Capacity Building workshop

# Energy Conservation in thermal applications

4th April 2018 at Belgaum

**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

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# Workshop summary

## Overview of workshop

Capacity Building workshop of Local Service Providers (LSPs) on "Energy Conservation in thermal applications" was organized by TERI on 4th April 2018 in association with Belgaum Foundry Cluster (BFC) under GEF-UNIDO project. Total 22 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. Sadanand Humbarwadi, UNIDO, welcomed the participants and introduced the speakers. He mentioned the importance of thermal applications in a typical foundry unit for production and energy consumption and implementation of energy conservation measures can reduce energy consumption significantly. He encouraged participants to take advantage of TERI experts during workshop, which are made available by UNIDO for capacity building of LSPs.

Mr. Vivek Sharma, TERI, gave descriptive presentation on introduction to the losses in thermal applications in foundries. He explained in details the parameters to monitor which will guide us to identify losses in the system. He also mentioned the instruments required for monitoring these parameters and solutions for reducing losses in thermal applications in foundries.

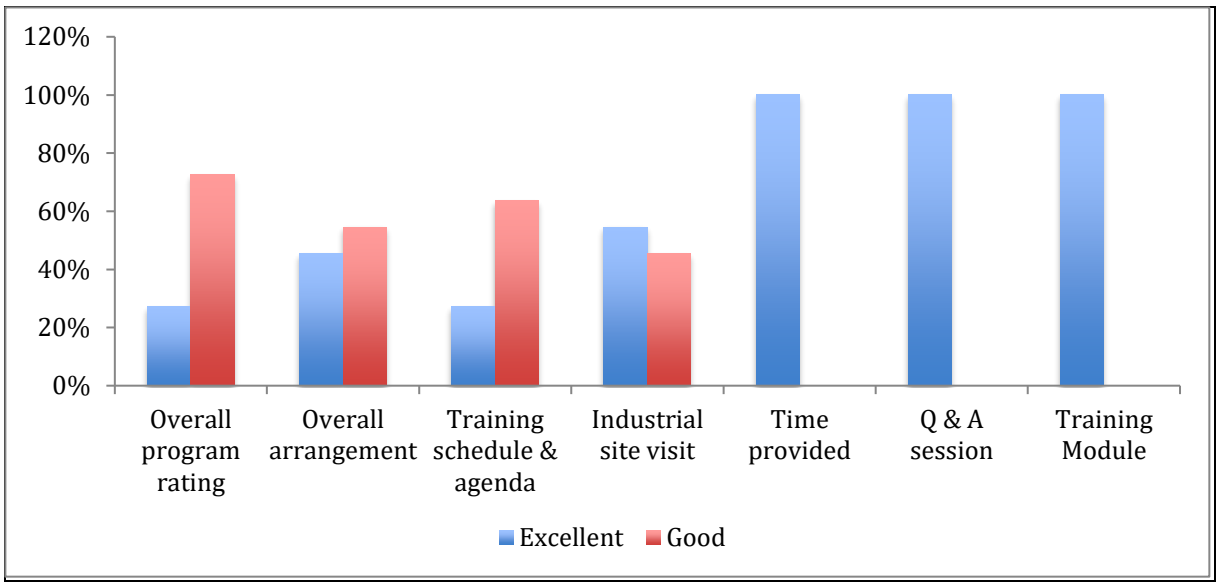
Mr. Dhananjay Navangul, an expert in thermal applications in foundries shared his experiences about the present technologies and operating practices of number of thermal applications like sand drying, ladle preheating, heat treatment, mould drying and core drying. He spoke about the importance of understanding of thermal losses in the present system to improve overall energy efficiency of the foundry. He explained in detail the areas where it is possible to improve operating practices, which eventually results in significant amount of energy savings. He also explained about how energy efficient equipment though high cost can result in lower running cost over a lifetime due to its efficient operation.

Mr. Sameer Kanbargi, a biomass grasifier expert form the cluster gave presentation on case studies of implementation of biomass gasifiers in foundries. He mentioned number of applications where biomass gasifier can be used for thermal applications in foundries. He also shared and experience of implementation of biomass gasifiers and benefits in productivity improvement, energy consumption reduction, time reduction and workplace environment.

After the lunch, plant visit to the M/s Big Castings Private Limited was arranged, so that participants can experience the actual implementations done for energy conservation 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, time schedule and training module provided to them. More than 50% of participants were rated industrial site visit as "Excellent". More than 60% participants have rated overall program as "Good" while rest of them have rated it as "Excellent". About 100% 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) More detailed information on Biomass gasifier
2) Request to present learning and services offered by LSPs in thermal applications

# Learning's by participants

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

1) Brief understanding of losses in thermal applications
2) Energy efficient ladle preheating system
3) Energy conservation opportunities in sand & core drying system
4) Applications of biomass gasifier

# Annexures

# Annexure 1: Agenda of the program

**Capacity building workshop**

## Energy Conservation in thermal applications

*Wednesday, 4 April 2018*

*Training Hall, Belgaum Foundry Cluster*

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**

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**Agenda**

| | |
|---|---|
| 10:00 – 10:30 | **Registration** |
| 10:30 – 10:40 | **Welcome Address**<br>Mr Ram Bhandare, Chairman, Belgaum Foundry Cluster |
| 10:40 – 10:50 | **GEF-UNIDO-BEE project and initiatives in Belgaum cluster**<br>Mr Sadanand Humbarwadi, UNIDO Cluster Leader - Belgaum |
| 10:50 – 11:05 | **Thermal energy savings in foundries: An overview**<br>Mr Vivek Sharma/Mr Ashish Sakhare, TERI |
| 11:05 – 12:00 | **Energy cost savings in Heat Treatment Furnace, Ladle Pre heating, Core Baking Ovens, Sand Drier & Cooler and Mould Drier**<br>Mr Dhananjay Navangul, Dhanaprakash Industrial Corporation |
| 12:00 – 12:50 | **Biomass gasifier for thermal applications in foundries**<br>Mr Sameer Kanabargi, Phoenix Products |
| 12.45 – 13:00 | **Q&A** |
| 13:00 – 14:00 | Lunch |
| 14:00 – 16:00 | **Site Visit / On-site training**<br>Visit to Phoenix Products |
| 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. | Mr Jagdish G | Afeco Heating Systems | 9371634910 | marketing@afecoheating.com |
| 2. | Mr Ajit A Chougala | Big Castings Pvt Ltd | 9964763950 | Ajit.chougala@bigcastings.com |
| 3 | Mr S R Suryavanshi | Aqua Alloys (P) Ltd | 9243222920 | projects@aqualloys.com |
| 4 | Mr Vishwanath S K | Alexa Tech Pvt Ltd | 8884656590 | vishwanathsk@alexatech.com |
| 5 | Mr Manjunath P Savadatti | Big Castings Pvt Ltd | 9513395172 | Manjunath.savadatti@bigcastings.com |
| 6 | Mr Krishna N Naik | Kudale Iron Works | 8861527845 | kudaliw@gmail.com |
| 7 | Mr Dhananjay Navangul | Dhanaprakash Ind Corp | 9975377377 | dhana@dhanapraksh.com |
| 8 | Mr Jotiba Hindole | AKP Foundries P Ltd | 9448497515 | maintenance@akpfoundries.com |
| 9 | Mr Sandeep V | YCP Industries | 9916273548 | info@ycpindustries.com |
| 10 | Mr Mahadev M Mutageker | A K P Ferro cast | 9535119815 | Mahadevmut@gmail.com |
| 11 | Mr Sameer Kanabargi | Phoenix Products | 9448480724 | Phoenix_bgm@hotmail.com |
| 12 | Mr Shivraj Zambare | WESMAN | 9403373552 | Kolhapur@wesman.co.in |
| 13 | Mr Mohan B Bennalkar | Phoenix Products | 8892076563 | mohanbennalkar@gmail.com |
| 14 | Mr Parasharam Sanadi | Phoenix Products | 7793261796 | Phoenixproductdesign123@gmail.com |
| 15 | Mr P Nagaraj | BFPL Unit II | 9480839971 | maintenance@bfplindia.com |
| 16 | Mr Ravi K | Amit Fero Cast | 8880325101 | ravikaallimanig@gmail.com |
| 17 | Mr Shivaji Gavade | Technosystems | 9036828075 | technosystem@bsnl.in |
| 18 | Mr Sonukumar D Patil | Belgaum Foundry Clusters | 9742164712 | bfcgubproject@gmail.com |
| 19 | Mr Shrinivas S Desai | Glocost | 9449950374 | |
| 20 | Mr Ramesh Khargaonkar | Allied Founders | 9902852709 | maintenance@alliedfounder.india.com |
| 21 | Mr Dudappa Yusirkar | Allied Founders | | |
| 22 | Mr S V Gavada | Jineshwar Malleable & Alloys | 9243207139 | jineshwarma@yahoo.co.in |

