

L.No: 06

Topic: Boiler Troubles

Introduction:

The water fed into the boiler for the production of steam is called boiler feedwater.

Boiler feed water should be free from turbidity, oil, dissolved gases, alkali and hardness causing substances.

If the hard water obtained from natural sources is fed directly into the boilers, the following troubles may arise.

Boiler Troubles (or) Disadvantages of using hard water in boilers.

- \* Formation of scales and sludges in boilers.
- \* Priming & foaming (carry over)
- \* Caustic embrittlement
- \* Boiler Corrosion

Formation of Scales and Sludges in boilers

\* When water is continuously converted into steam in boilers (or) heat exchangers, the concentration of dissolved salts in water increases progressively.

\* When the concentration of the salt reaches their saturation point, they are thrown out in the form of precipitates on the inner walls of the boilers (or) heat

exchangers. The least soluble one gets precipitated first.

## Sludge

\* loose, slimy and non-adherent - precipitate

\* Sludge forming substances are  $MgCO_3$ ,  $MgCl_2$ ,  $MgSO_4$  and  $CaCl_2$

\* Disadvantages: Sludges are poor conductors of heat

Excess of sludge formation decreases the efficiency of boiler

\* Prevention:

\* Sludge formation can be prevented by using softened water.

\* Sludges can also be removed by blow down operation

\* Blow-down operation is a process of removing a portion of concentrated water by fresh water frequently from the boiler during steam production

## Scale

Hard, adherent coating

- Scale forming substances are  $Ca(HCO_3)_2$ ,  $CaSO_4$ ,  $Mg(OH)_2$

- Disadvantages: Scales act as thermal insulators. It decreases the efficiency of boiler.

\* Scale formation can be prevented by dissolving using acids like  $HCl$ ,  $H_2SO_4$

\* Scale formation can be removed by

✓ External Treatment

✓ Internal

\* They can also be removed by applying thermal shocks.

## Disadvantages of Scale formation

- \* Wastage of fuels
- \* Decrease in efficiency
- \* Boiler explosion

## Prevention of Scale formation

→ At the initial stage, Scales can be removed using Scraper, wire brush

→ If scales are brittle, they can be removed by thermal shocks.

→ By using suitable chemicals like dil.  $H_2SO_4$ , EDTA with which they form suitable complexes.

→ If the Scales are loosely adhering, they can be removed by frequent blowdown operation.

## Priming and Foaming (Carry over)

During the production of Steam in the boiler, due to rapid boiling, some droplets of liquid water are carried along with Steam.

Steam containing droplets of liquid water is called wet steam.

These droplets of liquid water carry with them some dissolved salts and suspended impurities. This phenomenon is called carry over. It occurs due to priming & foaming

## Priming

Priming is the process of production of wet steam.

It is caused by

- \* High steam velocity
- \* Very high water level in the boiler
- \* Sudden Boiling of water
- \* Very poor boiler design.

## Prevention

- Controlling the velocity of steam
- Keeping the water level lower
- Good boiler design
- Using treated water.

## Foaming

The formation of stable bubbles above the surface of water is called foaming.

These bubbles are carried over by steam leading to excessive priming.

It is caused by

- presence of oil & grease
- presence of finely divided particles.

## Prevention

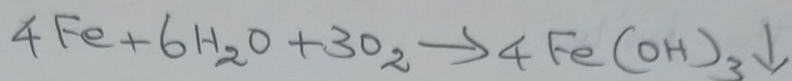
- \* Adding antifoaming chemicals like

Castor oil

- \* Adding coagulants like sodium aluminate, aluminium hydroxide

## Dissolved oxygen

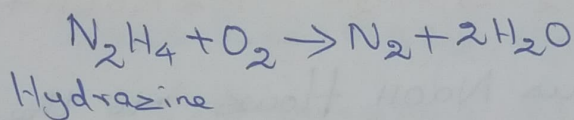
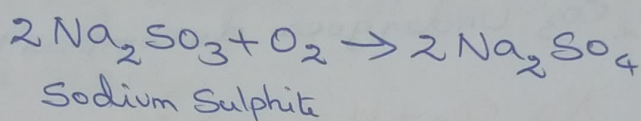
The dissolved oxygen in water attacks the boiler material at higher temperature.



