Principle of boiler operation

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Coal-fired Power plant
Property of Steam

Components of a Boiler
The boiler is the central part of the power plant.

Circulating Fluidized Bed (CFB) Boilers

Bubbling Fluidized Bed (BFB) Boilers

CFB Gasifiers

Pulverized Coal Fired Boilers

HRSG, WHB, Package Boilers

Waste to Energy Plants

Grate/Stoker Fired Boilers

For High Efficiency and Low Emissions
BASIS OF CLASSIFICATION

1. FIRING METHOD
2. Energy source
3. Steam use
4. Water circulation
5. Steam pressure
6. Construction

1. FIRING METHOD

- Grate firing
  - Traveling grate stoker firing
- Front fired burner
  - Tangential fired
- Opposed jet firing
  - Down-jet firing
- Cyclone firing
  - Bubbling fluidized bed
- Circulating fluidized bed
2. Energy source

- Coal
- Liquid fuel
- Gas
- Solid waste
- Biomass
- Recovery fuel
- Waste heat
- Nuclear fuel

3. Use of steam

- Utility (Electricity)
- Industrial
- Cogeneration
- Naval
- Marine
- Domestic heating
- Cooking
4. Types of construction
- Packaged shell
- Packaged water tube
- Field erected

5. Water circulation
- Natural
- Forced
- Combined
Packaged Boiler

- Most process industries or big apartment complexes prefer this.
- Entire boiler is skid mounted
- Very compact design, but limited in capacity

DOMESTIC HOT WATER BOILER

- Most extensively used boiler in the West
- Perhaps most reliable
- Water in shell and flue gas in vertical tubes
- Operates on on-off control system
- Burner and fan are often combined
STOKER FIRED BOILER

- The work horse of first half of 1900
- Coal burns in a fixed layer
- The grate carrying the fuel is either stationery or moving
- Maximum capacity is limited by length of grate

Front fired Water tube

- Very popular in intermediate size industries.
- Oil/gas is burned in a flame from the front.
- Front firing is also used in large boiler.
- Packaged watertube.
Marine water tube

- Extremely compact
- Weight and reliability are more important than efficiency
- High flue gas temperature

Tangent wall firing

- Field erected pulverized coal fired
- Large capacity
- Flame from four corners creates vortex at furnace center
PULVERIZED COAL FIRED BOILER

Bubbling fluidized bed boiler
Circulating Fluidized Bed Boiler

WHY SPECIFICATION

- This is the first step in a project
- A good specification saves bundles
- Over specification is costly
- Under specification is risky
SPARE CAPACITY

- Spare capacity is kept at all levels. It is a protection against stoppage of the whole plant due to the failure of a small component (one feed pump out service).
- It also guards the plant against unforeseen difficulties (Blockage in grid plate).
- It allows the plant to overcome transient overload (110% MCR).

BOILER SPECIFICATION PARAMETERS

- STEAM (flow, pressure, temperature)
- FEED WATER (economizer inlet temp.)
- FUEL (type, composition, heating value, physical properties)
- SORBENT
- EMISSION (SO2, NOx, Particulates)
- SOLID WASTE
- PRESSURE DROP
- AUXILIARIES
- SITE
- PERSONNEL
DESIGN STAGES

- PRELIMINARY DESIGN
- DETAIL PROPOSAL DESIGN
- FINAL DESIGN
  - thermal design (process design)
  - hydrodynamic design (circulation, draft plan)
  - equipment selection (fan, feeder, ESP, etc)
  - mechanical design (pressure vessel code)