

# GEF - UNIDO - BEE PROJECT

on

"Promoting EE/RE in selected  
MSME Clusters in India"

## COMBUSTION SYSTEMS



Confederation of Indian Industry



# Combustion

## What is Combustion?

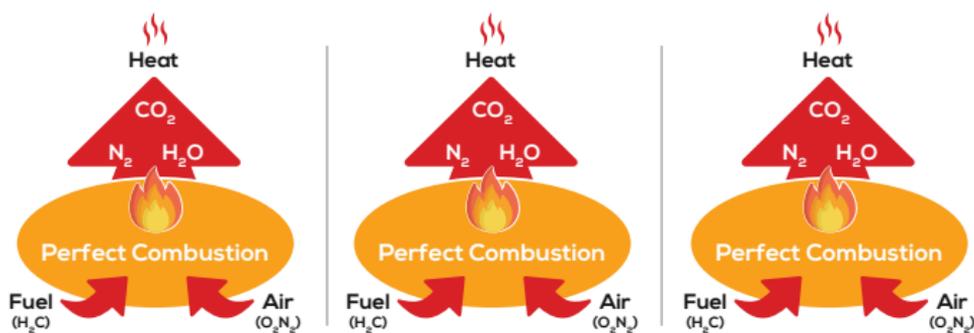
- Combustion is a rapid combination of oxygen with fuel resulting in release of heat and light
- Carbon, Hydrogen and Sulphur in the fuel combine with oxygen in the air to form Carbon Dioxide, Water Vapour and Sulphur Dioxide and releasing the heat
  - Carbon + Oxygen – Carbon Dioxide + Heat
  - Hydrogen + Oxygen – Water + Heat
  - Sulphur + Oxygen –  $\text{SO}_2$  + Heat

## Good/ Perfect Combustion

- Perfect combustion depends on exact amount of fuel and oxygen for burning so get the available heat in the fuel and nothing left over
- Good Combustion requires
  - Proper Proportioning of fuel and air
  - Through mixing of fuel and air
  - Initial and sustained ignition of mixer
- Too much or too little fuel with the available combustion air may potentially result in unburned fuel and carbon monoxide generation.



## Perfect Combustion



## Normally 1 CFT of air releases 100 BTU of heat

- 1 CFT of gas having gross CV of 1000 BTU requires 10 CFT of air to burn completely
- Flue gas analysis is used to indicate the Air/Fuel ratio and the degree of completeness of combustion
- In complete combustion  $\text{CO}_2$  is maximum while there will be no  $\text{CO}$ ,  $\text{H}_2$  &  $\text{O}_2$ . By adjusting Air/Fuel ratio to obtain maximum  $\text{CO}_2$  & Minimum of  $\text{O}_2$  the operator can set the burner close to the best fuel efficiency



# Combustion System



## Burners

A device that produces a controlled flame by mixing a fuel with oxygen and allowing for ignition and combustion. The flame is generally used for the heat, infrared radiation, or visible light it produces



## Design Characteristics Of Burner

- Flame shape and length
- Combustion volume
- Flame stability
- Turn down ratio



## Selection of combustion system

- Burner location should ensure free travel of flame
- Burner sizing with best turndown
- Burner sizing considering air preheat temperature



