Capacity Building workshop

Energy Conservation (with focus on melting)

24th March 2018 at Indore

Under the project
Capacity Building of Local Service Providers (LSPs)

Supported by
GEF-UNIDO-BEE Project
Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India

Table of contents

Workshop summary

Overview of workshop

Capacity Building workshop of Local Service Providers (LSPs) on Energy Conservation with focus on melting was organized by TERI on 24th March 2018, Saturday in association with BFC under GEF-UNIDO project. Total 35 participants were present during the workshop and for the industry visit, which was organized after the workshop. Agenda of the workshop and list of participants are attached in the annexure 1 and annexure 2 respectively.

Summary of points discussed in the meeting

Mr. Devendra Jain welcomed the participants and thanked TERI and UNIDO for arranging the capacity building workshop. He highlighted that, in a typical foundry unit induction furnace is primary equipment responsible for production and energy consumption and implementation of Kaizens can improve the productivity with reduction in energy consumption in induction furnaces significantly. He encouraged participants to take advantage of TERI experts during workshop, which are made available by UNIDO for capacity building of LSPs.

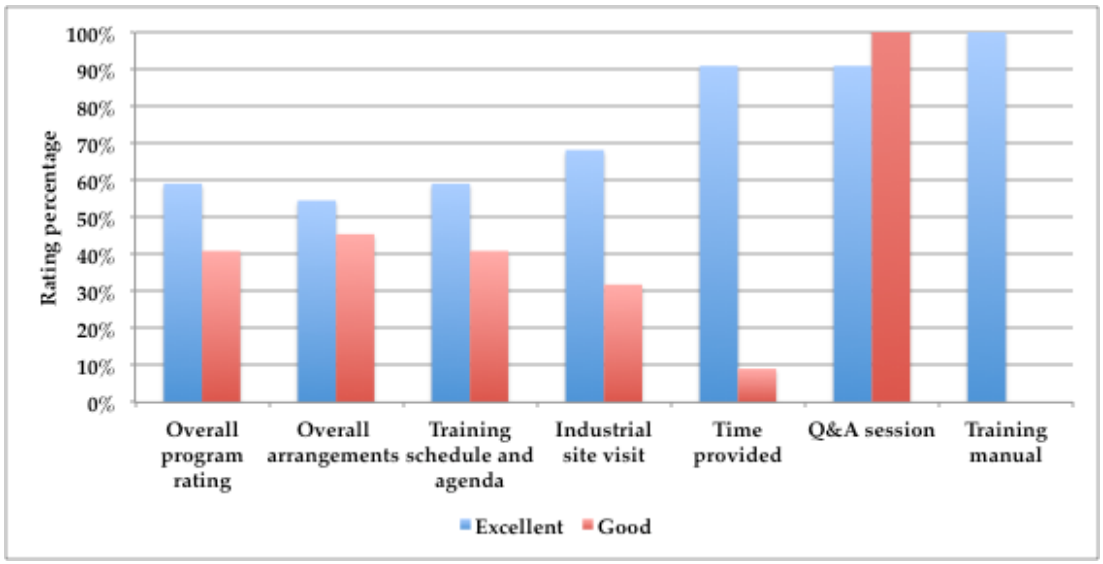
Mr. Prosanto Pal, gave descriptive presentation on general energy conservation measures which can be implemented in foundry along with some best operating practises for melting. HE highlighted adoption of Best operating practises for overall improvements along with statistics of specific energy consumption benchmarking done for foundry industries for various casting types.

Mr. Nilesh Shedge gave presentation on actual case studies of implementation of Kaizen in induction furnace and implementation done by TERI in foundries. He mentioned the importance of monitoring for identification of non-value added activities in the induction furnace operation. He also shared and experience of implementation of Kaizens and benefits of implementation in productivity, energy consumption, time reduction, workplace environment etc.

After the lunch, plant tour through the M/s Porwal Auto Components Ltd. was arranged, so that participants can experience the actual implementations done for productivity improvements (Kaizens) and lean practices followed by the unit. Selected photos of the workshop and visit are attached in the annexure 3.

Feedback forms

Based on the analysis of the feedback forms received from the participants, it is observed that workshop was well received by the participants and 100% participants were satisfied with training module provided to them. Around 60% of participants were rated training schedule and industrial site visit as “Excellent”. Total 60% participants have rated overall program as “Excellent” while rest of them have rated it as “Good”. About 55% of participants were satisfied with arrangements made and time provided. Few sample feedback forms are attached in the annexure 4.



Analysis of feedback forms

Suggestions by participants

Some participants have made suggestions as follows;

1) Requirement of detailed shopfloor training for Kaizen implementation
2) More detailed and specific case studies on the topic
3) Training program on power, demand and pf
4) Requirement of seminar on furnace crucible lining

Learning's by participants

Some of the topics learned by the participants and mentioned by them are listed below;

1) Brief understanding of Lean principles
2) Workplace organisation
3) Cycle time reduction
4) Feeding material sequence and size
5) Monitoring & data collection for induction furnace
6) Same size of crucible and pouring ladle to reduce losses
7) To avoid hill metal

Annexures

Annexure 1: Agenda of the program

Capacity building workshop

Energy conservation (with focus on melting)

Saturday, 24 March 2018

Porwal Auto Components Ltd., Pitampur Industrial Area, Indore

Under the project:

Capacity Building of Local Service Providers (LSPs)

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Agenda

10:00 – 10:30	**Registration**
10:30 – 10:40	**Welcome Address** Mr Devendra Jain, Managing Director, Porwal Auto Components Ltd.
10:40 – 10:50	**GEF-UNIDO-BEE project and initiatives in Indore cluster** Mr Prabhat Sharma, UNIDO Cluster Leader - Indore
10:50 – 11:50	**Operating practice improvements and energy benchmarking of Induction Furnaces** Mr Prosanto Pal, TERI
11:50 – 12:50	**Retrofits and new Technologies in Induction Furnaces** Mr Nilesh Shedge, TERI
12.45 – 13:00	**Q&A**
13:00 – 14:00	Lunch
14:00 – 16:00	**Site Visit / On-site training**
16.00 – 16:30	Feedback from participants
16:30 – 16:45	**Vote of thanks**

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Annexure 2: List of participants

S.No.	Name	Organization	Mobile No.	Email ID
1	Shailesh Shakalya	Mahle Engine Co. Pvt. Ltd.	9826829935	shaileshshakalya@gmail.com
2	Gagan Mahajan	Mahle Engine Com. Ind.	9826539388	Gaganmahajan29@gmail.com
3	Devendra Jain	Porwal Auto Components Ltd.	9893130999	devendrajain@porwalauto.com
4	L D Amla	Jash Engineering Ltd.	9755496000	ida@jashindia.com
5	Vijay Verma	Jash Engineering Ltd.	9929291092	vijayvermamails@gmail.com
6	Sangram Patil	Jash Engineering Ltd.	7869962233	sangram@jashindia.com
7	Prasanto Pal	TERI	9811799933	Prasa nto@teri.res.in
8	Prabhat Sharma	GEF-UNIDO-BEE Project	7470375107	cl.indorecluster@gmail.com
9	Nilesh Shedge	TERI	9978601047	Nilesh.shedge@teri.res.in
10	Harinarayan	Pioneer, Ujjain	9630079091	hnchundui@gmail.com
11	A N Pandey	Pioneer, Ujjain	7389941905	Anpandey1963@gmail.com
12	Suyash Pandey	Jash Engg. Indore	9039512126	Suyeshpandey88@gmail.com
13	N Garg	N G Enterprises	9827033041	gargniranjan@yahoo.com
14	Nandan Gargn	Nandan Enterprises	9630055541	nandanenterprisesindore@gmail.com
15	Rajdeo Sah	Infinite Solutions	9583182981	Rajdeoinfisolutions.org
16	R S Mukati	Raneka Industries	8889912436	Rsmukati75@gmail.com
17	Pramod Yadav	Raneka Industries	7415688202	
18	Praveen Sinha	Porwal Auto Ltd.	7024222713	praveensinha@porwalauto.com
19	Bhupesh Singh	PACL	9109143279	bhupeshsingh@porwalauto.com
20	Kamlesh Mohtria	PACL	9755033346	
21	Sunil Lanjewar	PACL	9993070824	sunillanjewar@porwalauto.com
22	Ravindra Patel	PACL	7024140115	Er.RavindraPatel44@gmail.com
23	N Malakar	PACL	9752533701	npal@porwalauto.com
24	S R Ghodgamkar	PACL	9424551728	sharadrghodgamkar@yahoo.com
25	Subhash Sihij	Asiatic Group	9425055507	Subhash@asiaticgroup.in
26	Hemant	Asiatic Group	7869955401	Subhash@asiaticgroup.in
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28	Amit Karmkar	PACL	7509490759	Amitkarmkar10@gmail.com
29	Atin Jain	PACL	9826570094	atinjain@porwalauto.com
30	Nutan Joshi	PACL	9826059220	nutanjoshi@porwalauto.com
31	Anish Jain	PACL	9993070836	aneeshjain@porwalauto.com
32	Raja Saluja	Saluja Auto	9826156019	Rajasaluja.metro@gmail.com
33	Sanjeev Choudhary	Dynomec Pumps P Ltd.	9926204601	Dynomec.pumps@rediffmail.com
34	Prateek Choudhary	Dynomec Pumps Pvt. Ltd.	8878885777	Prateekchoudhary13@yahoo.in
35	Priyanshu Gandhi	Dynomec Pumps Pvt Ltd.	8878625137	Gandhi.priyanshu@gmail.com

