# Boiler Water Chemicals

*Categories and Uses*

## Key Benefits of Proper Boiler Water Treatment

Optimizing boiler water chemistry is critical for preventing scale, corrosion, and system inefficiencies. This guide categorizes essential boiler water treatment chemicals, explaining their functions and applications. By understanding the role of oxygen scavengers, alkalinity builders, scale inhibitors, dispersants, and condensate treatments, operators can maintain efficient and long-lasting boiler system.

- **Improved System Efficiency & Equipment Longevity**

  Proper chemical treatment minimizes scale buildup and corrosion, leading to better heat transfer, reduced energy consumption, and extended boiler life.

- **Enhanced Steam Quality & Reliability**

  Controlling oxygen, alkalinity, and condensate chemistry ensures clean, dry steam production, reducing carryover risks and protecting downstream equipment.

| Chemicals | Application | Comments |
|---|---|---|
| **Sodium Hydroxide** (Caustic Soda) | Increases alkalinity, raises pH, and precipitates magnesium to create fluid sludge. | Does not contain carbonate, preventing $CO_2$ formation in steam. pH control improves calcium precipitation when used with phosphate. |
| **Sodium Phosphate** | Precipitates calcium as hydroxyapatite to prevent scale formation. | Requires sufficiently high alkalinity and pH to react effectively. |
| **Sodium Aluminate** | Precipitates calcium and magnesium to prevent scale formation. | Forms a flocculent sludge. Commonly used in river water pretreatment. |
| **Chelating Agents** (EDTA, NTA) | Controls scale by forming heat-stable, soluble complexes with calcium and magnesium. | Prevents deposition on metal surfaces. May break down at high temperatures. Best used with oxygen-free water. |
| **Tannins, Starches, Lignin Derivatives, Carboxymethyl-Cellulose** | Prevents feedwater line deposits and modifies scale crystal structure to produce a non-adherent sludge. | Organic dispersants (also called protective colloids) used with phosphate programs. Rarely used due to high feed demand and inconsistent results. |
| **Polymers/Copolymers** | Disperse sludge and distort crystal structures of calcium and magnesium deposits. | Prevents fouling by corrosion byproducts. Can be used with chelant, phosphate, or carbonate programs. |
| **Sodium Sulfite** | Removes dissolved oxygen to prevent oxygen corrosion. | Reacts with oxygen to form sodium sulfate. May decompose at high temperatures, producing $H_2S$ in steam. Catalyzed versions react more rapidly. |
| **Hydrazine** | Prevents oxygen corrosion in high-pressure boilers. | Reacts with oxygen to form nitrogen and water. Classified as a carcinogen, requiring careful handling. |
| **Filming Amines** (Octadecylamine, Soya Amine & Others) | Protects return-line surfaces by forming a protective film against corrosion. | Prevents oxygen and $CO_2$ attack. Requires continuous low-level feed based on steam production. |
| **Neutralizing Amines** (Cyclohexylamine, Morpholine, DEAE) | Controls return-line corrosion by adjusting condensate pH. | Neutralizes carbonic acid formed from $CO_2$ in steam. Selection depends on system pressure and distribution characteristics. |
| **Sodium Nitrate** | Inhibits caustic embrittlement in boiler water. | Used where feedwater may have embrittling characteristics. Requires proper monitoring to avoid excessive buildup. |
| **Antifoams** (Polyglycols, Silicones, Diethanolamides) | Reduces foaming in high-solids boiler water. | Typically used alongside scale control and sludge conditioning programs to maintain steam purity. |