## Selection of Blower

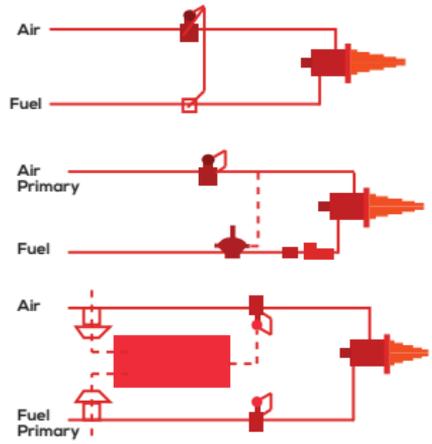
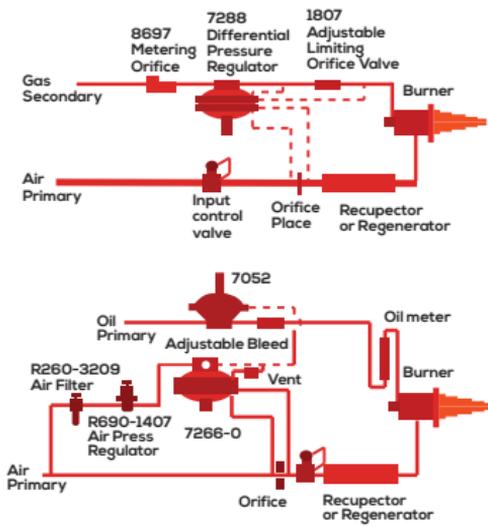
- Pressure and volume flow rate should match requirements of burner
- Oversized blower may give rise to pulsation
- Blower should have flat characteristic performance
- Inlet filters to prevent unwanted depositions on Impellers and consequent imbalances