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24 March 2018, Porwal Auto Components Ltd., Pitampur Industrial Area, Indore

S. No	Name	Organization	Mobile No	Email ID	Signature
1.	Shailesh Shakalya	Mahle Engine Co. (I) Pvt. Ltd.	9826829935	shaileshshakalya@gmail.com	
2.	Gagan Mahajan	Mahle Engine Com. Ind.	9826539388	gganmahajan29@gmail.com	
3.	Devendra Jain	Porwal Auto Components Ltd	9893130999	devendrajain@porwalauto.com	
4.	L. D. Amen	Jash Engineering Ltd.	9755416000	lda@jashindia.com	
5.	Vijay Verma	Jash Engineering Ltd.	9929291092	vijayvermamails@gmail.com	
6.	Sangram Patil	Jash Engineering Ltd.	7869962283	sangram@jashindia.com	
7.	Prosanta Pal	TERI	9811799933	prosanta@teriin.res.in	

S. No	Name	Organization	Mobile No	Email ID	Signature
8.	Prabhat Sharma	GEF-UNIDO-BEE Project	7470375107	cl.indoreclusters@gmail.com	
9.	Nilesh shedge	TERE	9978601047	nilesh.shedge@teri.res.in	
10.	Harinarayan	Pioneer, Ujjain	9630079091	hnchundai@gmail.com	
11.	A.N. Pandey	Pioneer, ujjain	7389941905	anpandey1963@gmail.com	
12.	Sugash Pandey	Jash Engg. Profile	9039512126	sugashpandey85@gmail.com	
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14.	Nandan Garg	Nandan Enterprises	96300-55541	nandanenterprisesindore@gmail.com	
15.	Rajdeo Sah	Infinite Solutions	9583182981	rajdeo@infisolutions.org	
16.	R.S. Mukati	Ranka Industries	8889912436	rs mukati 75@gmail.com	
17.	Pramod Yadav	Ranka Industries	7415688202		

S. No	Name	Organization	Mobile No	Email ID	Signature
18	PRAVEEN SINHA	Porwal Auto Ltd	7024222718	praveensinha@gmail.com / praveensinha@porwalauto.com	[signature]
19	Bhupesh Singh	PACL	9109143279	bhupeshsinghe@porwalauto.com	[signature]
20	Kamlesh Mohbia	PACL	9755033346	kamleshmahobiy648	[signature]
21	Sunil Lonjewar	PACL	9993070824	sunillonjewar@porwalauto.com	[signature]
22	Ravindra Patel	PACL	7024140445	Er.RavindraPatel44@gmail.com	[signature]
23	N. Malakar	PACL	9752533701	npal@porwalauto.com	[signature] 24/3/18
24	S.R Ghodgaonkar	PACL	9424551728	shrendraghodgaonkar@yahoo.com	[signature] 24-3-2018
25	Subhash singh	Asiatic mktg co. Kenoser Comp/KSB Pump	9425055507	Subhash@asiaticgroup.in	S. [signature]
26	Hemant	— do —	7869955401	— do —	[signature]
27	P. Jagadeesh	PACL	8667298089	jagadeeshkumar23090@gmail.com	P. Jagath

S. No	Name	Organization	Mobile No	Email ID	Signature
28	Amit Kaumkar	PACL	7509490759	amitkaumkar10@gmail.com	
29	ATIN JAIN	PACL	9826570094	atinjain@porwalauto.com	
30	Nitanjan	PACL	9826059220	nitanjan.[illegible]@porwalauto.com	
31	Anish Jain	PACL	9993070836	aneesjain@porwalauto.com	
32	Raja Saluja	Saluja Auto	9826156019	rajasaluja.motor@gmail.com	
33	Sanjeev Choudhary	Dynomec pvt ltd	9926004601	dynomec_pumps@[illegible]mail.com	
34	PRATEEK CHOUDHARY	DYNOMEC PUMPS PVT. LTD.	8878885777	prateekchoudhary13@yahoo	
35	Priyanshu Gandhi	DYNOMEC PUMPS PVT. LTD	8878625139	gandhi.priyanshu@gmail.com	
36					
37					

Annexure 3: Selected photographs of the event

Annexure 4: Sample feedback forms

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24 March 2018

Porwal Auto Components Ltd., Pitampur Industrial Area, Indore

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Evaluation Sheet for Participants

Feedback Form for Participants			
Parameter	*Feedback*		
	Excellent	Good	Average
How would you rate the overall programme?	✓		
How would you rate overall arrangements?	✓		
How was the training schedule and agenda?	✓		
How was the industrial site visit?	✓		
Do you think that adequate time was provided for each topic?	Yes [ ]	No [✓]	
Do you think that satisfactory answers were given to your questions during the training programme?	Yes [ ]	No [✓]	
Do you think that the background training manual is informative and useful enough?	Yes [✓]	No [ ]	
Do you think that the discussion on EE/RE will help you in your work?	Yes [✓]	No [ ]	
Suggestions & Recommendations for improvement:			
Name two learning, which from this programme you will be able to implement in your plant?			
i) Tapping temp$^{\circ}$ Not beyond 1500° at our plant.			
ii) Air leakage ~~tag~~ red tag use and after correction green tag put.			
Signature:			
Name of participant:	RAVINDRA PATEL		
Organization:	PORWAL AUTO COMPONENTS LTD. PITHAMPUR		
Mobile No:	7024140118		
Email ID:	er.ravindra.patel44@gmail.com		

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Do you think that satisfactory answers were given to your questions during the training programme?	Yes [✓]	No [ ]	
Do you think that the background training manual is informative and useful enough?	Yes [✓]	No [ ]	
Do you think that the discussion on EE/RE will help you in your work?	Yes [✓]	No [ ]	
Suggestions & Recommendations for improvement:			
Name two learning, which from this programme you will be able to implement in your plant?			
Line graphs & Scatter plots to analyse the data and come out with the best practice.			
Signature:			
Name of participant:	Sunil Lanjewar		
Organization:	Porwal Auto Components Ltd.		
Mobile No:	99930-70824		
Email ID:	sunillanjewar@porwalauto.com		

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How would you rate overall arrangements?	✓		
How was the training schedule and agenda?		✓	
How was the industrial site visit?	✓		
Do you think that adequate time was provided for each topic?	Yes [✓]	No [ ]	
Do you think that satisfactory answers were given to your questions during the training programme?	Yes [✓]	No [ ]	
Do you think that the background training manual is informative and useful enough?	Yes [✓]	No [ ]	
Do you think that the discussion on EE/RE will help you in your work?	Yes [✓]	No [ ]	
Suggestions & Recommendations for improvement:			
we should improve & implement in the organisation together.			
Name two learning, which from this programme you will be able to implement in your plant?			
we will improve melting practice.			
Signature:			
Name of participant:	Rutan Joshi.		
Organization:	Porwal Auto Components Ltd.		
Mobile No:	9630451387		
Email ID:	rutanjoshi@porwalauto.com.		

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Do you think that satisfactory answers were given to your questions during the training programme?	Yes [✓]	No [ ]	
Do you think that the background training manual is informative and useful enough?	Yes [✓]	No [ ]	
Do you think that the discussion on EE/RE will help you in your work?	Yes [✓]	No [ ]	

Suggestions & Recommendations for improvement:

1. Saddle preheater m/c
2. f/c. cover
3. Blindage m/c. –

Name two learning, which from this programme you will be able to implement in your plant?

