Steam Generator

1. Classification & types of Boiler
2. Important terms of Boiler
3. Comparison between fire tube & water tube boiler
4. Description & working of common boilers (Cochran, Lancashire, Babcock & wilcox boiler)
5. Boiler Draught (Forced, induced, and balanced)
6. Boiler mountings & accessories

Boiler: A boiler is an enclosed pressure vessel where heat generated through the combustion of fuel is used for converting water into steam

Classification & Types.

⇒ ① Fire tube Boiler

→ Capacity < 25 T/h
→ Pressure < 20 bar
→ Fluctuation in demand
eg: Cochran, Lancashire, Locomotive Cornish

② Water Tube Boilers

→ Capacity < 4.5 - 120 T/h
→ pressure < 200 bar
→ More control
→ Stringent water quality
→ NO - Drum
eg: Babcock & wilcox boilers, Stirling boiler, Lemont

⇒ Low pr. boiler ⇒ p < 20
Intermediate pr. boiler ⇒ p ⇒ 20 - 80
high pr. boiler ⇒ p > 80 bar

⇒ Position of Furnace

① Internally Fired (inside shell)
eg: Cochran, Lancashire

② Externally Fired (outside shell)
eg: Babcock & wilcox, stirling

⇒ Position of Principal Axis

① Horizontal
→ easy to inspect & repair
eg: Cochran Boiler, Lancashire, Locomotive boiler

② Vertical
→ less area
eg: Babcock & wilcox boiler, Stirling boiler, yarrow boiler

③ Inclined

⇒ Application

① Mobile boiler
Locomotive boiler

② Stationary boilers
→ Babcock - wilcox

⇒ Circulation of water

① Natural
Lancashire
P < (P critical = 221.2 bar)

② Forced
eg: velox, Lamont
Benson

⇒ ① High Pr. Boiler ② Intemediate Pr. Boiler ③ Low Pr. Boiler
↓
Above 80 bar Pr.
→ Forced Pump is used
→ Velox, Benson, Lemont
→ Babcock & Wilcox
→ Natural Convection current
→ Cochran, Lancashire, Cornish, Locomotive.

⇒ ① Single tube boiler ② Multiple tube boiler

⇒ Once through Boilers operate above critical pressure i.e; 221.2 bar. As the density of water and steam are same above the critical pressure, there will be no circulation. These types of boilers are also called as positive forced circulation boilers.

Q.1 Which types of boilers are called drum-less boilers?
a) Natural circulation boilers b) Fire tube boiler
c) Positive forced circulation d) Forced circulation boiler

2. What is advantage of having smaller ratio of water to steam space?
a) steam can be generated at a faster even if boiler is cold
b) increases the rate of evaporation

3. What is the steam pressure limit of Natural circulation boilers?
a) 650 bar b) 180 bar c) 400 bar d) 550 bar

4. Chances of sediments depositing inside the water tubes in the shell is due to?
a) low working pressure b) Natural circulation of water
c) Partial circulation of water d) High working pressure

5) Out of the given option choose the advantage that supports fire tube boilers?

a) water circulation is cyclic
b) Used as a mobile boiler
c) water circulation is limited inside boiler shell

6) Which are the major types of boilers that are operated in world Today

a) Natural circulation boiler
b) Forced circulation boiler
c) Fire tube boiler
d) Once-through boiler

Important terms

1. Boiler shell : steel
2. Combustion chamber : Concrete or fire bricks
3. Grate : Cast Iron (bars)
4. Furnace
5. Mountings : for safety
6. Accessories : [increase efficiency] ~~integral parts~~

Difference:

