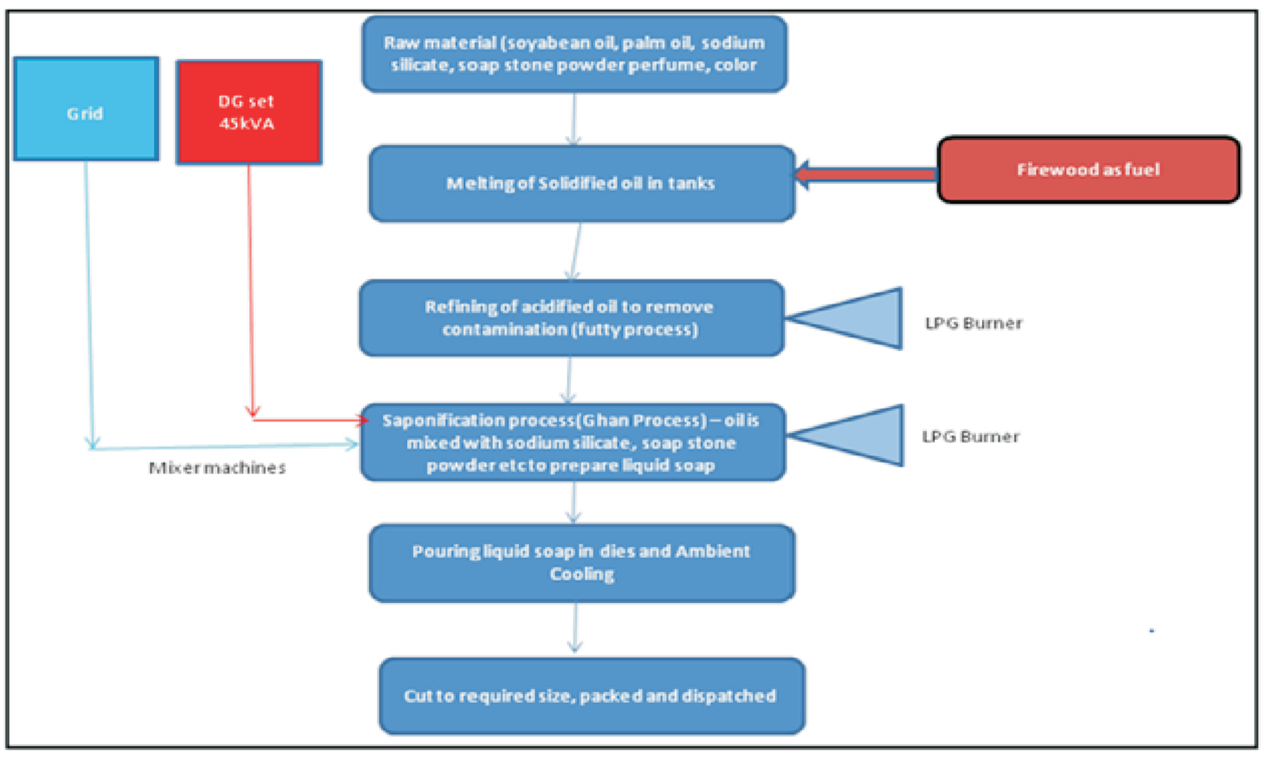
A CASE STUDY FROM FARIDABAD MIXED CLUSTER

9% reduction in energy bill of a washing soap MSME unit through Energy Efficiency Measures

Unit Profile

This unit is a MSME unit engaged in manufacturing of washing soaps and chips producing about 7900 tpa. Total Energy bill of the unit was Rs.82.0 lakh per annum which was around 13% of total turnover. About 81% of the unit's energy bill was on account of Piped Natural Gas, 12% accounted for Grid electricity and remaining 7% accounted for HSD in DG

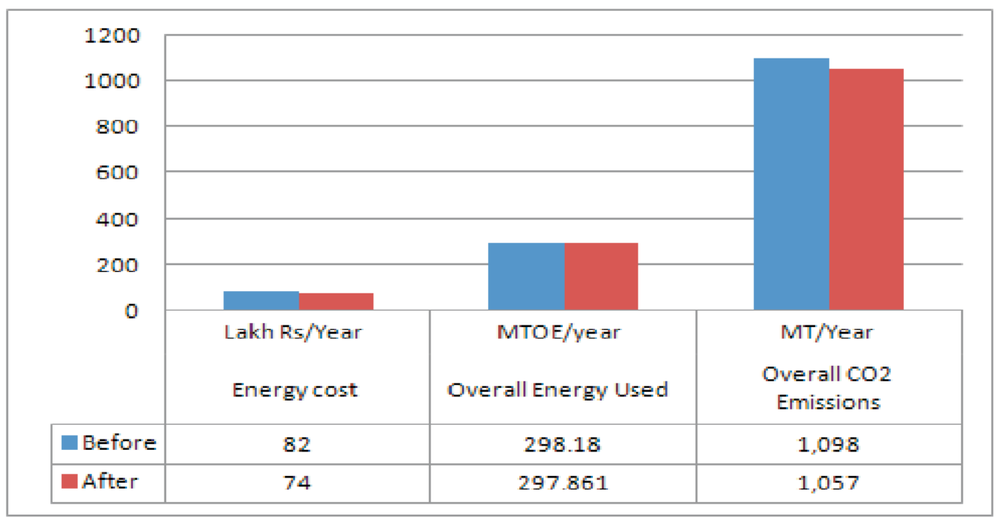
Process description



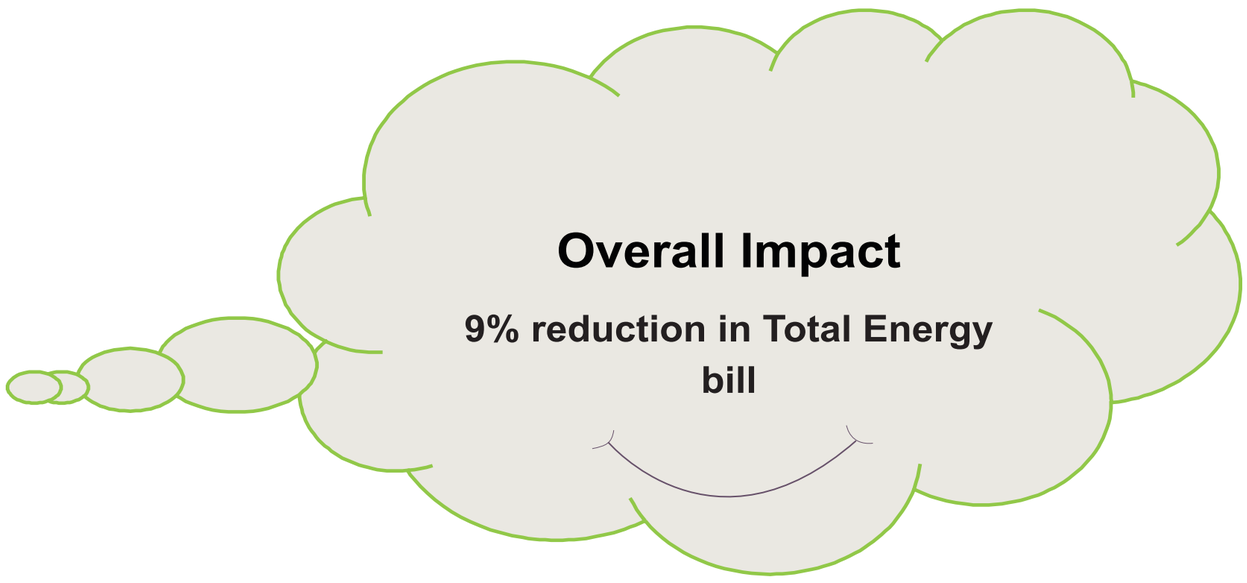
The manufacturing process involves the receiving of acid oils followed by processes like melting process where the solidified acid oil is heated using firewood followed by refining process in which the liquefied acid oil is refined for 6-8 hours which is locally known as futty process this is followed by saponification process in which the refined acid oil is mixed and heated with caustic soda in presence of water. Here the actual required quality of soap is maintained. Further sodium silicate, soap stone powder, color and perfume are added and heated in gas pan using LPG burners; this process is locally known as Ghan process. After the mixture gets thicken it is poured into dies and is ambient cooled. Then the soap cakes are cut to the required sizes (finished products) and after packing are dispatched.

Piped natural Gas and Grid Electricity were used to operate major energy consuming equipments in the unit i.e. Oil pump, Mixer motors, AC and other utilities i.e. pumps, motors associated with equipments, and lighting.

Overall Impact: post- implementation



	Lakh Rs/Year Energy cost	MTOE/year Overall Energy Used	MT/Year Overall CO2 Emissions
Before	82	298.18	1,098
After	74	297.861	1,057



INTERVENTIONS

Replacement of the fuel from LPG to PNG for refining and saponification

Baseline Scenario

The unit was using industrial LPG cylinders of 49 kg each as fuel in the refining and saponification process to heat the liquid mixture (majorly oils) to not more than 70°C. Conversion of LPG burners to PNG was recommended. As per the measurements done during the field visit, the soap temperature is maintained at around 70°C-75°C in both saponification and refining tanks. Also the unit has 5 refining tanks and 15 saponification tanks. Analysis of the historical LPG consumption figures (for FY 2011-12) shows that the average consumption of LPG in the unit is 9,055 kg/month.

Recommendation

The unit was advised to replace the existing fuel i.e. LPG with PNG.

Implemented Scenario

Based on the project's recommendation, the unit replaced LPG with PNG for meeting thermal energy demand.

Newly installed system consumes 1,50,928 SCM of PNG per annum.

The Investment of Rs.10 lakh made by the unit has resulted in monetary savings in energy cost of Rs.7.3 lakh per year with simple payback period of 16 months.

Reduction in opening loss in refining vessels

The heat loss from the refining tank was 3.5 M kcal/year. As suggested, the unit covered the refining tank with metal sheet to reduce opening loss to about 0.7 M kcal.. This has helped the unit to reduce the heat loss and the overall fuel consumption.

Replacement of T-12 lamps by T-8 lamps

The unit was lighting the production area through 50 no. of T-12 lamps. With the suggested recommendation, the unit replaced 50 no. of T-12 lamps by 70 no. of T-8 lamps. This has resulted in an annual energy saving of 414 kWh of electricity, equivalent to about Rs. 3,528 per year with simple payback period of 26 months.

