Capacity Building workshop

Lean Manufacturing

21st March 2018 at Coimbatore

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 Lean manufacturing was organized by TERI on 21st March 2018, Wednesday in association with BFC under GEF-UNIDO project. Total 60 participants 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. R Sivakumar welcomed the participants and gave a brief about initiatives of UNIDO in the cluster and purpose of training programs organised for LSPs in the cluster. He encouraged participants to take advantage of TERI experts during program, which are made available by UNIDO for capacity building of LSPs

Mr. Arun Ranganathan (VP-COINDIA) welcomed and thanked TERI and UNIDO for arranging the capacity building workshop. He highlighted that, in a typical foundry unit implementation of lean manufacturing can improve the productivity with reduction in energy consumption significantly. He encouraged participants to ask and share their experiences during workshop with TERI experts to make training sessions more interactive.

Mr. Ashish Sakhare gave descriptive presentation on introduction to the Lean manufacturing with examples of types of wastes in typical foundry. He explained in details the principles of Lean manufacturing which will guide us to the perfection. He also mentioned the importance of leadership and team efforts required for implementation of the lean manufacturing and shared some of the implemented case studies.

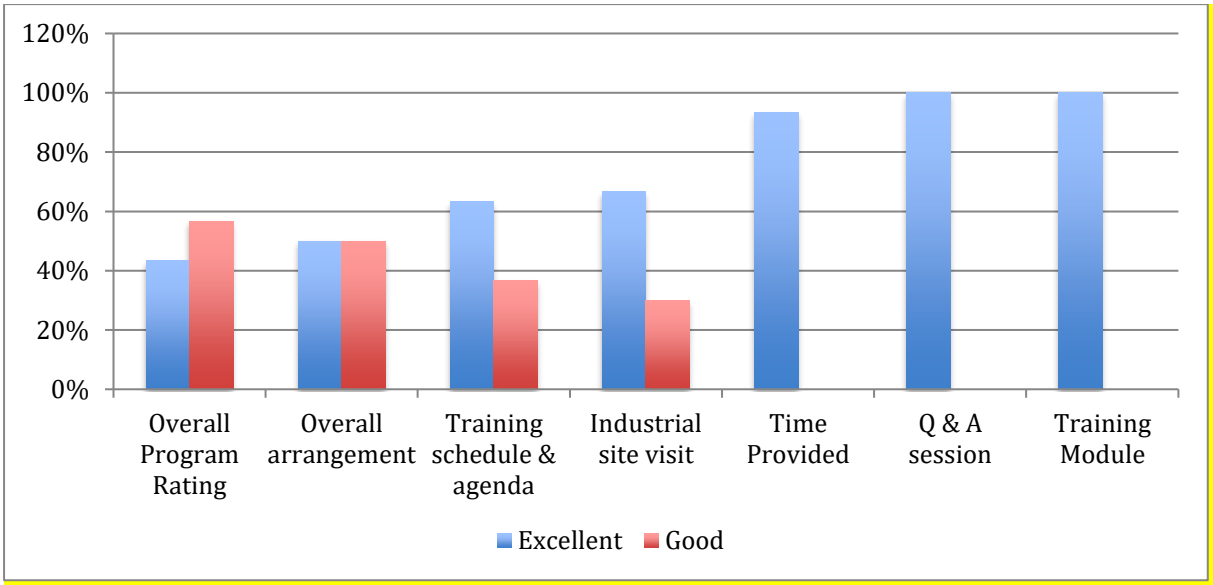
Mr. Nilesh Shedge gave presentation on implementation of Kaizen in induction furnace and shared some case study done by TERI in foundries. He mentioned the importance of monitoring for identification of non-value added activities in the induction furnace operation. He also shared and experience of implementation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

Mr. S R Sankar, lean expert from the cluster shared his experiences about the implementation of lean manufacturing in Coimbatore cluster. He also spoke about the importance of implementation of lean manufacturing in the foundry operations to improve overall productivity of the foundry. He share some of the case studies implemented in the foundry unit like online packaging, which eventually results in improved productivity of the unit.

After the lunch, plant tour through the M/s Ellen Industries Private limited was arranged, so that participants can experience the actual lean tools implementations done for productivity improvements 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 Q&A session and training module provided to them. More than 70% of participants were rated training schedule and industrial site visit as "Good". More than 40% participants have rated overall program as "Excellent" while rest of them have rated it as "Good". All the 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) Request to add some videos of lean practices in foundries
2) Requested more training programs including shop floor workforce

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) Waste reduction & Workplace organisation (5S)
3) Reduction in unnecessary movement
4) Feeding material sequence and size
5) Monitoring & data collection for induction furnace
6) Same size of crucible and pouring ladle to reduce losses

Annexures

Annexure 1: Agenda of the program

Capacity Building workshop

Lean Manufacturing

Wednesday, 21 March 2018

IIF-Coimbatore Chapter, 2nd Floor, Unit No. B-3B,

Opp. Carmel Garden School, Puliyakulam Main Road, Coimbatore

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

---

Agenda

10:00 – 10:30	Registration
10:30 – 10:40	**Welcome Address** Mr Arun Ranganathan, Vice President, COINDIA
10:40 – 11:10	**Introduction to Lean Manufacturing** Mr Ashish Sakhare, TERI
11:10 – 11:40	**Kaizen in induction furnace operation** Mr Nilesh Shedge, TERI
11:40 – 12:40	**Case-studies on Lean implementation** Mr S R Sankar, Consultant
12:40 – 13:00	Q&A
13:00 – 14:00	Lunch
14:00 – 16:00	**Site Visit / On-site training** Visit to an industrial unit
16.00 – 16:30	Feedback from participants
16:30 – 16:45	**Vote of thanks**

Organized by

The Energy and Resources Institute

COINDIA

Annexure 2: List of participants

S. No	Name	Organization	Mobile No	Email ID
1.	Mr S Sivalingam	PSG Foundry	9944001176	icesivasgs@gmail.com, PSGfoundry@gmail.com
2.	Mr K Ravi Kumar	FLS	9944485428	fdylproduction@flowlink.net
3	Mr N Jayapathi	TECA	9363228913	jayapathi@gmail.com
4	Mr N Suresh	M.J.P. Enterprises (Pvt) Ltd	9500778066	mjfoundry@gmail.com
5	Mr G Vijayakumar	Veesaa Foundry	8940924430	veesaafoundry@gmaill.com
6	Mr R Chandrasekar	M/s Bakgiyan Foundry	7373776385	chandrasekar@bakgiyan.com
7	Mr G Surya Prakash	Veesaa Foundry	9942557537	veesaafoundry@gmaill.com
8	Mr T Bakthavathsalam	Beena Consultancy	9894633883	bakthavathsalam.t@gmail.com
9	Mr D Selvi Soundaram	Best Engineering Pumps Pvt Ltd	9489331639	bestgroupiso@gmail.com
10	Mr T Merajkala	Best Engineering Pumps Pvt Ltd	9894364572	merajkala@gmai.com
11	Mr R Ramprakash	Best Engineering Pumps Pvt Ltd	9223789003	bestlcnc@gmail.com
12	Mr V P Ramesh	Best Engineering Pumps Pvt Ltd	9843519985	bestlcnc@gmail.com
13	Mr M Murugesan	Aquasub Engg Foundry	9842970346	mmfdy@aquagroup.in
14	Mr M Vignesh	Aquasub Engg Foundry	9488161571	vignesheeekk@gmaill.com
15	Mr R Srirangan	Aquasub Engg Foundry-II	9500305572	rsrirangan1992@gmail.com
16	Mr S Praveen Ram	Aquasub Engg Foundry-II	8870855875	spraveenram@gmail.com
17	Mr S Muthiah	Ammarun Foundry	9095053535	asmuthiah1974@gmail.com
18	Mr S Subramani	R V Refractories	9600095551	kalyanmani@vsnl.net
19	Mr S Venkatesh + 2	Suresh Engg Works	9843231821	sew.info@gmail.com
20	Mr S Arjunan	Sree Bakgiyam Engg Corp	7397518555	mr@bakgiyam.com
21	Mr D Manikandan	Alcop Innovations Pvt Ltd	9894930912	alcop@gmail.com
22	Mr S Rajasekaran	Anish Kumar Spinning Mill	9750910909	anishkumarsuguna@gmail.com
23	Mr R Dhana Shekar	Bakgiyan Eng Pvt Ltd	9443316950	
24	Mr Y Siddharth	SKCET	9585037475	scienti666@gmail.com
25	Mr D S Vigneshwar	SKCET	9629149310	dsvigneshwar98@gmail.com
26	Mr G Vignesh	SKCET	8428931282	vignesha8gvoindaraj@gmail.com
27	Mr J A Vijay Kumar	SKCET	9944499641	Vijayash1729mechminion@gmail.com
28	Mr Raguramsingh M	Srikrishna College of Technology	9894581116	raguramsingh1990@gmail.com
29	Mr P Sabesh Kumar	Srikrishna College of Technology	9629446498	sabeshkumar18@gmail.com
30	Mr S Vignesh	Srikrishna College of Technology	9791272910	SID003624@gmail.com
31	Mr Sampath Kumar S	Srikrishna College of Technology	9042149370	sekarsampathkumar@gmail.com
32	Mr Praveen S	Srikrishna College of Technology	7695901482	praveenrock181098@gmail.com
33	Mr S Sasikumar	SE Forge Ltd	9894131318	parksasi@gmail.com
34	Mr R Subash	SE Forge Ltd	9003027673	subas.nke@gmail.com
35	Mr A Baskot	Integra Automation Pvt Ltd	9976290151	paskot0395@gmail.com
36	Mr S Vellikodi	Integra Automation Pvt Ltd	8525864937	
37	Mr S R M D Choudhri	Beena Consultancy	9600652985	Srmd1181@gmail.com
38	Mr K Boopathi	M/s Sri Suguna Machine Works	9442221267	Boopathi4uall@gmail.com
39	Mr K Ramalingam	M/s Deffree Engg (P) Ltd	9751059325	ac@deffree.com
40	Mr R Theivendra	M/s Bakgiyan Eng Pvt Ltd	9443316943	theindran@bakgyan.com
41	Mr V Siva	M/s Bakgiyan Eng Pvt Ltd		

S. No	Name	Organization	Mobile No	Email ID
42	Mr K K Ramanan	SKCET	9488100674	lbeumc120@skcet.ac.in
43	Mr P Kumar	Nehru Institute of Engineering Technology	9688772396	kumarmeiephd@gmail.com
44	Mr M Jeevanantham	Eltex Super Castings	8825751347	jeevananthamar@gmail.com
45	Mr C Balaji	Eltex Super Castings	9943605508	Balamech567@gmail.com
46	Mr M Selvaraj	Indo Shell Cast Pvt Ltd	9345265224	shellmoulding1@indoshellcast.com
47	Mr C Vichu Kumar	Indo Shell Cast Pvt Ltd	9345252228	shellmoulding2@indoshellcast.com
48	Mr M Gopala Krishnan	Vanajaa Enterprises	9698942449	gopalkris787@gmail.com
49	Mr S Vijayakumar	Mahedra Pumps Pvt Ltd, Unit IV	9788556838	U4electrical@mahendrapumps.in
50	Mr D Ramalingan	Mahedra Pumps Pvt Ltd, Unit IV	9942399015	u4foundry@mahendrapumps.in
51	Mr J Arumugam	Anesh Foundry (Suguna Pumps)	9942079428	arumugamsunsh01@gmail.com
52	Mr Arun Ranganathan	COINDIA	9524683333	arun@sugnagroup.com
53	Mr R Siva Kumar	COINDIA	9965250504	Siva.raja076@gmail.com
54	Mr Sankar	R G Magmt Consultant		
55	Mr S Soundarrajan	COINDIA	9944286628	info@coindia.in
56	Mr Sekar	Sri Ramakrishna Industries Unit I	7200428295	
57	Mr Harry	Sri Ramakrishna Industries Unit I	7200428295	
58	Mr Ayyaran	Rajpreath Industries	9443355533	rajpreath@gmail.com
59	Mr Nilesh Shedge	TERI	9579448627	nil.shedge@gmail.com
60	Mr Ashish Sakhare	TERI	8587923342	ashish.sakhare@teri.res.in