1. Small size raw material charge
2. oil, Grease, sand Rusty Raw material not charge
3.

Signature:	
Name of participant:	Kamlesh mahobiya
Organization:	Porwal Auto Limited Pitampur(M.P.)
Mobile No:	9755033346
Email ID:	kamlesh mahobiy@64.com mail

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Annexure 5: Copy of presentations

Capacity building workshop

Kaizen in Induction Furnace

Retrofits and new technologies in Induction Furnace

Saturday, 24th March 2018

Indore

Nilesh Shedge, TERI

gef

UNIDO

ENERGY IS LIFE
BEE
CONSERVE IT

teri
The Energy and Resources Institute

- Best Operating Practices in Induction Melting Furnace
- Power Curves
- Case Study: Kaizen in Induction Furnace
- Implementation photos

Induction Melting Furnace: Best Operating Practises

Bad Raw Material

Bad Raw Material

Good Raw Material

Good Raw Material

Fish Cutting

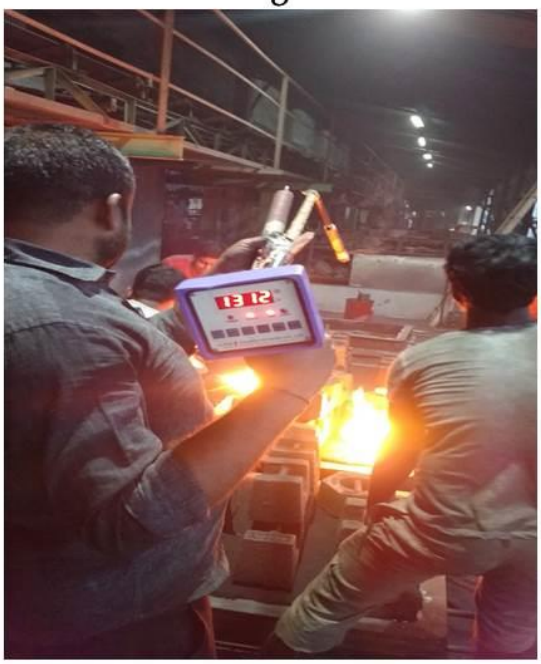
Lid Cover

Lid Cover

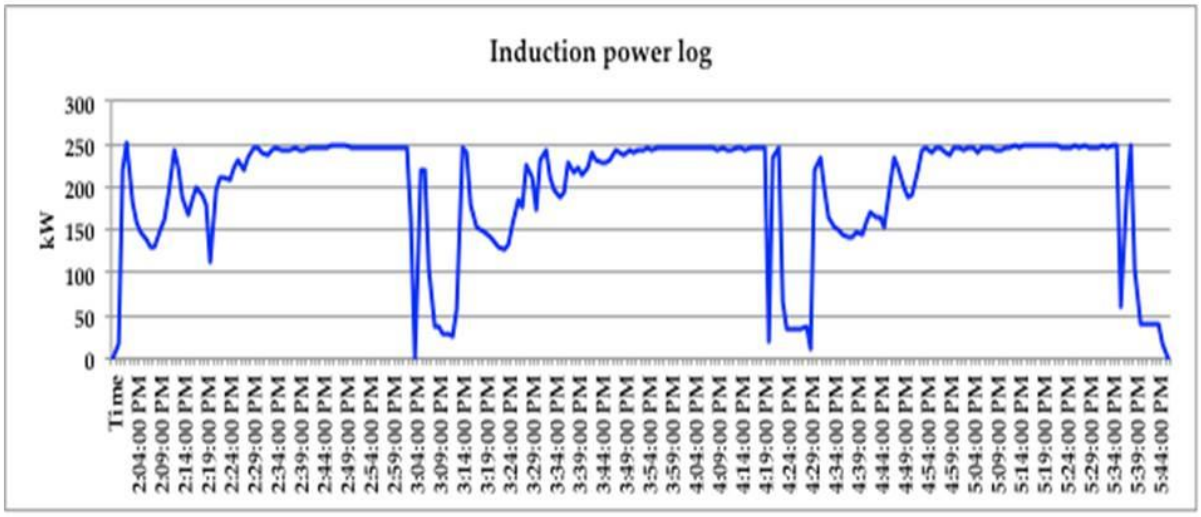
Temperature drop from Tapping to pouring

At Tapping 1524 oC

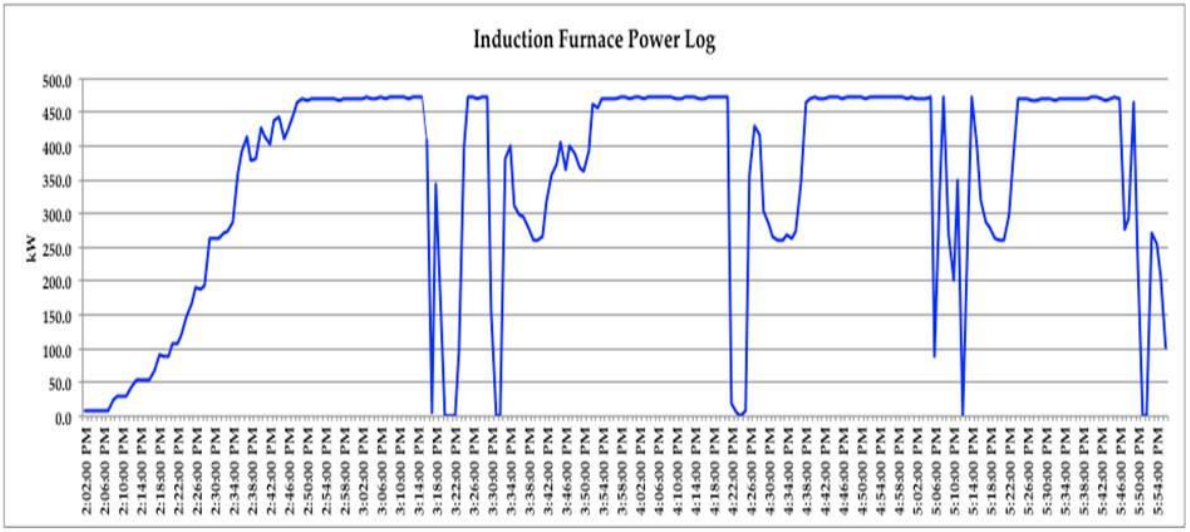
At Pouring 1312 oC



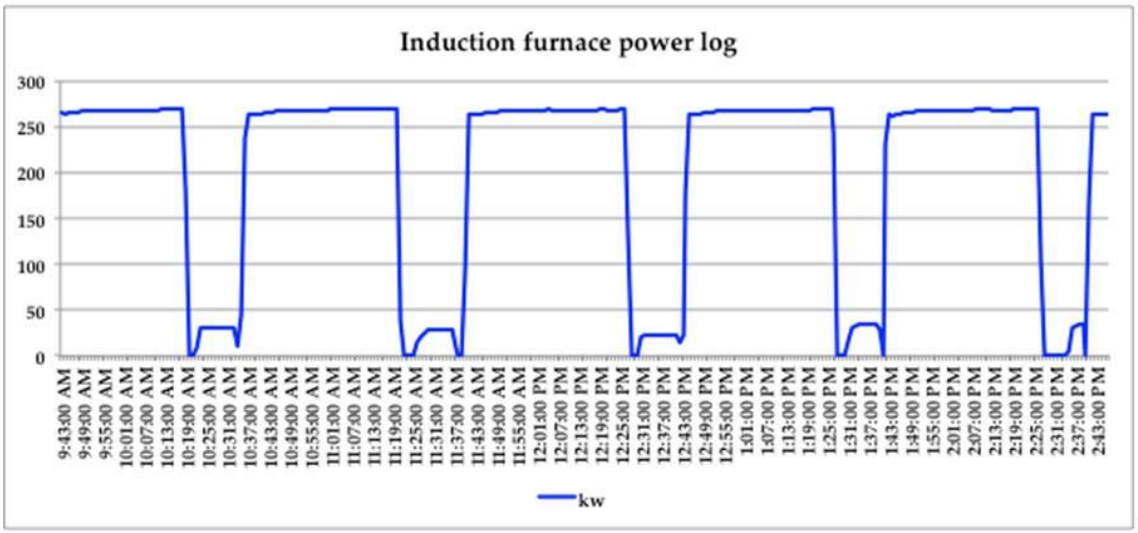
Power lag/delay in Induction furnace
250kW/250 kg
SEC: 736kWh/tonne @1600 °C
Power delay: 25min



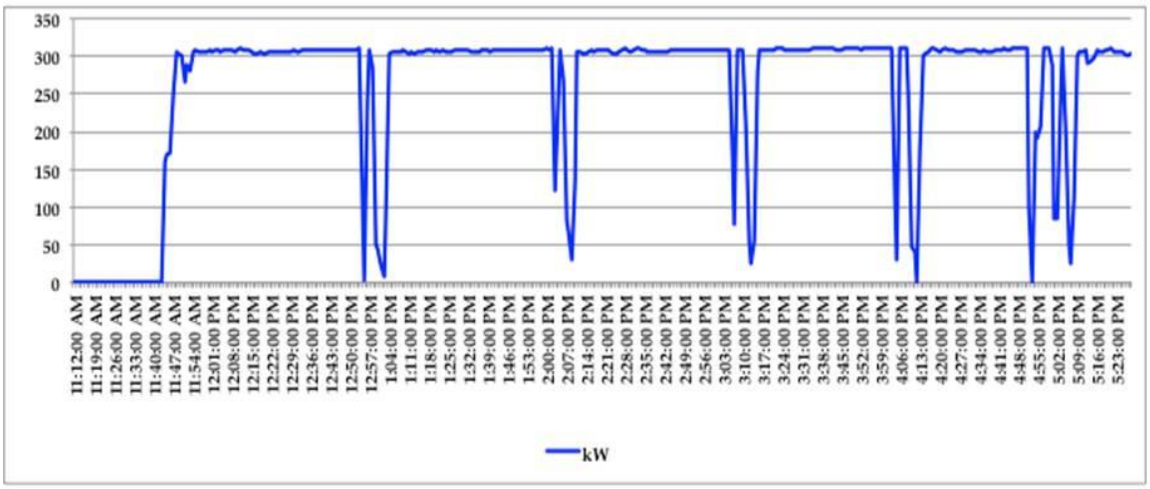
Power lag/delay in Induction furnace
450kW/500 kg
SEC: 675kWh/tonne @1450 °C
Power delay: 18min