CS-14

A CASE STUDY FROM FARIDABAD MIXED CLUSTER

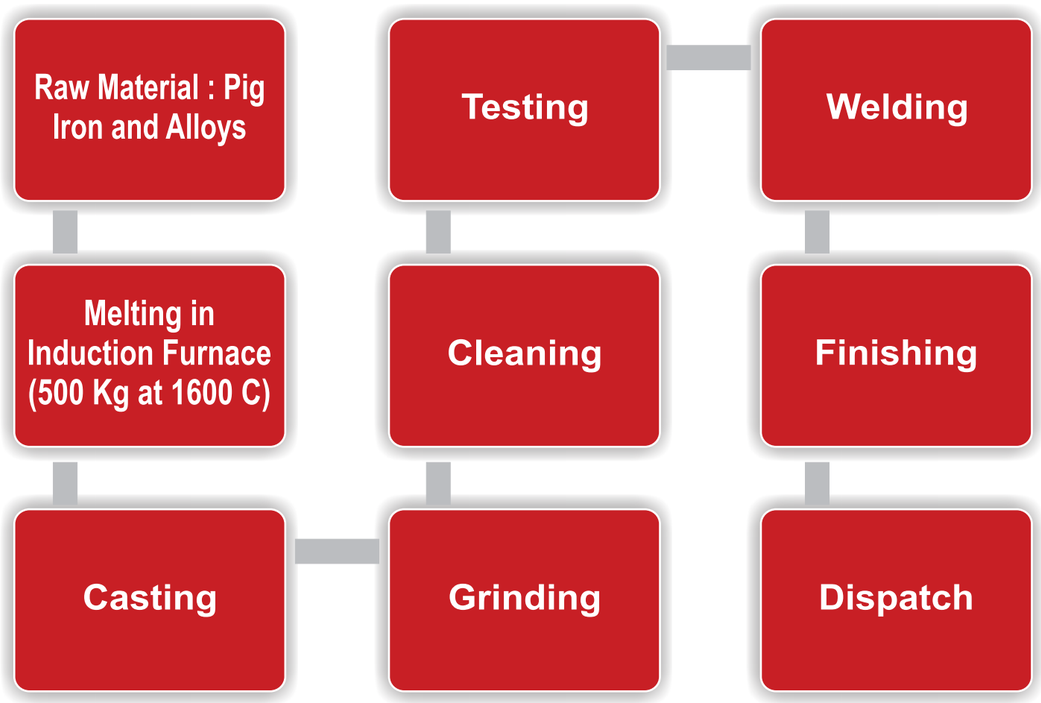
32% reduction in energy bill of a casting MSME unit through Energy Efficiency Measures

Unit Profile

This unit is a MSME unit engaged in manufacturing of casting components & components of ash handling plants producing about 320 tpa. Total Energy bill of the unit was Rs.64.3 lakh per annum which was around 2% of total turnover. About 49.5% of the unit's energy bill was on account of Diesel-DG, 28.82% accounted for Furnace oil and remaining 21.68% accounted for Grid electricity.

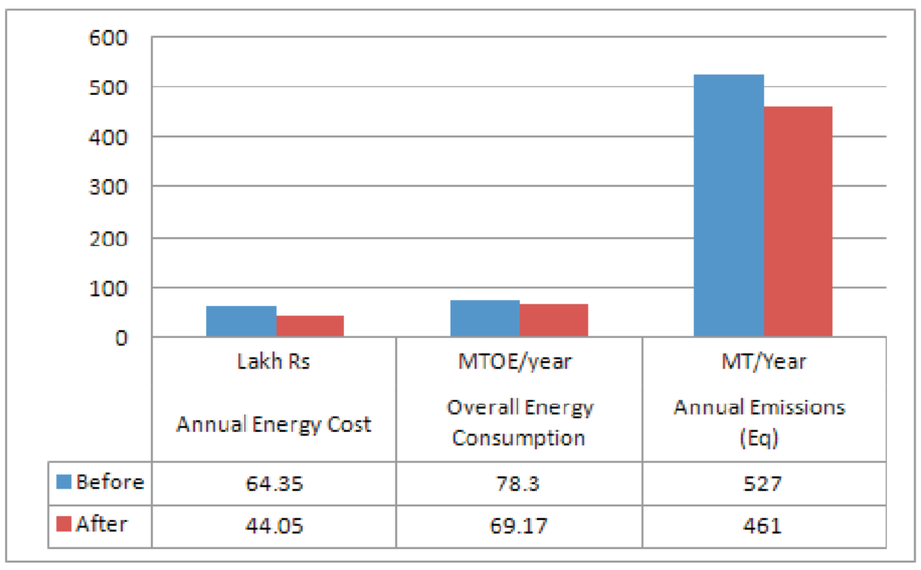
Process description

The manufacturing process involves the procurement of raw material from market. However, the scrap selection basically depends upon the final requirement of the customer. Usually, MS/ CI/ Pig Iron grade scrap is procured from the market for melting purpose. The scrap is first weighed and fed into the induction furnace for melting. The liquid metal is poured into cast to obtain the desired shape. The cast undergoes trimming to give a final shape and dimensions. If required, the final cast is also given heat treatment in heat treatment furnace where the internal stresses of the product are removed by normalizing and iso-annealing as per client and product requirement



Furnace Oil, Diesel and Grid Electricity were used to operate major energy consuming equipments in the unit i.e. induction furnace, heat treatment furnace and other utilities i.e. pumps, motors associated with equipments, and lighting.

Overall Impact: post- implementation



	Lakh Rs Annual Energy Cost	MTOE/year Overall Energy Consumption	MT/Year Annual Emissions (Eq)
Before	64.35	78.3	527
After	44.05	69.17	461

Overall Impact

32% reduction in Total Energy bill (i.e. savings of INR 20 lakh p.a.) Simple payback of 8 months

INTERVENTIONS

Performance monitoring & controlling of induction furnace & rejects control

Baseline Scenario

Energy meter was provided on the furnace panel. But, power consumption was not being monitored. Without monitoring, the plant cannot perform the performance. Temperature of molten metal was excessive in certain cases. The specfic energy consumption based upon the molten metal was 868 kWh/MT.

Recommendation
The unit was advised to procure optical pyrometer so that excess temperature of molten metal can be avoided.

Implemented Scenario

Based on the project's recommendation, the unit procured optical pyrometer
Newly installed system saves 45,989 kWh of electricty per annum.

The Investment of Rs.11 lakh made by the unit has resulted in monetary savings in energy cost of Rs.6 lakh per year with simple payback period of 21 months.

Operating hour controlling of 250kVA DG set

The loading on the 250 kVA DG was very low. As suggested, the unit stopped 250kVA DG set till the time 500kVA can feed power requirement. This has helped the unit to reduce the overall full consumption without affecting the requirement.

Monitoring of Heat Treatment Furnace

The unit had no energy meter provision for heat treatment furnace. With the suggested recommendation, the unit installed an energy meter at H.T furnace. This has resulted in an annual energy saving of 7200 kWh of electricity, equivalent to about Rs. 77,000 per year with simple payback period of eight months.

CS-15

A CASE STUDY FROM FARIDABAD MIXED CLUSTER

31% reduction in Energy bill of a Die Casting MSME unit through Energy Efficiency Measures

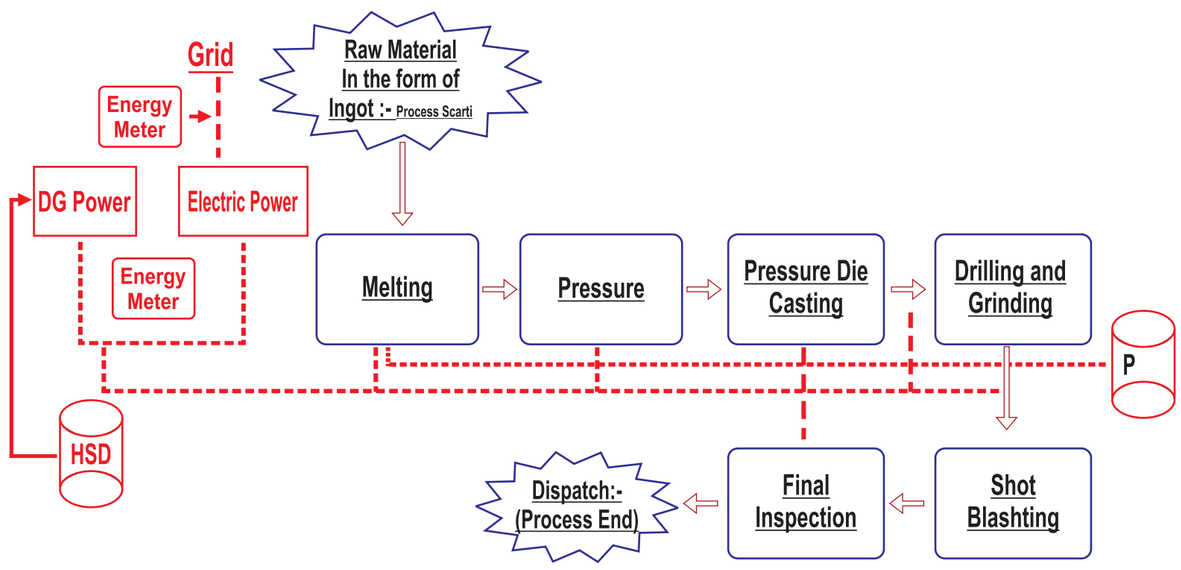
Unit Profile

This unit is a MSME unit engaged in manufacturing of Aluminium & Zinc die casting components and brake lining. Total Energy bill of the unit was Rs.232 lakh per annum which was around 10% of total turnover. About 65% of the unit's energy bill was on account of Piped Natural Gas, 21% accounted for Grid electricity and remaining 14% accounted for HSD-DG.