The Energy and Resources Institute

Capacity building workshop

Lean Manufacturing

21 March 2018, IIF-Coimbatore Chapter, Coimbatore

S. No	Name	Organization	Mobile No	Email ID	Signature
1.	S. SIVALINGAM	PSG FOUNDRY	9944001176	icasiva.sgs@gmail.com psgfoundry@gmail.com	[illegible]
2.	K. RAVIKUMAR.	FLS	9944485428	fdy1production@flowlink.net	[illegible]
3.	N. JAYAPATHI	TECA	9363228913	jayapathi@gmail.com	[illegible]
4.	N. SURESH	M.J.P. Enterprises (PVT) Ltd	9500778066	mjpfoundry@gmail.com	[illegible]
5.	G. Vijayakumar	Veesaa Foundry	8940924480	Veesaa foundry@gmail.com	[illegible]
6.	R. Chandrasekar	MLS Bakiyam Foundry	7373776385	chandrasekar@[illegible].com	[illegible]
7.	G. Surya Prakash	Velan foundry	9942554537.	Velan foundry@gmail.com	[illegible]

S. No	Name	Organization	Mobile No	Email ID	Signature
8.	T. Bakthavathsalam		9894633883	bakthavathsalam.t@gmail.com	[signature]
9.	D. Selvi Soundaram	Best Engineers Pumps Pvt Ltd, vellandi Palayam	9489331639	bestgroupico@gmail.com	[signature]
10	T. Menykala	"	9894364572	menykala@gmail.com	[signature]
11	R. Ramprakash	Best Engineers Pumps Pvt Ltd, Foundry Division	9003278902	bestlenc@gmail.com	[signature]
12	V.P. Ramesh	"	9843519985	"	[signature]
13	M. Murugesan	Aquasub Engg fdy	9842970346	mmfdy@aquagroup.in	[signature]
14	M. VIGNESH	Aquasub Engg - fdy	9488161571	vigneshecekk@gmail.com	[signature]
15	R. Srirangan.	Aquasub Eng. Fdy-II	9500305572	rsrirangan1992@gmail.	[signature]
16	S. Praveen Ram	Aquasub Engg. Fdy-II	8870855875	spraveenram@gmail.com	[signature]
17	S. Muthiah	Production manager	9095053835	asmuthiah1974@gmail.com	[signature]

S. No	Name	Organization	Mobile No	Email ID	Signature
18	S. SUBRAMANI	R.V. REFRACTORIES	9600095551	kalyanmani@vsnl.net	
19	S. VENKATESH+2	SURESH ENGG WORKS	9843231821	sew.info@gmail.com	
20	S. ARJUNAN	SREE BAKKIYAM ENGG CORPORATION	73975 18555	mr@bakkiyam.com	
21	D. Manikandan	Alcop Innovations Pvt Ltd	9894930919	Alcop@gmail.com	
22	S. Rajasekaran	Anishkumar Engg Mills	97509 10909	Anishkumarsugumar@gmail.com	
23	R. Bhanu Shekar	Bakkiyam Engg Pvt. Ltd	9443316940	–	
24	M. Siddhartha	SKCET	9585037475	Scientist666@gmail.com	
25	D.S. Vigneshwar	SKCET	9629149310	dsvigneshwar98@gmail.com	
26	M. Vignesh.	SKCET	8428931282	vigneshagovindaraj@gmail.com	
27	J.A. Vijay Kumar	SKCET	9944499641	Vijayash1994mechanician@gmail.com	

S. No	Name	Organization	Mobile No	Email ID	Signature
28	Raguramsingh M	Sri Krishna College of Technology	9894581116	raguramsingh1990@gmail.com	[signature] 21.3.18
29	P. Sabesh Kumar	" "	9629446498	Sabeshkumar18@gmail.com	[signature]
30	S. Vignesh	" "	9791272910	SID003624@Gmail.com	[signature]
31	Sampath kumar. S	" "	9042149370	selvanSampathKumar@gmail.com	[signature]
32	Praveen . S	" "	7695901482	Praveenrock1990s@gmail.com	[signature]
33	S. Sasikumar	SEFORGE, LTD	9894131318	Parksasi@gmail.com	[signature]
34	R. Subash	"	9003027673	Subas.nkl@gmail.com	[signature]
35	A. Baskar	Integra automation Pvt.Ltd	9976240151	baskar0245@gmail.com	[signature]
36	S. Velliyadi	" "	8525864937	—	[signature]
37	S.R.M.D.CHOUDRI	Beena Company	9600652985	[illegible]11810@gmail.com	[signature]

S. No	Name	Organization	Mobile No	Email ID	Signature
38	K. BOOPATHI	M/s. Sri Sugana Machineworks	9442221267	boopathi4uall@gmail.com	
39	K. Ramalingam	M/s. Deffree Engg(P) Ltd	9751059325	ac@deffree.com	
40	R. Theivendran	M/s Balajiyam Engg Pvt Ltd	9443316548	—	
41	V. Siva	M/s Balajiyam Engg Pvt Ltd	—	—	
42	K.K. Ramaran	SKCET	94881 00674	kkrmc130@skcet.ac.in	
43	P. KUMAR	NEHRU INSTITUTE OF ENGINEERING & TECHNOLOGY	9688772396	kumarmeiephd@gmail.com	21/3/18
44	M. Jeevanantham	M/s Eltex Super Castings	8825751347	jeevananthamar@gmail.com	
45	C. BALAJI	M/S ELTEX SUPER CASTINGS	9943605508	balaroch567@gmail.com	21/03/18
46	M. Selvaraj	M/s Indo Shell Cast (P) Ltd	9345265224	Shellmoulding1@Indoshellcast.com	
47	C. VICHU KUMAR	"	9345 25 2228	Shell moulding 2 @ indoshell cast. com	

S. No	Name	Organization	Mobile No	Email ID	Signature
48	M. Gopala krishnan	VMNAJAA EnterPrises	9699942449	Gopal kriz 787@ gmail	[signature]
49	S. VIJAYAKUMAR	Mahendra pumps unit IV.	9788556836	U4electrical@mahendra pumps.in.	[signature]
50	D. Ramalingam	"	9942399015	U4foundry@mahendra pumps.In	[signature]
51	J. Arumugam.	Anesh foundry (Sugunapumps)	9942074428	arumugam suresh 01@gmail	[signature]
52	Arun Ranganathan	COINDIA - VP.	9524683333	arun@sugunagroup.com	[signature]
53	R. SIVAKUMAR.	COINDIA - UNIDO Project	9965250502.	siva-rajnor@gmail.com	[signature]
54	SANKAR.	RG Mgmt Consultants			
55	N: lam.	TERI			
56	Arjun.	TERI			
57.	S. Soundararajan	COINDIA	9944286628	info@coindia.in	[signature]
58.	Sekar	Sri Kamakshi Industries unit	7200412845	Sekar@mekamail.com	[signature]
59.	Hari.	"	"	"	"
60.	AYYAPAN.				

Annexure 3: Selected photographs of the event

Annexure 4: Sample feedback forms

Capacity building workshop

Lean Manufacturing

Wednesday, 21 March 2018

IIF-Coimbatore Chapter, Coimbatore

Supported by:

GEF-UNIDO-BEE Project

Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India

---

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:			
Covering overall topics on manufacturing but not only on specific process.			
Name two learning, which from this programme you will be able to implement in your plant?			
Lean Manufacturing & 5 implementation of Kaizen			
Signature:			
Name of participant:	M. Siddharth		
Organization:	SKCET		
Mobile No:	95850 87475		
Email ID:	scientbbb@gmail.com		

Organized by

The Energy and Resources Institute

Capacity building workshop

Lean Manufacturing

Wednesday, 21 March 2018

IIF-Coimbatore Chapter, Coimbatore

Supported by:

GEF-UNIDO-BEE Project

Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India

---

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:			
Need more explanation about overall topics. and want to keep exact practicality.			
Name two learning, which from this programme you will be able to implement in your plant?			
Lean Manufacturing & continuous Improvement			
Signature:			
Name of participant:	M. Vignesh. (Student)		
Organization:	SKCET (college)		
Mobile No:	8122831282		
Email ID:	vignesh98govindaraj@gmail.com.		

Organized by

The Energy and Resources Institute

COINDIA®

Capacity building workshop

Lean Manufacturing

Wednesday, 21 March 2018

IIF-Coimbatore Chapter, Coimbatore

Supported by:

GEF-UNIDO-BEE Project

Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India

---

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:			
Live technical scenario in foundries should be implemented in future.			
Name two learning, which from this programme you will be able to implement in your plant?			
Signature:			
Name of participant: K. HARI BHARATH			
Organization: VINAYAGA CASTINGS			
Mobile No: 99446 84088			
Email ID: haribharath@gmail.com			

Organized by

The Energy and Resources Institute

COINDIA

Capacity building workshop

Lean Manufacturing

Wednesday, 21 March 2018

IIF-Coimbatore Chapter, Coimbatore

Supported by:

GEF-UNIDO-BEE Project

Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India

---

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?			
Core Shifting.			
painting			
Signature:			
Name of participant:	K. BOOPATHI		
Organization:	Sri Sakthi Machine Works		
Mobile No:	9442221267		
Email ID:	boopathi4uall@gmail.com		

Organized by

The Energy and Resources Institute

Annexure 5: Copy of presentations

21th March 2018

teri
Creating Innovative Solutions
for a Sustainable Future

teri
Creating Innovative Solutions
for a Sustainable Future

Content

- Introduction
- History
- Lean Principles
- Goals
- Lean Tools
- Type of wastes
- Identification of Waste

teri
Creating Innovative Solutions
for a Sustainable Future

Who will win the Race?

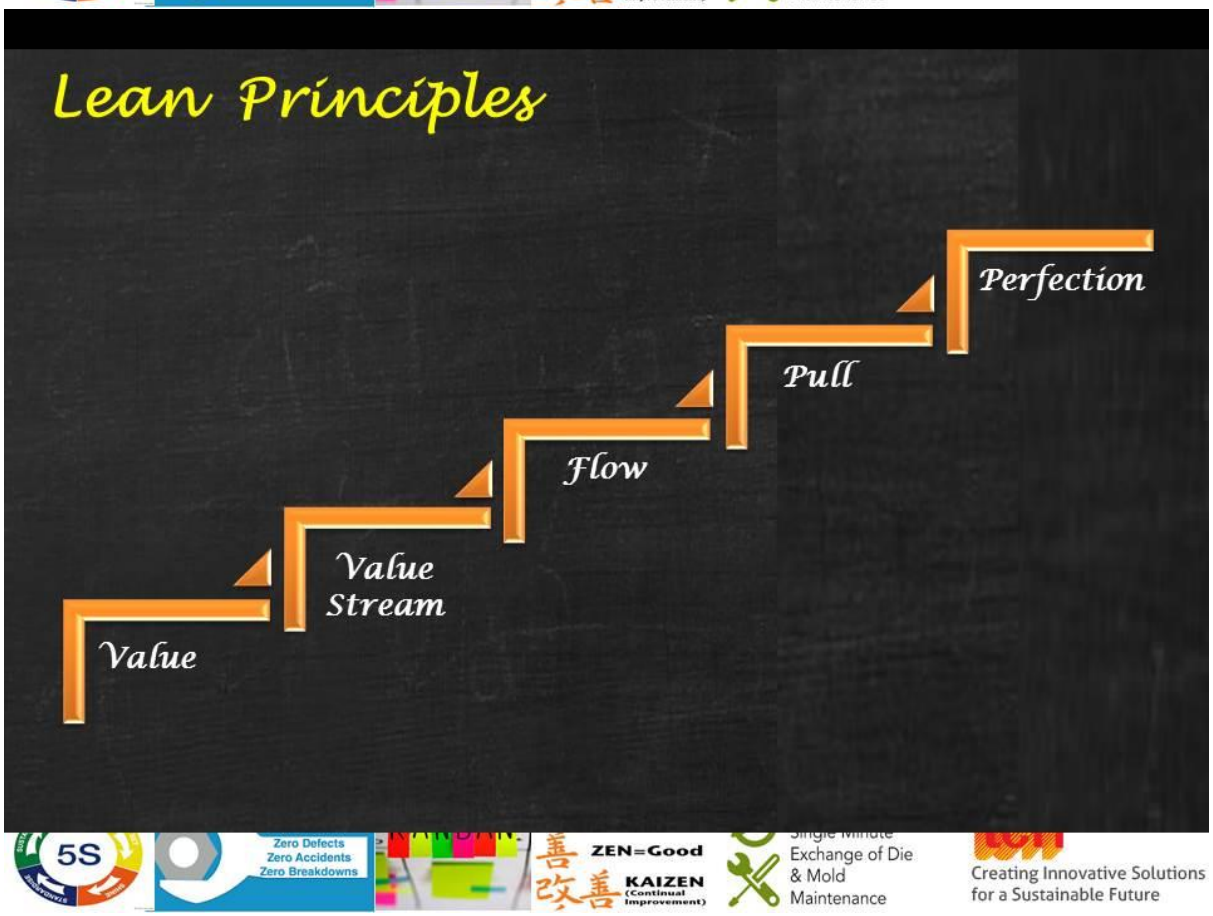
5S | TPM Zero Defects Zero Accidents Zero Breakdowns | KANBAN | KAI=Change ZEN=Good KAIZEN (Continual Improvement) | SMED Single Minute Exchange of Die & Mold Maintenance | teri Creating Innovative Solutions for a Sustainable Future