# Increasing Combustion Efficiency

## Proper furnace design

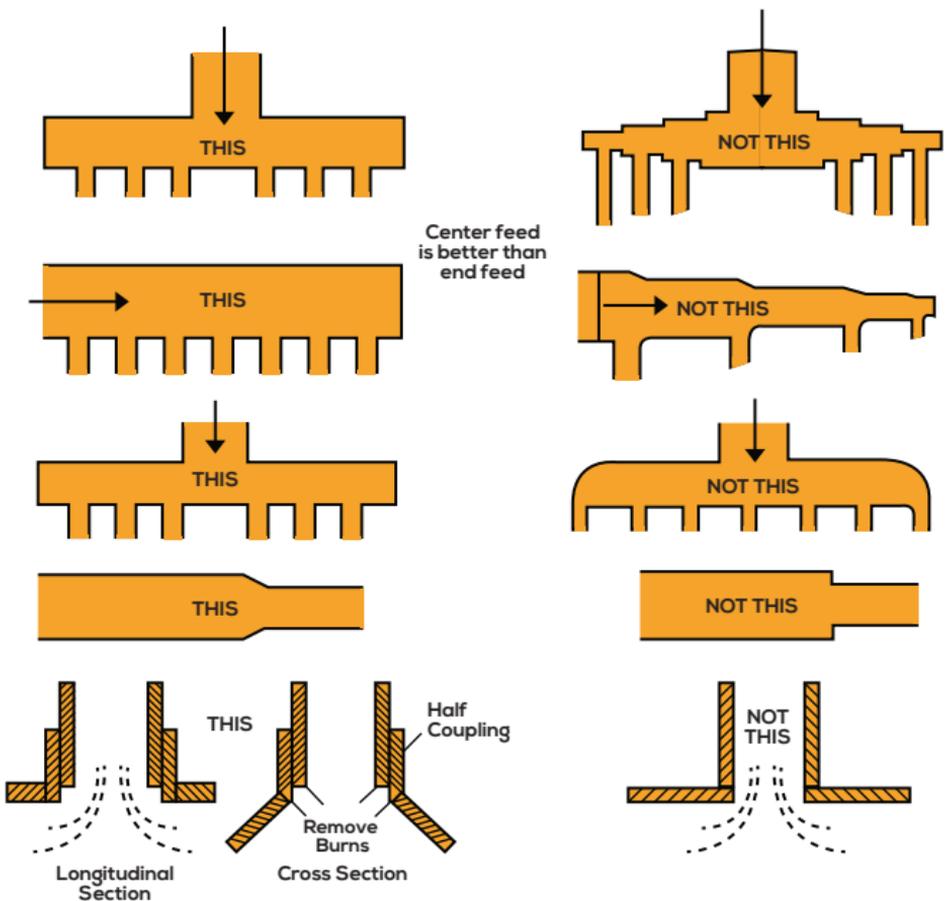
### Maintaining proper air/fuel ratio



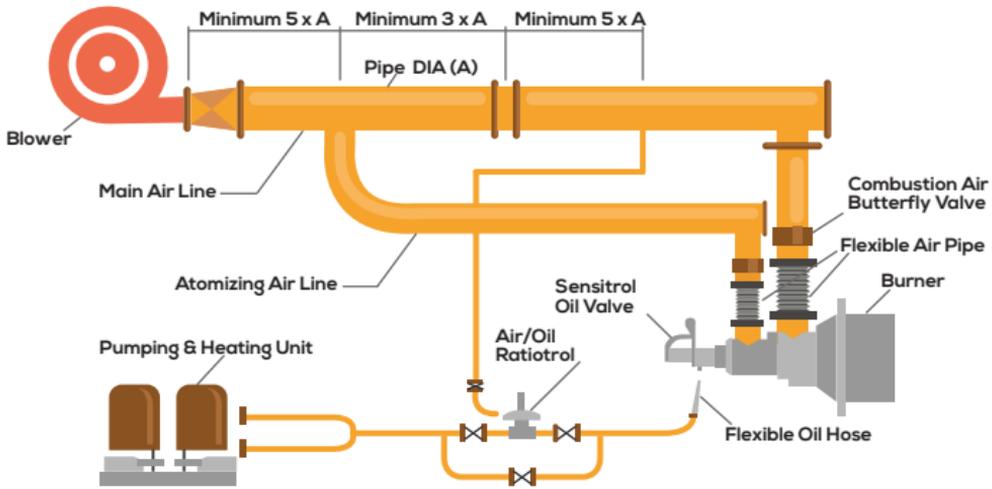
Size of air pipe from blower should be as per manufacturer to ensure exact flow at designed pressure

Size of air pipe from recuperator should be as per supplier. Preheated air pipe must be bigger diameter than cold air.

Manifolds should be designed for uniform flow distribution and minimum pressure loss



## Design of Air Ducting and Piping



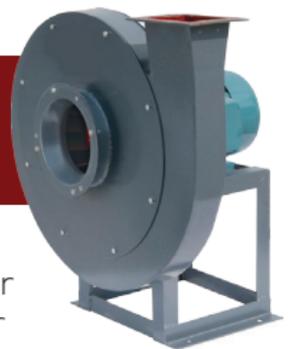
- Correct distances must be maintained between blower and valves, and between valves and branching points.
- Introduction of automatic temperature control
- Introduction of automatic furnace pressure control
- Use of recuperator or regenerator for waste heat recovery
- Proper maintenance of furnace linings
- Periodic packing of ceramic wool or fibers around burner tiles

## Best operating practices for Maintenance

- Periodic cleaning of burner oil nozzles
- Periodic cleaning of oil filters, blower filters and gas filters
- Stopping all fuel spillages and leakages
- Replacement of broken/worn out burner tiles
- Prompt replacement of worn out valves and instrumentation
- Periodic calibration of instrumentation
- Periodic checking and re-adjusting to preset values of air and fuel pressures at burners