Process description

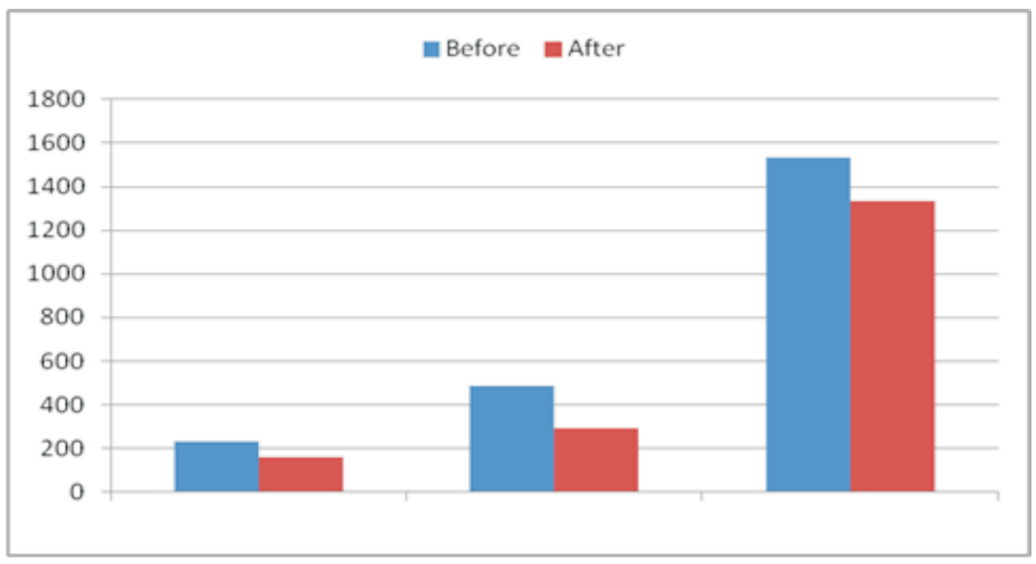
The manufacturing process involves the melting of aluminium ingot in a furnace up to 700°C and manually feeding it to Pressure Die Casting (PDC) Machine. Here cold chamber process is used for Die Casting in Horizontal Pressure Die Casting (PDC) Machine. These casted components are inspected for the casting defects. There After casted component are sent to machine shop for drilling & grinding. These machined components are then sent for quality checking. Final products are packed and stored for dispatch.

rocess Flow Diagram for Aluminium Die Casting



Piped natural Gas, Grid Electricity and HSD were used to operate major energy consuming equipments in the unit like air compressors cooling towers and other utilities such as HVAC, pumps, motors associated with, and lighting.

Overall Impact: post- implementation



Overall Impact

31% reduction in Total Energy bill (i.e. savings of INR 79.27 lakh p.a.) Simple payback of 9 months

INTERVENTIONS

Replacement of the existing PNG fired furnace With Electric powered furnace

Baseline Scenario

All the furnaces in the unit were PNG fired furnaces. They were operating at an average of 7% efficiency, which was relatively low due to high flue gas temperature causing high heat loss in flue gas and high percentage of oxygen in flue gas causing loss of fuel and unaccounted loss in furnace due to opening, leakage etc. Furnaces with a total production capacity of 1177MT/year were consuming around 198488 standard cubic meter (SCM) of PNG annually

Recommendation

The unit was advised to replace the existing PNG-fired furnace with a energy efficient electric powered furnace.

Implemented Scenario

Based on the project's recommendation, the unit replaced PNG-fired furnace with electric powered furnace of same capacity.

Newly installed furnaces consume 412020 kWh per annum.

The Investment of Rs.23 lakh made by the unit resulted in monetary savings in energy cost of Rs.44 lakh per year with simple payback period of only seven months.

Preheating of Combustion Air

The average flue gas temperature coming out of melting furnace is in the range of 700-800^{0}C. Flue gas was directly being exhausted to atmosphere. As suggested, the unit has installed a waste heat recovery system to preheat the combustion air. This has helped the unit to reduce heat loss in flue gas and fuel consumption.

Cooling Tower Optimization

The unit had a cooling tower fan which ran for whole year without any automation. With the suggested recommendation, the unit has installed an automation system which automates the CT fan by monitoring hot and cold water temp. This has resulted in an annual energy saving of 32,000 kWh of electricity, equivalent to about Rs. 2.53 lakh per year.

CS-16

A CASE STUDY FROM KOLHAPUR FOUNDRY CLUSTER

MSME foundry unit invests Rs 13 lakhs in energy efficiency measures and saves over Rs 6 lakhs year after year!

Background

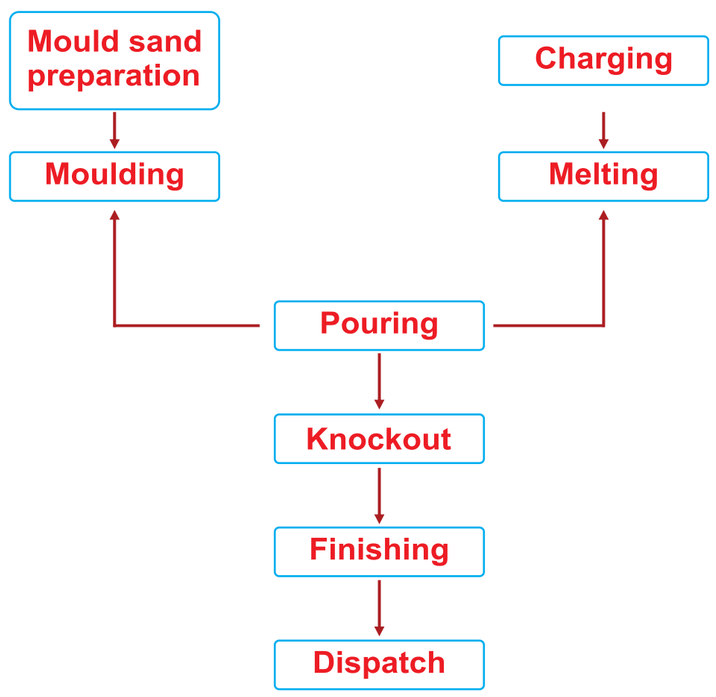
Kolhapur, in Maharashtra, is a foundry cluster. It has around 300 MSME foundries producing about 600,000 tonnes of castings annually, accounting for about 7-8% of India's total castings production. The production capacity of these units varies from less than 1000 tonnes to over 10,000 tonnes per annum (tpa).

Unit profile

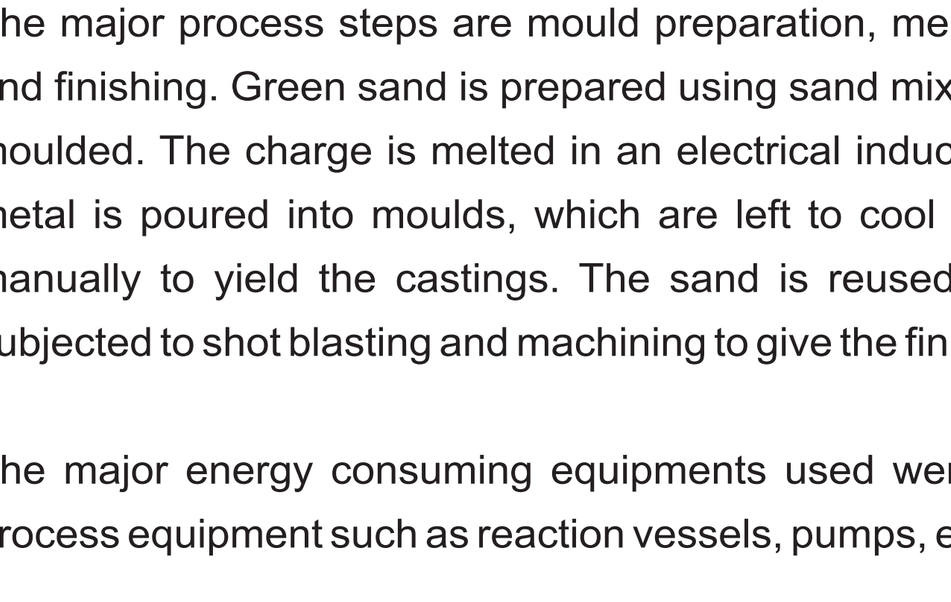
This unit is a MSME unit that manufactures graded cast iron (CI) castings, producing about 430tpa. The annual energy bill of the unit was INR 61 lakhs, which was around 5% of total turnover. The annual energy consumption was around 75tonnes of oil equivalent (toe) in the form of grid electricity.

Process description

The major process steps are mould preparation, melting, pouring, knockout and finishing. Green sand is prepared using sand mixer and is then manually moulded. The charge is melted in an electrical induction furnace. The liquid metal is poured into moulds, which are left to cool and then 'knocked out' manually to yield the castings. The sand is reused, and the castings are subjected to shot blasting and machining to give the finished products.



The major energy consuming equipments used were electrical induction furnace and electrical motors associated with process equipment such as reaction vessels, pumps, etc.



Overall Impact

10% reduction in total energy bill (i.e. annual savings of INR 6 lakhs) with a simple payback of2.1 years

INTERVENTIONS

Replacement of existing induction furnace by new induction farnace and cooling tower

Baseline Scenario

The unit was operating an induction furnace of 100 kW rated capacity (100 kg crucible capacity). The specific energy consumption (SEC) of the induction furnace was 850 kWh per tonne of melting, which was high for this category of furnaces.

Recommendation

The unit was advised to (1) replace the existing induction furnace with a new, energy efficient induction furnace of slightly higher rating and capacity, and (2) replace the existing cooling tower with a new, energy efficient cooling

Implemented Scenario

As recommended, the unit installed a new induction furnace of 175 kW capacity and 150 kg crucible capacity. It also replaced the existing cooling tower with a new energy efficient cooling tower The SEC of the new system is 650 kWh per tonne.

This investment of INR 12.7 lakhs is saving 86,400 kWh of electricity annually, equivalent to INR 6.1 lakhs. The simple payback period is 2.1 years.

Replacement of existing raw water pump by energy efficient pump

The existing cooling water pump had a flow rate lower than the design flow rate, and its efficiency was only 27%. As advised, the unit replaced this pump with an energy efficient water pump. This investment of 0.3 lakh is saving 2277 kWh of electricity annually, equivalent to INR 0.2 lakh. The simple payback period is 1.6 years.

