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Good Water For Healthy Boiler

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Boiler

Boilers are heat transfer devices, where in water in the form of either liquid or gaseous steam is commonly employed as a medium for the transport of heat to some distant point of use.

Boiler Objective and Types

- **The objectives of a boiler are:**
  - To **release the energy** in the fuel as efficiently as possible
  - To **transfer the released energy** to the water and to generate steam as efficiently as possible
  - To **separate the steam from the water** and export to the plant where the energy can be transferred to the process as efficiently as possible

- **In general 2 different main types of boiler exist:**

  Shell boiler(cylindrical boilers, low to medium pressure)

  Water-tube boiler(High pressure)

Boiler – Water side issues

- ✓ **Deposits / Scaling**
  - ✓ Hardness
  - ✓ Metal Oxides
  - ✓ Silica
  - ✓ Organic matter
- ✓ **Corrosion**
  - ✓ Free carbon dioxide
  - ✓ Oxygen
  - ✓ Low pH value
- ✓ **Carry-over**
  - ✓ transport of moisture and impurities with steam

Boiler – Water Carry Over

- **Mechanical**
  - Improper construction of boiler internals
  - Too high water level
  - On-off firing / on-off feed water addition
  - Steam demand exceeding boiler capacity
- **Leading to**
  - Poor steam quality
  - Deposits in condensate lines
  - Decreased boiler efficiency and limited steam production
- **Chemical**
  - Improper cleaning of new boiler
  - High suspended solids
  - High alkalinity
  - Oil or organic impurities in boiler
  - Improper water treatment control

Effects of Water side issues

- Increased Boiler Fuel Consumption – Scale / Deposit hamper heat transfer.
- Decreased Boiler Availability – Tube failure due to expansion / bursting.
- Poor Steam Quality – Excess of water in the steam due to carry over.
- Decreased Boiler Through put (Production) – Scale / Deposition
- Increased Heating Cycle Time – Wet steam has a lower heat content

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Boiler Water - Treatment Alternatives

- Water Softening System
- De Alkalization System
- Demineralization System
- Reverse Osmosis System

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Water Constituents Vs. Technology

Problem	Softening	De Alkalization	Demineralization	Reverse Osmosis
Hardness removal	✓	✓	✓	✓
pH Change	×	✓	✓	✓
TDS Change	×	✓	✓	✓
Dissolved Oxygen	×	×	×	×
Silica	×	×	✓	✓

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IS 10392 1982 Specification for Boiler Water

Sr.No.	Characteristics	Requirement for Boiler Pressure		
1.	FEED WATER	Up to 2.0 MN/m2	2.1 to 3.9 MN/m2	4.0 to 5.9 MN/m2
	Total Hardness as CaCO3 mg/l	10.0	1.0	0.5
	pH Value	8.5 - 9.5	8.5 - 9.5	8.5 - 9.5
	Dissolved Oxygen mg/l max	0.1	0.02	0.01
	Silica as SiO2 mg/l max	----------	5.0	0.50
2	BOILER WATER			
	Total Hardness of filtered sample as CaCO3	---------- NOT DETECTABLE ----------		
	Total Alkalinity as CaCO3 mg/l max	700.00	500.00	300.00
	Caustic Alkalinity as CaCO3 mg/l max	350.00	200.00	60.00
	pH Value	11.0 - 12.0	11.0 - 12.0	10.5 - 11.0
	Residual Sodium Sulphite as Na2SO3 mg/l	30 - 50	20 - 30	----------
	Residual Hydrazine as N2H4 mg/l	0.1 to 1.0 (if added)	0.1 - 0.5 (If added)	0.05 - 0.3
	Ratio Na2SO4/Caustic Alkalinity as NaOH	Applicable to riveted boilers only		
	Phosphates as PO4 mg/l	20 - 40	15 - 30	5 - 20
	Total Dissolved Solids mg/l max	3500	2500	1500
	Silica as SiO2 mg/l	Less than 0.4 of caustic alkalinity		15.0

Blowdown

In a boiler as water evaporates, the concentration of inorganic salts, suspended solids and organic matter increases in the boiler water. In order to keep the total dissolved solids and suspended solids in limits as specified in IS 10392 – 1982 a certain portion of boiler water is removed / drained. This process is known as blow down.

During blow down the energy associated with fuel to increase the temperature of liquid feed water up to saturation temperature is wasted. Efforts to reduce the blowdown by deploying appropriate water treatment equipment needs to be considered.

Continuous Blowdown

It is continuous removal of boiler water from steam drum via valve or orifice plate to limit the concentration of dissolved solids.

Intermittent Blowdown

Intermittent blowdown is given with full valve open to scrub out boiler heat transfer surface for removal of sludge, suspended solids and dissolved solids.

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Blowdown

Example

- Water Purification System : Softening Plant

  Feed water TDS 400 mg/l , Total Alkalinity 100 mg/l & Total Hardness 5 mg/l

  Blowdown Based on TDS = 400 / (3500 – 400) * 100 = 12.9%

  Blowdown Based on Total Alkalinity = 100 / (700-100) * 100 = 16.66%

- Water Purification System : DM Plant (SBA Outlet)

  Feed water TDS 10 – 15 mg/l, Total Alkalinity 10 mg/l Total Hardness < 1 mg/l

  Blowdown : 2% mandatory to maintain suspended solid and sludge free boiler heat transfer surfaces.

Blowdown

Example

- Water Purification System : Softening Plant. Condensate Recovery : 70%. Condensate temperature : 90 0C. Steam Generation : 10 TPH.

  Raw water TDS 400 mg/l , Taw water Total Alkalinity 100 mg/l

  Feed water TDS = 3 * 400 + 7 * 10 / 10 = 127 mg/l

  Feed water Total Alkalinity = 3 * 100 + 7 * 5 / 10 = 33.5 mg/l

  Blowdown Based on TDS = 127 / (3500 – 127) * 100 = 3.76%

  Blowdown Based on Total Alkalinity = 33.5 / (700-33.5) * 100 = 5%

WT Plant – Operation Cost Components

- Raw water cost
- Chemical cost (Regeneration chemicals, chemicals for pH correction, membrane cleaning, antiscalent, Membrane preservative chemicals)
- Energy / power cost (Energy required to operate pumps, blowers etc)
- Manpower cost
- Wastewater Treatment Cost (quantum of wastewater generated and cost of treating it for recycle / disposal)
- Maintenance cost (Resin top up, media top up, membrane cleaning, Cartridges, etc)

WT Plant – Selection

- WT plant operation cost
- Technical feasibility of blowdown (if blowdown % is high it is not practically possible to give the blowdown as the water also serves to cool the boiler heat transfer surfaces)
- Cost of blowdown
- WT plant capital cost
- Life cycle cost assessment of the WT plant

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Target for Boiler Water Treatment

- Avoid precipitation of scale-forming salts and iron oxides
- Elimination of dissolved oxygen by means of thermal deaerator and/or oxygen scavengers / or Film Formation
- Adequate pH in feed-water, boiler water and steam-condensate system
- Passivation of surfaces and magnetite layer stabilization
- Minimize risk of carry-over

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Q ????????? Please……

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Thank you !!!

Au Revoir !!!