## Combustion air blowers

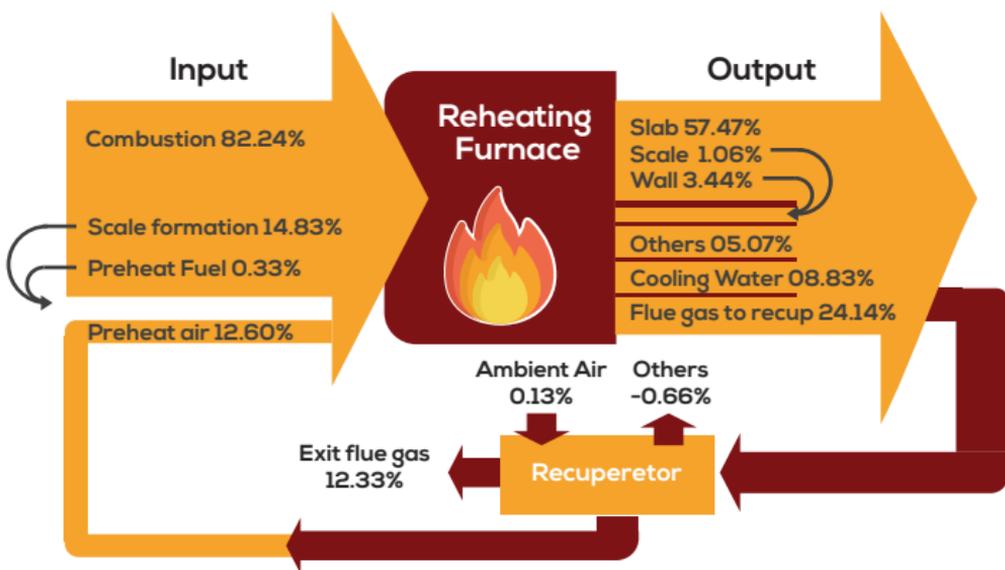


- Flatline combustion blowers deliver uniform pressure over range of air volumes
- Burners can operate over wide range of fuel throughout without compromising on pressure requirements
- Ensures optimum atomization, lower pollution, and of course higher profits from complete and more efficient combustion
- Blower should have flat line performance curve to deliver air at constant pressure regardless of volume
- If some burners are turned on or off during operation, air pressure to remaining burners should not be affected

# REHEATING FURNACE



Less than 25% of total energy goes into heating metal

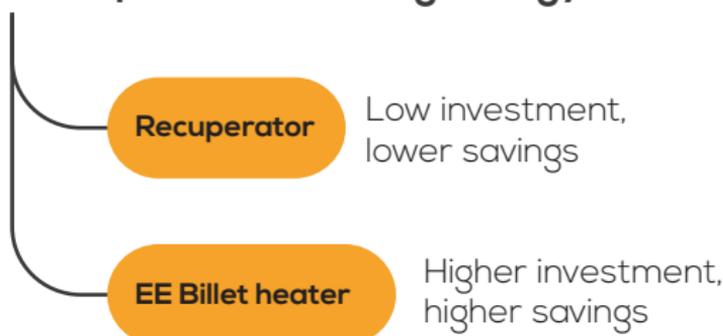


Reheating Furnace : Energy Flow Diagram

## Common reasons for poor energy efficiency

- Furnace capacity un-matched with rolling capacity
- Improper selection of combustion equipment
- Inefficient recuperators or absent recuperator.
- Absent / by-passed automatic air / fuel ratio control system.
- Absent automatic temperature control system
- Absent automatic furnace pressure control system
- Improper maintenance and operation of furnace and combustion system
- Losses from the furnace outside walls or structure
- Heat transported out of the furnace by the load conveyors, fixtures, trays, etc
- Radiation losses from openings, hot exposed parts
- Heat carried by the cold air infiltration into the furnace
- Heat carried by the excess air used in the burners