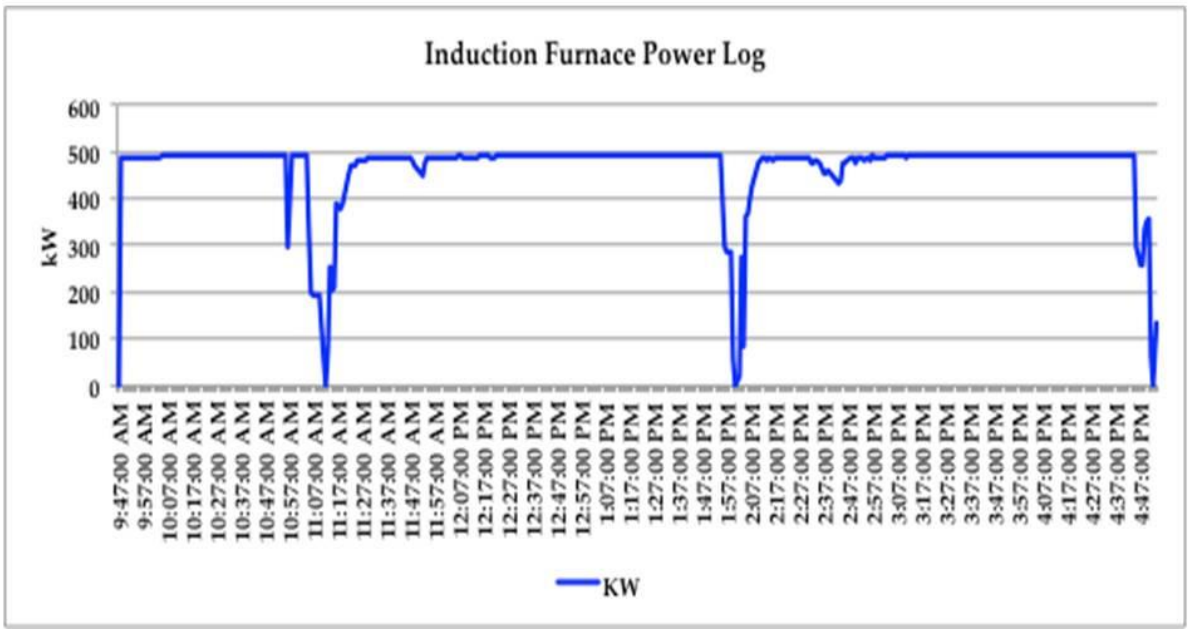
Ideal Power Curve Induction furnace
250kW/300 kg
SEC: 607kWh/tonne @1500 °C



Ideal Power Curve Induction furnace
300kW/500kg
SEC: 610kWh/tonne @1650 °C



Ideal Power Curve Induction furnace
500kW/2T
SEC: 595kWh/tonne @1620 °C



KAIZEN
CASE STUDY OF FOUNDRY

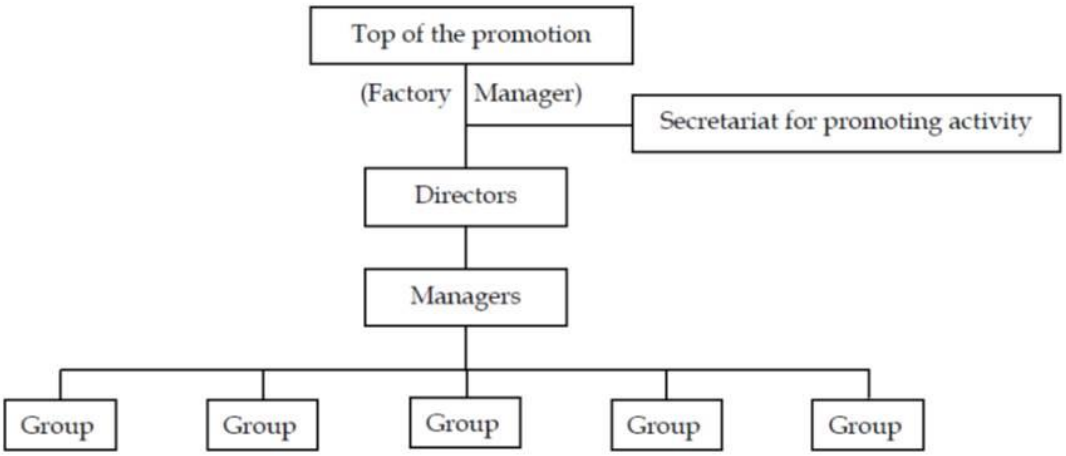
Background of the unit

- Located in Kolhapur Maharashtra
- Year of establishment: 1995
- Annual production of 1,450 tonnes
- Grey cast iron castings
- Sectors catered: Automobile, air compressors, tractor, railway and textile
- Induction furnace: 550 kW, 500 kg, SCR type

Kaizen – Methodology

- Formation of implementation support group
- Formation of small groups
- Formulating criteria and means of evaluation of the activities
- Data collection, analysis and visualization
- Identification of problem statements
- Looking for solutions with help of “small group activity”
- Validation and implementation of suggested solution
- Post implementation verification by data collation

Implementation support group



Data Collection format

PART 1 – Basic data

Melt No.	Date	Operator Name	Material Grade

PART 2 – Raw material composition data

Charging Weight (kg)					Supplementary Material (kg)	
Pig iron	Steel Scrap	C.I Scrap Boring	Domestic Scrap (RR)	Heel Metal	Inoculant	Graphite Agent

Data Collection format

PART 3 – Time and power reading

Material charging start		Material charging End		C.E. Meter Check		Tapping start		Tapping End	
Time	Power	Time	Power	Time	Power	Time	Power	Time	Power

PART 4 – Temperature and energy

Tapping temperature (^{o}C)	Total time (min)	Total power consumption (kWh)	Specific energy consumption (kWh/t)

Data Collection format

PART 5 – Chemical composition

Standard Chemical Composition (%)					
C	Si	Mn	P	S	C.E

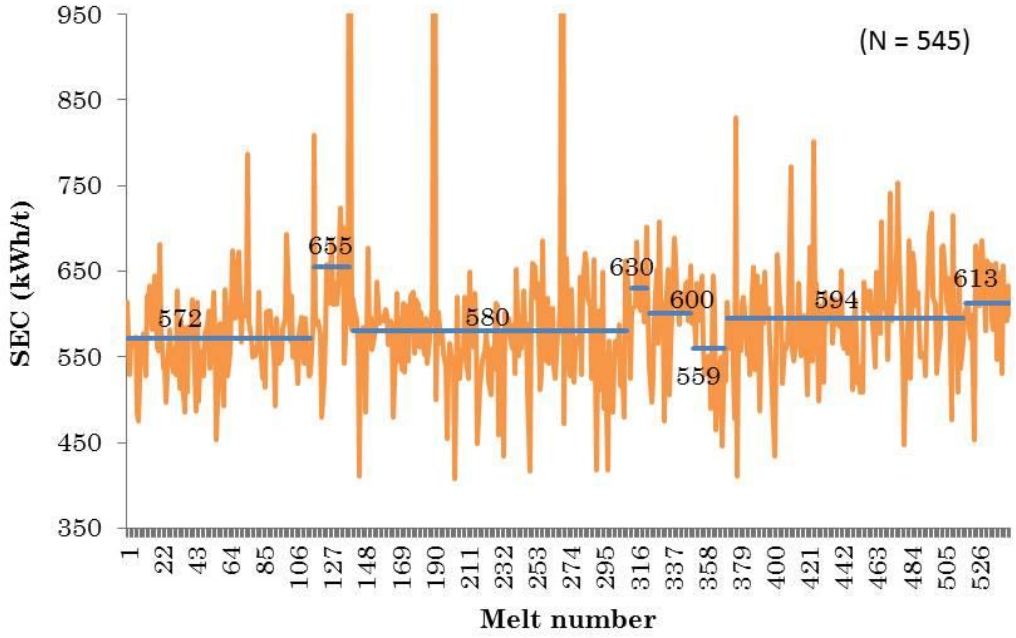
Summary data Collected

- Monitoring of furnace for 8 months
- Grades manufactured by foundry: FG220, FG260, FG300 and FG350
- Most common grade FG220: considered for study
- 545 heats of FG220 grade monitored
- Total quantum of data collected – 16,955 values