## BELGAUM FOUNDRY CLUSTER

### Energy Conservation in thermal applications

04.04.2018

| NAME OF THE PARTICIPANT | NAME OF THE COMPANY | EMAIL ID | MOBILE | SIGNATURE |
|---|---|---|---|---|
| Jayant G. | Afeco Heating Systems | marketing@afecoheating.com | 9371634910 | |
| Ajit A. Chougala | Big Castings Pvt. Ltd | ajit.chougala@bigcastings.com | 9964763950 | |
| J.R. Suryavanshi | Aqua Alloys (P) Ltd. | projects@aquaalloys.com | 9243222920 | |
| Vishwanath S.K | AKXA Tech Pvt Ltd | Vishwanath.SK@akxa | 8884656590 | |
| Manjunath S.P. Saradatti | Big castings (I) Pvt. Ltd. | manjunath.saradatti@bigcastings | 9513395172 | |
| Krishna N Nair | Kudale Iron Works | kudaliw@gmail.com | 8861527845 | |
| Dhananjay Navangul | Dhanaprakash Ind Coop Sangh | dhana@dhanaprakash.com | 9975377377 | |
| Jotiba Hindole | AKP Foundries Pvt Ltd. | maintenance@akpfoundries | 9448997515 | |
| Sandeep V. Bidkar | YCP Ind. | info@ycpindustries.com | 9916275548 | |
| Mahadev. M. mutagekar | AKP. Ferrocast. | Mahadev.mut@gmail.com | 9535119815 | |
| Sameer Kanabargi | Phoenix Products | phoenix_bgm@hotmail.com | 9448480724 | |
| Shivaji Zambare. | WESMAN. | kolhapur@wesman.com | 9403373552 | |
| Mohan B. Bennalkar | Phoenix Products | mohanbennalkar@gmail.com | 8892076583 | |
| Parasharam Sanadi | Phoenix Products | phoenixproductdesign123@gmail.com | 7795261796 | |
| P. Nagaraj | BFPL Unit II | maintenance@bfplindia.com | 9480839971 | |
| Ravi. K | Amit Ferro Cast | Ravikassimaniga gmail.com | 8880325101 | |

## BELGAUM FOUNDRY CLUSTER

### Energy Conservation in thermal applications

| SL NO | NAME OF THE PARTICIPANT | NAME OF THE COMPANY | EMAIL ID | MOBILE | 04.04.2018 SIGNATURE |
|---|---|---|---|---|---|
| 17 | Shivaji Garvade | Technosystems | technosysbm@bsnl.in | 9036928075 | |
| 18 | Sonukumar R. Patil | Belgaum foundry clusters | bfcglobproject@gmail.com | 9742164712 | |
| 19 | Shrinivas S Desai | Glocost | — | 9449953574 | |
| 20 | Ramesh Khargaonkar | Allied foundars | maintainance@allied. | 9902852 | |
| 21 | Dudappa Yaligar. | " | foundar.india.com | " | |
| 22 | S.V. Garada. | Jineshwara malleable & alloys. | jineshwarma@yahoo.co.in | 9243207139 | |
| 23 | | | | | |
| 24 | | | | | |
| 25 | | | | | |
| 26 | | | | | |
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| 32 | | | | | |

# Annexure 3: Selected photographs of the event






# Annexure 4: Sample feedback forms

Capacity building workshop

## Energy Conservation in thermal applications

*04 April 2018*

*Training Hall, Belgaum Foundry Cluster*

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

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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:** | | | |
| good. | | | |
| | | | |
| | | | |
| | | | |
| **Name two learning, which from this programme you will be able to implement in your plant?** | | | |
| Aluminium HPDC, GDC | | | |
| | | | |
| | | | |
| | | | |
| **Signature:** | | | |
| **Name of participant:** Shivaji Zambare | | | |
| **Organization:** Wesman | | | |
| **Mobile No:** 9403737552 | | | |
| **Email ID:** Kolhapur@wesman.com. | | | |

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Capacity building workshop

## Energy Conservation in thermal applications

*04 April 2018*

*Training Hall, Belgaum Foundry Cluster*

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| 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 [ ] | |
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| 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?** | | | |
| 1) Sand Drying & | | | |
| 2) Core and mould Drying System. | | | |
| | | | |
| | | | |
| **Signature:** Shivaji Gavade | | | |
| **Name of participant:** Shivaji Gavade | | | |
| **Organization:** Technosystems. | | | |
| **Mobile No:** 9036828075 | | | |
| **Email ID:** technosystems@bsnl.in. | | | |

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Capacity building workshop

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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:** | | | |
| We expect a chance for presentation in coming sessions at BFC in furnace, Heat treatment aspects. | | | |
| **Name two learning, which from this programme you will be able to implement in your plant?** | | | |
| Biogas plant for furnaces. | | | |
| **Signature:** | | | |
| **Name of participant:** | Jagdish A. | | |
| **Organization:** | Afeco Heating Systems | | |
| **Mobile No:** | 9371534910 | | |
| **Email ID:** | marketing@afecoheating.com | | |

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Capacity building workshop

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| How would you rate the overall programme? | | ✓ | |
| How would you rate overall arrangements? | | ✓ | |
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| 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:**

— Nothing —

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

1) Case. drying (Heating) system.

2) Biomass gasifies for sand drying

| | |
|---|---|
| **Signature:** | Garada. |
| **Name of participant:** | S. V. Garada. |
| **Organization:** | Jineshwar Malleable & alloys. |
| **Mobile No:** | 9243207139. |
| **Email ID:** | jineshwarma@yahoo.co.in |

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# Annexure 5: Copy of presentations

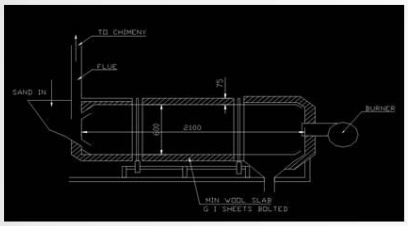

## Heating Equipments in a Typical Foundry

- Sand Drying & Cooling
- Ladle Drying & Preheating
- Core Drying
- Mould Strengthening and Paint Drying
- Heat Treating
- Sand Reclamation
- Aluminium Melting and Holding
- Aluminium chips Drying and Melting

## Conventional Sand Driers

## Sand Drying

Conventional Sand Drying techniques vs New Drying Techniques

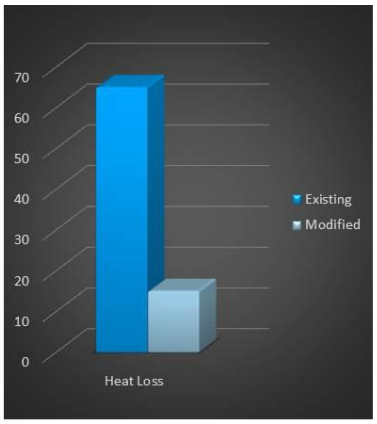



Efficient Drying Techniques

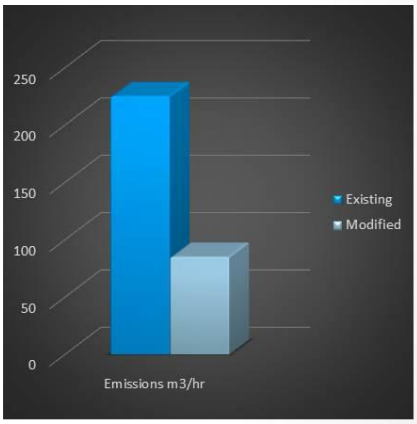
*Energy* Efficient Sand Driers

## Sand Drying-Energy Efficiency Improvement

**Full Insulation to Drier**
**Both Ends Closed**




**100% Combustion Burner**
**Chimney for Flue and steam removal**




## Ladle Preheating

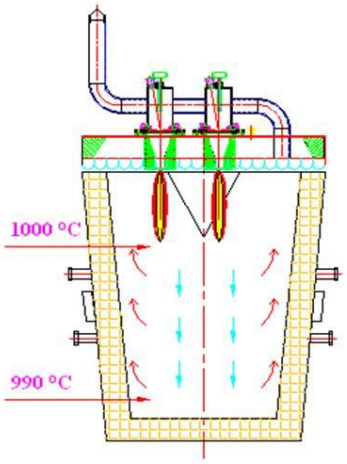
Inefficient Ladle Preheating techniques vs Efficient Preheating Techniques

