



Steam Heating Systems

A steam boiler is a large teakettle. The spout is connected to a coil wherein steam is cooled, condenses to liquid water and drips back into the kettle. The chemistry of three waters must be controlled to protect a closed steam heating system:

Make-up water is tap water which enters the system to “make-up” for any water losses anywhere in the system (boiler water, steam or condensate).

Boiler water is water from the guts of the boiler. Boiler water is composed of water which enters the boiler as make-up water and condensed steam.

Condensate is condensed steam. If steam bubbles break properly at the boiling surface, chemically-rich water stays in the boiler and pure steam results.

Rusting Corrosion

problem - Oxygen, dissolved in water, not water itself, reacts with iron and forms “rust”. If no oxygen were present in a closed loop, oxidation or rusting would be impossible. Scavenging or “using up” the dissolved oxygen in a closed loop ends the possibility of rusting and pitting corrosion.

 **solution - Sulfite** (sodium sulfite) - mailed to client if water analysis indicates it is needed. Sulfite ion (SO_3^-) reacts with dissolved oxygen (O_2), forming sulfate ion (SO_4^-). Thus, dissolved oxygen molecules are withdrawn from solution and made permanently unavailable for any other reaction - including that of rusting and pitting iron and steel.

Foaming

problem - The tendency for boiler water steam bubbles not to break at the surface, that is, for the boiler water to “foam” and “carry over” with the steam, is contributed to by: high boiler water conductivity (high concentration of dissolved salts) or organic contaminants such as oils or surfactants in the feed-water.

 **solution - Antifoam** increases the surface tension of boiling water, causing steam bubbles to break easily and not be “carried over” as foam with the steam leaving the boiler.

Steam Line Corrosion

problem - Carbon dioxide enters a steam boiler in the feed water as a dissolved gas or associated with water hardness and alkalinity. CO_2 molecules leave the boiler as a gas and dissolve in the cooler condensed steam, carbonating it and making it mildly acidic.

 **solution - Volatile amine** - a base (the opposite of an acid) which evaporates and condenses much like water. Amine molecules go through the water-steam-condensate cycle with water, carbon dioxide and volatile acids and neutralize them.