Introduction

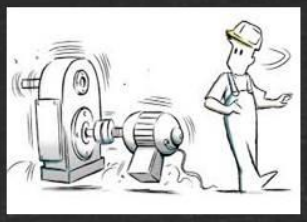
- Lean manufacturing is a systematic method for waste minimization ("Muda") within a manufacturing system without sacrificing productivity
- Lean also takes into account waste created through overburden ("Muri") and waste created through unevenness in work loads ("Mura")

5S | TPM Zero Defects Zero Accidents Zero Breakdowns | KANBAN | KAI=Change ZEN=Good KAIZEN (Continual Improvement) | SMED Single Minute Exchange of Die & Mold Maintenance | teri Creating Innovative Solutions for a Sustainable Future


History
In 1990 James Womack, Daniel T. Jones, and Daniel Roos wrote a book called "The Machine That Changed the World: The Story of Lean Production- Toyota's Secret Weapon in the Global Car Wars That Is Now Revolutionizing World Industry"
In this book, Womack introduced the Toyota Production System to World.
What was new was a phrase-
"Lean Manufacturing."
5S
TPM
Zero Defects
Zero Accidents
Zero Breakdowns
KANBAN
KAI=Change
ZEN=Good
KAIZEN
(Continual Improvement)
SMED
Single Minute
Exchange of Die
& Mold
Maintenance
teri
Creating Innovative Solutions for a Sustainable Future

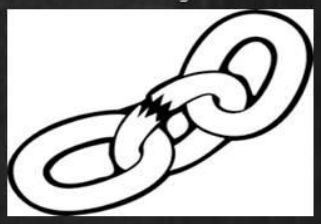

Lean Principles
Value
Value Stream
Flow
Pull
Perfection
5S
Zero Defects
Zero Accidents
Zero Breakdowns
ZEN=Good
KAIZEN
(Continual Improvement)
Exchange of Die
& Mold
Maintenance
Creating Innovative Solutions for a Sustainable Future

Zero Breakdowns



Zero Delays

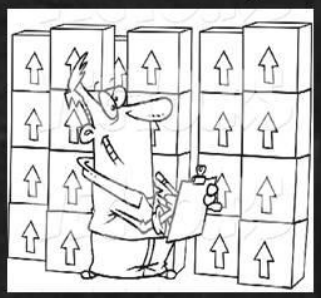
Zero Defects



GOALS

Zero Accidents

Zero Inventory



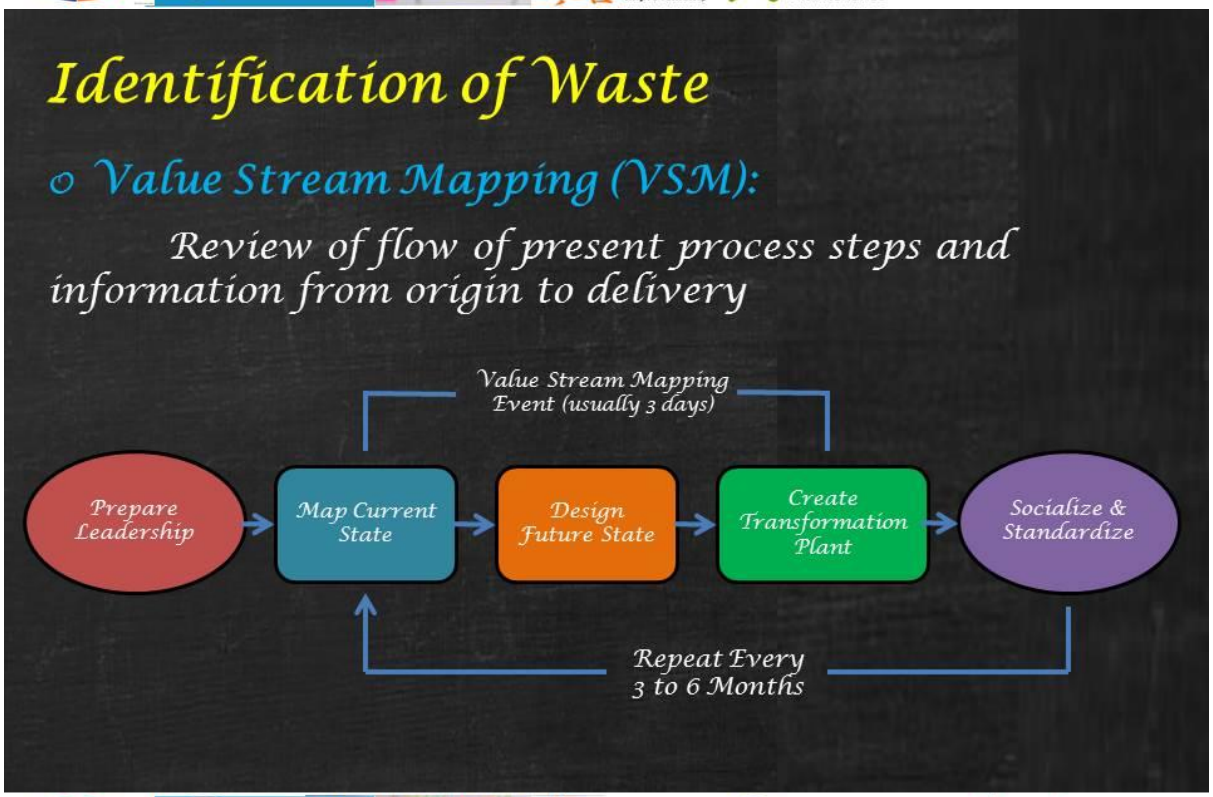
Lean Tools

- VSM (Value Stream Mapping)
- 5s & Visual Management
- Kaizen (Continuous Improvement)
- Standardized Work
- Kanban (Pull System)
- Poka-Yoke (Error Proofing)
- Root Cause Analysis
- SMED (Single Minute Exchange of Dies)
- TPM (Total Productive Maintenance)
- Jidoka (Automation)
- JIT (Just-In-Time)
- One-piece Flow
- Heijunka (Load Leveling)

(Source: Department of Chemicals and Petrochemicals, 2016)

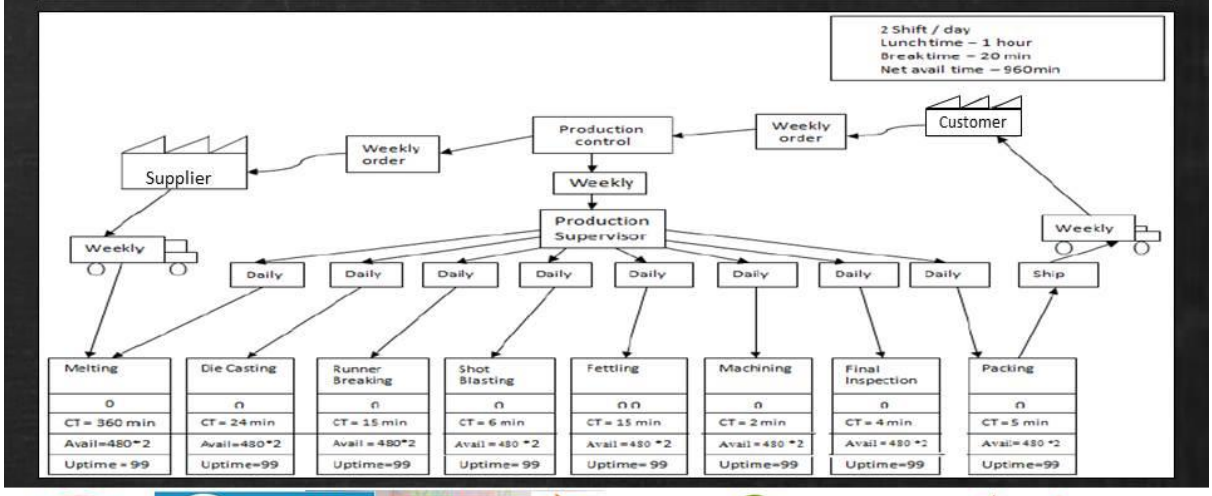

Types Of Wastes
Waiting
Overproduction
Excess inventory
Waste
Excess Motion
Defects
Unused creativity
Inappropriate processing
Transporting
(Source: Department of Chemicals and Petrochemicals, 2016)


5S
TPM
Zero Defects
Zero Accidents
Zero Breakdowns
KANBAN
KAI=Change
ZEN=Good
KAIZEN
(Continual Improvement)
SMED
Single Minute Exchange of Die & Mold Maintenance
teri
Creating Innovative Solutions for a Sustainable Future


Identification of Waste
Value Stream Mapping (VSM):
Review of flow of present process steps and information from origin to delivery
Value Stream Mapping Event (usually 3 days)
Prepare Leadership
Map Current State
Design Future State
Create Transformation Plant
Socialize & Standardize
Repeat Every 3 to 6 Months


5S
TPM
Zero Defects
Zero Accidents
Zero Breakdowns
KANBAN
KAI=Change
ZEN=Good
KAIZEN
(Continual Improvement)
SMED
Single Minute Exchange of Die & Mold Maintenance
teri
Creating Innovative Solutions for a Sustainable Future

	Melting	Die Casting	Runner Breaking	Shot Blasting	Fettling	Machining	Final Inspection	Packing
Cycle Time	360 min	30 min	5 min	6 min	30 min	2 min	4 min	5 min
Operator	1	1	1	1	1	1	1	1
Up Time %	98.97	98.97	98.97	98.97	98.97	98.97	98.97	98.97
Availability	960 min	960 min	960 min	960 min	960 min	960 min	960 min	960 min



Sort

Priority	Frequency of use	Action Required	Tag
High	Daily	Store at the workplace where it is easily assessable	Green tag: 1 We DO Need It, 2 Keep It
Medium	Once per week, once per month	Store together near the workplace	Green tag: 1 We DO Need It, 2 Keep It OR Yellow Tag: 1 We MAY need this, 2 Keep It Until (Disposal Date)
Low	Less than once per year	Throw away OR store away from the workplace	Yellow Tag: 1 We MAY need this, 2 Keep It Until (Disposal Date) OR Red tag: 1 Not Needed, 2 Dispose of It Now
No	Unusable items	Throw away	Red tag: 1 Not Needed, 2 Dispose of It Now

Set in Order

Shine

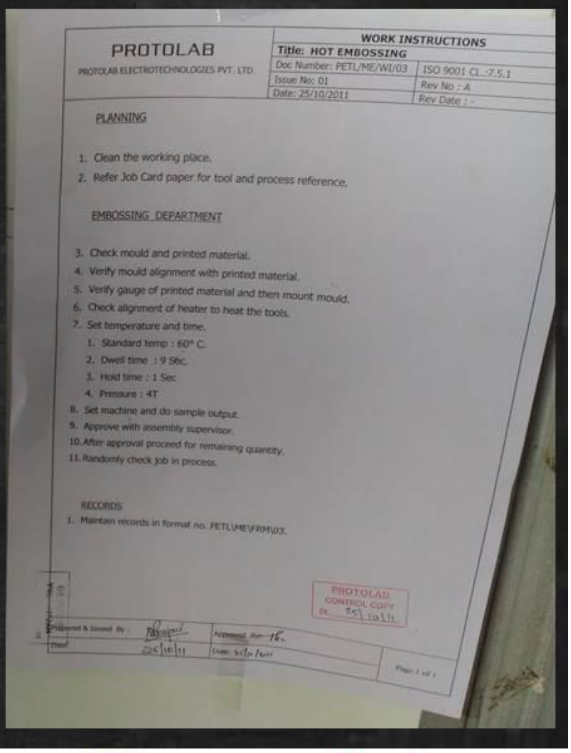
BEFORE

AFTER

5S | TPM Zero Defects Zero Accidents Zero Breakdowns | KANBAN | KAI=Change ZEN=Good KAIZEN (Continual Improvement) | SMED Single Minute Exchange of Die & Mold Maintenance | teri Creating Innovative Solutions for a Sustainable Future

Standardise

- Operating Practices
- Maintenance Practices
- QC guidelines
- Inspection Instructions
- Safety Instructions
- Cleaning practices & checklist



PROTOLAB
PROTOLAB ELECTROTECHNOLOGIES PVT. LTD.