Inefficient Way of Ladle Preheating

Energy Efficient Ladle Preheaters

Mostly ladles are dried using wood, coal, plastics, waste materials
Preheating is done by crude inefficient systems = **Huge Heat Loss**
**Result** - The Ladle Lining doesn't reach to required Temperature
Many foundries opt for
Hot Metal Rinsing - **One of the most unwanted process**.

# Ladle Preheating Energy Efficient Solution





**Uniform Temperature ,No Heat Loss,Built in Recuperator**

# Ladle Preheating Safety And Interlocks

Several interlocks

| | |
|---|---|
| Fuel stop | - When Blower Trip. |
| Fuel stop | - Air press Low. |
| Fuel Stop | - Gas Pressure low. |
| Fuel stop | - Flame absent. |
| Power shut off | - Full cycle to restart |
| Temp Set Point reached | - Burner off |
| Flame off | - Lock out –Manual reset |
| Lid swing | - Only after at top position |
| Lid down | - No impact – sensor |
| Lid up | - Burner close |

Low pressure alarm and Gas Shut off
High Pressure alarm and Gas Shut off
Mechanical Auto Slam shut off valve
Pressure switch on Lid - If combustion pressure exceeds the set limit , fuel valve is shut off .

# Ladle Preheating Emissions

No smoke
No unburnt Hydrocarbon No CO
All parameter within national acceptable limits
Exhaust temp - Low due to Recuperator

# Core Drying

Conventional Core Drying techniques vs Efficient Drying Techniques


Complete removal of moisture and quality of drying of the coating depends upon : Temperature, Time, High convection flow. There are two conventional Drying processes: Torching and Drying in an Oven.

# Core Drying Inefficient Practices (Torching)

## Torching

Torching is the most crude method, based mainly on human skill. Its success depends on torch flame, length, temperature, and how close the flame is held to the core surface. A Torch heats nearby atmosphere more than the core. Use of old style pressure torches had reported fatal accidents. Excess use of Torching hampers mould/core strength due to excessive temperature, resulting in Resin burn-off. The control over drying is poor.

## Igniting Alcohol Based Paints

Foundries are still using alcohol based paints and paint is ignited and due to alcohol burning paint dries
There is no control over ignition , flame , temperature
Alcohol paints are now banned due to its hazardous nature

# Core Drying Energy Efficient Practices

## Drying in an Oven

A core is to be dried to remove the moisture from its skin
The core of core is not required to be dried

## Flash Drying

High velocity hot air impeachment on core surface flash vaporizes the moisture from surface helping paint to adhere to core suraface

## Environment Management

Efficient Core Drying Ovens are smokeless, produce very little pollution, and high in thermal efficiency.

# Mould Drying

Conventional Mould Drying techniques vs Efficient Drying Techniques


Complete removal of moisture and quality of drying of the coating depends upon : Temperature, Time, High convection flow. There are two conventional Drying processes: Torching and Drying in an Oven.

# Mould Drying Inefficient Practices (Torching)

## Torching

Torching is the most crude method, based mainly on human skill. Its success depends on torch flame, length, temperature, and how close the flame is held to the core surface. A Torch heats nearby atmosphere more than the core. Use of old style pressure torches had reported fatal accidents. Excess use of Torching hampers mould/core strength due to excessive temperature, resulting in Resin burn-off. The control over drying is poor.

Heating Moulds in closed Oven

The moulds are heated in batch oven , where the entire mould is heated
This is not recommended at all for resin bonded moulds
This may harm the mould strength

# Mould Drying Energy Efficient Practices

**Mould Drying**:
Continuous Conveyorized Mould Drying
Online hood type Mould drying
For Large Floor Moulds –Mobile Mould Driers

Advantages
Accurate temperature measurement ,control ,recording
Fuel consumption is optimized
Large Volumes handled
Automation with your mould handling system

**Environment Management**

Efficient Core Drying Ovens are smokeless, produce very little pollution, and high in thermal efficiency.

# Heat Treatment Furnaces

Conventional Heat Treating techniques vs Efficient Heat Treating Techniques

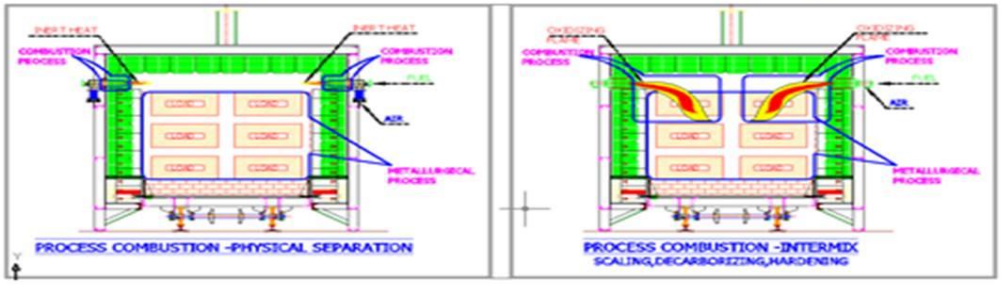
Inefficient Heat Treatment

Energy Efficient Heat Treatment

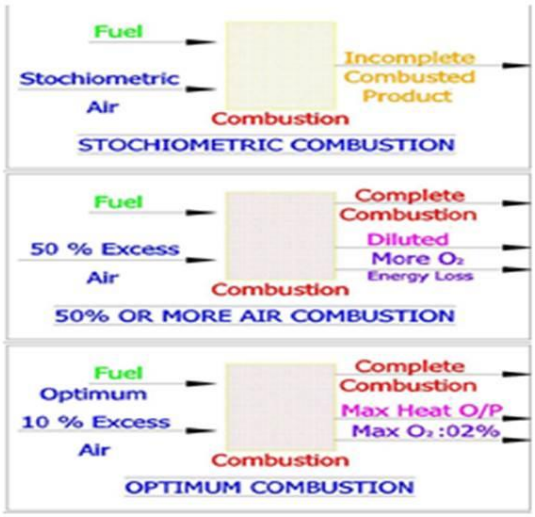
Efficiency Improvement --- Calculated Insulation to minimize Walls Heat Loss
Uniformity by Appropriate Burners Combustion system
Heat Recovery thr Recuperaors /Regenerators
Sealing Design arrests heat losses
PLC ,SCADA System controls all parameters

# Process ⇔ Combustion
# Physical Separation

Combustion completes within burner
Inert Flame come out- Heat the Load
Combustion process has no influence on metallurgical process




# Excess Air Control

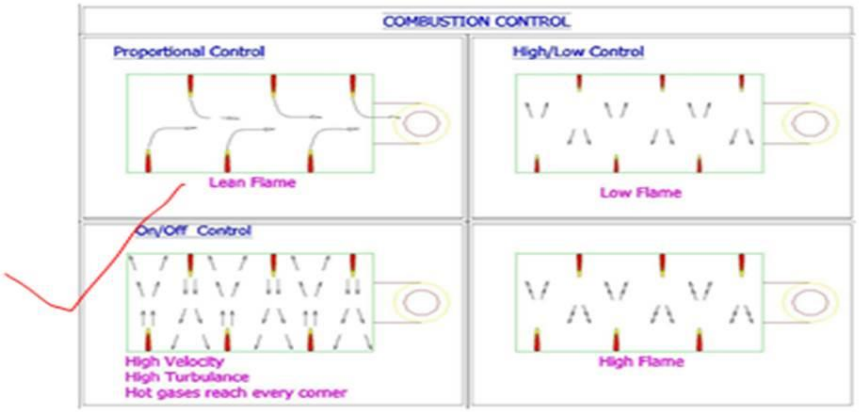



- Combustion incomplete with theoretical air
- Higher excess air --lowers efficiency
- 10% excess air optimizes both conditions