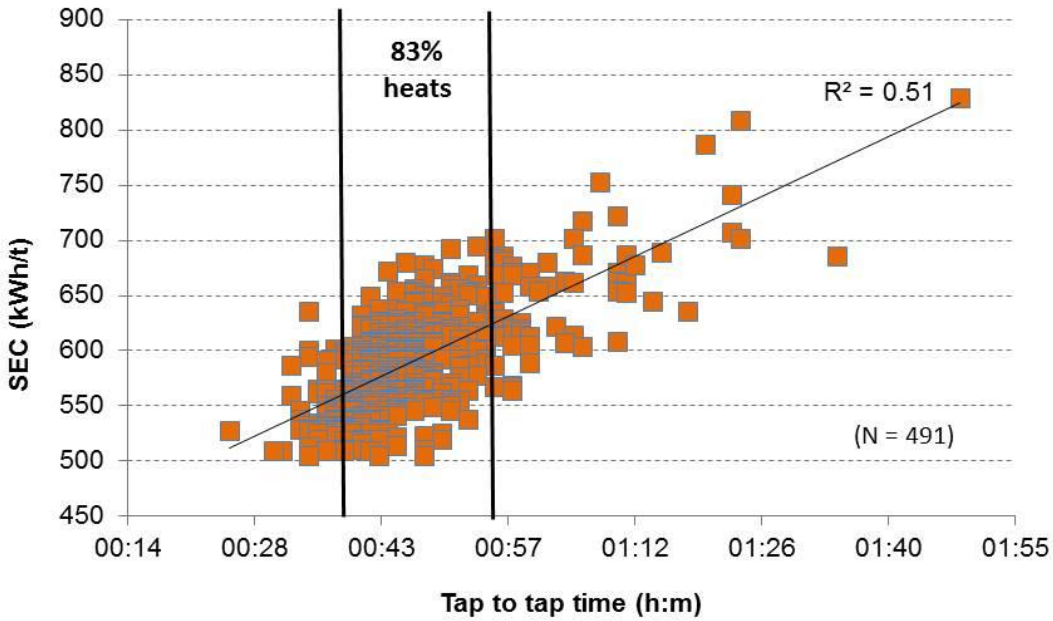
Visualization of data

S. No.	Data analysis	Visualization tool
1	Melt no. vs. SEC	Line graph
2	TTT vs. SEC	Scatter plot
3	TT occurrence	Histogram
4	TT vs. SEC	Scatter plot
5	SEC vs. Operator	Line graph
6	Rejection vs. Occurrence	Pareto chart

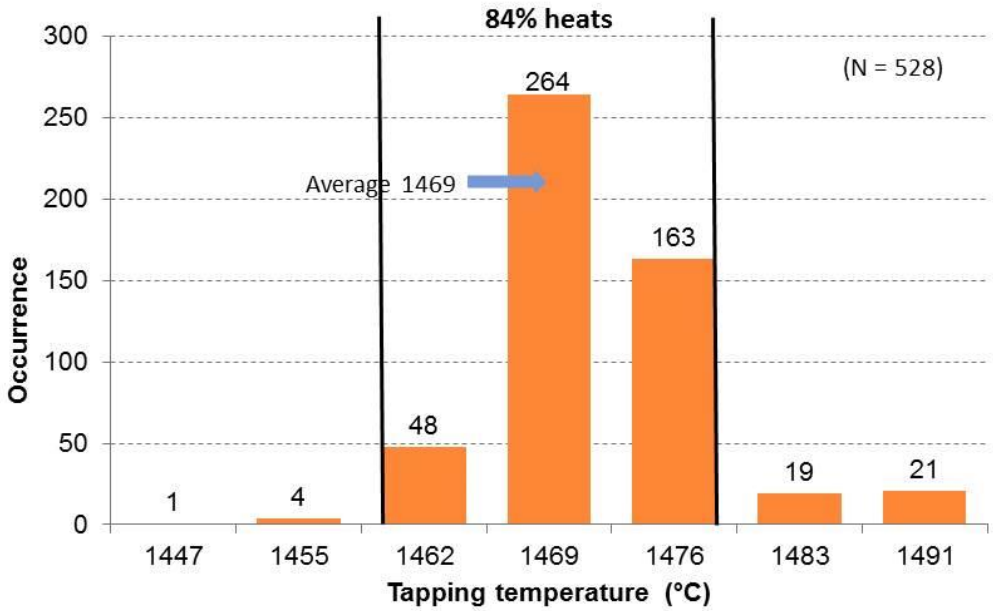
Melt no. vs. SEC (Line graph)



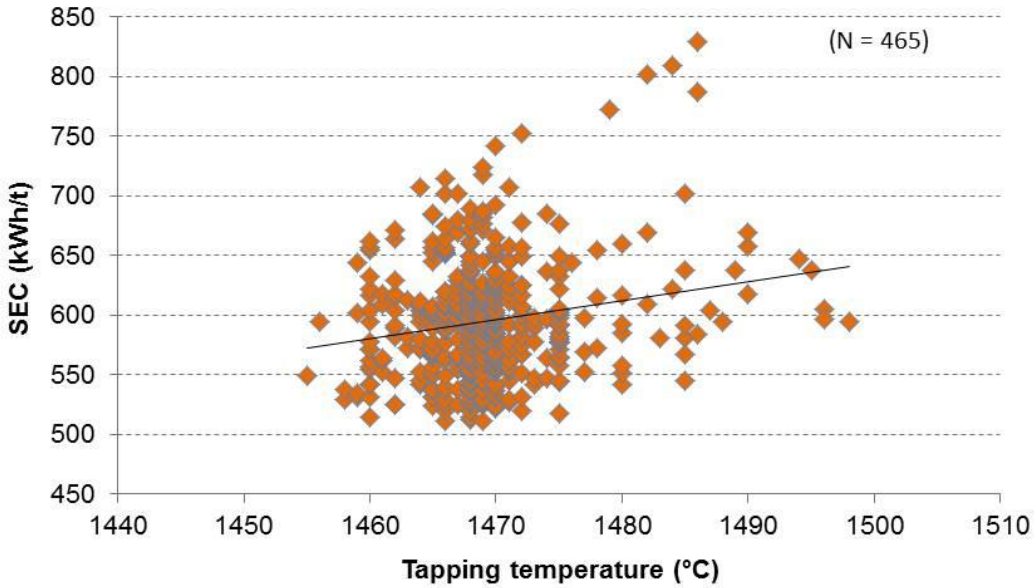
TTT vs. SEC (Scatter plot)



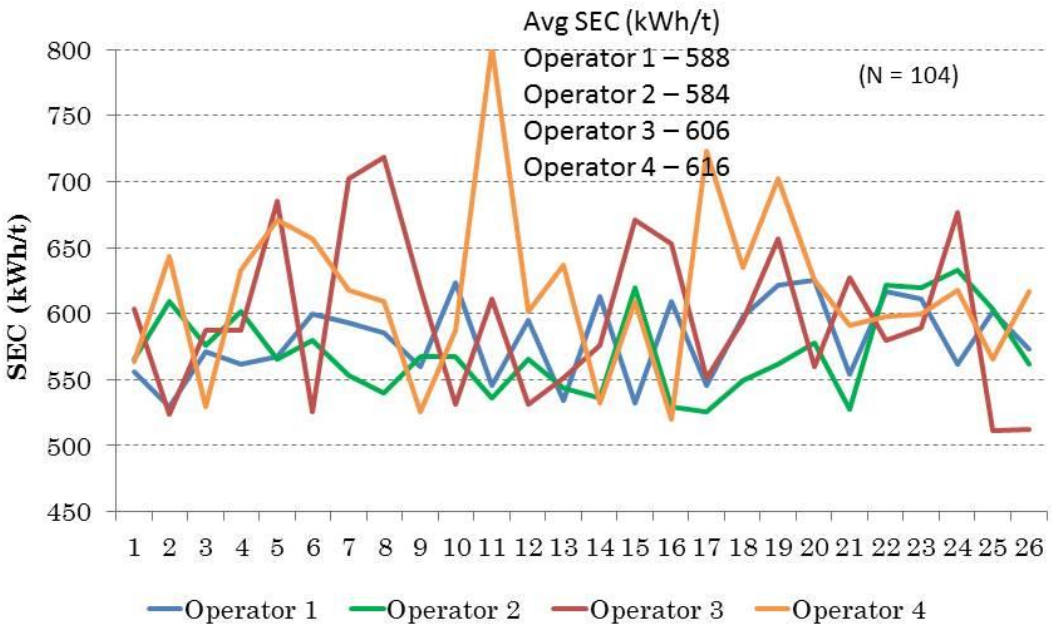
Tapping temperature occurrence (Histogram)



