Preventing Common Boiler Deposits

Technical Bulletin 1-020
Boiler Systems

Importance of Boiler Deposit Control
Because scale deposits are insulating, they reduce how efficiently heat is transferred from the combustion gases through the metal boiler tubes to make steam. This reduced heat transfer efficiency means more fuel must be used to generate the required amount of steam.

As the graph to the right shows, some deposits are more insulating than others. For example, 1/32" of normal scale reduces heat transfer efficiency by 2%, while 1/32" of high iron and high silica scale reduces efficiency by 7%. Regardless of the source, scale in boilers is expensive. For example, a mere 1/64" of high iron scale in a boiler system with a 250-HP load can increase fuel costs by almost $20,000 per year.

Preventing Common Boiler Deposits
The internal boiler treatment chemicals work in conjunction with pretreatment, blowdown, and corrosion control measures to prevent dissolved and suspended solids from depositing on boiler heat transfer surfaces. This aspect of a treatment program is primarily focused on preventing hardness, silica, and iron scale deposits inside the boiler.

Hardness Deposits
Because of the inverse solubility of calcium and magnesium carbonate with respect to temperature, hardness ions will readily form an adherent scale deposit on boiler tubes. Hardness deposits are best controlled by effective and reliable pretreatment in the form of softening. Poor softener control or upsets will absolutely lead to scaling conditions and, if severe enough, to boiler tube failure. The purpose of the internal deposit control program is to provide deposit protection should small amounts of calcium and/or magnesium hardness enter the boiler.

Silica Deposits
Depending on the boiler water chemistry, silica can form amorphous (glassy) silicate deposits, as well as react with calcium and magnesium hardness. At higher pressures, silica will volatilize and form steam side deposits, which is a big concern if turbines are present. Silica deposits are highly insulating and, once formed, very difficult to remove. The primary means of preventing silica deposits in steam boilers are

1. Keep the boiler silica level below a certain threshold (typically 180 ppm for low pressure boilers) via blowdown. Where high makeup silica levels necessitate high blowdown rates, installation of a Reverse Osmosis (RO) unit can prove very cost-effective.
2. Keep the boiler OH-alkalinity at a minimum of 2.0 times the boiler silica level. This greatly increases the solubility of silica compounds. Regardless of the boiler silica levels, a minimum of 200 ppm of OH-Alkalinity should be maintained for general corrosion protection and to assure the boiler chemistry reactions occur.

Iron Deposits
Any iron in the feedwater will tend to form an insoluble iron hydroxide precipitant inside the boiler. Unless properly conditioned, this precipitant will tend to form iron deposits on heat exchange surfaces. The best method for controlling iron deposits is to eliminate the source by either pretreatment or better corrosion control in the feedwater and condensate return systems.

*Information is based on U.S. Department of Energy document: Energy Tips - Steam (Steam Tip Sheet #7, January 2006)