High temperatures achieved
Flue heat loss minimized
Less oxygen- Less scaling

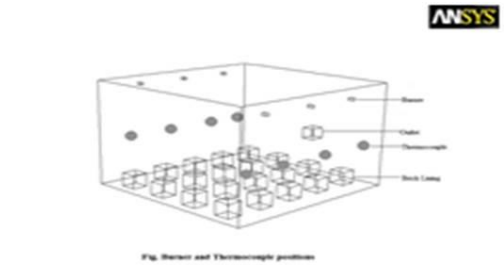
**Economy**

# Combustion Control




# CFD –Simulation Model

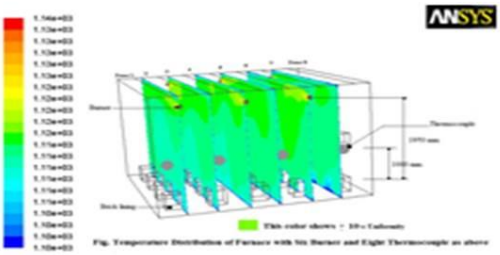
**Model**




Mesh

Jul 17, 2015
ANSYS FLUENT 12.0 (3d, dp, pbns, lke)

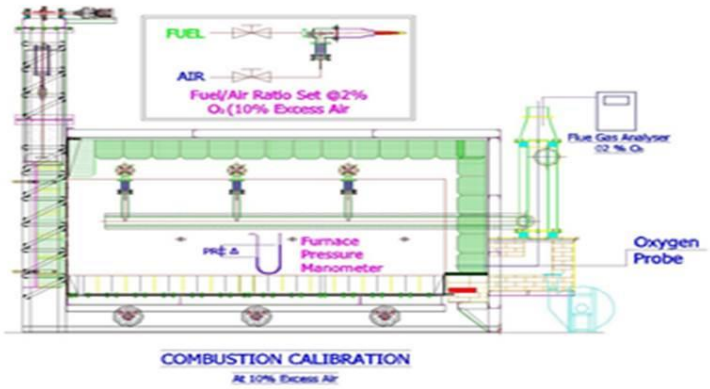
**CFD Results**



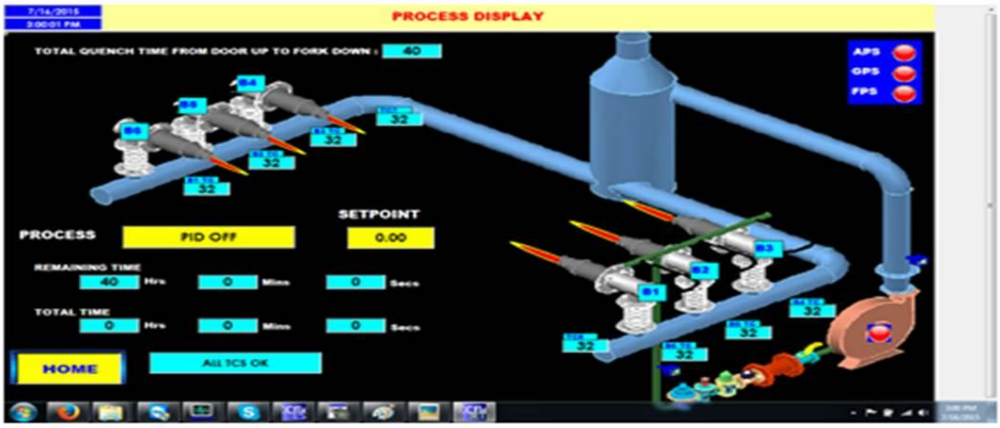

Contours of Static Temperature (c)

Jul 17, 2015
ANSYS FLUENT 12.0 (3d, dp, pbns, lke)

# Combustion Calibration

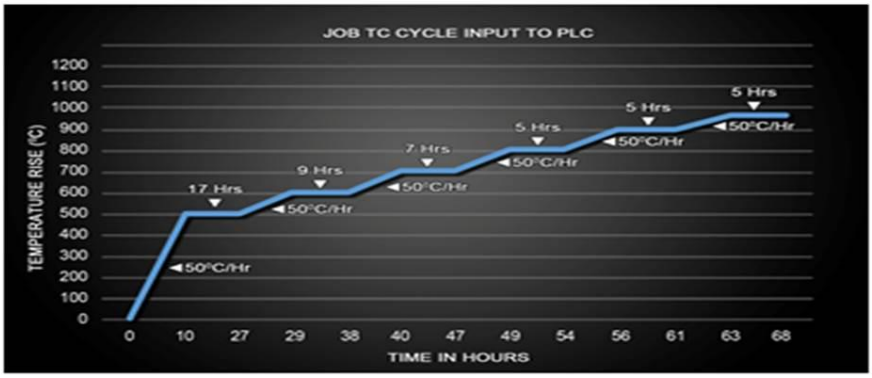



# SCADA



# Case1-Validation of Furnace

Critical Components Heat Treat Allowed only after Furnace Validation (TUS)




# Rapid Quenching

Inefficient Quenching techniques vs Our Rapid Quenching Techniques


Heating and Cooling both completes heat treatment process

Quenching needs to be completed in 25-45 secs only
Air or Water Cooling needs certain velocities ,heat transfer rates
Possible only with Automated systems with PLC SCADA Systems
Q

# Agitation for Quenching

Airless Agitation-

- Jets-Bottom
- Propeller Jets –Sides

# Tank Agitation

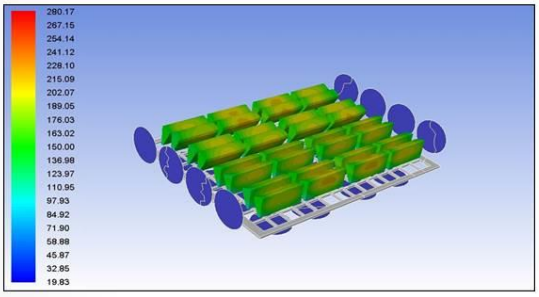
Conventional Quenching Tank vs Energy Efficient Tank Agitation Techniques

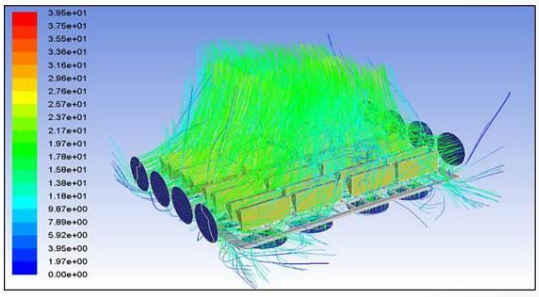
No Agitation

Enegry Efficient Tank Agitaion

No Agitation –Results are not acceptable now
Conventional Agitation yield mixed results at high Power and complex piping and handling
New Submersible Agitation Technology provides best results ,simple ,low power equipments

## Rapid Air Quenching Technology

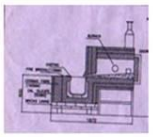



## Energy Efficient Aluminum Melting for GDC ,HPDC

### Aluminum Dry Hearth Direct Melting & Indirect Crucible Holding

- Solids Melt Quickly on Sloppy Hearth ,Liquid slips into Crucible – Liquid heated indirectly –more area--no High Heat--less oxidation
- Liquid temp up to 800 C, continuously available
- Degassing +Dedrossing +Thin charge melts in bath



### Dry Hearth Melting Crucible Holding

# Aluminium Chips Drying


Aluminum chips /swarf is by product of Machine shop .Chips are important recycling raw material
Drying the chips economically and melting by new technics offer 95% recovery

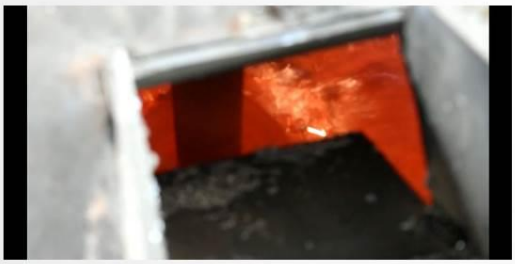
# Aluminum Chips Recycling System

## Rotary Chips Drier

## Hot Chip Conveyor

## Aluminum Chips Recycling system

### Vortex Chips Melting



### Molten Aluminum Casting

## Sand Reclamation

Inefficient Sand Reclamation vs Our Sand Reclamation Techniques

Waste Sand

Energy Efficient Sand Reclamation

The resin bonded sand disposal is a big problem at one hand and rising fresh sand availability is another problem .The Sand recycling system is the solution
Mechanically reclaimed sand followed by Thermal reclamation provides the complete solution to this problem .
Hot and cold bed fluidization technology offers the cost effective solution .