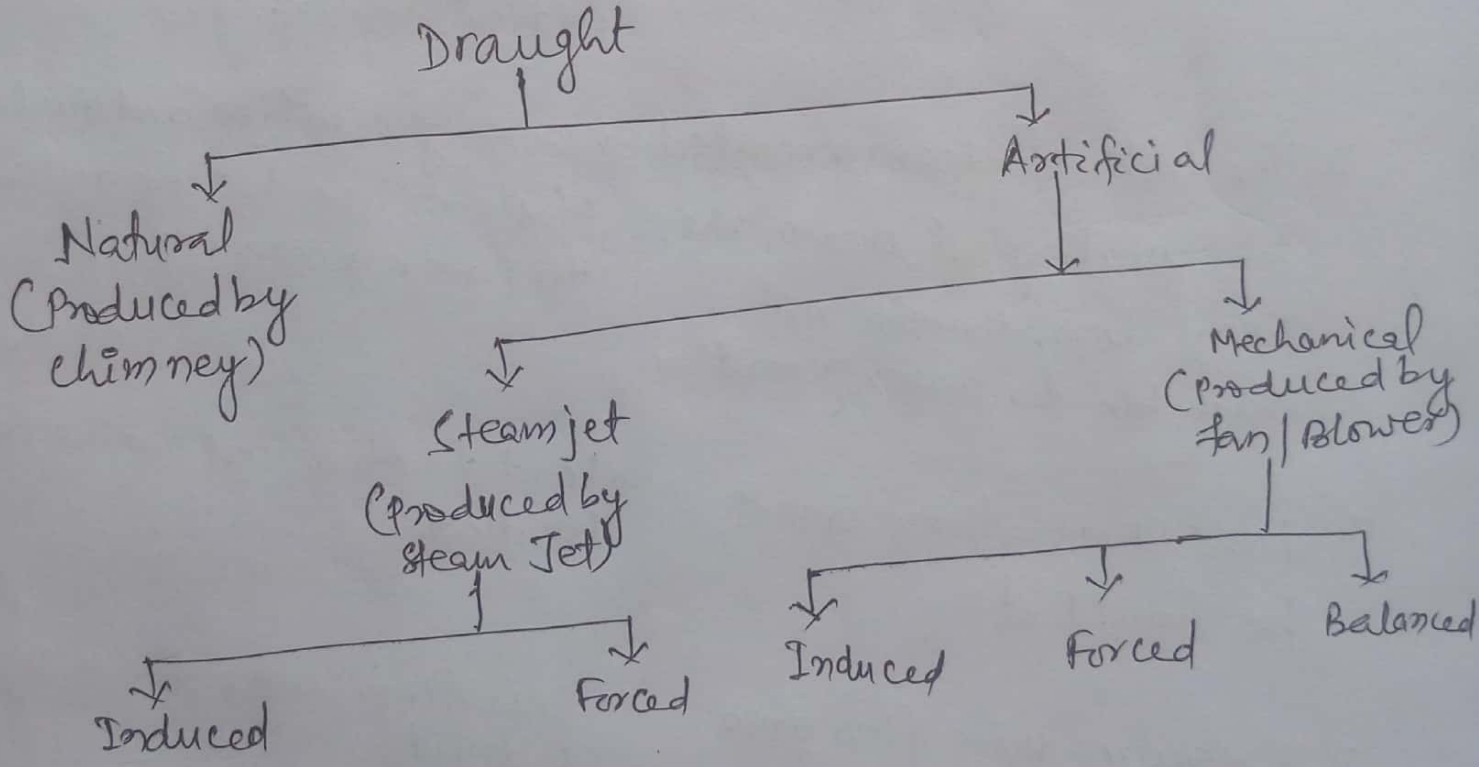
	Fire Tube Boiler	Water tube Boiler
1.	In fire tube boilers, hot flue gases passed through tubes and water surrounds them	→In water-tube boiler, water passes through tubes and hot flue gases surround them
2.	These are operated at low pressure upto 20 bar.	→The working pressure is high enough, upto 250 bar in super critical boilers.
3.	The rate of steam generated and quality of steam are very low; therefor not suitable for power generation	→ steam generation and quality of steam are better and suitable for power generation
4.	Load fluctuations cannot be handled	→ Load fluctuations can be easily handled
5.	It requires more floor area for a given output.	→ less floor area for a given output.
6.	bulky & difficult to transport	→ light in weight & not transportation problem
7.	Overall efficiency is upto 75%.	→overall efficiency with an economizer is upto 90%.
8	water doesn't circulate in a definite direction	→Direction of water circulated is well-defined
9.	Drum size is large and damage caused by bursting is large	→ If water tube is damaged, it can be easily replaced or repaired

Boiler Draught

→ Small pressure difference causing flow of air and gases through the boiler

→ It is essential to supply a sufficient quantity of air for combustion and to remove the product of combustion

→ Draught also provide velocity to flue gases and so increase the heat transfer co-efficient in the boiler



Induced Draught (ID)

⇒ In this system a fan or blower is located at or near the base of the chimney which creates a partial vacuum in the furnace and flue passage.

⇒ Thus the air and flue gases are drawn through the boiler due to comparatively higher pressure of outside air

Forced Draught (FD)

⇒ It is a positive pressure draught

⇒ The fan is installed at the base of boiler before grate which forces the outside air through fuel gases through flue passage, economizer etc.

⇒ The enclosure for the furnace has to be very tightly sealed so that gases from the furnace do not leak out in the boiler house.

Balanced Draught

⇒ It is a combination of forced and induced draught.

⇒ FD fan overcomes the resistance in air pre-heater and grate.

⇒ ID fan overcomes draught losses through boiler, economizer and connecting flue passages etc.

* Difference between Mountings & Accessories.

	Boiler Mountings	Boiler Accessories
01.	⇒ For safety of the boiler	⇒ to increase the efficiency
02.	⇒ Form integral parts of the boiler	⇒ not integral part of the boiler
03.	⇒ They are usually mounted on the boiler shell	⇒ They are usually installed outside the boiler shell
04.	⇒ A boiler should not be operated without mounting	⇒ A boiler can be operated without accessories.
05.	⇒ Ex: Water level indicator, Main steam stop valve, Pressure gauge, Feed check valve, Fusible plug, Blow off cock, Safety valve	⇒ ex: Superheater, Economizer, Air heater, Feed pump or injector, steam trap