

## **BOILER FEED WATER AND BOILER TROUBLES**

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## 1.5 BOILER FEED WATER

- The water fed into the boiler for the production of steam is called boiler feed water.
- Boiler feed water should be free from dissolved salts, suspended impurities, silica, turbidity, oil, alkali and hardness producing substances.

### REQUIREMENTS OF BOILER FEED WATER

Any natural source of water does not supply a perfectly suitable boiler feed water. The boiler feed water must have the following requirements.

TYPES	AMOUNT
Hardness	< 0.2 ppm.
Soda alkalinity	0.15-1.0 ppm
Caustic alkalinity	0.15-0.45 ppm
Excess soda ash	0.3-0.55 ppm
Dissolved gases like oxygen, carbon dioxide	0 ppm

### Specifications of boiler feed water

S. NO	SPECIFICATIONS	DISADVANTAGES
1.	Boiler feed water should have zero hardness.	Scale and Sludge's will be produced, which prevents efficient heat transfer.
2.	It must be free from dissolved gases like O <sub>2</sub> , CO <sub>2</sub> .	It leads to boiler corrosion.
3.	It should be free from dissolved salts and alkalinity.	Produces caustic embrittlement, which causes brittleness of boiler parts.
4.	It should be free from oil and turbidity.	Produces priming and foaming.
5.	It should be free from suspended impurities.	Produces wet steam.
6.	It should be free from total	Produces priming, foaming and caustic

dissolved solids.	embrittlement.
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## 1.6 BOILER TROUBLES (OR) DISADVANTAGES OF USING HARD WATER IN BOILERS

Presence of impurities in boiler feed water may lead to the following problems:

- Sludge and scale formation
- Priming and foaming (carry over)
- Caustic embrittlement
- Boiler corrosion

### SLUDGE AND SCALE FORMATION IN BOILERS

- When water is evaporated in boilers to produce steam continuously, concentration of dissolved salts present in water increases progressively.
- When the concentration of the salts reaches their saturation point, they are thrown out of water in the form of precipitates on the inner walls of the boilers.
- The least soluble one gets precipitated first.

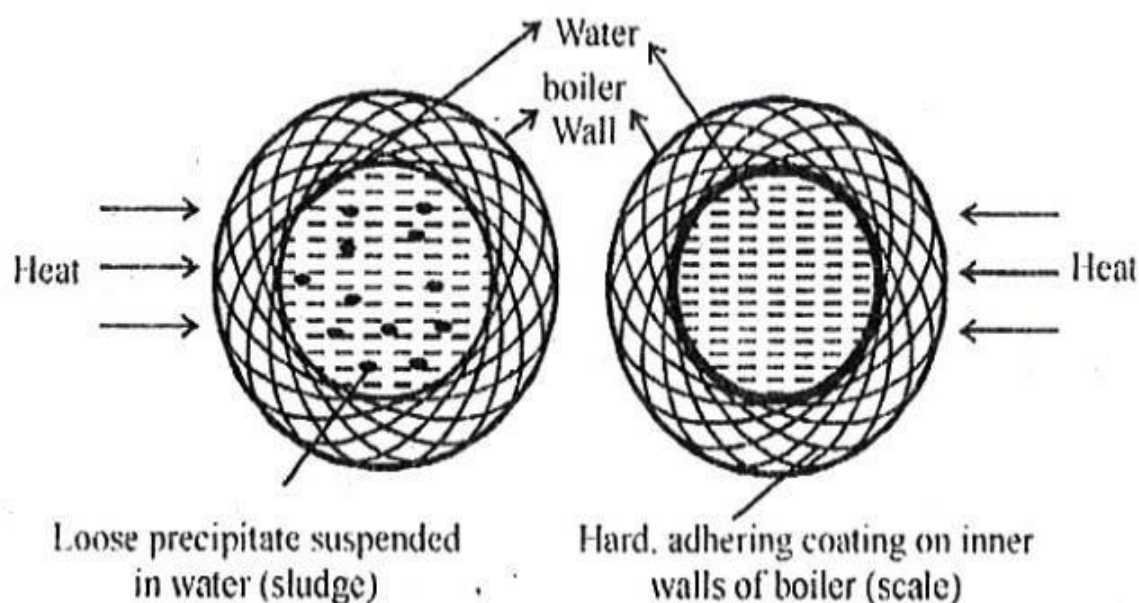


Figure 1.6.1 Scale and Sludge in Boilers

[Source: <https://www.rgpvonline.com/answer/chemistry/10.html>]

## SLUDGE FORMATION

- If the precipitate formed inside the boiler is soft, loose and slimy it is known as sludge.
- Sludge's are formed by substances like  $MgCO_3$ ,  $MgCl_2$ ,  $MgSO_4$  and  $CaCl_2$ .
- They have greater solubility in hot water than cold water.