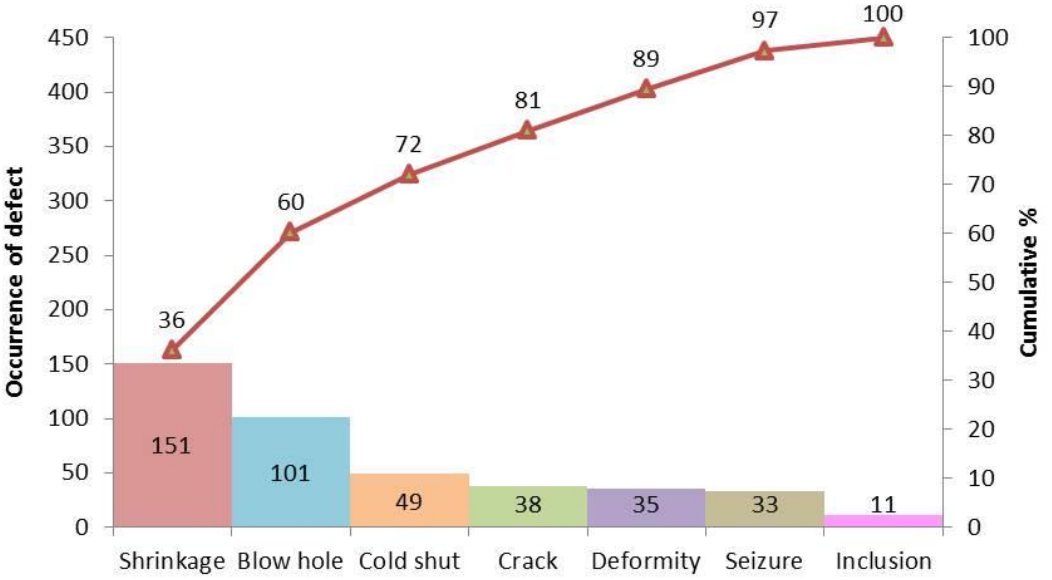
Tapping temperature vs. SEC (Scatter plot)



SEC vs. operator (Line graph)



Rejection occurrence (Pareto chart)



Activities for implementation

Category	Proposal	Priority
Operation of high frequency induction furnace	Creation of the check standard list based on the past troubles	△
	Creation of the prior checking standard for oil pressure and water system	△
Maintenance of high power factor operation	Prior-operation check of the installation state of magnetic shield board	◎
	Connection situations, and cleaning situation of bus bar, etc.	◎

Activities for implementation

Category	Proposal	Priority
Heat radiation from furnace body	Heat radiation from cooling coil (amount of cooling water)	○
	Heat radiation from an outer wall (furnace building plan, consideration of insulation)	△
Shortening of materials charging (input) time	Form (shape) of input materials, proper charging amount	◎
	Mixing of different materials (Prevention from adhesion of slag, sand, refractory, etc.)	◎

Activities for implementation

Category	Proposal	Priority
Management of the ladle preheat	Enhancement of back (rear) insulation	○
	Consideration of ladle cap	△
Creation of production plan and accomplish	Reduction of residual hot water, reduction of waiting time of mould	△

Activities for implementation

Category	Proposal	Priority
Melting operation	Prevention from overheat of molten metal in operation	◎
	Consideration of heat radiation prevention cap from molten metal surface	◎
	Creation of operation melting work standard	◎

◎ *Taking immediate action is recommended,*

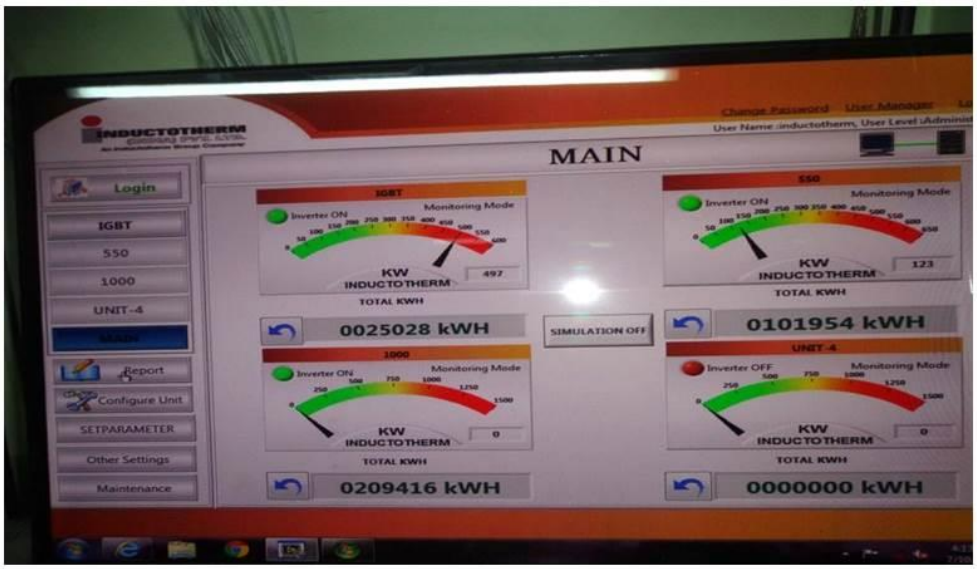
○ *Taking an action not immediately but sometime after is recommended,*

△ *Taking an action carefully and thoroughly*

Activities carried

- Installed the energy monitoring system on Induction Furnaces
- Training of two young operators by experienced operators and foundry manager
- Better line-up of moulds for liquid metal – no holding
- Lid mechanism for Induction furnace
- Replacement of soft water pump with energy efficient pump
- Replacement of raw water pump with energy efficient pump
- Replacement of aluminium blades of cooling tower fan by FRP blade
- Removal of enclosure at air inlet in Cooling tower no.1
- Replacement of existing lighting system with efficient lighting system in phase manner
- Provided cerawool cover on ladle to prevent radiation losses

Implementation



Installation of induction furnace energy monitoring system

Implementation

Lid mechanism for induction furnace crucible

Implementation

Proper sizing of pump and improving energy efficiency

Implementation

Removal of obstruction to cooling tower air intake and FRP blades

Implementation

Cerawool cover for pouring ladle

Implementation

Proper sizing of the former

Implementation

OLTC Transformer

Implementation

Implementation

The Energy and Resources Institute

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Best Operating Practices (BOP) in Induction Furnace

Training Workshop

Energy Conservation (focus on induction melting)

Indore
24 March 2018

Prosanto Pal
The Energy and Resources Institute

Contents

- TERI's experience in foundries
- Energy saving options in a plant
- BOP recommendations for induction furnace

2

- Started working in foundries since 1991
- Initial energy audits in Agra and Howrah
- Demonstration DBC + PCS installed at Howrah in 1998
- Over 130 TERI designed DBC in operation
- 185 detailed energy audits conducted in induction furnace units in Kolhapur & Rajkot
- Over 60% of the audit recommendations implemented

Energy saving options in industry

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Areas of energy savings in a plant

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(1) Improving energy efficiency of Induction furnace

- BOP
- Retrofit
- Revamp

(2) Energy-saving in other areas (moulding, air compressor, lighting, ladle preheating, heat treatment)

(3) Energy-saving by improving yields

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Energy usage in typical induction furnace foundry