WORK INSTRUCTIONS
Title: HOT EMBOSSING
Doc Number: PETL/ME/WI/03 | ISO 9001 Cl..7.5.1
Issue No: 01 | Rev No : A
Date: 25/10/2011 | Rev Date : -

PLANNING

1. Clean the working place.
2. Refer Job Card paper for tool and process reference.

EMBOSSING DEPARTMENT

3. Check mould and printed material.
4. Verify mould alignment with printed material.
5. Verify gauge of printed material and then mount mould.
6. Check alignment of heater to heat the tools.
7. Set temperature and time.
   1. Standard temp : 60° C.
   2. Dwell time : 9 Sec.
   3. Hold time : 1 Sec
   4. Pressure : 4T
8. Set machine and do sample output.
9. Approve with assembly supervisor.
10. After approval proceed for remaining quantity.
11. Randomly check job in process.

RECORDS

1. Maintain records in format no. PETL\ME\FRM\03.

PROTOLAB CONTROL COPY

5S | TPM Zero Defects Zero Accidents Zero Breakdowns | KANBAN | KAI=Change ZEN=Good KAIZEN (Continual Improvement) | SMED Single Minute Exchange of Die & Mold Maintenance | teri Creating Innovative Solutions for a Sustainable Future

Sustain

- Defining Roles

THINGS TO DO / FOLLOW UP

Name: Date:

Sr. No.	Things to do (Self)	Target Date	Things to Follow	With Whom	Target Date

Daily Notes:

Frequency Based Activity Check List

Name: Month:

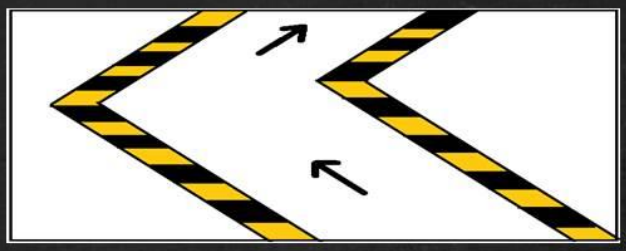
Designation:

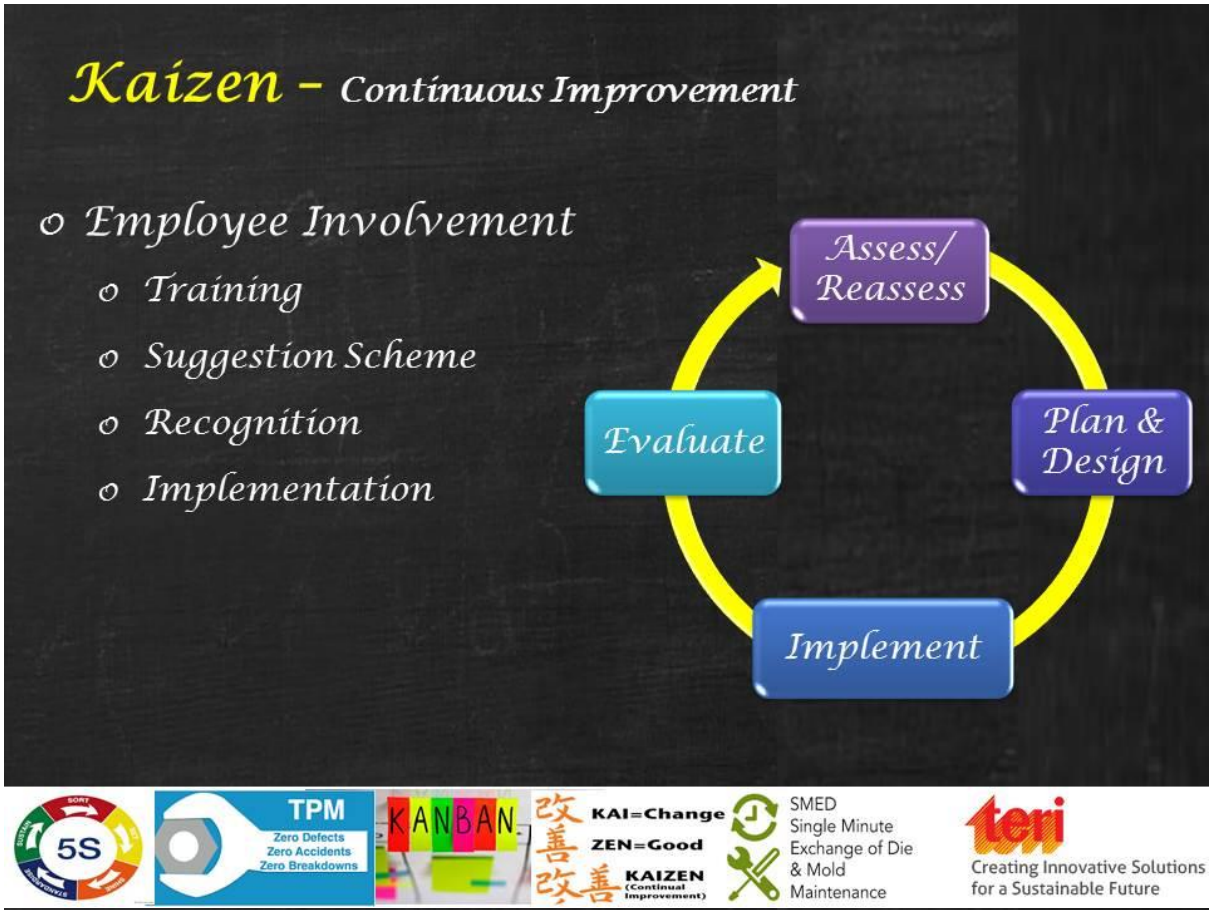
S. No	Activity	Frequency	Checklist
		Daily	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
		Weekly	First Week / Second Week / Third Week / Fourth Week
		Fortnight Activities	First half Of the Month / Second half of the Month
		Monthly Activities	
		Remark & Notes	

- Leadership
- Monitoring
- Audit

Visual Management

- Operating Practices
- Maintenance Practices
- QC guidelines
- Inspection Instructions
- Safety Instructions

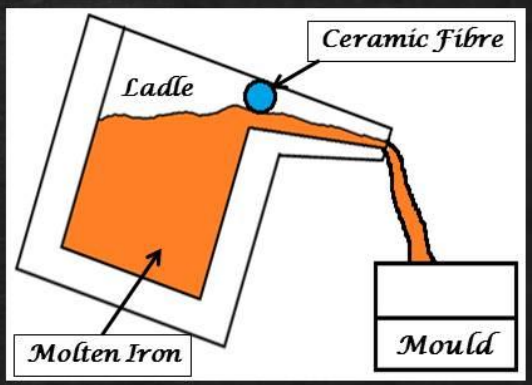



Kaizen – Continuous Improvement
Employee Involvement
Training
Suggestion Scheme
Recognition
Implementation
Assess/ Reassess
Plan & Design
Implement
Evaluate
5S
TPM
Zero Defects
Zero Accidents
Zero Breakdowns
KANBAN
KAI=Change
ZEN=Good
KAIZEN
(Continual Improvement)
SMED
Single Minute Exchange of Die & Mold Maintenance
teri
Creating Innovative Solutions for a Sustainable Future


Kaizen – Continuous Improvement
Date: .....
Suggestion Form
Name: .....
Department: .....
Emp. Code (If any): .....
Problem:
Solution Suggested (If any):
Emp. Signature
To Be Filled By Management
Suggestion categorisation (tick suitable)
A B C D
Suggestion Related to (Tick suitable)
P C Q S E M
Action Decided
Responsibility
Target Date
Benefit Achieved:
Horizontal Deployment possible (Yes/No)
It Yes, then where it will applicable
Signature (Scheme co-ordinator)
Note: A= If saving more than 10k
B= If saving between 2k -10k
C= Saving less but suggestion valid.
D= Invalid suggestion.
P = Productivity
C = Cost
Q = Quality
S = Safety
M = Morale
E = Environment
5S
TPM
Zero Defects
Zero Accidents
Zero Breakdowns
KANBAN
KAI=Change
ZEN=Good
KAIZEN
(Continual Improvement)
SMED
Single Minute Exchange of Die & Mold Maintenance
teri
Creating Innovative Solutions for a Sustainable Future

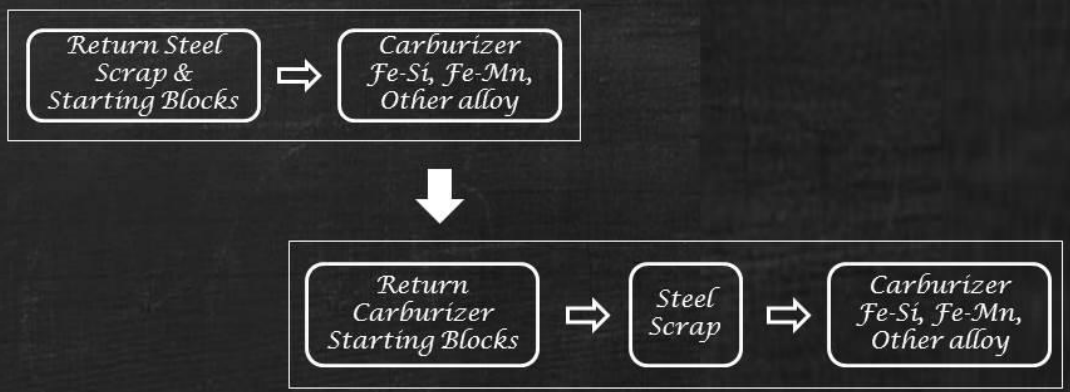
Kaizen – Continuous Improvement

Problem	The slag in a pouring ladle comes into cavities in the mould during pouring process
Solution	Slag inclusion were able to be protected by using ceramic fibre as shown below



Kaizen – Continuous Improvement

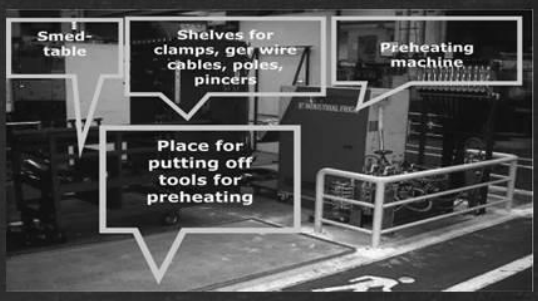
Problem	It takes 120 min for cast iron melting in 200 kg melting furnace. This means that oxidation of materials will be likely to occur, and also melting efficiency is low
Solution	Melting procedure was changed as per sequence mentioned in below figure