Energy ,Cost & Environment saving Technology is the Future for Foundry
Thank you

PHOENIX

***Sameer S Kanabargi***

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*Belgaum 590 008. KARNATAKA.*

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*Email : phoenix_bgm@hotmail.com* .Website: www.phoenixproducts.info

**Foundry Cluster**

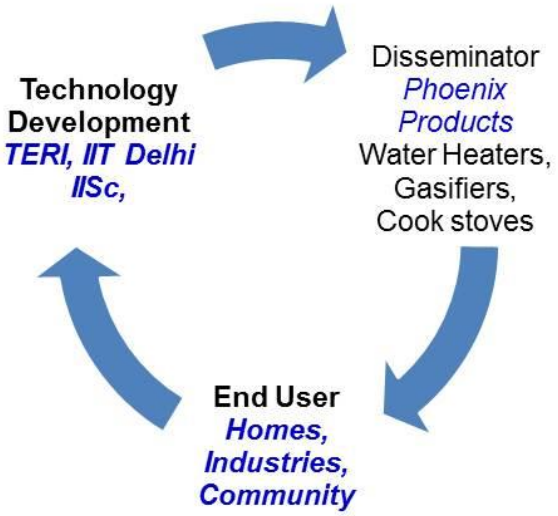
PHOENIX

***We have been addressing a critical link in the chain of technology dissemination.***

*We have grounded from Labs of Research Institutions to End Users around*

*20 different technologies from Bath water Stoves, Cook stoves, Gasifiers, Industrial Boilers to many Energy efficient technologies of*

***TERI, TIDE, IIsc., ARTI, IIT Delhi.***



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# GOAL

***Our major goal is to take the Energy Efficient technologies to the end users.***

***Create awareness about the suitable technologies available with "Cost –Benefit" analysis.***

***Making these technologies user friendly & maintainable at the user level.***

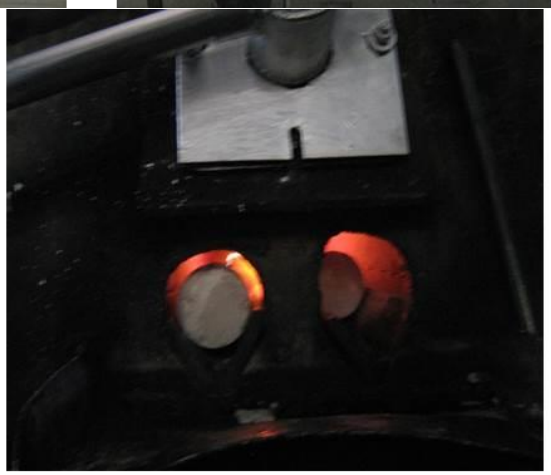
***Energy efficiency, Environment & Economy.***

# *Applications in Foundry Industries*

- Foundries: Sand Drying
- Core Drying
- Laddle Pre Heating
- Scrap / feed metal preheat

- Aluminium : Dross Melting
- Scrap Melting
- Billet Heating
-
- Lead heating / Melting: for Battery Terminals

# Ladle drying & pre heating



# Aluminum scrap melting

Aluminum Billet Heating for extrusion of sections.

Foundry Sand Drying for Resin Coating

# Various Heating Applications

Firing of boiler

Firing of kiln

Melting of metal

Annealing and
Heat Treatment

Hot air generation

Bakery & Biscuit Oven

Training to the end users at a reputed Foundry.

Technology being explained.

# Sized Woody Biomass









PHOENIX

# GASIFIER

Applications: -

Bleaching / dyeing in fabric or yarn stage,
Lead processing oven,
Cocoon cooking oven,
Community cooking at hotels, Dhabas, canteens, bakery, Khava Making etc.
Puffed rice making,
Aluminium Billet Melting.
And for all other type of Thermal Application.

Benefits : -

- Reduction in fuel cost by 40% to 70 % .
- Saving of fuel cost helps pay back the investment costs.
- Pay back on investment is 90 to 350 working Days.
- LPG Consumption has reduced by Half.
- Reduces Emission, Smoke and cleaner working condition.

## Aluminium Melting by Gasifier (Wood Gas)

SAVE FUEL ! SAVE ENERGY !

## Gasifier for Aluminum Extrusion

This is Aluminium extrusion unit . Here aluminium is extruded & made into sections like window frames, partitions etc. aluminium scrap is melted & formed into long bars of Dia from 100 to 150 mm & cut into form of billet & length 160 to 200 mm.

These billets are heated to temperature of 500 to 650 degree for extrusion. The temperature depends on the type of section to be extruded this unit uses tunnel type billet heater where earlier they were using Furnace Oil as the fuel.

***The Data as on 27/3/2008***






**Fuel cost (before installation of Gasifiers)**
Cost of Furnace Oil (FO) Rs.18/- Ltr (fluctuating)
Per hour Fuel Consumption 16 Liters FO
Cost of fuel per hour Rs. 288.00
Company works for 12 hrs shifts
Per day Fuel cost is Rs. 3456.00
**We have installed one 20 KG Gasifiers for Aluminium Billet heating.**
**The savings is as follows**
Cost of Wood as a Fuel is Rs. 3.00/- Per Kg.
Per Hour Fuel consumption 20 Kg Wood
Cost of Fuel Per Hour Rs. 60/-
Per day fuel cost is Rs. 720.00
**Savings per day is Rs. 2736/-**
**Pay Back Period is 3 – 6 months.**
The owner is satisfied with the Gasifier and is **saving Rs. 2736.00 per day** compared to FO, LDO & Diesel.

**BIOMASS GASIFIER FOR SAND DRYING**

*Phoenix Biomass Gasifier has been installed at a foundry in Belgaum for Sand Drying application.*

*Previous fuel consumption was 20 Kg LPG per hour,*

*Cost of 20Kg LPG/hr @ Rs.40.00 = Rs. 800.00* (as on 10/08/2009)

*80 Kg Biomass/Wood @ Rs. 3.00= Rs. 240.00*

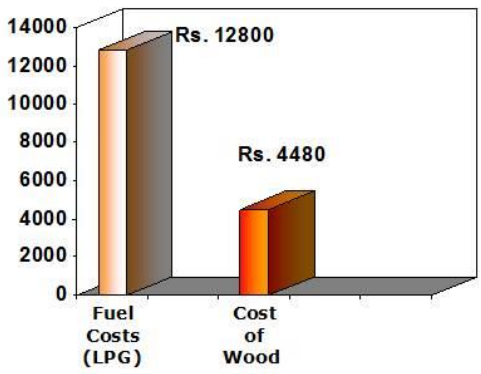
***Savings per Hour= Rs. 560.00***

*Therefore for 16 working hours, saving is*

*Rs. 560 x 16 = 8960.00 per day.*

*After Installation of Biomass Gasifier the fuel cost has been* ***reduced to Rs.240.00 i.e. 70 %.***

***Pay back was 30 days.***



SAVE FUEL ! SAVE ENERGY !

# Gasifier for Agro Industries

The preparation of puffed rice is energy and labour intensive process. loose biomass and tyres are used to meet the thermal energy requirements in these units that give rise to considerable pollution. The ovens and the methods used to produce the puffed rice in most of the units are very primitive.

