

Industrial boilers

Introduction

A boiler is used to generate steam at a desired pressure and temperature by transferring heat produced by burning fuel to water to change it to steam.

Steam is used for the following purposes:

- Power generation
- Processing
- Heating

Requirements of an efficient boiler

- 1) Should generate maximum amount of steam at a required pressure and temperature and quality with minimum fuel consumption.
- 2) Should be light in weight and should not occupy large space.
- 3) Should conform to safety regulations.
- 4) Should have low initial cost, installation cost and maintenance cost.
- 5) Should be able to cope with fluctuating demands of steam supply.
- 6) All parts and components should be easily accessible for inspection and repair.

Classification of boilers

Boilers can be classified on various ways.

a) Tube contents

One way is to classify on the basis of tube contents. On this basis, boilers can be classified as: Fire tube boiler and water tube boiler.

Fire tube boiler

In fire tube boiler, hot gases pass through the tubes and water surrounds them. Heat from the gases (produced by combustion) is transferred to water, which is then converted to steam.

Examples: **Cochran, Lancashire, Cornish, Locomotive** boilers

Water tube boilers

In water tube boiler, water flows inside the tubes and the hot gases flow outside the tubes.

Examples: **Babcock and Wilcox boiler** (which has straight but inclined water tubes);

Stirling boiler (which has bent water tube).

Fire tube boiler needs stronger outer shell to contain steam pressure, water tube boiler does not need that.

b) Method of firing

Internally fired: Furnace region is provided inside the boiler shell and is completely surrounded by water-cooled surfaces. E.g., Lancashire, Locomotive

Externally fired: Furnace region is provided outside. E.g., Babcock and Wilcox boiler

c) *Pressure of steam*

Low pressure boiler: Steam pressure below 80 bars.

Examples: Cochran, Cornish, Lancashire, locomotive boilers

High pressure boiler: Pressure above 80 bars.

Examples: Babcock and Wilcox, Lamont

d) *Circulation of water*

Natural circulation: Circulation of water in the boiler takes place by natural convection current produced by the application of heat.

Examples: Lancashire, Locomotive, Babcock and Wilcox boilers

Forced circulation:

Lancashire boiler

- Two large fire tubes

Cornish boiler

- Single large fire tube

Cochran boiler

Locomotive boiler

- Many small tubes

Babcock Wilcox water tube boiler

Fluidized bed boilers

Steam accumulators

Heat accumulators are used to equalize the load on the boilers. They store energy during periods when the output of the boiler exceeds the demand and restores and supplies back the energy when the demand is more than the output of the boiler.

There are two types of steam accumulators:

Variable Pressure System (Ruth's accumulator)

Constant pressure System (Kiesselbach Accumulator)

Boiler mountings and accessories

Boilers are equipped with two categories of components: boiler mountings and boiler accessories. Boiler mountings are the machine components that are mounted over the body of the boiler itself for the safety of the boiler and for complete control of the process of steam generation. Boiler accessories are those components which are installed either inside or outside the boiler to increase the efficiency of the plant and to help in the proper working of the plant.

Following are the boiler mountings and accessories frequently used:

	Boiler Mountings	Functions
1	Two safety valves	To permit the steam in the boiler to escape to atmosphere when pressure in the steam space exceeds a certain specified limit.
2	Two water level indicators	To ascertain constantly and exactly the level of water in the boiler shell.
3	Pressure gauge	To record the pressure at which the steam is generated in the boiler.
4	Fusible plug	To extinguish fire in the event of water level in the boiler shell falling below a certain specified limit.
5	Steam stop valve	To shut off or regulate the flow of steam from the boiler to the steam pipe or from the steam pipe to the engine
6	Feed check valve	i) To allow the feed water to pass into the boiler. ii) To prevent the back flow of water from the boiler in the event of the failure of the feed pump.
7	Blow-off cock	To drain out the water from the boiler for internal cleaning, inspection or other purposes.
8	Man and mud holes	To allow men to enter inside the boiler for inspection and repair.
	Boiler accessories	Functions
1	Air preheater	Waste heat recovery device in which the air to on its way to the furnace is heated utilizing the heat of exhaust gases
2	Economizer	To recover some of the heat being carried over by exhaust gases (This heat is used to raise the temperature of feedwater supplied to the boiler)
3	Steam superheater	To superheat the steam generated by boiler
4	Feed pump	To raise the pressure of water and force it into the boiler
5	Injector	To feed water in vertical and locomotive boilers