CS-17

A CASE STUDY FROM KOLHAPUR FOUNDRY CLUSTER

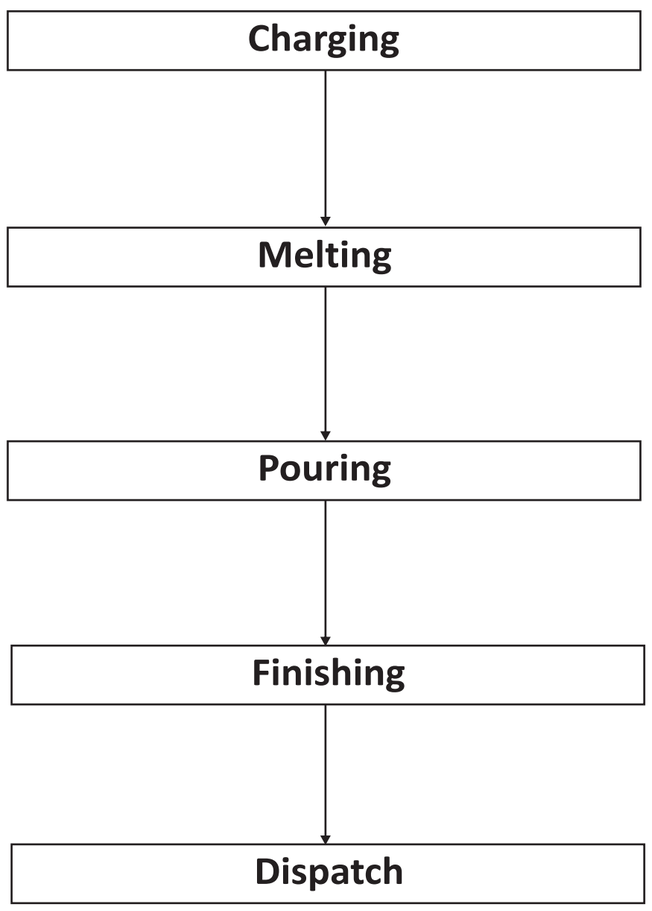
MSME foundry unit slashes energy bill by 57% through energy efficiency measures-and recovers investment in 6 months!

Unit profile

This unit is a MSME unit manufacturing aluminium castings.The annual production is about 70 tonnes. The total annual energy bill of the unit was about Rs. 14 lakhs. The total annual energy consumption was about 25tonnes of oil equivalent (toe), of which furnace oil (FO)accounted for 94% (24toe)and grid electricity 6% (1 toe).

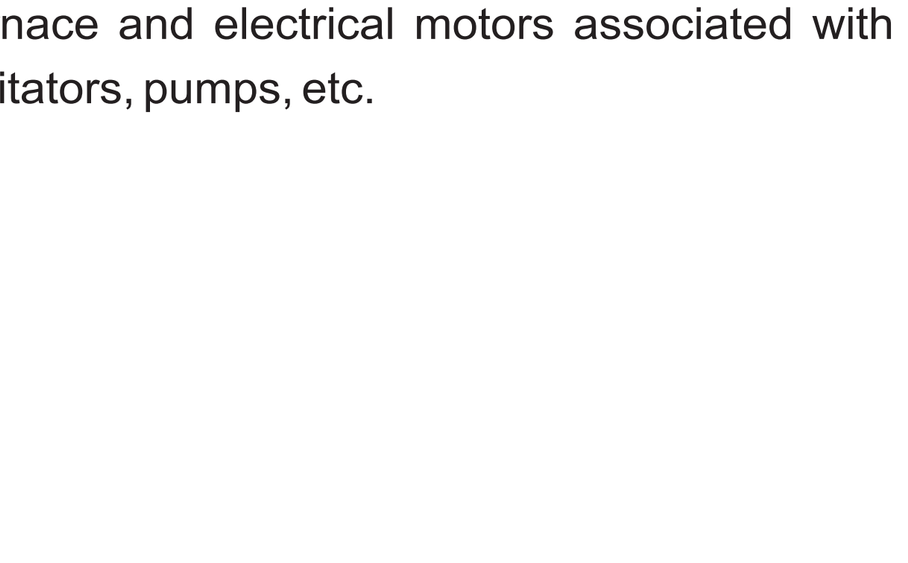
Process description

The major process steps are mould sand preparation and charge preparation followed by melting, pouring, knockout and finishing. The dies are pre-heated and coatings are applied on them. The charge is melted in an FO-fired melting furnace. The liquid metal is poured into the dies. After cooling, the dies are 'knocked out' to yield the castings, which then undergo fettling and machining to give the finished products.



The main energy consuming equipments used were an FO-fired melting furnace and electrical motors associated with process equipment such as agitators, pumps, etc.

Overall Impact: post- implementation



Overall Impact

57% reduction in total energy bill

INTERVENTIONS

Replacement of FO-fired furnace with electrical induction furnace

Baseline Scenario

The unit's FO-fired furnace of 100 kg capacity had a specific energy consumption (SEC) of 0.213 toe/t melting, which was very high for this category of furnace.

Recommendation

The unit was advised to replace this furnace with a 24 kW electrical induction furnace of 125 kg capacity.

Implemented Scenario

As advised, the unit replaced its FO-fired melting furnace with a 24 kW electrical induction furnace of 125 kg capacity, with digital temperature controller.

This investment of INR 3.9 lakhs is saving around 20.2 toe of energy each year, equivalent to INR 8.4 lakh. The simple payback period is 0.5 year.

Energy efficient lighting

As advised, the unit replaced all its 40W fluorescent tube lights (FTLs) having copper ballasts with 28W FTLs having electronic ballasts. This investment of INR 0.06 lakh is saving 564 kWh annually, equivalent to INR 0.07 lakh. The simple payback period is 0.9 year.

Use of translucent sheet to reduce lighting load

The unit's shop floor had a 72W CFL, a 70W metal halide lamp and a 150W mercury vapour lamp. Earlier, these lamps were switched on in the afternoon and operated for six hours till night. As advised, the unit installed translucent sheets on both side walls of the shop floor so as to reduce the usage of lighting to about five hours daily. This investment of INR 0.1 lakh is saving 330 kWh annually, equivalent to INR 0.04 lakh. The simple payback period is 2.6 years.

CS-18

A CASE STUDY FROM KOLHAPUR FOUNDRY

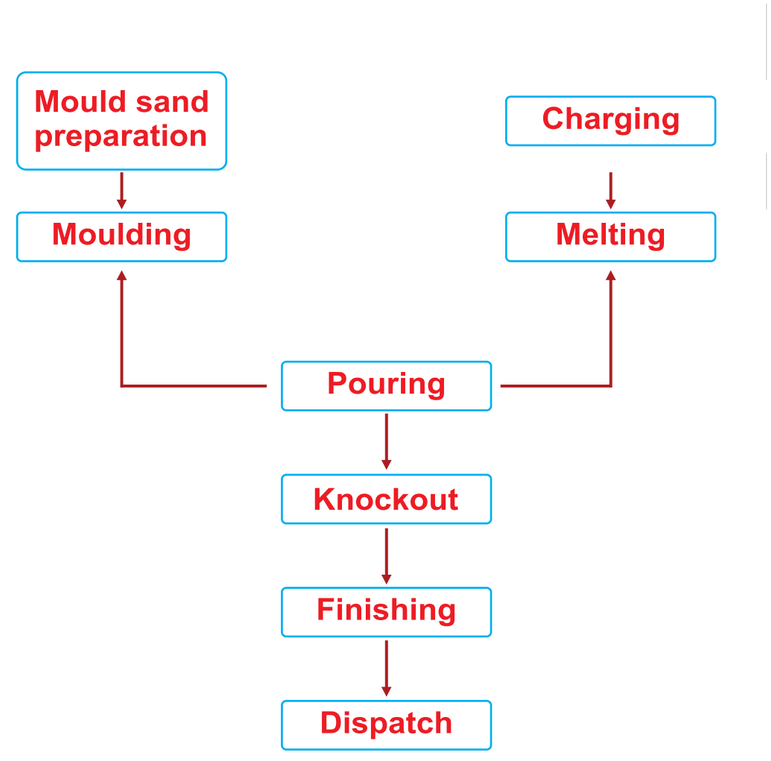
MSME foundry unit invests Rs 19 lakhs on energy efficiency measures-and recovers it within a year!

Unit profile

This unit is a MSME unit manufacturing cast iron and spheroidal graphite iron (SGI) castings. The annual production is about 770 tonnes.The total annual energy bill of the unit was about INR 169 lakhs, which was around 14% of total turnover. The total annual energy consumption was about 211tonnes of oil equivalent (toe)in the form of grid electricity.

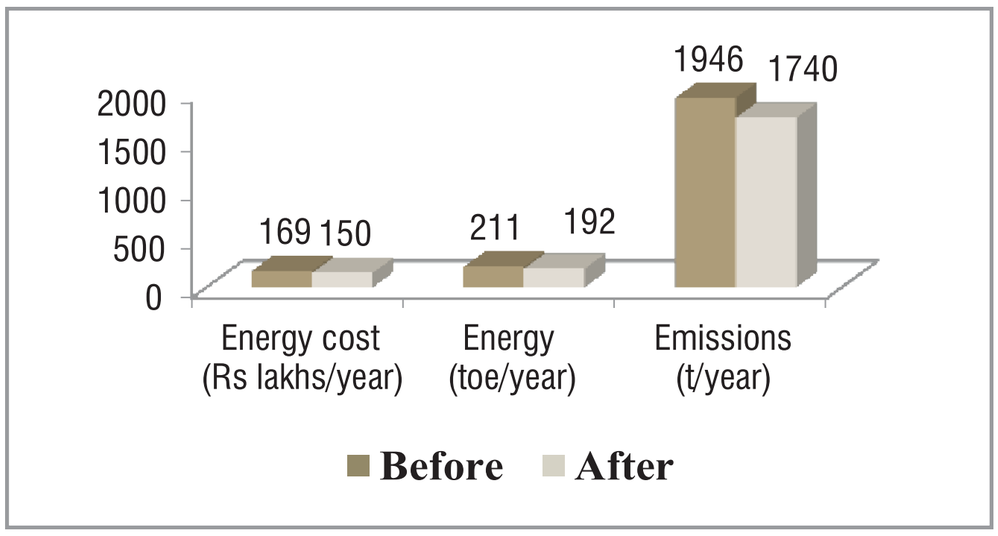
Process description

The major process steps are mould preparation, melting, pouring, knockout and finishing. Green sand is prepared using sand mixer and is then manually moulded. The charge is melted in an electrical induction furnace. The liquid metal is poured into moulds, which are left to cool and then 'knocked out' manually to yield the castings. The sand is reused, and the castings are subjected to shot blasting and machining to give the finished products.



The main energy consuming equipments used were an electrical induction furnace, and electrical motors associated with air compressor, pumps, and other utilities.

Overall Impact: post- implementation



Overall Impact

11% reduction in total energy bill (i.e. annual savings of INR19lakhs) with a simple payback period of 1 year

INTERVENTIONS

Down-sizing of existing induction furnace to meet process requirement

Baseline Scenario

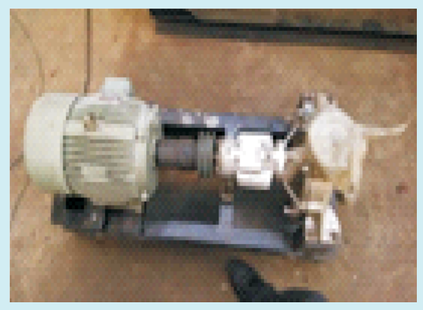
The unit was operating an induction furnace of 350 kW rated capacity (500 kg crucible capacity). Its specific energy consumption (SEC) was relatively high, at 820 kWh/tonne of melting. Also, the unit produces small castings, and the large crucible capacity increased holding time and resulted in significant energy loss during holding.