The traditional roaster is used for making poha (Puffed Rice) here sand is used for indirect medium for heating. Sand has to be heated to temperature of 3500 C & the paddy is fed through hopper, which will get indirectly heated to a temperature of 2500 C required for puffing Rice.

The earlier process was wood burning in a traditional oven where there was lot of radiation losses & improper combustion. The other problem were smoke and dust with introduction of Gasifier all the problems have been taken care also there was a deduction in the fuel cost.

After introduction of Gasifier the unit owners are saving 30-60 % of the fuel cost in terms of Rs. 3600/-per day.

**Fuel cost (Earlier)**

- Cost of Wood @ Rs. 3/- Kg.
- Fuel consumption Per hour 160 Kg (i.e. Rs. 480/-)
- Fuel consumption per day for 12 Hrs. 1920 Kg (i.e. Rs.5760/-)

**•Where the savings is as follows**

- Fuel cost Rs. 3/- Kg.
- Fuel consumption Per hour 60 Kg (i.e. Rs. 180/-)
- Fuel consumption per day for 12 Hrs. 720 Kg (i.e. Rs.2160/-)
- Savings is Rs. 3600/- per day (Rs.5760 – Rs.2160)

SAVE FUEL ! SAVE ENERGY !

**BIOMASS GASIFIER FOR WAX MELTING**

*Phoenix Biomass Gasifier has been installed at a Perfumery Wax Candle making unit in Mysore for Wax Melting application.*

*Previous fuel consumption was 18 Kg Diesel per hour,*

*Cost of 18 Kg LPG /hr @ Rs. 50.00 = Rs. 900.00*

*80 Kg Biomass Wood @ Rs. 4.00 = Rs. 320.00*

***Savings per Hour = Rs. 580.00***

*Therefore for 16 working hours, saving is*

*Rs. 580 x 12 = 6960.00 per day.*

*After Installation of Biomass Gasifier the fuel cost has been saved by more than* ***50 %.***

# Hot Air Generator for Foundry Core Drying

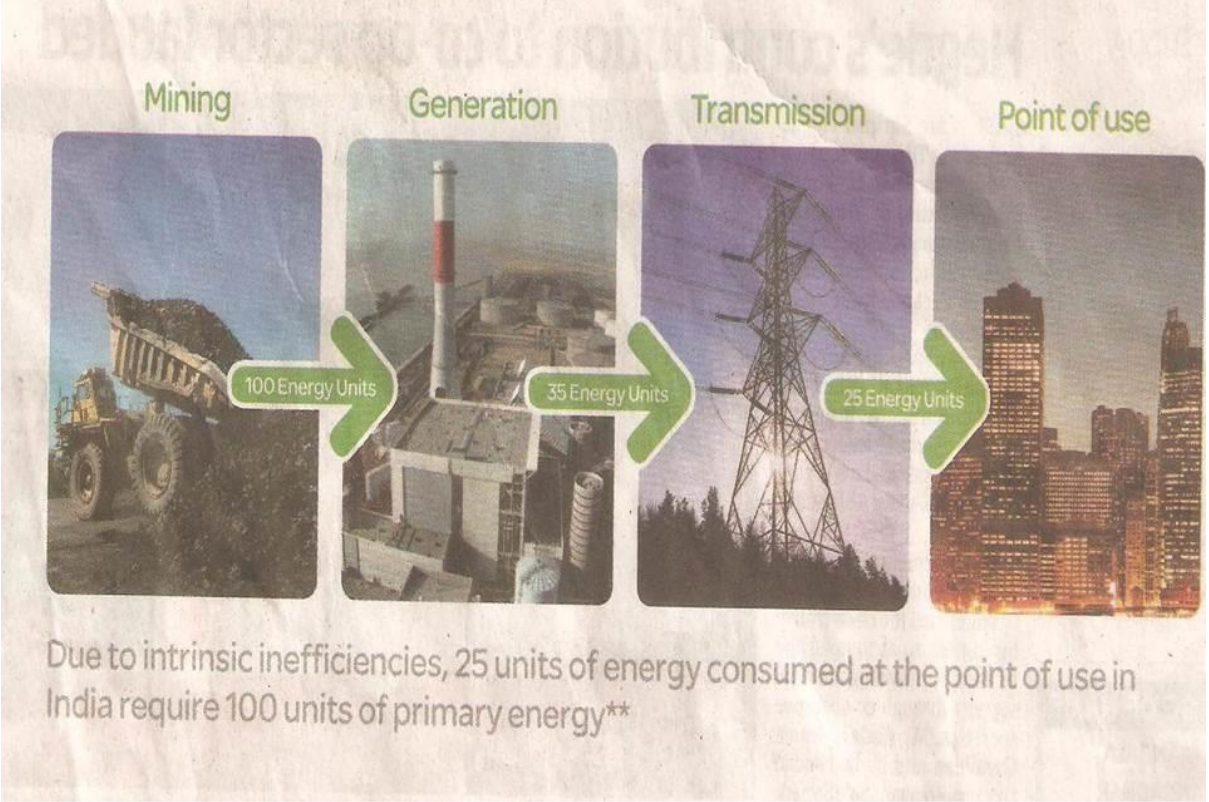

# New Applications Working on:

- Poultry to replace LPG Brooding ( Room Heaters)
- Hotels as a Industry Cooking, Steam , hot water etc.
- Dairy & Milk Processing (Ghee, Khova etc.)
- Jaggery Making.
- Core Drying & Pig Iron & Scrap pre heating in Foundry.
- Lead Melting for Battery Terminals.
- Bakery.

# More Applications

- Biscuit making.
- Candle making.
- Agarbatti & perfumery candle making.
- Condiments viz; Chips etc.
- Dyeing / Silk reeling etc.
- Sodium Silicate & Glass manufacturing.
- Powder coating.
- Tan Dish pre heating.
- Chemicals drying.
- Puffed rice making


UltraTech




- ***Benefits to the Users:***
- *60% saving on fuel compared to LPG / Furnace oil / Kerosene*
- ***Replication Potential***
- *The Gasifier technology for Foundry Sand drying may be replicated in at least 50 Foundries in Belgaum district alone & 1000 units across the country.*
- *The Gasifier technology reduces the burden of already troubled foundry industry*
- ***Sustainability***
- ***Quick "Pay Back"*** *.*
- ***Biomass Advantages with Solutions***
- *Local, renewable energy resource in stored form.*
- *Possibility of meeting total energy requirements.*
- *With this "Sustainable, Affordable & Reliable energy source locally is made.*
- *We can save ourselves from foreign Exchange deficiency by making use of locally available Biomass Fuel against foreign fossil fuel.*

SAVE FUEL !

SAVE ENERGY !

## Phoenix - Biomass Smokeless Stoves





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# Thermal energy savings in foundries: An overview

Capacity building workshop
Energy Efficiency and Renewable Energy Technologies
Wednesday, 4th April 2018
Belgaum

Creating Innovative Solutions for a Sustainable Future

The Energy and Resources Institute

## Contents

- Furnaces basics
- Check points
- Energy saving Best Operating Practices
  - Notes
  - Examples
  - Do's and Don't's
- Summary

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# Furnace- Types

| | |
|---|---|
| Fuel | • Oil fired<br>• Gas fired<br>• Coal fired<br>• Electricity |
| Charging mode | • Batch/Intermittent<br>• Pusher/Walking Beam, Hearth/Boggie/Rotary |
| Mode of Heat Transfer | • Radiation (Open fire)<br>• Convection (Indirect) |