SMED (Single-Minute Exchange of Die)

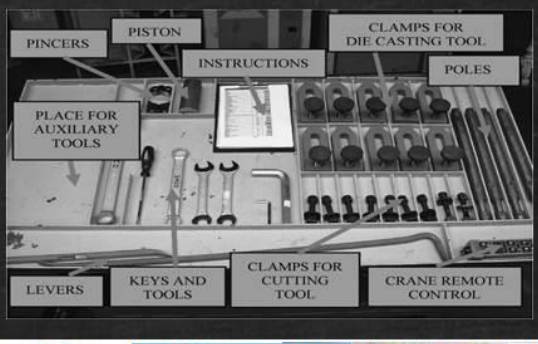
- The goal of SMED is to get all changeovers and start-ups down to 10 minutes/minimum possible time
- Real time analysis of changeover process
  - Activities
  - Tools required
  - Time consumed
  - Material movement

SMED - station

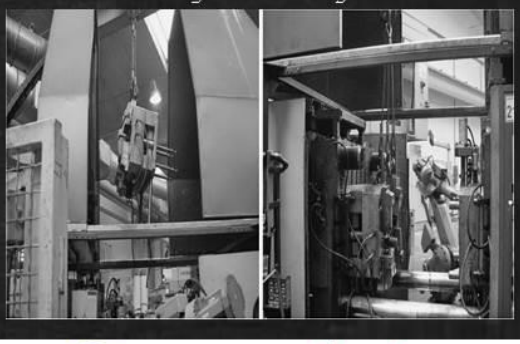


SMED - markings

SMED - Table



Crane for heavy dies



Achievement

Activity	Time required Before (min)	Improvements	Time required After (min)	Time savings (min)
Transportation	35	Instructions (order)	15	20
Heating	90	Pre-heating	0	90
Auxiliary tools	49	SMED - Table	9	40
Dismantling of cutting tool	37	Instructions (order)	27	10
Mounting on cutting tool	64	Signs, Standardization, Procedure, Locating pins	49	15
Dismantling of die-casting tool	58	Instructions (order)	44	14
Mounting on die casting Tool	115	Signs, Standardization, Procedure, Locating pins	89	26
Starting	15	Instructions (order)	7	8
Total	463	Total	240	223

Ashish Sakhare
Research Associate,
The Energy & Resources Institute (TERI)
+91-11-2468-2100
ashish.sakhare@teri.res.in

LEAN

MANUFACTURING

ELLEN

ELLEN INDUSTRIES PRIVATE LIMITED
COIMBATORE
FROM FEBRUARY 2015 TO SEPTEMBER 2015

LEAN IMPLEMENTATION FINAL PRESENTATION

ELLEN

GUIDED BY

MR.SR.SANKAR
RG MANAGEMENT CONSULTANTS
COIMBATORE

SUPPORTED BY

MR.D.VIGNESH

MANAGING DIRECTOR

ELLEN INDUSTRIES PRIVATE LIMITED

COIMBATORE

SUPPORTED BY

MR.N.SUBRAMANIAN

GENERAL MANAGER

ELLEN INDUSTRIES PRIVATE LIMITED

COIMBATORE

TEAM MEMBERS

- Foundry

- Moulding - Mr.Aruchamy
- Pattern Shop - Mr.Vijaya Kumar
- Melting - Mr.Vijaya Kumar
- Core Shop - Mr.Velusamy
- Maintenance - Mr.Rajkannan
- Stores - Mr.Samuel
- Lab - Mr.Somasundaram
- Fettling - Mr.Aravindh

STAGES OF LEAN

- Fettling to Packing
- Moulding
- Melting
- Quality & Autonomous Maintenance
- 5S, Visual Monitoring System & Standardisation

FETTLING TO PACKING

OBSERVATION

- Huge area was occupied by castings for several months- resulted in fettling work station displacement.
- FIFO was not followed from knock-out resulted in:
  - Quality rejection track untraceable.
  - Heat nos. searching for packing
  - Mix-up of castings
  - On time delivery to customers was difficult and also packing at slow pace.
- No Specific Area for Rework and Packing
- Grinding Machines and Surface Finishing areas are very far distance from Initial Stage Inspection
- Materials Zig Zag Movement

FETTLING TO PACKING

OBSERVATION

FETTLING TO PACKING

OBSERVATION

FETTLING TO PACKING

Changes Done for Further Improvements

FETTLING TO PACKING

IMPLEMENTATION

- Bay Concept has to be Created for Knockout Region
- Shifting Mount Point & Corner machines(Cut-off Machine) nearby Shot Blast machine
- Packing the Existing Stock Material
- Need to Regularise Online Packing
- Removing the Non- Moving Items from the Shop floor
- Painted Items & Packed Castings should be Moved to Storage Area Immediately.
- Re shotblasting has to be Avoided.

FETTLING TO PACKING

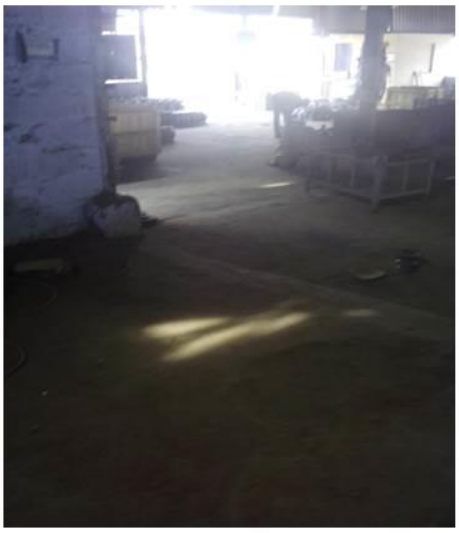
RESULTS

FETTLING TO PACKING

RESULTS

FETTLING TO PACKING

RESULTS



FETTLING TO PACKING

RESULTS

- More Space Created.
- Machines Moved nearby the Shotblast Machine stopped unwanted Movements
- Zig Zag Movement has been avoided
- Online packing, Painting, Despatch to Job work resulted in speedy movement of the material.
- Re-shot blasting of some items had been discontinued.
- Concept of On Time Delivery has been created.

FETTLING TO PACKING

RESULTS

Duration	Shotblasted	Moved to Next Stage/Despatch	Percentage
28.02.15 – 07.03.15	26254.96	25879	98.56%
08.03.15 - 14.03.15	33485.36	33485.36	100%
16.03.15- 21.03.15	26610.00	26610.00	100%

FETTLING TO PACKING

RESULTS

- Before Lean - Ebara Despatch Monthly once or Twice to the tune of 20 tonnes .
- After Lean - Ebara Despatch on a weekly Basis to the tune of 14 tonnes.

MOULDING

OBSERVATION

- Mould Box Shortage
- Sand Accumulation
- Shifting Cores by Hands.
- Disa Machine Core's Unloading area was far distance from moulding machine.
- Sand Leakage due to Knock Out Vibrator Opening
- Core Bulge issue
- Not Achieving Production Target
- Sand Accumulation in Bucket Elevator Area
- Knock Out Hoist movement leads to Sand Leakage

MOULDING

OBSERVATION

- Sand mixing needs deep observation and results in moulding hardness deviation.
- Production planning not followed and resulted in poor co-ordination and waiting created.
- Core re-work activities took place while mould box preparing.
- Cores shortage resulted in pattern change.
- Moulding hardness test not done frequently

MOULDING

OBSERVATION

- There was no Standard Dry Mix Time, and not following Standard Water Addition.
- Hot Sand Return Problem Noticed.
- Sand Sticking observed in Batch Hopper & It needs a Person regularly for Clearing.
- High sand leakage From Batch hopper's Fish Mouth.
- Leakage observed in Muller Door.
- Batch Hopper's dividing Plate Problem
- Accuracy Problem in Weighing Scale

MOULDING

OBSERVATION

MOULDING

IMPLEMENTATION

- New Sand Addition Area to be Shifted
- Providing a Stirrer for Removing Sand Stick
- Dividing Plate Angle should be Changed
- Muller door pneumatic Cylinder has to be changed.
- Providing a Stopper for arresting Knock out Hoist.
- Suitable correction to be done for Fish Mouth Leakage.
- Digital Weighing Scale should be Implemented

MOULDING

IMPLEMENTATION

- Sand accumulation has to be removed.
- Production planning to be followed.
- Cores to be checked before moulding process.
- Cores quantity to be checked well in advance of moulding process to avoid any waiting.
- Frequent monitoring of Moulding hardness to be implemented.
- It has been suggested to focus on Job rotation to achieve the Production Target by giving proper Training to the Workers.

MOULDING

IMPLEMENTATION

- Implementing Pallet Movements for Core Shifting
- Increasing the No. Of Mould Boxes
- 60 Boxes per hour Trial to be Done
- Disa Core's unloading to be done on Western side nearby the Core Shooter Machine
- Providing Core Gauges for "C" Range Trumplates
- Suitable Corrective Action will be taken for Hot Sand Return Problem

MOULDING

RESULTS

- Pallet Movement Started for shifting Cores
- Extra Mould Boxes Quantity increased to match 60 boxes/hour Target.
- 60 Boxes/ Hour Trial Made & Achieved.(Power Track)
- Disa Core's Unloading Area Shifted nearby the Machine avoided unwanted movements.
- Knock Out Vibrator opening get Closed and Prevented Sand Leakage.
- Door Provided for Bucket Elevator & Sand Leakage Level gets decreased.
- Every Hour Mould Hardness Checking has been Implemented.

MOULDING

RESULTS

- New Sand Area shifted nearby Bucket Elevator and one human resource has been avoided.
- Digital Weighing Scale Provided.
- Knock-out Hoist Stopper Provided and sand Leakage gets reduced.
- Dividing Plate Angle Changed.
- Sand Accumulation cleared and the pallet flow eased. Also dust creation due to wind stopped by clearing the sand.
- Cores are checked and quantity tallied helps smooth flow of production and increase in the out-put.

MOULDING

RESULTS

Item	NO. Of Boxes produced Per Hour	
	Before Lean	After Lean
Head Covers	40	65
9C Casing	45	65
NH 35	50	70
Power Track	45	65
13C Casing	30	36
3D Casing	33	36
2B & 4B Trumplates	50	65

MOULDING

RESULTS

MELTING

OBSERVATION

- High Power Consumption.
- High Tapping Temperature
- Cap Volt Duration High for Every Melt
- Huge Spillage while Pouring
- Slag Formation in Furnace
- Using Raw Materials without taking it's Weight.
- No identification in SG Runner Bars Storage Area
- Monorail Movement Problem.
- Due to Laddle Height Problem Last Box Pouring becomes very tough. And it may cause sandrop.

MELTING

OBSERVATION

- Slag Removing done on Laddle after Tapping.
- Very Tough for Pouring nearby the Moulding machines
- Ladle Observed with full of slag and not pre-heating done.
- Pouring time not monitored.
- Only one sank is taken for pouring and the balance material kept in the furnace resulted in holding temperature loss and also material property loss.
-

MELTING

IMPLEMENTATION

- Tapping temperature to be analysed and take proper action.
- Cap volt to be monitored. It is due to chocking of material in the furnace.
- To improve pouring, ladle nose to be corrected.
- Molten metal to be discharged at a time in all the three sanks for pouring.
- Purchasing Ferrogen for Slag Removing
- Single Point Pouring System to be Started for Reducing Power Consumption

MELTING

IMPLEMENTATION

- Weighing Raw Materials to be followed.
- Create Identification code for SG Runner Bars.
- Smoothen the Monorail Movement
- Ladle Hook Height to be Corrected.