Recommendation

The unit was advised to replace this furnace with a lower capacity induction furnace.

Implemented Scenario

As advised, the unit replaced the existing induction furnace with a new 100 kW induction furnace with 150 kg crucible capacity. The SEC of the new system is about 700 kWh/tonne of melting.



This investment of INR 10.5 lakhs is saving 169,039 kWh annually, equivalent to INR 13.9 lakhs. The simple payback period is 0.8 years.

Reducing leakage losses in compressed air system

The leakage in the existing compressed air piping system was measured to be 19%, which was very high. As advised, the unit identified and plugged the leakage points. At no cost, this measure is saving 34,690 kWh annually, equivalent to a INR 2.9 lakhs.

Replacement of existing air compressor with energy efficient air compressor

As advised, the unit replaced its existing reciprocating air compressor, which had a fixed pressure setting, with a new variable speed screw air compressor, which delivers compressed air as per process requirements. This investment of INR 8.5 lakhs is saving 25,970 kWh annually, equivalent to INR 2.1 lakhs. The simple payback period is 4 years.

Energy efficient lighting

As recommended, the unit replaced the existing 40W fluorescent tube lights (FTLs) and 250W mercury vapour lamps (MVLs) with 28W FTLs and 150W metal halide lamps respectively. This investment of INR 0.2 lakh is saving 2232 kWh per year, equivalent to about INR 0.2 lakh. The simple payback period is 1 year.

CS-19

A CASE STUDY FROM KOLHAPUR FOUNDRY CLUSTER

MSME foundry unit invests Rs 23 lakhs on energy efficiency measures-and saves over Rs 36 lakhs annually in energy bill!

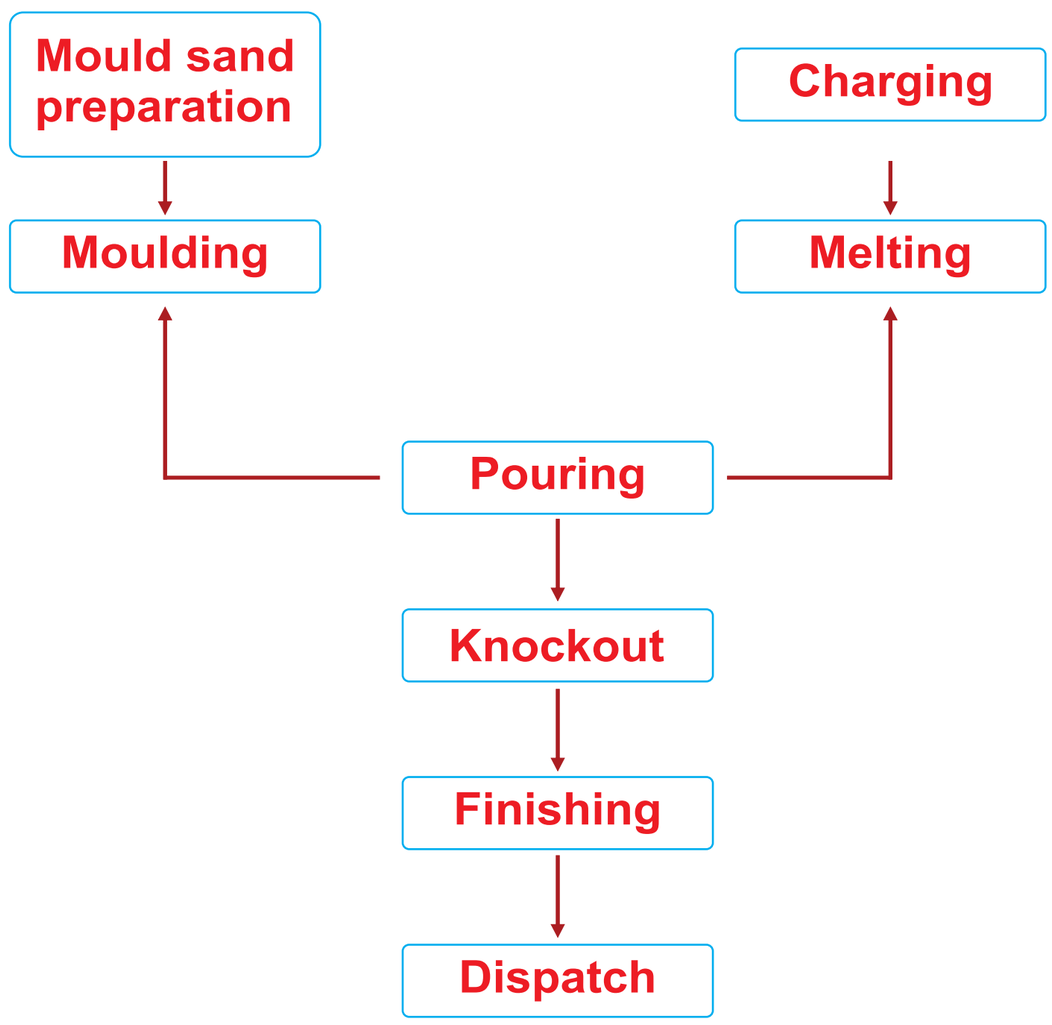
Unit profile

This unit is a MSME unit manufacturing graded cast iron (CI) and spheroidal graphite iron (SGI) castings. The annual production is about 2672 tonnes. The total annual energy bill of the unit was about INR 258 lakhs. The total annual energy consumption was about 370 tonnes of oil equivalent (toe) in the form of grid electricity.

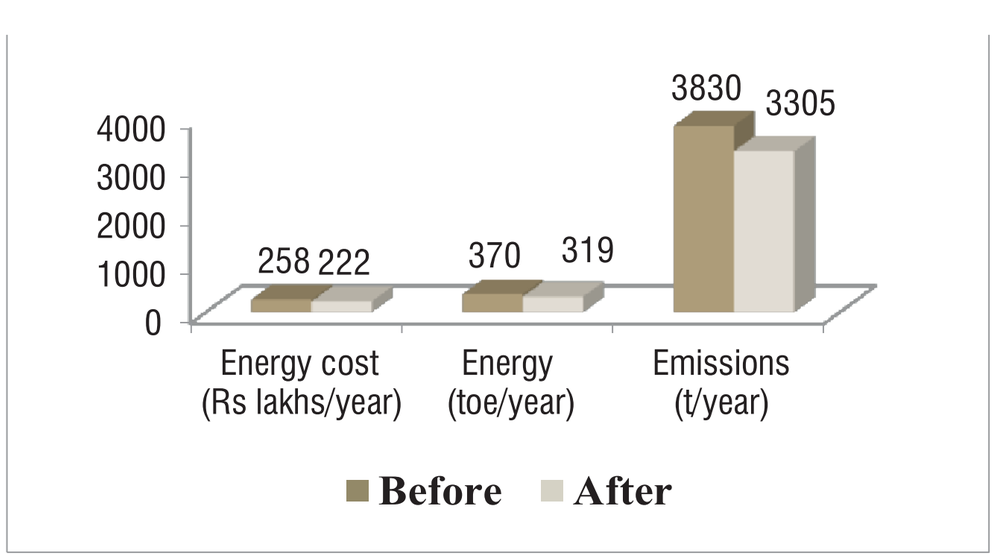
Process description

The major process steps are mould preparation, melting, pouring, knockout and finishing. Green sand is prepared using sand mixer and manually moulded. The charge is melted in an electrical induction furnace. The liquid metal is poured into moulds, which are left to cool and then 'knocked out' manually to yield the castings. The sand is reused, and the castings are subjected to shot blasting and machining to give the finished products.

The major energy consuming equipments used were an electrical induction furnace and electrical motors associated with process equipment such as reaction vessels, pumps, etc.



Overall Impact: post- implementation



Overall Impact

14% reduction in total energy bill (i.e. annual savings of INR 36 lakhs) with a simple payback of 0.7 years

INTERVENTIONS

Lid mechanism for the induction furnace

Baseline Scenario

The unit's induction furnace had a circular opening of 400 mm diameter without lid. As a result, radiation losses were high (32.7 kWh per batch).

Recommendation

The unit was advised to install a lid mechanism for the furnace.

Implemented Scenario

As advised, the unit installed a lid mechanism for its induction furnace to minimize radiation losses.

This investment of INR 5.6 lakhs is saving 208,380 kWh annually, equivalent to INR 12.7 lakhs. The simple payback period is 0.4 year.

Other energy efficiency measures

No.	Energy efficiency measure	Investment (lakhs INR)	Annual savings (lakhs INR)	Simple payback period (years)
2	Improving power factor and demand reduction	0.9	0.7	1.2
3	Installation of automatic voltage controller	14.2	3.9	3.6
4	Reduction in rejections by improving process response study	-	4.3	-
5	Quicker sampling, spectro-analysis, alloying and pouring	-	8.7	-
6	Arresting leakage in compressed air system	-	4.4	-
7	Optimizing pressure settings of three air compressors	-	0.3	-
8	Retrofitting air compressor with variable frequency drive (VFD)	2.5	1.1	2.3
9	Replacement cooling tower fan blades with FRP blades	0.1	0.2	0.5
10	Energy efficient lighting	0.5	0.1	5.0

CS-20

A CASE STUDY FROM PUNE FORGING CLUSTER

MSME forging unit invests Rs 67 lakhs to improve energy efficiency — and saves Rs 42 lakhs every year!