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# Furnace Components

Combustion Chamber

Burners

Chimney

Refractory

Blower

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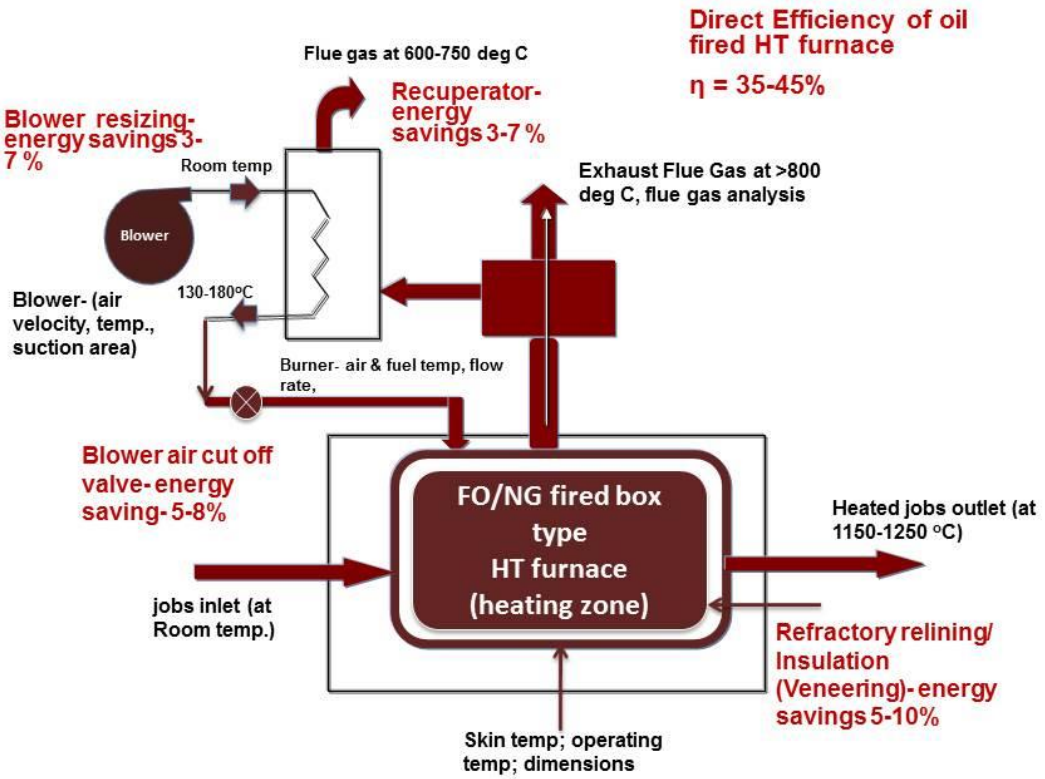
## FO/NG fired HT furnace




## Furnace- Applications

- Melting
- Forming
- Heat treatment
- Smelting
- Curing
- Drying

Operated over a broad temperature range from 150 Deg.C to 1500 Deg.C.

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# Furnace Efficiency

| Furnace type | Typical thermal efficiencies (percent) |
|---|---|
| 1) **Low Temperature furnaces** | |
| a. 540 – 980 °C (Batch type) | 20-30 |
| b. 540 – 980 °C (Continous type) | 15-25 |
| c. Coil Anneal (Bell) radiant type | 5-7 |
| d. Strip Anneal Muffle | 7-12 |
| **2) High temperature furnaces** | |
| a. Pusher, Rotary | 7-15 |
| b. Batch forge | 5-10 |
| **3) Continuous Kiln** | |
| a. Hoffman | 25-90 |
| b. Tunnel | 20-80 |
| **4) Ovens** | |
| a. Indirect fired ovens (20 °C –370 °C) | 35-40 |
| b. Direct fired ovens (20 °C –370 °C) | 35-40 |

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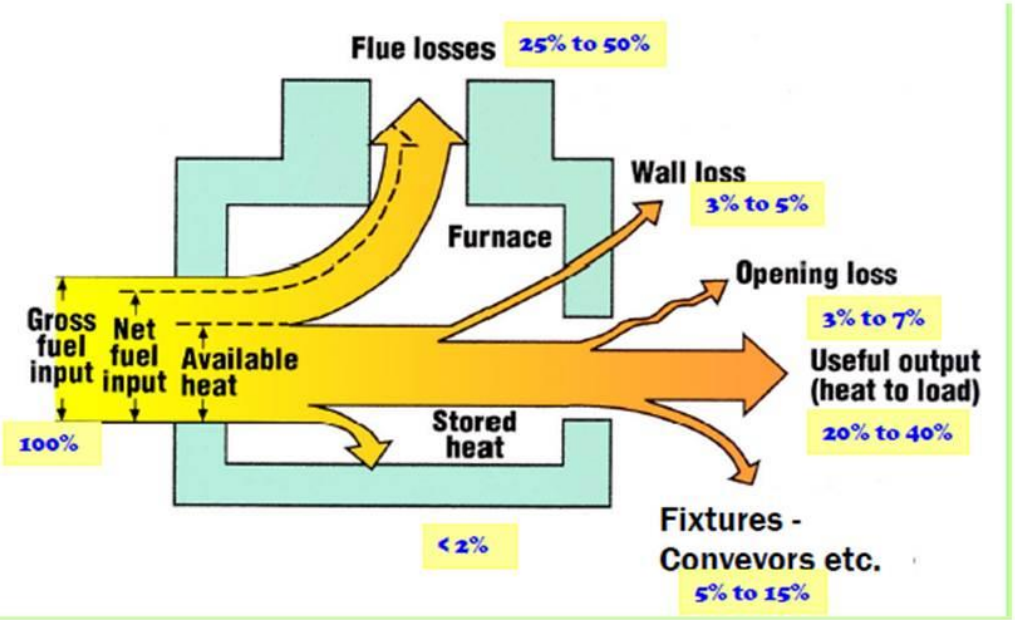
# Furnace Heat losses

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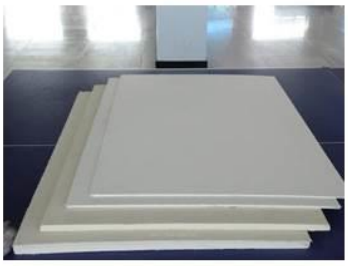
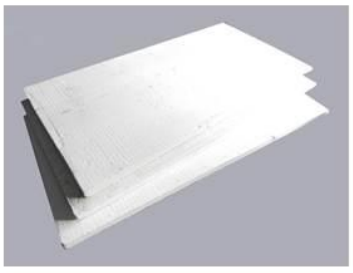
# Heat Losses in Core Shooter

Core Shooter

# Heat Losses in Core Shooter





Calcium Silicate block /Hysil block

# Improvement Opportunities- Combustion

- Optimization of combustion air for complete combustion either through automatic fuel / air ratio controller or measuring O2 in gas by analyzer
- Tuning of Burners

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# Flue Gas Analysis


Flue Gas Analyzers


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# Oxygen content

| Fuel Type | Oxygen content, % |
|---|---|
| Natural Gas | 3-4 |
| Furnace Oil | 7-8 |
| LPG | 4-5 |
| LDO | 6-9 |
| HSD | 7-9 |

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# Carbon Monoxide

- Carbon Monoxide signifies unburnt fuel content in Flue gas
- Unit of measurement- PPM
- Ideal PPM content <100ppm

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# Oxygen and Excess air relation

| % O2 | % Excess Air |
|---|---|
| 1 | 5 |
| 2 | 10.52 |
| 3 | 16.67 |
| 4 | 23.53 |
| 5 | 31.25 |
| 6 | 40 |
| 7 | 50 |
| 8 | 61.7 |
| 9 | 77 |
| 10 | 90.9 |
| 11 | 110 |

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# Blue Flame and Yellow/Red Flame

Yellow/Red Flame= Incomplete Combustion

Blue Flame= Complete Combustion

In case of manual control of firing rate in Furnace, combustion quality can be judged visually

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# Thermal Images- Heat Loss through walls

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# Instruments for Temperature measurement

IR Gun

Thermography

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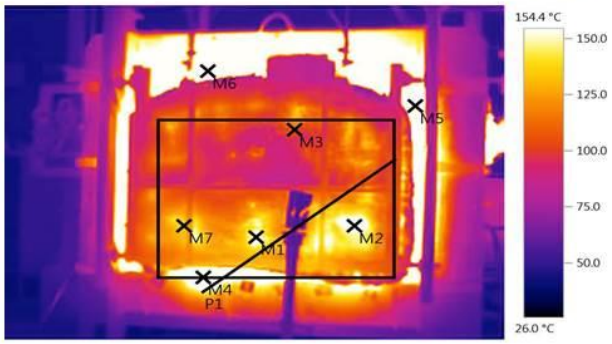
Actual Image