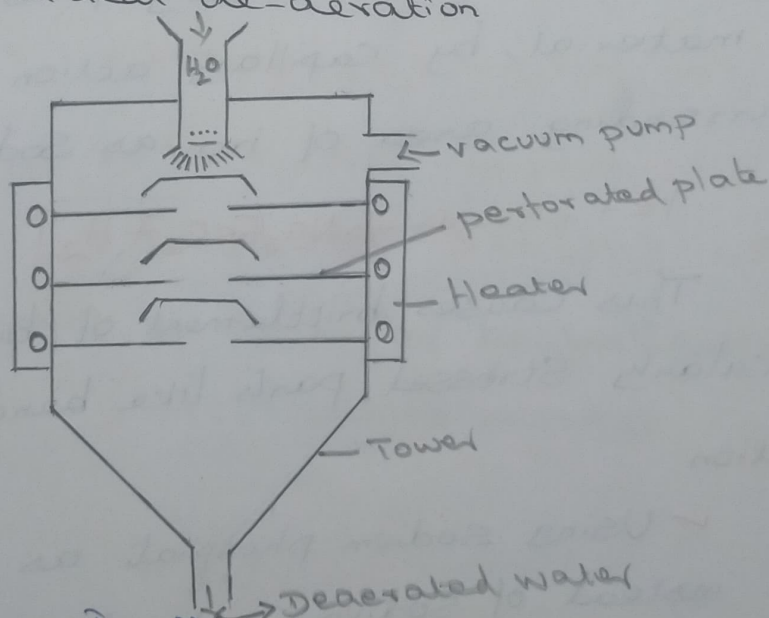
## Removal of dissolved oxygen

- \* Chemical Method
- \* Mechanical de-aeration Method

### Chemical Method



### Mechanical de-aeration



In this process, water is allowed to

fall slowly on the perforated plates fitted inside the tower. The sides of the tower are heated and a vacuum pump is also attached to it.

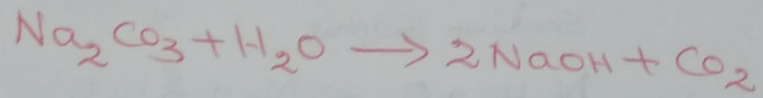
The high temperature and low pressure produced inside the tower reduce the dissolved oxygen content of the water.

## Caustic Embrittlement (Inter-crystalline Cracking)

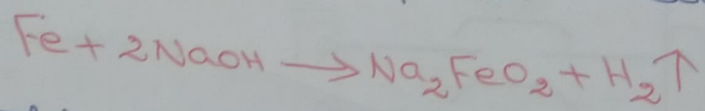
Caustic embrittlement is a type of boiler corrosion, caused by using highly alkaline water in the boiler.

It means inter-crystalline cracking of boiler metal.

Boiler water usually contains a small proportion of  $\text{Na}_2\text{CO}_3$ . In high pressure boilers this  $\text{Na}_2\text{CO}_3$  undergoes decomposition to give  $\text{NaOH}$



This  $\text{NaOH}$  flows into the minute hair cracks and crevices, usually present on the boiler material, by capillary action and dissolves the surrounding area of iron as sodium ferroate.



This causes embrittlement of boiler parts, particularly stressed parts like bends, joints etc.

Prevention

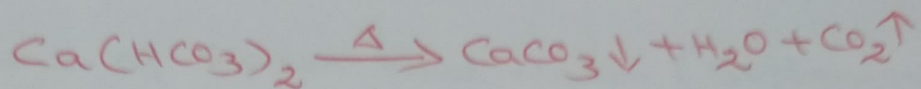
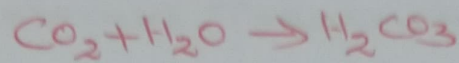
- ✓ Using sodium phosphate as softening agent instead of sodium carbonate.
- ✓ By adding tannin, lignin to the boiler water which blocks the hair cracks.

Boiler Corrosion

Corrosion in boilers is due to the presence of

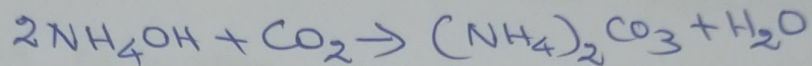
- \* dissolved oxygen
- \* dissolved carbon dioxide
- \* dissolved salts

Dissolved Carbon dioxide



Removal of dissolved carbon dioxide

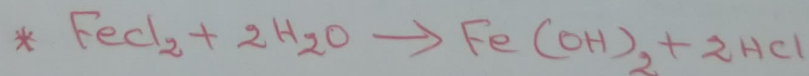
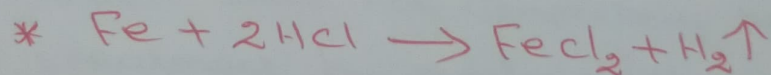
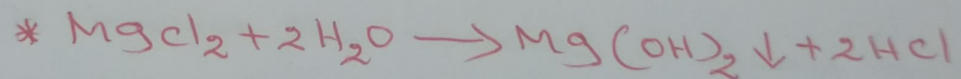
\* Adding a calculated amount of  $\text{NH}_4\text{OH}$  into water.



\* By mechanical deaeration method

Dissolved  $\text{MgCl}_2$

Salts like  $\text{MgCl}_2$ ,  $\text{CaCl}_2$  undergo hydrolysis at higher ~~se~~ temperature to give  $\text{HCl}$ , which corrodes the boiler.



Removal of acids by neutralisation

