

BEYOND

SMART CITIES

CERTIFIED INDUSTRIAL ENERGY PROFESSIONAL

CIEP TRAINING PROGRAM

FOR INDUSTRIAL ENERGY SPECIALISTS

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

ENERGY SPECIALIST CURRICULUM

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FUELS, FURNACES, AND FIRED EQUIPMENT

BASICS - 2

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WHAT SHOULD YOU LEARN



Classification of furnaces

General fuel economy measures in furnaces,

Excess air, Heat distribution, Temperature control, Draft control, Waste heat recovery.

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FURNACES

A furnace is an equipment to melt metals for casting or heat materials for change of shape (rolling, forging etc) or change of properties (heat treatment).

Based on the method of generating heat, furnaces are broadly classified into two types namely combustion type (using fuels) and electric type. In case of combustion type furnace, depending upon the kind of combustion, it can be broadly classified as oil fired, coal fired or gas fired.

✓Based on the mode of charging of material furnaces can be classified as (i) Intermittent or Batch type furnace or Periodical furnace and (ii) Continuous furnace.

✓Based on mode of waste heat recovery as recuperative and regenerative furnaces.

✓Another type of furnace classification is made based on mode of heat transfer, mode of charging and mode of heat recovery as shown in the Figure 4.1 below.

FURNACE CLASSIFICATION

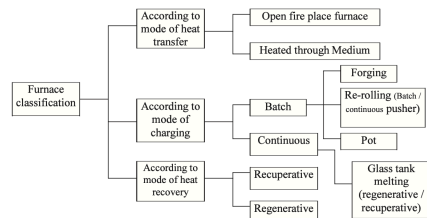


Figure 4.1: Furnace Classification

PERFORMANCE EVALUATION OF A TYPICAL FURNACE

Thermal efficiency of process heating equipment, such as furnaces, ovens, heaters, and kilns is the ratio of heat delivered to a material and heat supplied to the heating equipment.

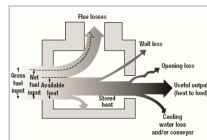


Figure 4.9 Heat Losses in Industrial Heating Furnaces

✓The purpose of a heating process is to introduce a certain amount of thermal energy into a product, raising it to a certain temperature to prepare it for additional processing or change its properties. To carry this out, the product is heated in a furnace. This results in energy losses in different areas and forms as shown in sankey diagram figure 4.9. For most heating equipment, a large amount of the heat supplied is wasted in the form of exhaust gases.

GENERAL FUEL ECONOMY MEASURES IN FURNACES

Typical energy efficiency measures for an industry with furnace are:

- 1) Complete combustion with minimum excess air
- 2) Correct heat distribution
- 3) Operating at the desired temperature
- 4) Reducing heat losses from furnace openings
- 5) Maintaining correct amount of furnace draught
- 6) Optimum capacity utilization
- 7) Waste heat recovery from the flue gases
- 8) Minimum refractory losses
- 9) Use of Ceramic Coatings

INDUSTRIAL HEATING FURNACES

Furnace is by definition a device for heating materials and therefore a user of energy. Heating furnaces can be divided into batch-type (Job at stationary position) and continuous type (large volume of work output at regular intervals). The types of batch furnace include box, bogie, cover, etc.

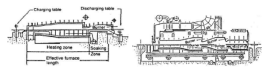


Figure 2.1: Pusher-Type Reheating Furnace



Figure 2.2: Walking Beam-Type Reheating Furnace

For mass production, continuous furnaces are used in general. The types of continuous furnaces include pusher-type furnace (Figure 2.1), walking hearth-type furnace, rotary hearth and walking beam-type furnace (Figure 2.2).

The primary energy required for reheating / heat treatment (say annealing) furnaces are in the form of Furnace oil, LSHS, LDO or electricity

PURPOSE OF THE PERFORMANCE TEST

The purpose of the performance test is to determine efficiency of the furnace and specific energy consumption for comparing with design values or best practice norms. There are many factors affecting furnace performance such as capacity utilization of furnaces, excess air ratio, final heating temperature etc. It is the key for assessing current level of performances and finding the scope for improvements and productivity.

- ✓ To find out the efficiency of the furnace
- ✓ To find out the Specific energy consumption

1. Furnace Efficiency, η
$$= \frac{\text{Heat output}}{\text{Heat Input}} \times 100$$
$$= \frac{\text{Heat in stock (material)} \quad (\text{kCals})}{\text{Heat in Fuel / electricity} \quad (\text{kCals})} \times 100$$
2. Specific Energy Consumption
$$= \frac{\text{Quantity of fuel or energy consumed}}{\text{Quantity of material processed.}}$$

FIRED EQUIPMENT BASICS



Fired Heaters, as the name specifies are obviously heaters or furnaces. They are pieces of equipment used in processing facilities (refineries, power plants, petrochemical complexes, etc) to heat fluids up to the desired temperature. So, the main purpose of fired heaters is to raise the temperature of the process fluid that flows through the tubes. The heat energy is supplied by combusting fuels. These fall in the static or stationary group of mechanical equipment and are designed based on API 560 standard. Today we will study the details about Fired Heaters, their components, types, construction features, and maintenance requirements?

Where are fired heaters used?

Fired heaters find wide applications throughout chemical industries like refineries, petrochemical and chemical industries, gas processing units, ammonia plants, olefin plants, fertilizer plants, etc. They are termed Feed Preheaters, Cracking Furnaces, Fractionators heaters, Steam reforming heaters, Crude Heaters, etc.

FIRED EQUIPMENT BASICS



How does a Fire Heater work?

Fire heater works by direct heat transfer from the product of combustion of fuels. The maximum flame temperature of hydrocarbon burned with stoichiometric air is about 3500°F (1926°C). Basically, this heat energy is released by combusting fuels into an open space and transferred to the fluids inside tubes which are ranges along the walls and roofs of the combustion chamber.

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FIRED EQUIPMENT BASICS



What is fired heater Draft?

A draft is the pressure differential that persists between air/fuel gas in the combustion chamber and atmospheric air. The draft is caused due to density difference between hot fuel gas and ambient air. A negative draft must be maintained in every part of the fire heater so that hot fuel gas cannot be leaked out. Draft reading in the middle of the furnace is used to control the draft & excess air. A heater draft is required to pull out fuel gases from the heater.

How draft is generated?

The draft can be created by the following means,
✓Full open the damper and close the louvers.
✓Open purging/snuffing of steam
✓Cut off the steam flow.
✓Close damper as per draft requirement.

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