MELTING

RESULTS

- After pouring slags are removed from the ladle and pre-heated- resulted in improvement of Pouring temperature.
- Material property maintained.
- Holding temperature loss avoided.
- Started to monitor the pouring time –resulted in pouring temperature maintenance.
- Tapping temperature was reduced from 1550 to 1450 per heat.
- Good energy saving.
- Ladle nose corrected resulted in material gain and increased in more pouring of moulding boxes.
- Cap volt has been reduced from 25 minutes to 10 minutes resulted in more heats and also energy saving.
- Trial made for Single Point Pouring System
- Mono Rail Platform Leveled for Smooth Flow.
- Laddle Hook adjusted to ease last box pouring level.

MELTING

RESULTS

- Laddle Corrected for Better Metal Flow reduces Spillages.

MELTING

RESULTS

- Spillage Reduction:-
- Due to the Laddle Correction 30kgs Metal Spillage Saving per Heat.
- 20 melts per day = 600 kgs
- 25 days of Production= 25*20 = 500 melts
- Spillage Reduction = 500*30 = 15000 kgs
- Amount =15000*60=9,00,000/Month

MELTING

RESULTS

- Tapping Temperature:-
- 3D Casing, C Range Trumplates reduced from 1500°C to 1450°C-1460°C
- Cap Volt Timing:-
- Cap volt timing reduced from 25 mins to 10 mins

QUALITY & AUTONOMOUS MAINTENANCE

OBSERVATION

- Machineries are maintained only at the time of break-down or mal-functioning. This affected the flow and production.
- No proper quality monitoring system in place.
- No proper work instruction given in the shop floor.
- Any change or deviation not properly considered or communicated at the time of moulding.
- Raiser worn out noticed in 13C Casing.

QUALITY & AUTONOMOUS MAINTENANCE

IMPLEMENTATION

- Kaizen team formation
- Poke-yoke techniques must be implemented for mistake-proofing and solving.
- Customer support team to be formed and to focus on Quality, Quantity and On time delivery.
- Regarding quality issues weekly technical session to be conducted by GM.
- Quality tracking system to be implemented
- Reasons for quality issues analysed and corrective action report to be prepared.
- Standard operating procedure(SOP) to be placed in the shop floor.
- Autonomous Maintenance System to be Implemented.
- Raiser Life Time Chart to be Prepared

QUALITY & AUTONOMOUS MAINTENANCE

RESULTS

- New quality board has been placed and monitoring has been started.
- Customer team has been able to achieve its delivery targets on time.
- Quality and Quantity issues discussed daily and corrective action taken immediately.
- With the help of SOP , quality issues started to reduce.
- By correcting the ladle nose, correct point of location helps the correct flow of molten metal and standard speed of pouring ensured.
- Corrective action and preventive action (CAPA) report prepared for each quality issues and resulted in quality rejection percentage.
- 13C Casing raiser Worn out Corrected.

QUALITY & AUTONOMOUS MAINTENANCE

RESULTS

- Weekly Technical Classes started by our GM.
- Autonomous Maintenance Checklist Prepared for Each & Every Machines and Workers are strictly instructed to follow Daily.
- Kaizen team was formed and Kaizens started to come.

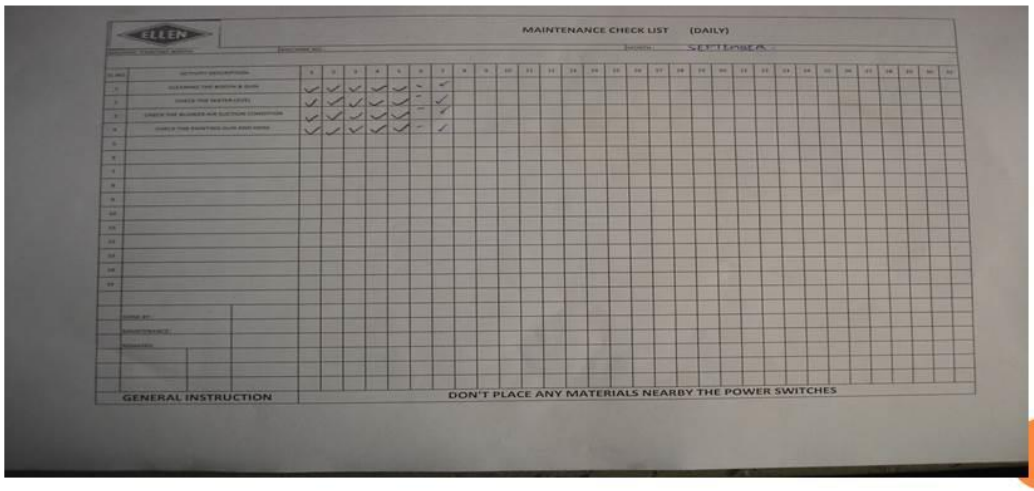
QUALITY & AUTONOMOUS MAINTENANCE

RESULTS - Kaizen

- Extra Ingate Provided for Albox Due to High % of Cold Metal.

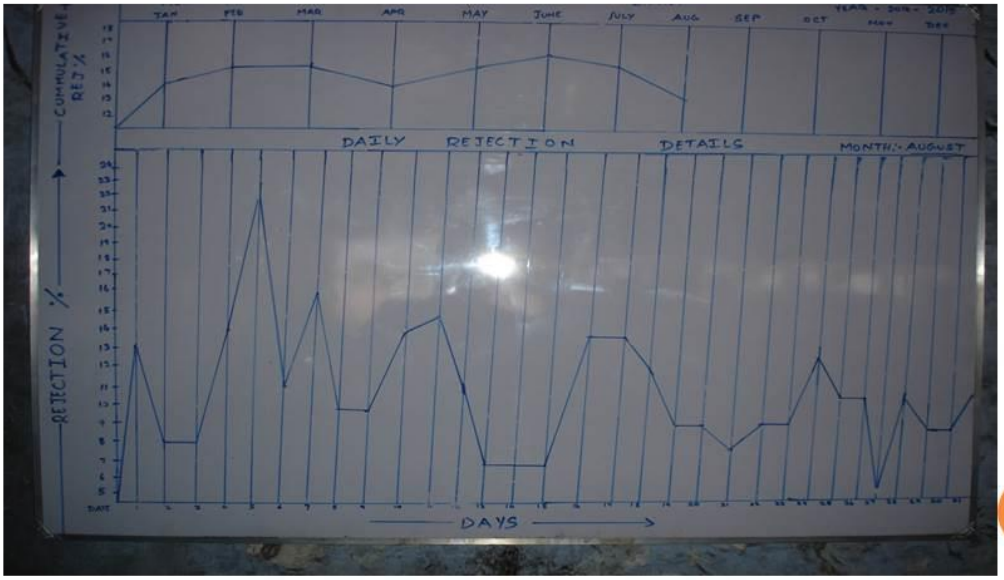
QUALITY & AUTONOMOUS MAINTENANCE

RESULTS- Autonomous Maintenance checklist



MOULDING

RESULTS- Quality Board



5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

Observation:-

- No clarity on material at the shop floor.
- Proper storing of material at the right place not there.
- Identification of material not available.
- Visible gang-way not there and hence the fettling activity takes place at the place available.
- There is no monitoring system in the shop floor.
- Activity synchronization is not there

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

ELLEN

IMPLEMENTATION

- 5s has to be implemented.
- Visual monitoring system has to be started.
- Implementation of activity synchronization
- Separate Colour Code given for Sample Items.
- Knock out Bay Concept has to be created.

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

ELLEN

Results

- Out-put for every hour monitoring system started
- Activity synchronization system implemented with the help of activity board.
- On time delivery increased.
- Implementation of 5s improved the material clarity, elimination of searching time, displacement.
- Work place definition created.
- Customer's satisfaction rate increased.

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

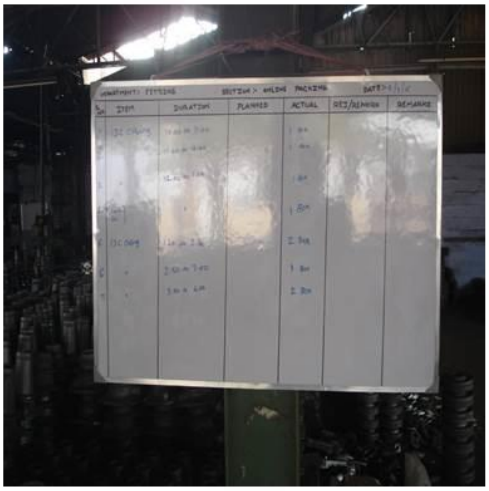
ELLEN

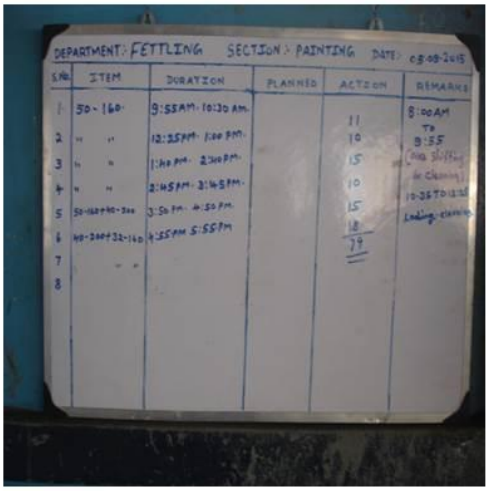
Results – RED TAG AREA

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

ELLEN

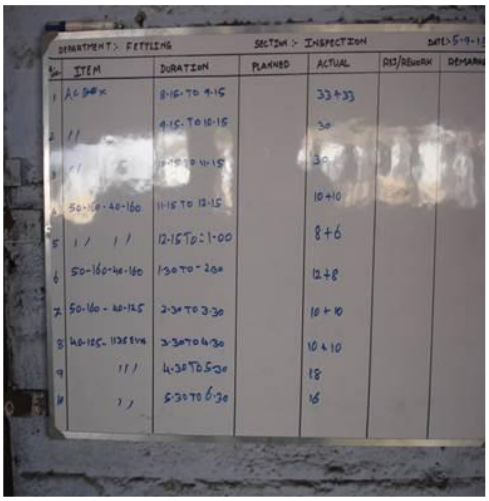
Results – VISUAL MONITORING SYSTEM





5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

Results – VISUAL MONITORING SYSTEM



5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

Results – 5S Works

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

ELLEN

Results – 5S Works

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

ELLEN

Results – 5S Work

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

ELLEN

Results – Gang Way

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

ELLEN

Results – Gang Way

5S,& VISUAL MONITORING SYSTEM & STANDARDISATION

Results – Gang Way

COMPARISON PHOTOS

Before

After

COMPARISON PHOTOS

Before

After

COMPARISON PHOTOS

Before

After

COMPARISON PHOTOS

Before

After

COMPARISON PHOTOS

Before

After

COMPARISON PHOTOS

Before

After

COMPARISON PHOTOS

Before

After

COMPARISON PHOTOS

Before

After

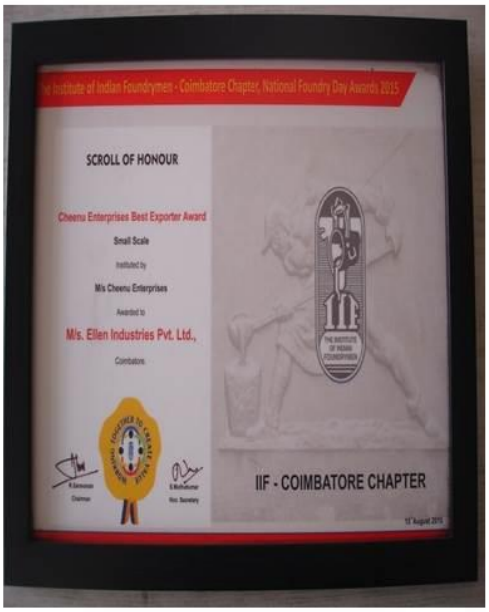
COMPARISON PHOTOS

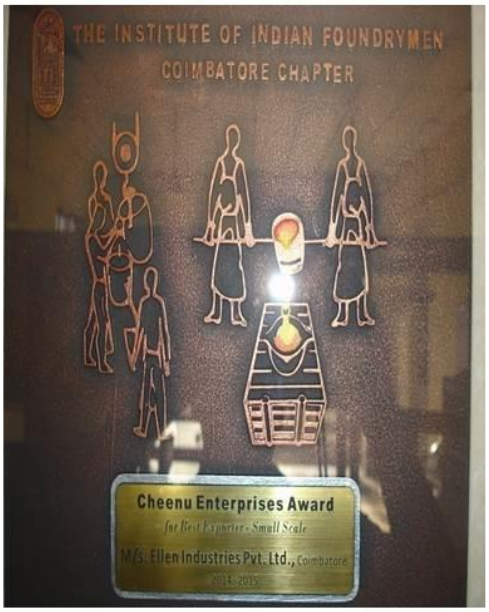
Before

After

BEST EXPORTER AWARD

BEST EXPORTER AWARD





HEARTY WISHES FOR THE AWARD

- **We shall wish ourselves for the achievement of Best Exporter Award from Institute of Indian Foundry men.**
- **We will keep this moment at all the time.**