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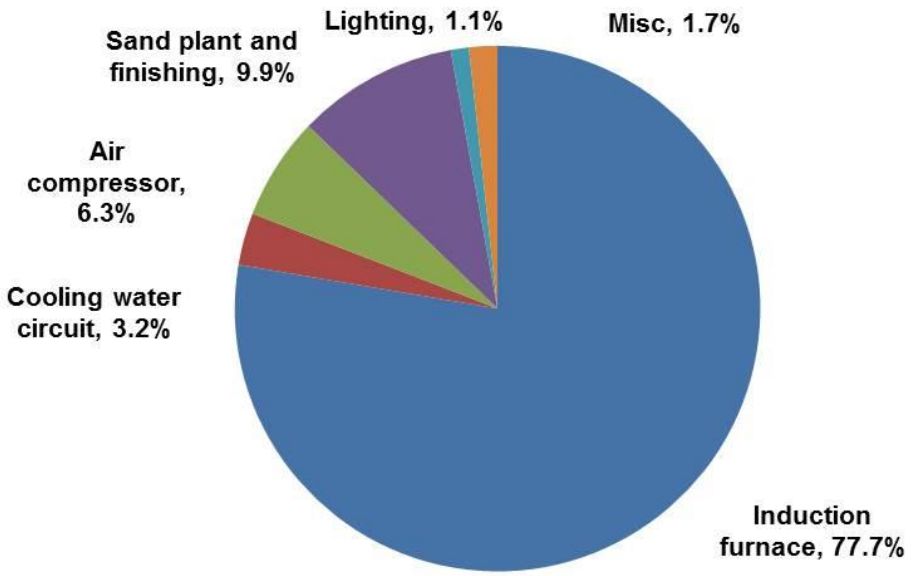
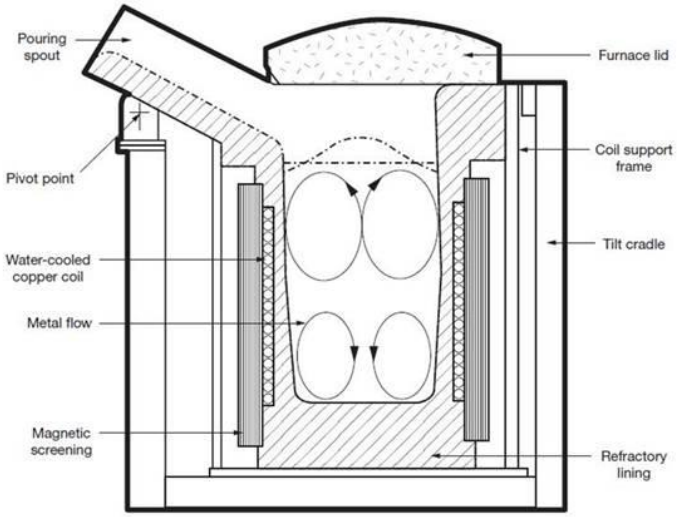
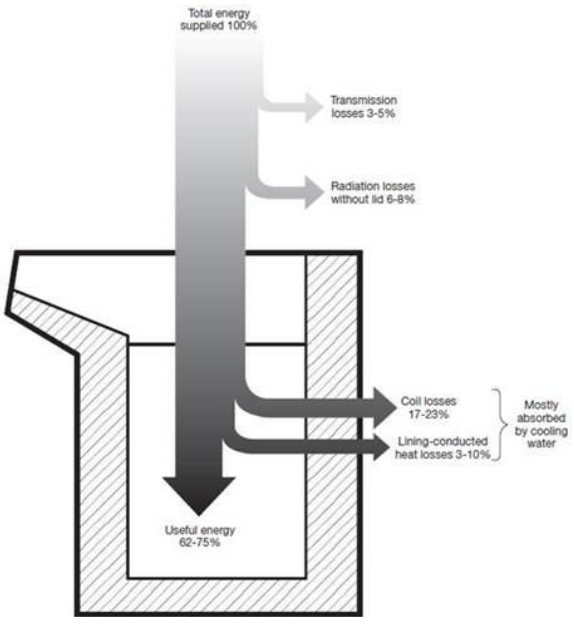


Typical arrangement of coreless induction furnace



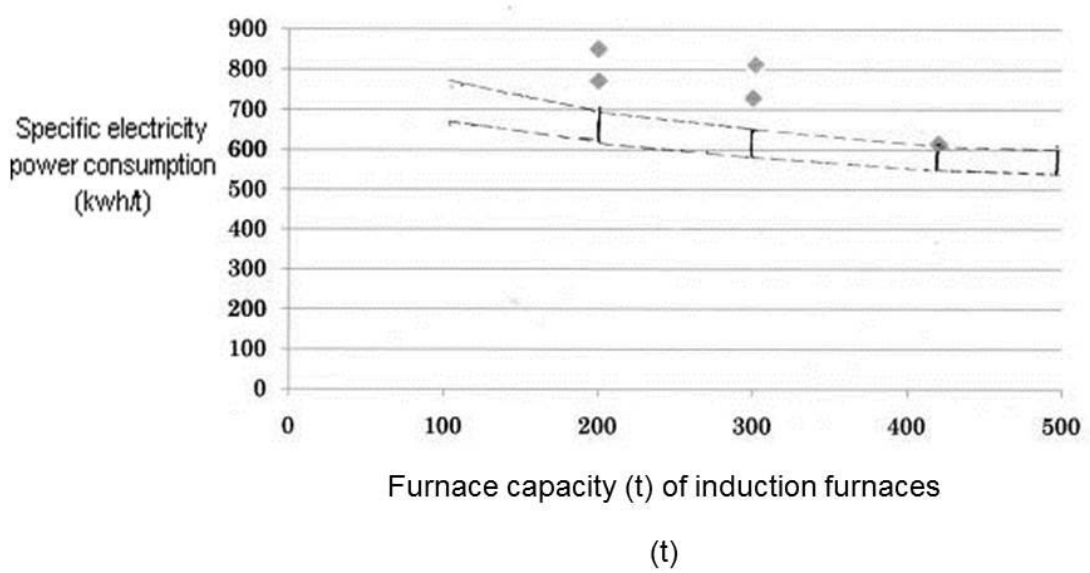
Energy loss in induction furnace



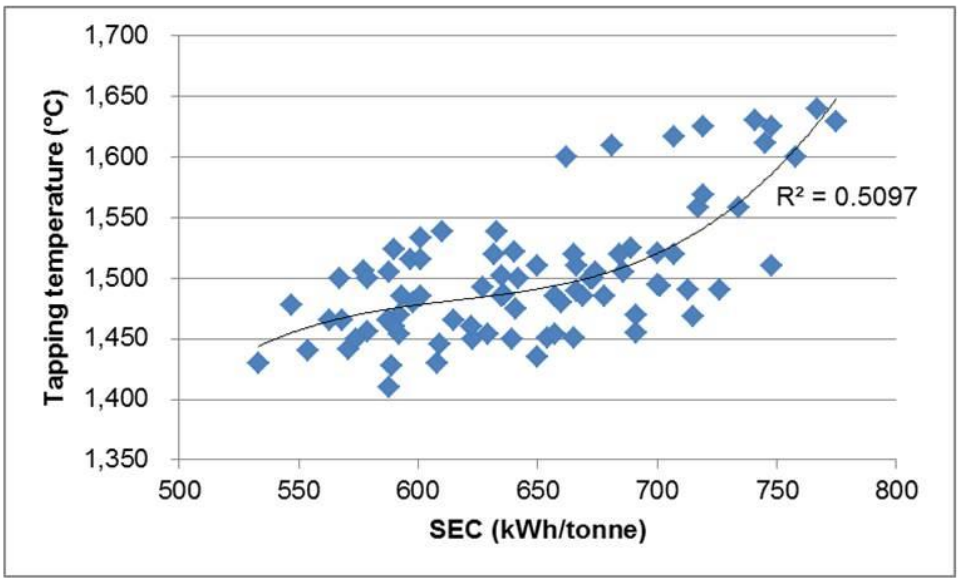
Specific energy consumption (SEC)

- Unit of SEC - kWh/t
  - Indicator of energy performance
  - SEC (furnace) - calculated on per tonne of charged metal
  - SEC (overall) - calculated on per tonne of good (saleable) castings
- SEC may be higher not on account of the poor design of furnace but due to poor operating practices

Relationship between furnace capacity and SEC (kWh/t)



Correlation between tapping temp & SEC



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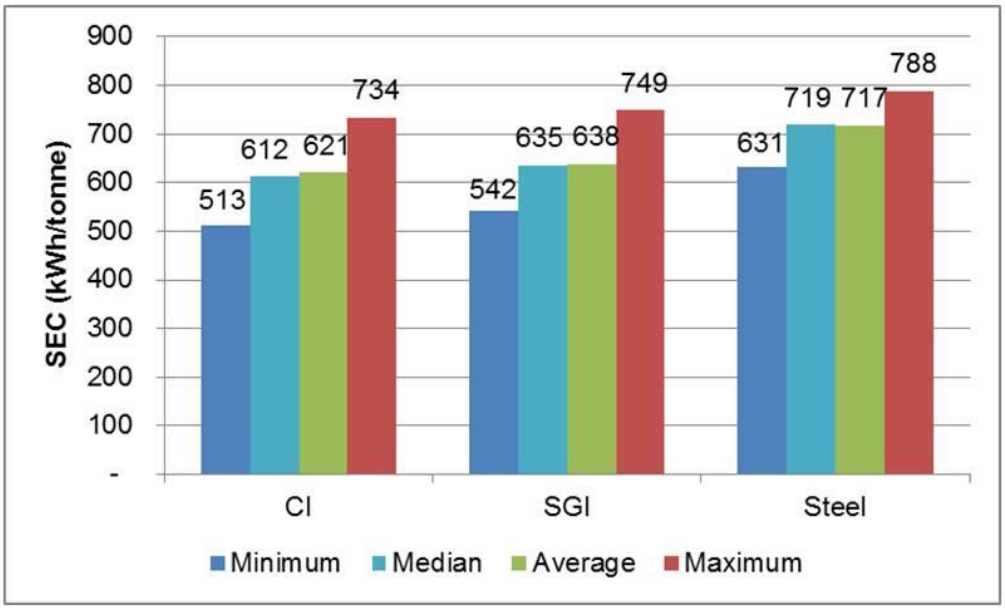
SEC variations for similar castings