Background

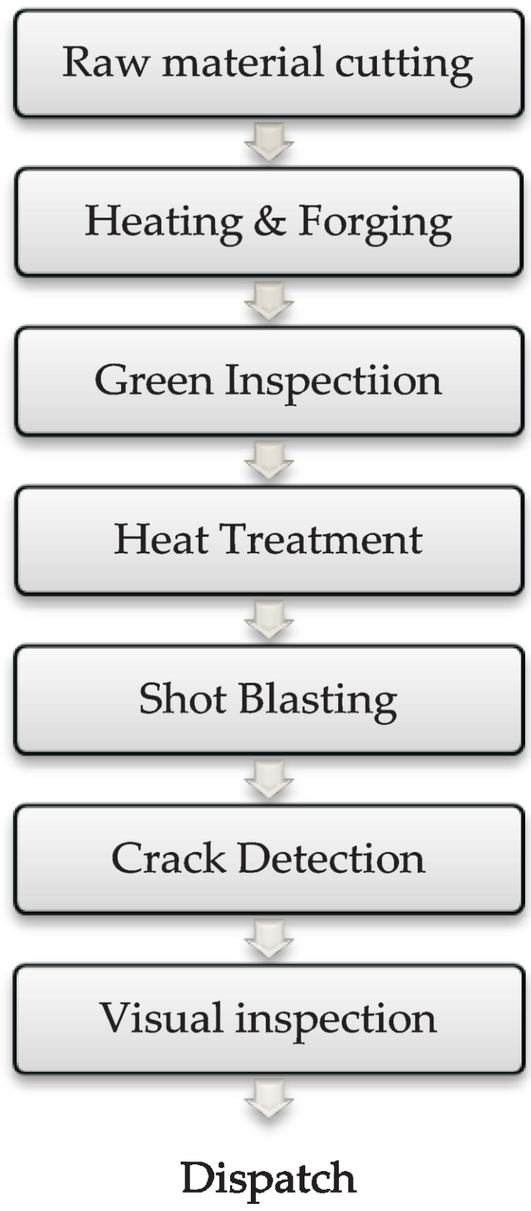
Pune, in Maharashtra, is a forging industry cluster. Large-scale units account for about 65–70% of the cluster's forging production, while MSMEs account for the remaining 30–35%. There are over 50 MSMEs producing forged components, with 20 heat treatment MSMEs functioning as their vendors. The production capacity of these units varies from 500 tonnes to over 3500 tonnes per annum (tpa).

Unit profile

This unit is a MSME unit that manufactures forged components like gears and spacers, producing about 930 tonnes annually. The total annual energy bill of the unit was INR 125 lakhs, which was around 7% of turnover. The annual energy consumption was about 222 tonnes of oil equivalent (toe), of which furnace oil (FO) accounted for 84% (186 toe), grid electricity 15% (33 toe), and diesel 1% (3 toe).

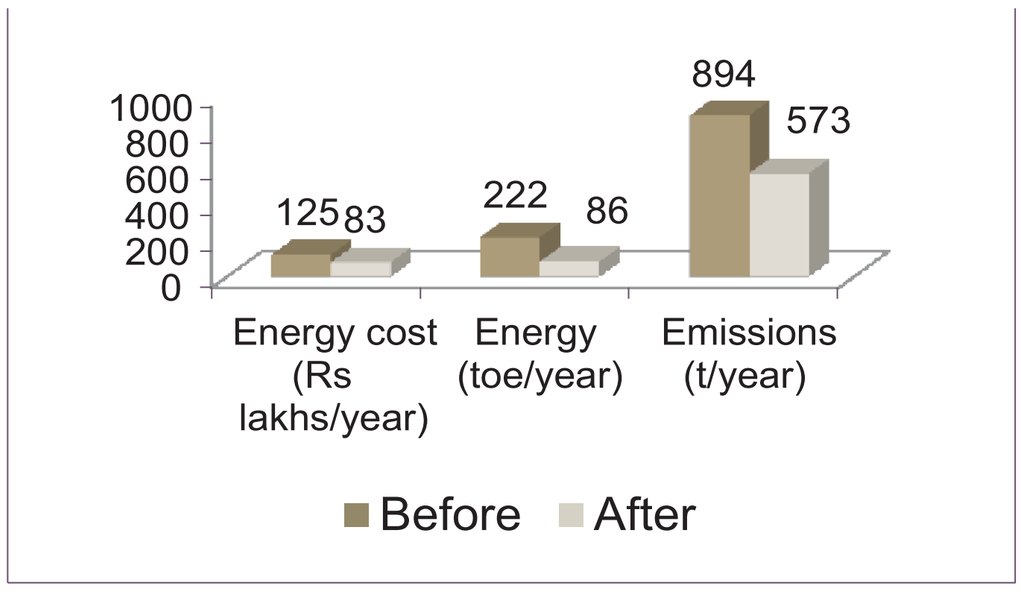
Process description

The manufacturing process involves the cutting of steel rods in the form of billets. The billets are heated in the furnace, forged with hammers and presses, trimmed, and subjected to heat treatment to give the final products.



The main energy consuming equipments used were four FO-based forging furnaces, and electrical motors associated with utilities like air compressor and pumps.

Overall Impact: post- implementation



Overall Impact

34% reduction in total energy bill (i.e. annual savings of INR 42 lakhs) with a simple payback of 1.6 years

INTERVENTIONS

Replacement of existing FO-fired forging furnace with induction billet heater

Baseline Scenario

The unit was operating an FO-fired box type forging furnace of capacity 400 kg per hour, associated with a 1.25- tonne hammer. Its efficiency was less than 10%.

Recommendation

The unit was advised to replace the existing FO-fired forging furnace with an induction billet heater of rating 200 kW (500 kg per hour capacity).

Implemented Scenario

As recommended, the unit replaced its existing FO-fired forging furnace with an energy efficient induction billet heater of rating 200 kW (500 kg per hour capacity). The new system consumes 419,400 kWh of electricity annually but saves nearly 138,000 litres of FO.

This investment of INR 67.1 lakhs is saving INR 42.1 lakhs annually. The simple payback period is 1.6 years.

Replacement of all condenser water pumps with a single energy efficient pump with VFD

Improvement of power factor

CS-21

A CASE STUDY FROM PUNE FORGING CLUSTER

MSME forging unit invests Rs 16 lakhs for improving energy efficiency—and saves Rs 24 lakhs every year!

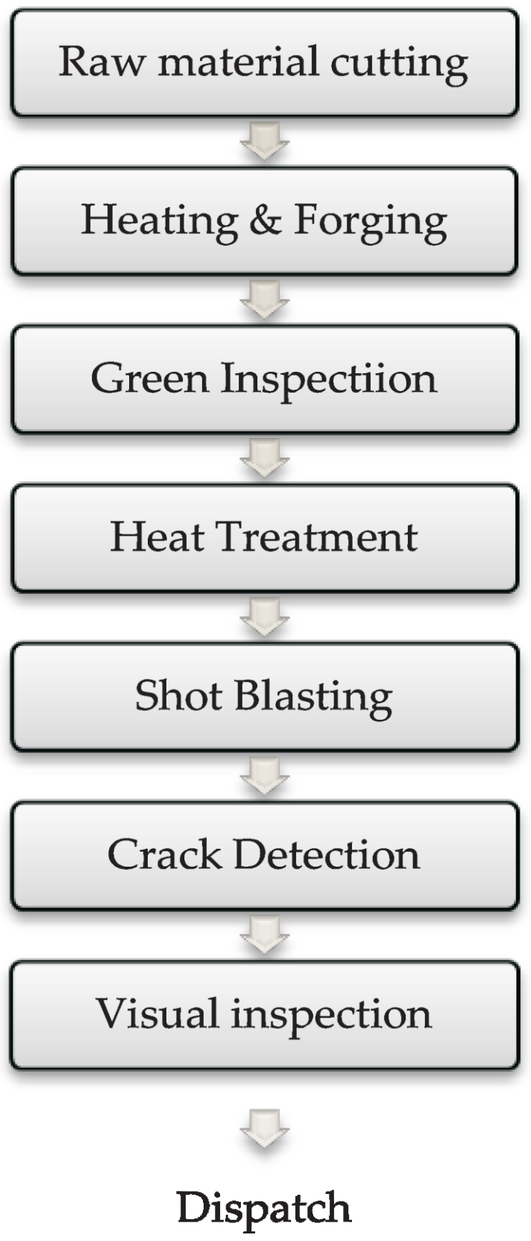
Unit profile

This unit is a MSME unit that manufactures forged auto components like axle, gear blanks, flanges and elbows, producing about 3600 tpa. The annual energy bill of the unit was INR 128 lakhs, which was around 68% of total turnover. The annual energy consumption was around 224 tonnes of oil equivalent (toe), of which furnace oil (FO) accounted for 91% (203 toe) and grid electricity 9% (21 toe).