LEARNING

- Time Value
- Non Valuable Activities
- Smart Work
- Team Work
- Space Utilisation
- Work Clarity
- Easy Accesibility of Material

THANKS

- **We thank our Managing Director & our Management for giving this wonderful Opportunity on implementing LEAN Concepts.**

Capacity building workshop
Kaizen in Induction Furnace

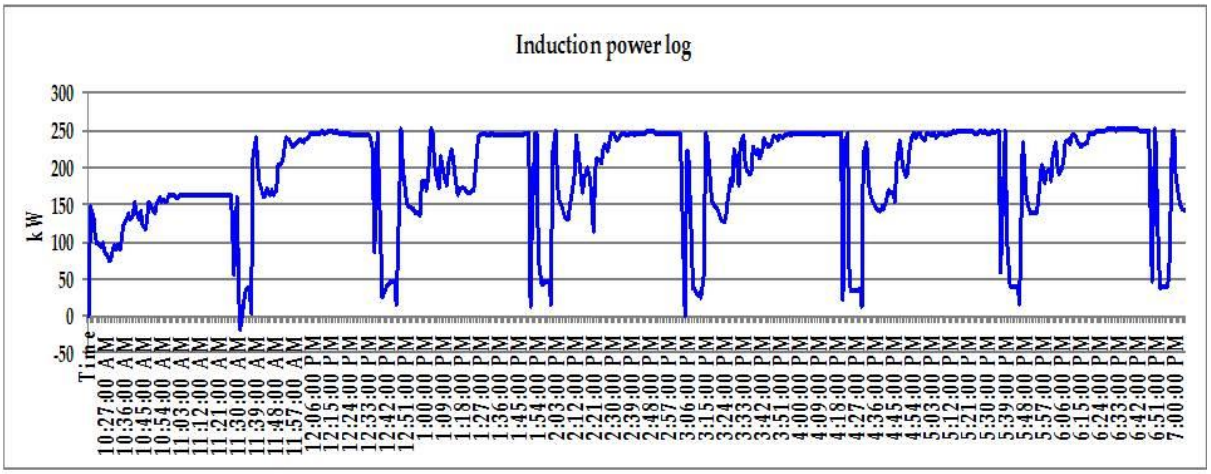
21ST March 2018

Coimbatore

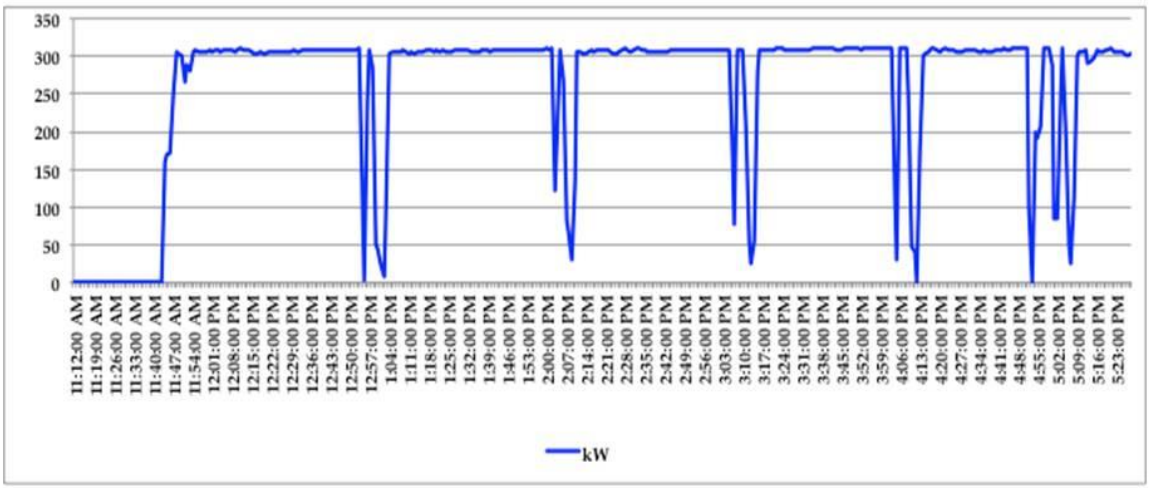
Nilesh Shedge, TERI

Induction Melting Furnace

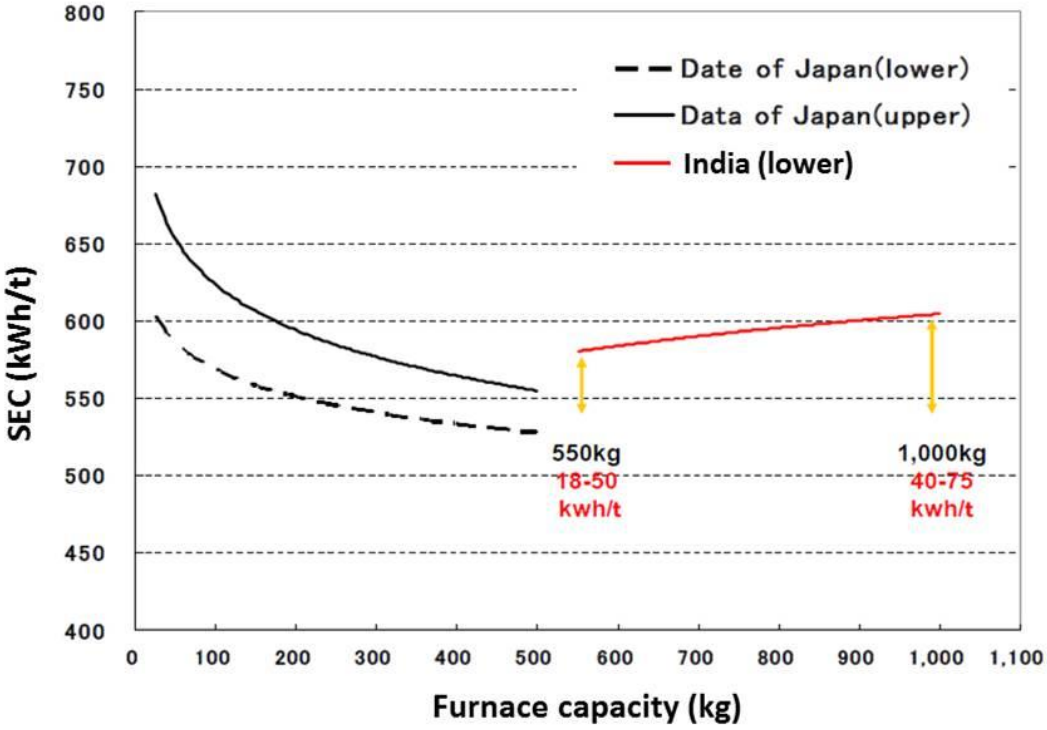
Power lag/delay in Induction furnace
250kW/250 kg
SEC: 736kWh/tonne @1600 °C
Power delay: 25min