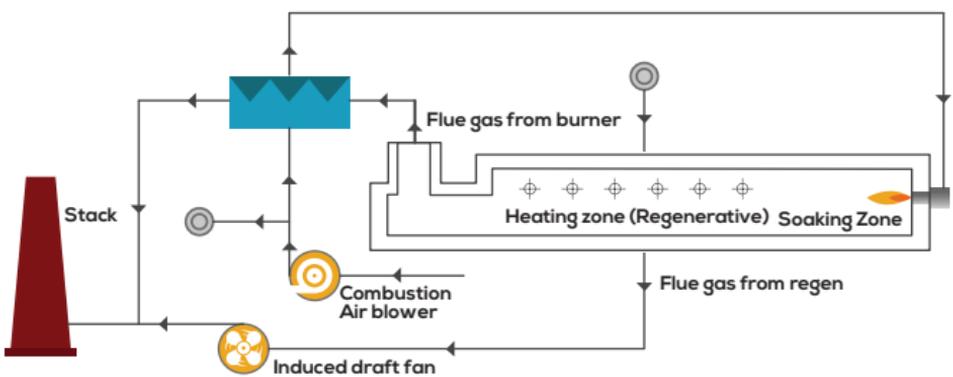
## Two options for saving energy



# RECUPERATOR



## What is a recuperator



Heat Exchanger which recovers heat from flue gases and preheats fresh air

## Why recuperator?

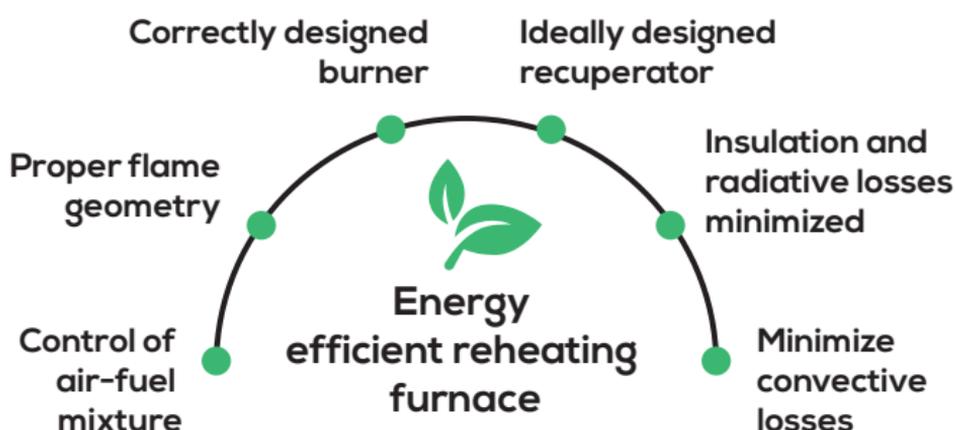
22°C higher combustion air temperature = 1% lower fuel consumption

## Example 1 : How much savings is possible with existing furnace?

Current consumption	: 33 liters/ton
Temperature of preheated air	: 250 C
Savings per ton	: 3 liters/ton
Annual production	: 3000 tons
Annual savings in oil	: 9,000 liters of FO
Annual savings in INR	: INR 2.7 Lakh

Investment in a 1 tph Billet Heater recuperator  
**INR 1.25 Lakh**

## EE Billet Heater - Features



## Reheating furnace in brass forging industry



### Example 2: Savings in an Energy efficient billet heater with recuperator

Current consumption	: 33 liters/ton
EE billet heater	: 22 liters/ton
Savings per ton	: 11 liters/ton
Annual production	: 3000 tons
Annual savings in oil	: 33,000 liters of FO
Annual savings in INR	: INR ~10 Lakh

Investment in a 1 tph Billet Heater  
**INR 12.5 Lakh**

# About Project

## Promoting Energy Efficiency & Renewable Energy in Selected MSME Clusters in India

To develop and promote a market environment for introducing energy efficiency and enhanced use of renewable energy technologies in process applications in the selected energy-intensive MSME clusters under GEF UNIDO BEE project.

The main objective of the project is to increase the capacity building of suppliers of EE/RE product and service providers

### Disclaimer

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### Contact Details



**Mr. Niranjan Rao Deevela**  
UNIDO

✉ [n.deevela@unido.org](mailto:n.deevela@unido.org)

☎ +91 9560003730



**Mr. P. V. Kiran Ananth**  
CII

✉ [kiran.ananth@cii.in](mailto:kiran.ananth@cii.in)

☎ +91 40 44185152