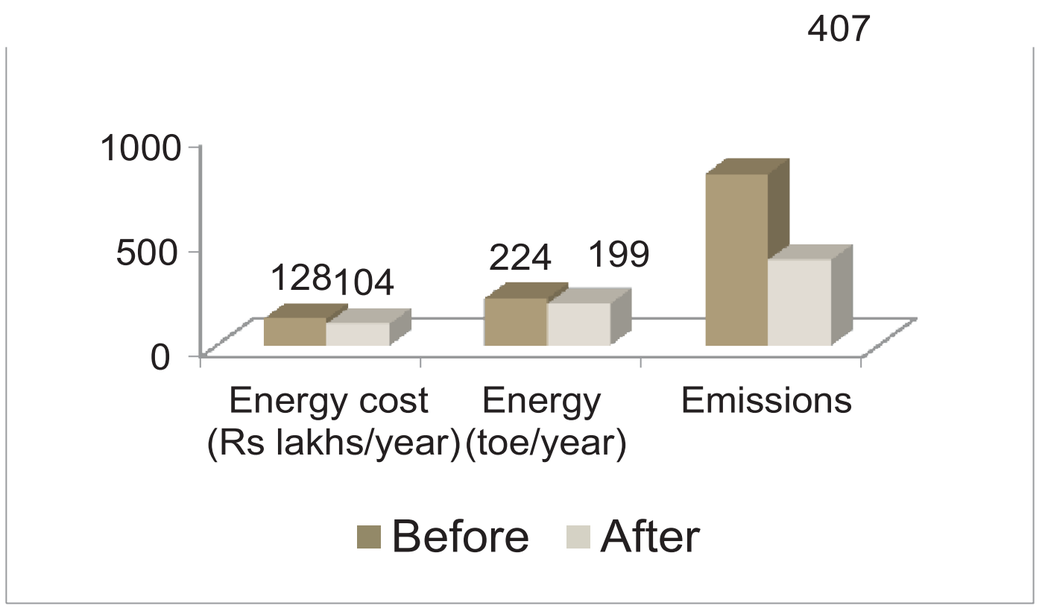
Process description

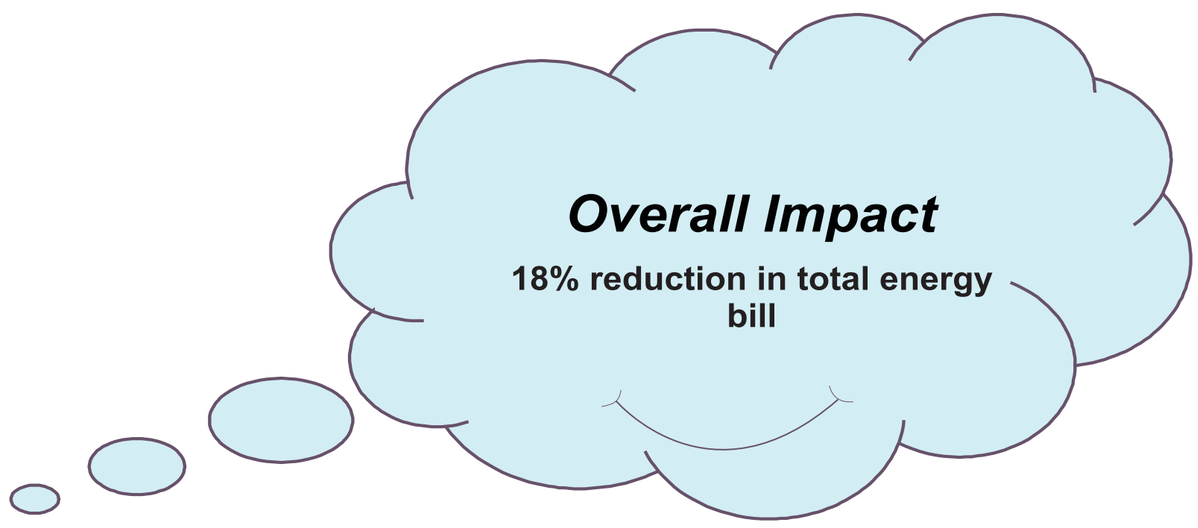
Steel rods are cut into billets, which are heated in an FO-fired furnace and forged with hammers and presses. The components are then subjected to various heat treatment processes like normalizing, hardening and annealing, and undergo shot blasting to give the final products.

The major energy consuming equipments used were three FO-fired forging furnaces, and electrical motors associated with process equipment such as air compressor, pumps, etc.



Overall Impact: post- implementation





INTERVENTIONS

Fuel switching from furnace oil to natural gas for forging furnaces

Baseline Scenario

The unit was operating three FO-fired box type forging furnaces: one of capacity 200 kg per hour, and two of capacity 250 kg per hour. These furnaces had efficiencies below 10%.

Recommendation

As natural gas (NG) supply was readily available, the unit was advised to switch from FO to NG as fuel for the forging furnaces.

Implemented Scenario

As recommended, the unit switched from using FO to NG as fuel for its three forging furnaces. The furnaces now consume about 208,800 SCM of NG annually, but save about 206,000 litres of FO.

This investment of INR 15.1 lakhs saves INR 23.6 lakhs annually. The simple payback period is 0.6 years.

Relining of one forging furnace to reduce surface heat loss

The forging furnace of capacity 200 kg/hour (associated with one-tonne hammer) showed high surface heat loss (about 13,100 kCal/hour) due to damaged refractory lining. As advised, the unit undertook relining of the furnace to cut down on surface heat losses. This investment of INR 0.9 lakhs is saving about 5600 SCM of NG annually, equivalent to INR 2.2 lakhs. The simple payback period is 0.4 year.

CS-22

A CASE STUDY FROM PUNE FORGING CLUSTER

MSME forging unit invests less than Rs 3 lakhs in energy efficiency—and saves over Rs 11 lakhs annually!

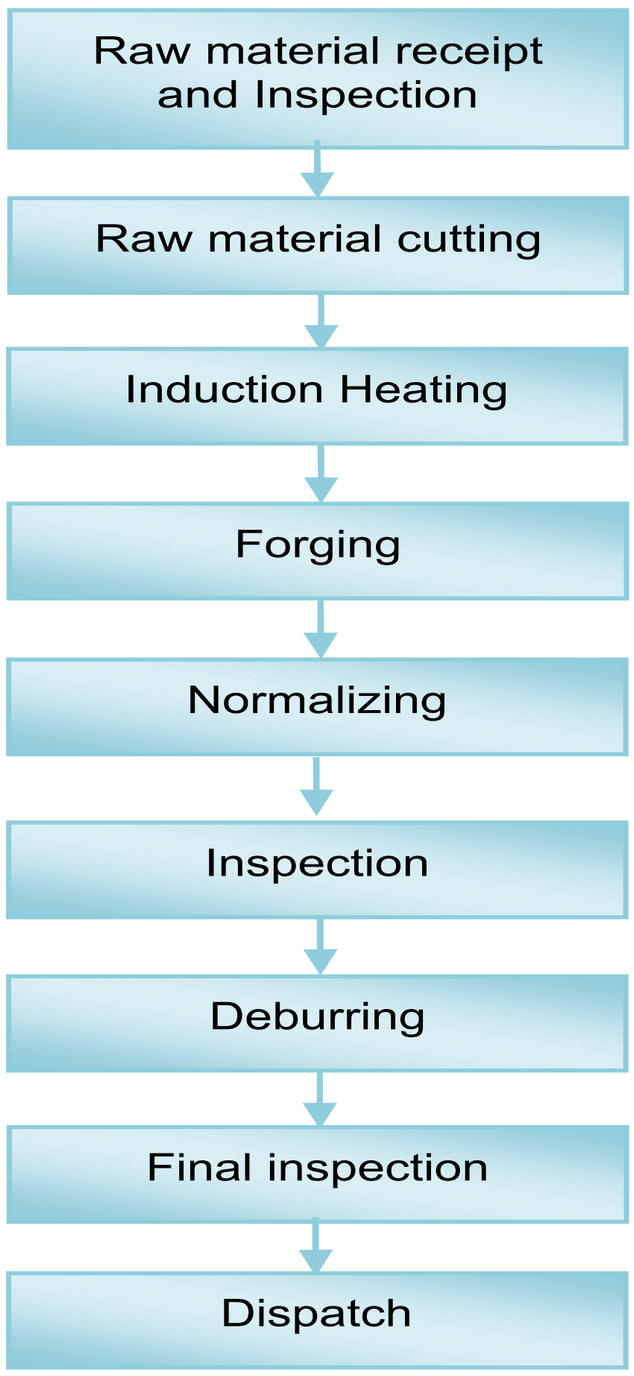
Unit profile

This unit is a MSME unit that manufactures forged components like gear blanks and transmission parts, producing about 1500 tonnes annually. The total annual energy bill of the unit was INR 343 lakhs, which was around 44% of turnover. The annual energy consumption was about 507 tonnes of oil equivalent (toe), of which grid electricity accounted for 60% (305 toe), LPG 28% (141 toe), and diesel 12% (61 toe).

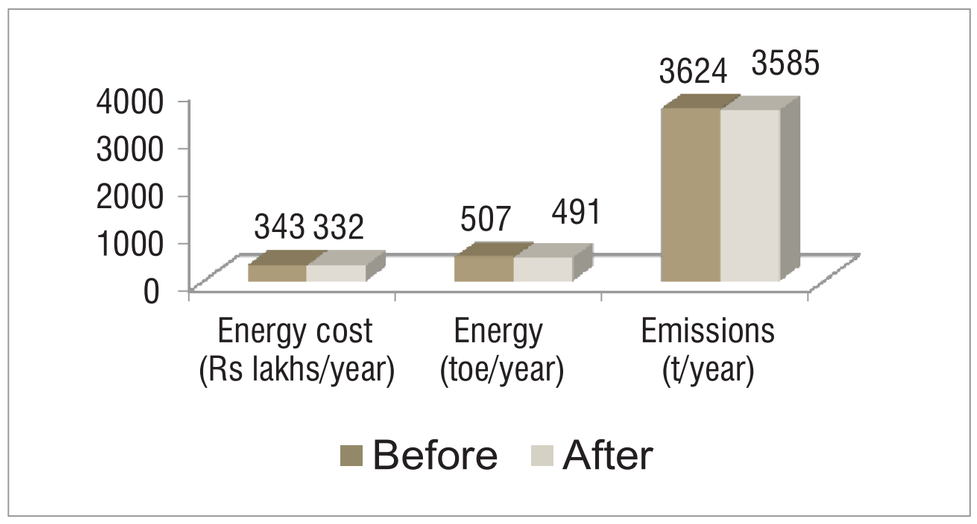
Process description

The manufacturing process involves the cutting of steel rods in the form of billets. The billets are heated in electrical induction furnaces, forged with hammers and presses, subjected to heat treatment in an LPG-fired normalizing furnace, and deburred to give the final products.

The main energy consuming equipments used were three electrical induction furnaces, one electrical normalizing furnace, one LPG-fired normalizing furnace, and electrical motors associated with utilities like air compressor and pumps.



Overall Impact: post- implementation



Overall Impact

3% reduction in total energy bill (i.e. annual savings of INR 11 lakhs) with a simple payback of 0.2 year

INTERVENTIONS

Application of veneering module at LPG-fired normalizing furnace

Baseline Scenario

The unit was operating an LPG-fired normalizing furnace of 600 kg per hour capacity. This furnace had an efficiency lower than 10% due to high surface heat losses (estimated at 36,139 kcal per hour) resulting from poor insulation.

Recommendation

The unit was advised to apply veneering modules on the inside surface of the furnace to reduce heat losses.

Implemented Scenario

As recommended, the unit applied veneering modules on the inside of the LPG-fired furnace. Implementation of veneering not only reduces the surface heat losses but also save the residual heat stored during the non-firing time.

This investment of INR 2.5 lakhs is saving INR 10.6 lakhs annually. The simple payback period is 0.2 year, i.e., barely three months.