Induction furnace ideal curve
300kW/500kg
SEC: 610kWh/tonne @1650 °C



Japan vs. India



KAIZEN
CASE STUDY OF FOUNDRY

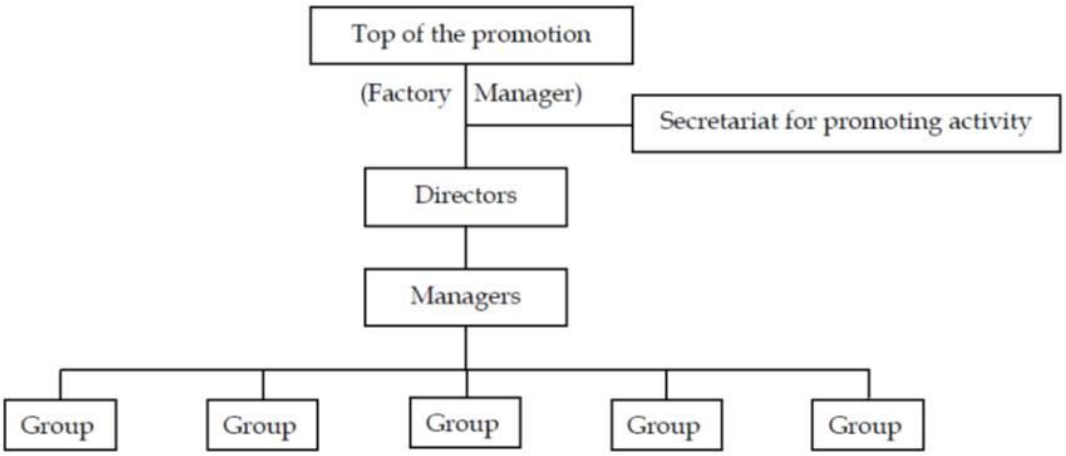
Background of the unit

- 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

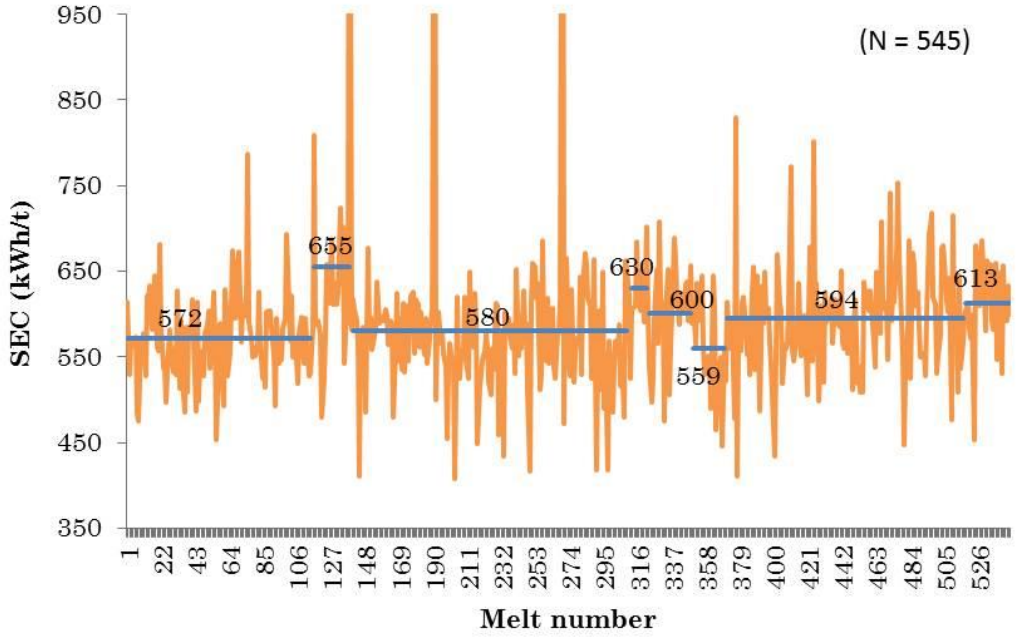
Summary data Collected

- 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

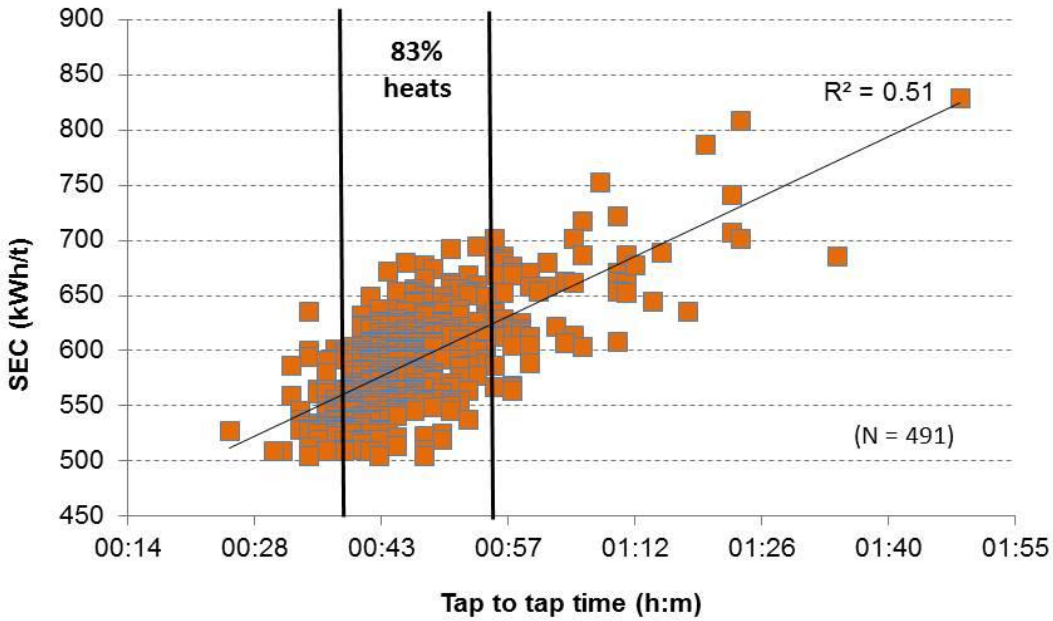
Visualization of data

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

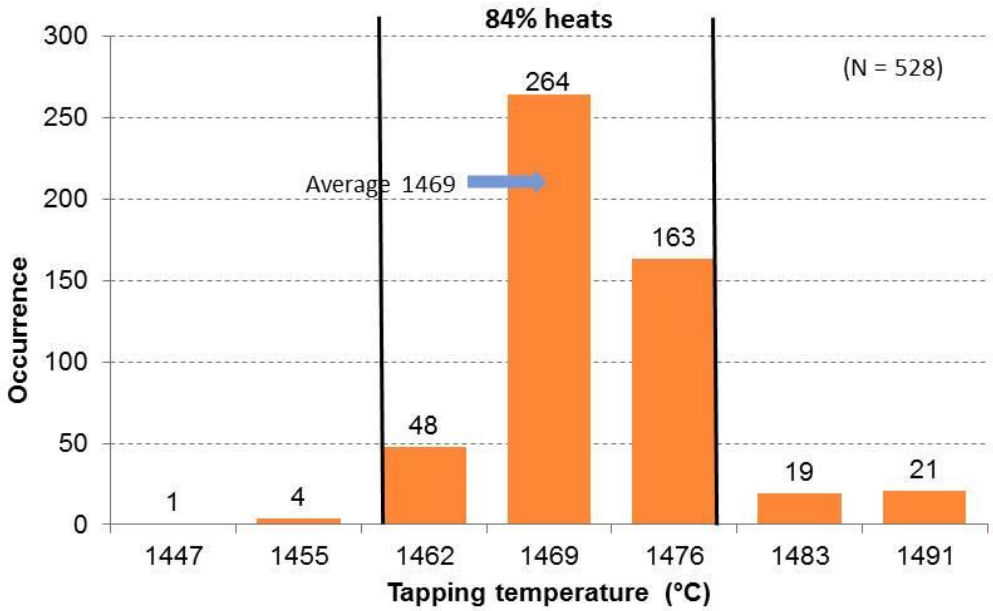
Melt no. vs. SEC (Line graph)



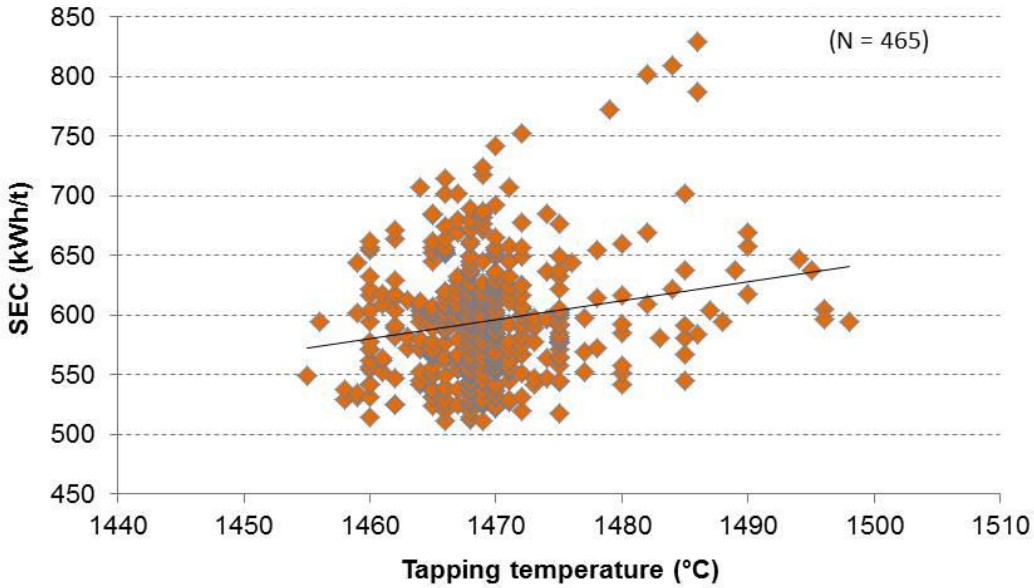
TTT vs. SEC (Scatter plot)



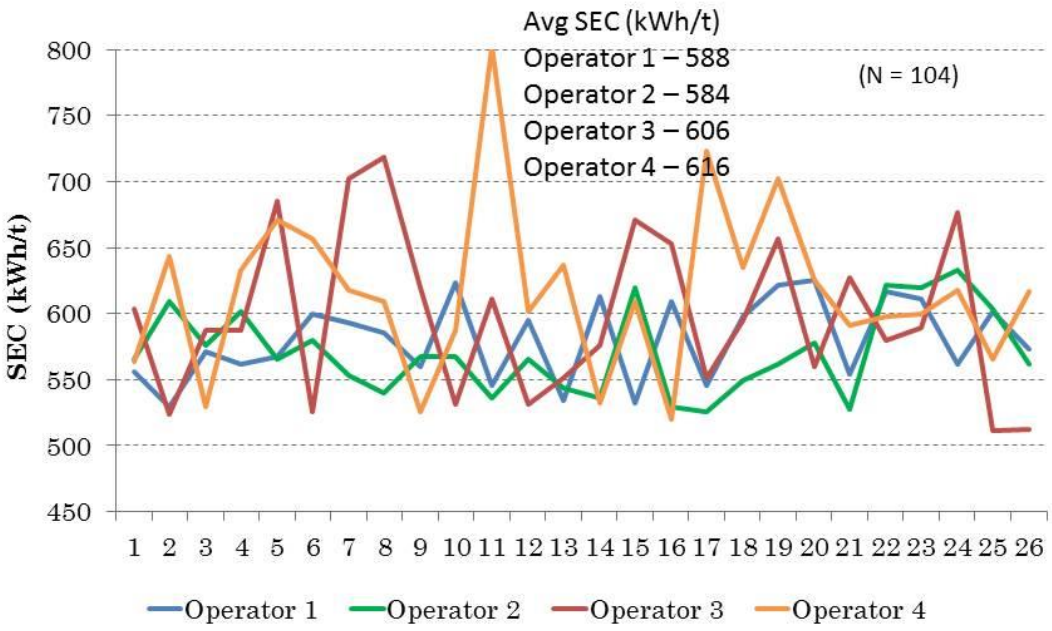
Tapping temperature occurrence (Histogram)



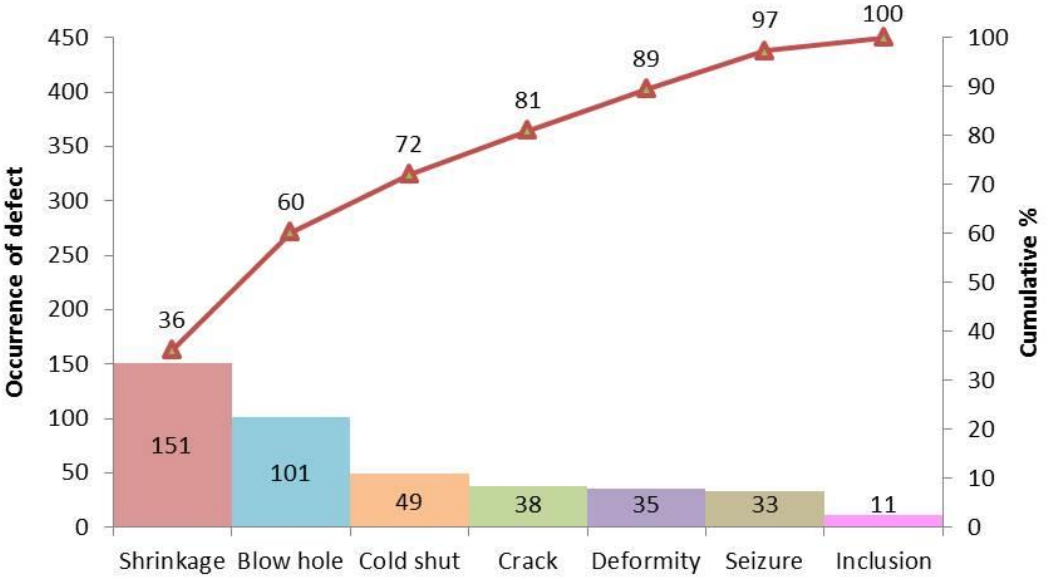
Tapping temperature vs. SEC (Scatter plot)



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,*

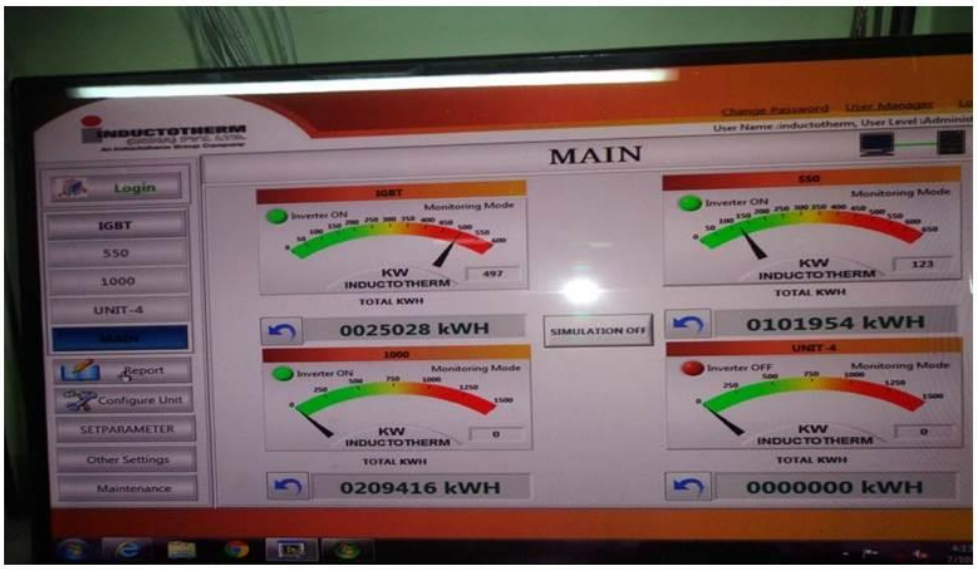
○ *Taking an action not immediately but sometime after is recommended,*

△ *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

The Energy and Resources Institute

Creating Innovative Solutions for a Sustainable Future

www.sameeeksha.org

For any information, please contact

Nilesh Shedge - 9978601047 (nilesh.shedge@teri.res.in)