## DISADVANTAGES

- Sludge's are poor conductors of heat which results in wastage of fuel.
- Excess of sludge formation decreases the efficiency of boiler (i.e.) it disturbs the functioning of boiler.

## PREVENTION

- Sludge formation can be prevented by using softened water.
- It can be removed by "blow down operation". It is a process of removing a portion of concentrated water frequently from the boiler during steam production.

## SCALE FORMATION

- Scales are hard deposits formed by the evaporation of hard water in boilers.
- If the precipitate forms a hard and adherent coating on the inner walls of the boiler, it is known as scale.
- Scales are formed by substances like  $Ca(HCO_3)_2$ ,  $CaSO_4$  and  $Mg(OH)_2$ .

## DISADVANTAGES

- Scales decrease the efficiency of the boiler.
- Scales are poor conductor of heat. Therefore, it causes decrease in evaporative capacity of the boiler and increase in the fuel consumption.
- When the scale cracks, water suddenly comes in contact with the overhead boiler metal. This causes the formation of a large amount of steam suddenly. So, sudden high pressure is developed, which may even cause the explosion of the boiler. (any crack developed on the scale leads to explosion.)

## PREVENTION

- Scale formation can be prevented by treating water in two ways:
  - External treatment
  - Internal treatment
- Scale formation can be prevented by dissolving it using acids like HCl and H<sub>2</sub>SO<sub>4</sub>.
- They can also be removed by applying thermal shocks, scrapers, wire brush, etc.

## REMOVAL OF SCALE FROM BOILERS

1. At the initial stage, scales can be removed using scraper, wire brush etc.
2. If scales are brittle, they can be removed by thermal shocks.
3. By using suitable chemicals like dil. acids, EDTA with which form suitable complexes.
4. If the scales are loosely adhering, they can be removed by frequent blow down operation.

## DISADVANTAGES OF SCALE FORMATION

### 1. WASTE OF FUELS

Scales have low thermal conductivity, so the heat transfer from boiler to inside water is not efficient. In order to provide steady supply of heat to water, overheating is done and this causes waste of fuel. The waste of fuel depends on the thickness and nature of the scale, which is shown in the table.

Thickness of scale(mm)	0.325	0.625	1.25	2.5	12
Waste of fuel	10%	15%	50%	80%	150%

### 2. DECREASE IN EFFICIENCY

Scales sometimes deposit in the valves and condensers of the boiler and choke. This results in decrease efficiency of the boiler.

### 3. BOILER EXPLOSION

Sometimes due to overheating the thick scales may crack and causes sudden contact of high heated boiler material with water. This causes formation of a large amount of steam and high pressure is developed which may lead to explosion.

### Differences between Sludge and Scale

S.No.	Sludge	Scale
1.	Sludge is a loose, slimy and non-adherent precipitate	Scale is a hard, adherent coating
2.	The main sludge forming substances are $MgCO_3$ , $MgCl_2$ , $MgSO_4$ and $CaCl_2$ etc	The main scale forming substances are $Ca(HCO_3)_2$ , $CaSO_4$ , $Mg(OH)_2$
3.	<b>Disadvantages:</b> Sludge's are poor conductors of heat. Excess of sludge formation decreases the efficiency of boiler.	<b>Disadvantages:</b> Scales act as thermal insulators. It decreases the efficiency of boiler. Any crack developed on the scale, leads to explosion.
4.	<b>Prevention</b> (i) Sludge formation can be prevented by using softened water. (ii) Sludge's can also be removed by blow-down operation. (iii) Blow-down operation is a process of removing a portion of concentrated water by fresh water frequently from the boiler during steam production.	<b>Prevention</b> (i) Scale formation can be prevented by dissolving using acids like HCl, $H_2SO_4$ (ii) Scale formation can be removed by (a) External treatment. (b) Internal treatment. (iii) They can also be removed by applying thermal shocks, scrapers, wire brush, etc.