CS-23

A CASE STUDY FROM PUNE FORGING CLUSTER

MSME forging unit reduces energy bill by 22% through energy efficiency measures

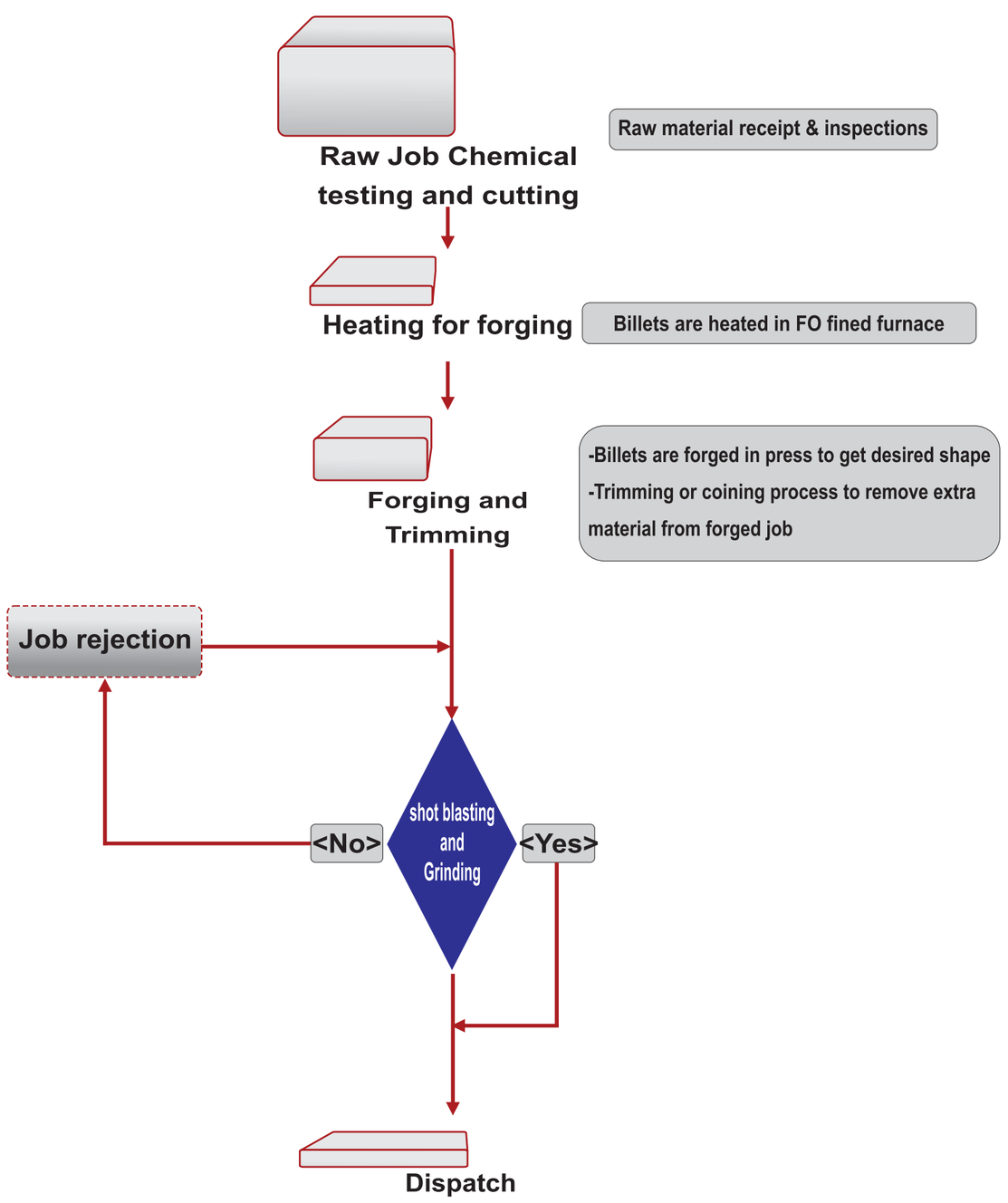
Unit profile

This unit is a MSME unit that manufactures forged auto components like gears, shafts and so on, producing about 1160 tpa. The annual energy bill of the unit was INR 119 lakhs, which was around 23% of total turnover. The annual energy consumption was around 259 tonnes of oil equivalent (toe), of which natural gas (NG) accounted for 90% (234 toe) and grid electricity 10% (25 toe).

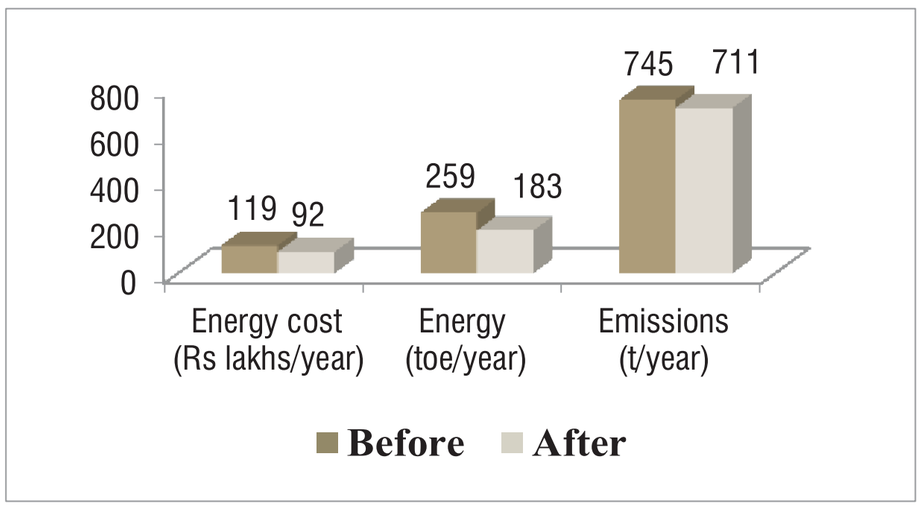
Process description

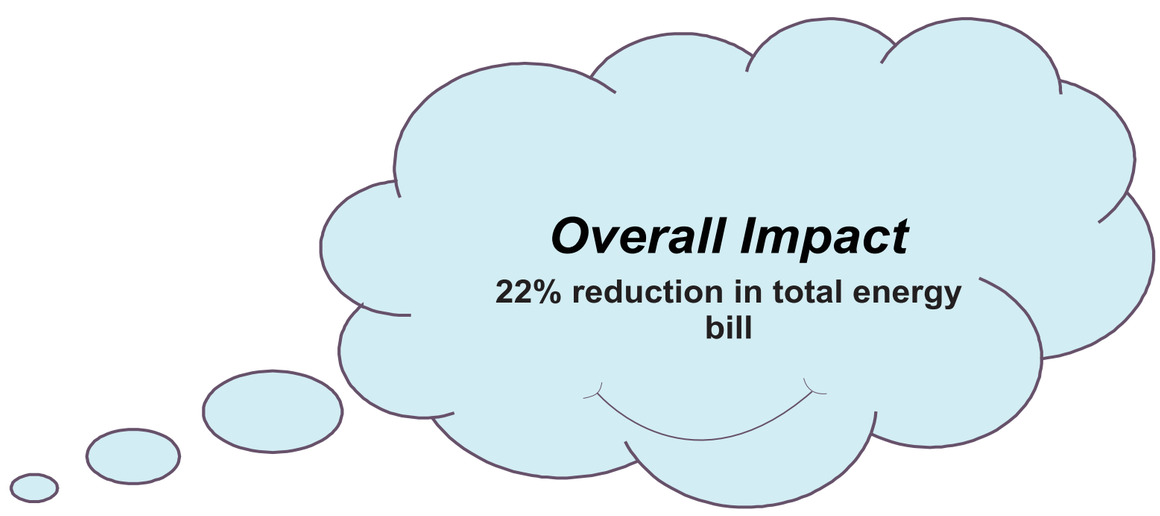
Steel rods are cut into billets, which are heated in an NG-fired furnace and forged with hammers and presses. The components are then subjected to various heat treatment processes, shot blasting and grinding to give the final products.

The major energy consuming equipments used were three NG-fired forging furnaces, and electrical motors associated with process equipment such as air compressor, pumps, etc.



Overall Impact: post- implementation



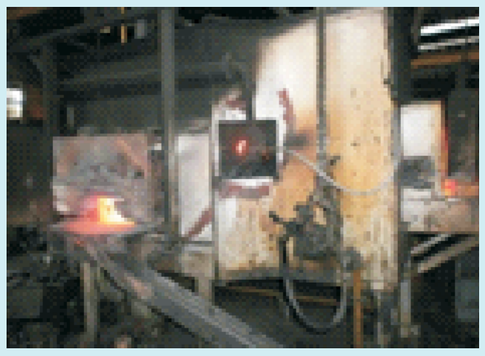


INTERVENTIONS

Replacement of existing NG-fired forging furnace with induction billet heater

Baseline Scenario

The unit was operating an NG-fired forging furnace of capacity 200 kg/hour, associated with 800 tonne forging press. The efficiency of this furnace was barely 7%.



Recommendation

The unit was advised to replace the NG-fired forging furnace with an. energy efficient induction billet heater of rating 175 kW (450 kg per hour capacity).

Implemented Scenario

Based on the project's recommendation, the unit replaced the NG-fired forging furnace with an. energy efficient induction billet heater of rating 175 kW (450 kg per hour capacity). The new system uses 173,086 kWh of electricity annually, but saves 106,623 SCM of NG.

This investment of INR 64.1 lakhs is saving INR 26 lakhs annually. The simple payback period is 2.5 years

Change of blower for forging furnace

The unit was operating an NG-fired forging furnace of capacity 250 kg per hour, which had an efficiency of only 7%. As advised, the unit replaced the existing blower with a new blower in order to optimize combustion air supply. This investment of INR 0.4 lakhs is saving 11,668 SCM of NG annually, equivalent to INR 4.90 lakhs. The simple payback period is just 2 months.

Replacement of old hammer motor with high efficiency motor

The unit was using a 1-tonne hammer which had a low-efficiency Eff3 class motor. As advised, the unit replaced this old motor with a new energy efficient Eff1 class motor. This investment of INR 1.3 lakhs is saving 5848 kWh of electricity annually, equivalent to INR 0.5 lakh. The simple payback period is 2.4 years.

References

Heating Values

Fuel	Unit	CV
Electricity	kCal/kWh	860
Coke	kCal/kg	6000
Natural Gas	kCal/scm	8500
Liquefied Petroleum Gas	kCal/kg	12500
Furnace Oil	kCal/Liter	9870
High Speed Diesel	kCal/kg	10500
Lignite (Indian Coal)	kCal/kg	4000

Carbon Emission Factor

Fossil Fuel		CO_2 emission factor
Gaseous fossil	Natural Gas	2.693 t/t
	Liquefied Petroleum Gas	2.985 t/t
Liquid Fossil	FO	3.101 t/t
	HSD	3.070 t/t
	Kerosene	3.149 t/t
	LDO	3.186 t/t
	Bio diesel	70.8 tonne per TJ
Solid Fossil	Anthracite	2.625 t/t
	Sub-Bituminous Coal	1.816 t/t
	Lignite	1.202 t/t
	Coke	107 tonne per TJ
Others	Electricity	0.89 kg per kWh

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Intergovernmental Panel on Climate Change 2006
 # CEA document;
TJ – Tera joule