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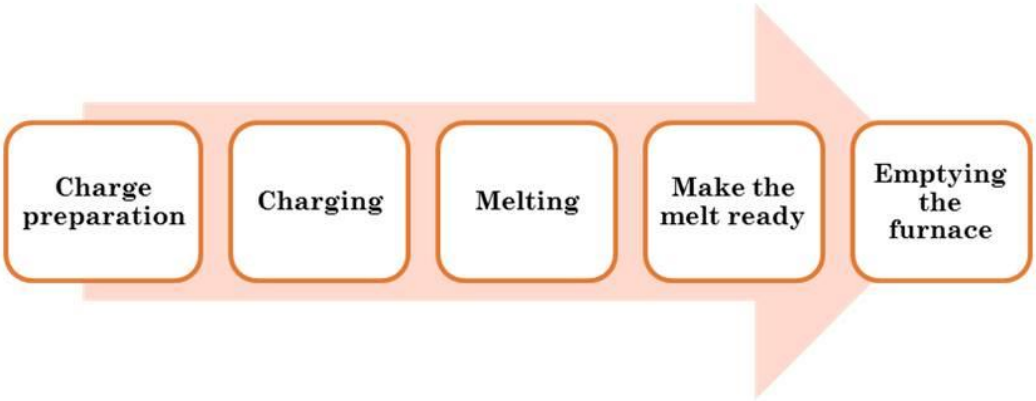
Significant potential to reduce SEC in Induction Furnaces

Steps of operation of induction furnace



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Charge preparation & charging

- Metal must be weighed & arranged near to furnace before starting the melting
- Charge must be free from sand, rust, oil/grease, moisture
- Maximum size scrap should not be more than 1/3rd. of diameter of furnace crucible
- Charge bigger size metal first followed by smaller size & fill gaps by turnings and boring

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Charge preparation & charging

- The foundry returns must be tum blasted or shot blasted to remove the sand
- Reduce charging time by use of mechanical vibrating feeder arrangement
- Furnace should not be charged beyond the coil level, i.e. charge the furnace to its capacity
- Limit the use of baled steel scrap and loose borings

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Raw material charger

Charging basket on track to charge raw material faster

- Run the furnace with full power
- Use lid mechanism for furnace crucible, radiation heat loss accounts for 4 – 5 % input energy. E.g. 500 kg crucible melting at 1450 °C with no lid cover leads to radiation heat loss of up to 25 kWh per tonne
- Avoid build-up of slag on furnace walls

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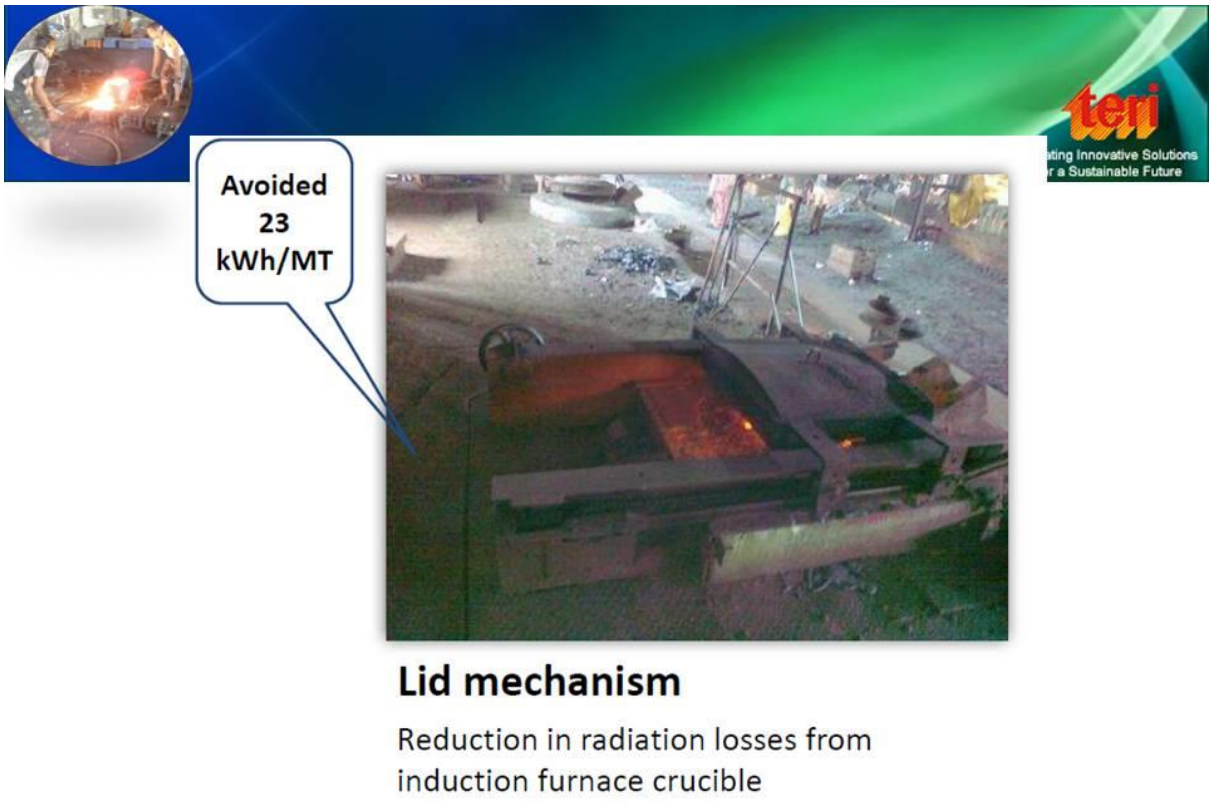
Melting and making melt ready

- Use proper tools for de-slagging. Use tools with flat head instead of rod or bar for de-slagging
- Spectro-testing lab must be located near to melt shop to avoid waiting time for chemical analysis
- Avoid un-necessary super-heating of metal. Superheating by 50 °C can increase furnace specific energy consumption by 25 kWh per tonne



Lid mechanism

Reduction in radiation losses from induction furnace crucible

Energy saving 9 kWh per batch

Lid mechanism

Reduction in radiation loss from induction furnace crucible

Avoided 11 kWh per batch

Lid mechanism

Reduction in radiation loss from induction furnace crucible

Avoided 3-4 kWh per batch

Lid mechanism

Reduction in radiation loss from induction furnace crucible

Avoided 12 kWh per batch

Lid mechanism

Reduction in radiation loss from induction furnace crucible

Lid mechanism

Reduction in radiation loss from induction furnace crucible

- Optimization of the ladle size to minimize the heat losses and empty the furnace in the shortest time
- Optimization of the ladle transportation.
- Use of ladle pre-heater

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Emptying the furnace

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- Quantity of liquid metal returned to furnace must be as low as possible
- Glass-wool or ceramic-wool cover for pouring ladle
- Minimize plant breakdown by implementing a planned maintenance schedule

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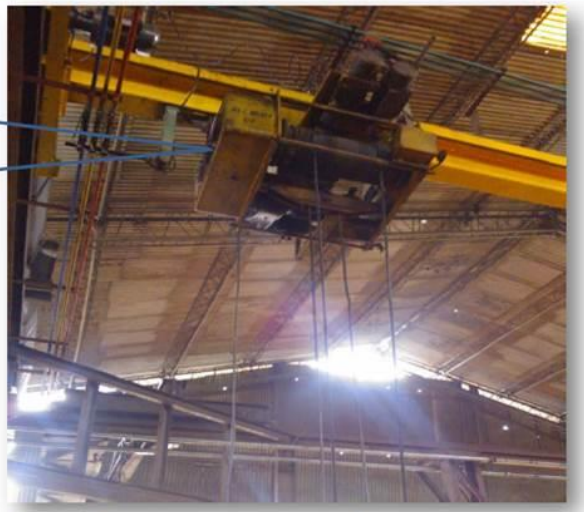
Mono-rail Pouring time saving 12 min per batch

Pouring automation

Reduction in time taken for pouring, saving of energy wasted during metal holding

Crane Pouring time saving 6-8 min per batch



Pouring automation

Reduction in time taken for pouring, saving of energy wasted during metal holding

Ladle pre-heater

Avoiding use of molten metal for heating pouring ladle

Ladle cover

Ceramic wool+MS cover for pouring ladles

Ladle cover

Ceramic wool+MS cover for pouring ladle

Ladle cover

Ceramic wool+MS cover for pouring ladle

- Separate energy meter for furnace must be installed
- Monitor & analyze energy consumption on heat by heat basis to calculate SEC of furnace on daily basis
- Coil cooling and panel cooling water's temperature and flow rate must be monitored regularly

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Energy monitoring and data analysis

- The panel must be checked on weekly basis and cleaning must be done on monthly basis
- Check the condition of fins in cooling tower, do cleaning of fins on monthly basis

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Thank You

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