Thermal Image

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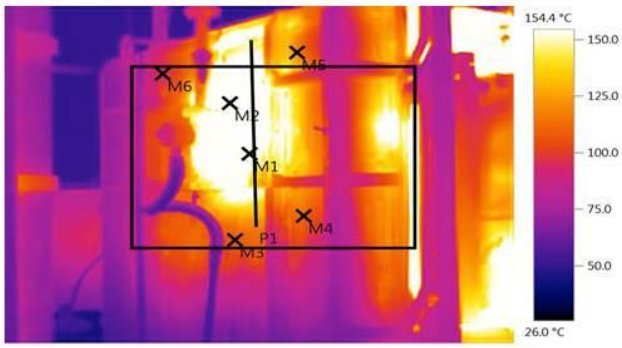
Actual Image




Thermal Image

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## Heat Losses- Check Points

- For Side Walls and Roof: Temperature should be less than 70°C
- For Doors: Temperature should be les than 150°C
- Flame should not be coming out of doors

Wall Temperature < (Ambient + 40 °C)

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## Relining of furnace to reduce heat losses

**Before: Damaged refractory**

**After: Relining**

- Optimum combustion volume of Furnace
- Burner positions: Upwards and not towards door
- Frequent patchwork of damaged refractory/insulation

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# Insulation Veneering

- Optimum thickness of Ceramic lining
- Frequent patchwork
- Attention on the Roof side

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# EE high velocity Gas burners

Before: Monoblock burners

After: EE High velocity burners

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# Waste heat recovery: Recuperator

Before: Direct Exhaust

After: Waste heat recovery

- Before WHR: Blower Air Temp. of 35°C
- After WHR: Blower Air Temp of 250°C
- Insulation cladding for blower air pipe

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# PID Controller: Heat Treatment furnace

- **Completer Automation**
- **Precise Temperature control**

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## Blower air control: Motorized Butterfly valve

- Butterfly valve with PID controller
- Precise A/F ratio

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## Blower air control: Motorized Butterfly valve

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# Manual control: Oil fired burners

- Avoid Manual control of firing rate
- Keep single setting in case of manual control fixed after

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# Blower position

Wrong position

Correct position

- Avoid obstruction to suction area of Blower
- Do not change damper setting in case of fixed manual setting

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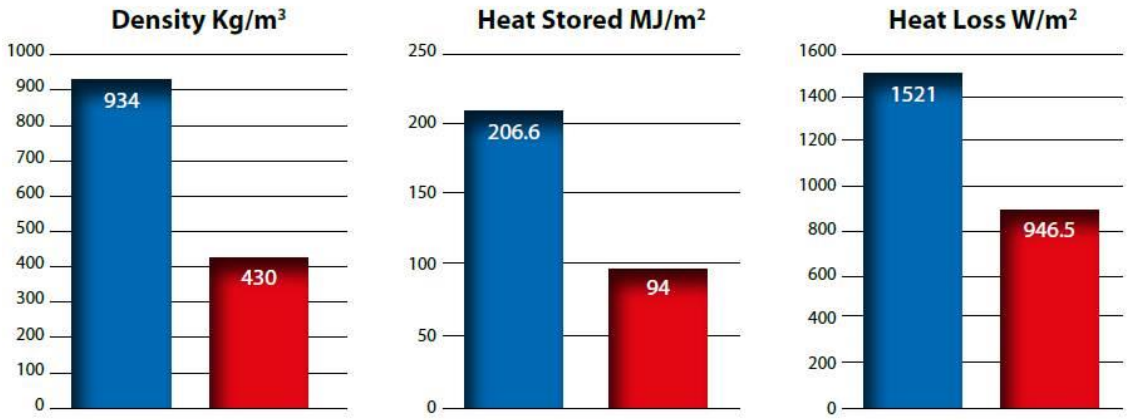
## Use of Low mass density refractory

- High open porosity
- Low thermal mass
- Low permeability
- Low thermal conductivity
- Low bulk density
- Lightweight

## Use of Low mass density refractory



# Thyristor control for Electric furnace

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# Energy Monitoring

- Fuel consumption quantity on daily basis should be monitored
- Specific Energy Consumption- Quantity of Fuel (litres, kg) per tonne of product.
- Side wall temperature parameters should be checked frequently

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# Energy Monitoring- Gas SCM flowmeter


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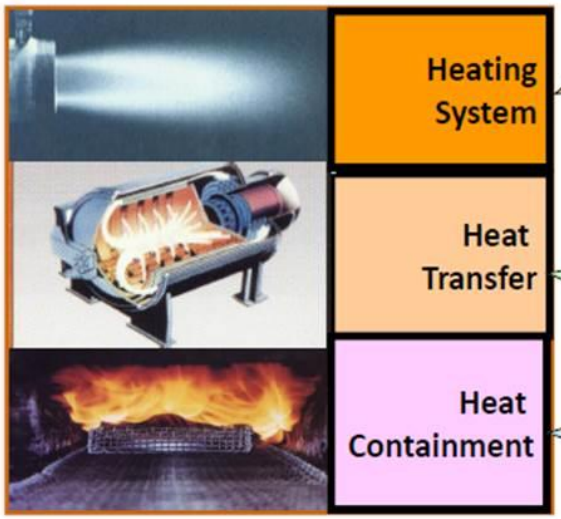
# Improvement Areas Summary



**Heating System**

- Air-fuel ratio control,
- Use of O2 enrichment,
- Air preheating,
- Turn down capability
- Flame size, shape

**Heat Transfer**

- Enhanced heat transfer,
- Temperature profile control
- Optimal process atmosphere

**Heat Containment**

- Optimum insulation
- Radiation losses
- Pressure control
- Cracks, openings etc.

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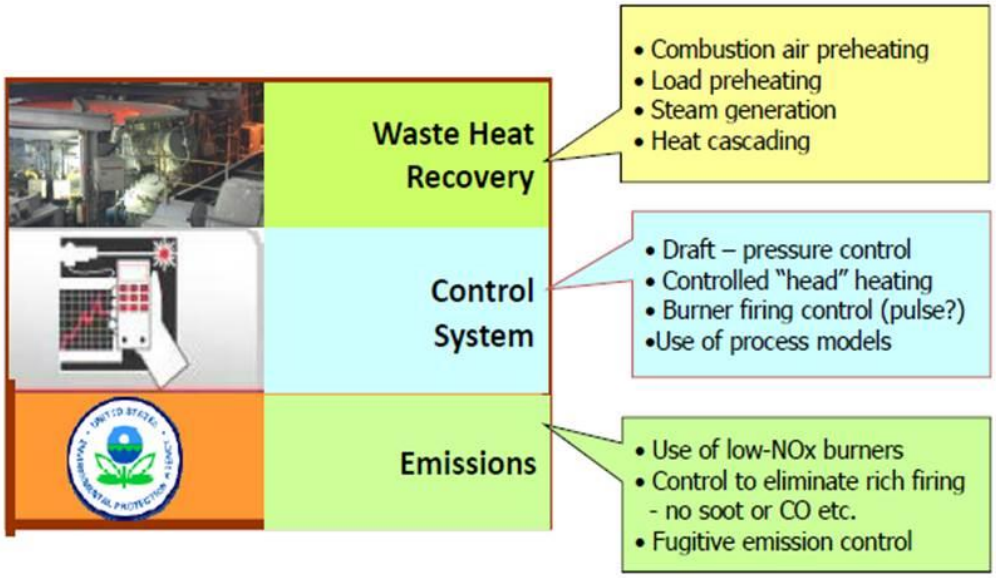
# Improvement areas summary

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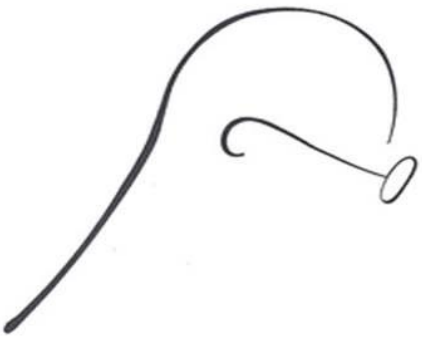

Be the change you want to see in the world

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