How to scale down boiler operating costs

Two methods of water treatment increase productivity and reduce operating costs

Gary Lowell has begun to enjoy the boiler repairman's annual visit to Pre Mix Concrete Corp.'s Rochester, Mich., plant. Last September, the repairman removed the heating coil from the hot water tank, performed a visual inspection, and then re-installed the unit in about an hour. With a quick check of the boiler's fuel-to-air setting, followed by the customary cup of coffee as the serviceman finished the inspection report, the annual visit was over.

Boiler-service calls to the ready-mix concrete plants overseen by Lowell, vice president of operations for Pre Mix Concrete Corp., haven't always been so routine—nor have they occurred annually. Three years ago, before Pre Mix Concrete began treating its batch water with a new chemical dispensing unit, repairs were frequent, often occurring during the height of production.

Treating the water to prevent scaling in water heating devices is nothing new as most boiler operators treat superheated recycling water. But many treatment systems are too expensive to treat large water volumes for the once-through flow patterns occurring in a concrete producer's plants.

Producers who don't treat batch water often are not aware of problems due to scale buildup in boilers until it's too late. Then they recognize obvious symptoms, such as slow water flow rates, lengthened heating periods, or excessive boiler pressure buildup. Economically preventing scale by preventing these warning signs results in significantly lower operating costs.

Scaling the cost of buildup

According to Bryon Tarbet, director of research at Power Engineering Co. (PECO), Salt Lake City, whose expertise includes water treatment, a little bit of scale can be costly to the producer. Calcium carbonate is an excellent insulator, he says. Scale with a thickness of a few hundredths of an inch can greatly reduce heat transfer rates and increase energy consumption and cost. The graph shows how a scale layer of a given thickness affects energy costs in operating a 1-M Btu boiler, a size typically used in concrete production.

Producers also can expect increased operating costs when they use untreated mineral-rich water, warns Tarbet. First, eliminating buildup requires lengthy downtime as maintenance employees use acid-washing techniques. Excessive scale buildup slows flow and can eventually block pipes, even presenting the danger of explosion from too much pressure. Also, pit-forming pockets of carbon dioxide often exist, further increasing corro-

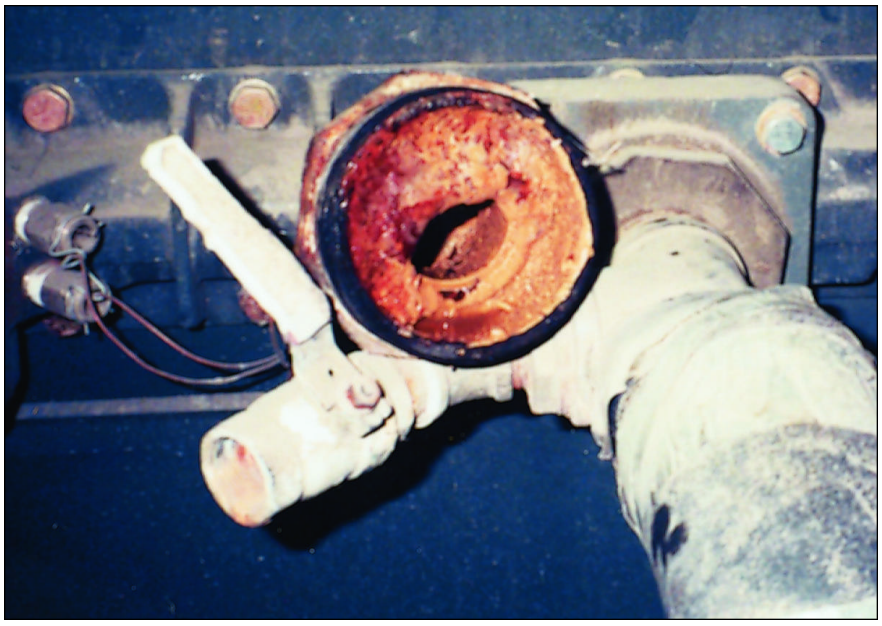

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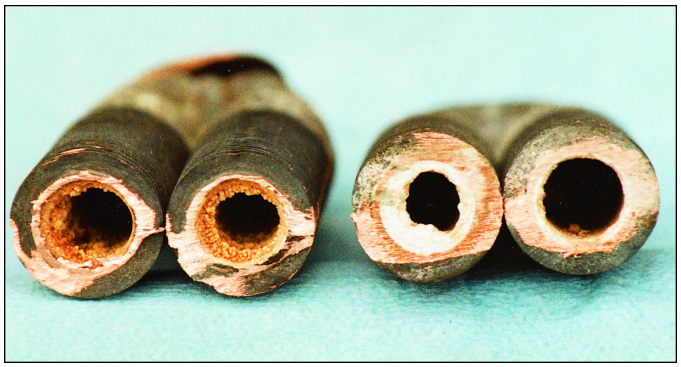
Figure 1. Without adequate treatment to prevent scale buildup, this 2-inch discharge pipe from a boiler shows scale buildup that occur red in a single season. The replacement cost for the piping and heat exchanger was $15,000.

sion. And acid washing of copper coils is not only expensive, it also leads to rapid deterioration and reduced service life of heating equipment.

In areas with hard water that causes severe scaling during hot-water production, producers typically acid wash pipes and tubes on a weekly basis. After just one production day, scaling up to a 0.02-inch-thick layer re-occurs. Even this small amount can be costly. A layer this thin can increase energy costs from $25,000 to $40,000 per year, depending on whether the producer uses natural gas or fuel oil.

To control their maintenance costs, several producers have employed two innovative water treatment processes that not only prevent scaling but also reduce existing scaling. Both systems inject small doses of proprietary chemical mixtures that alter the mineralogical structures of the calcium carbonate and other salt crystals, eliminating their interlocking abilities. Thus, as water temperature increases and minerals precipitate, the altered crystals continue flowing through the heating tubes rather than adhering to the pipeline's interior.



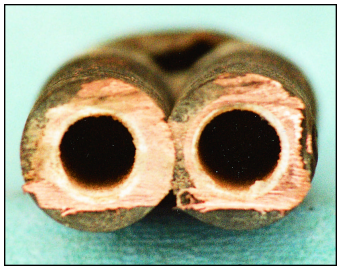


Figure 2. Heat-exchange tubes showing (from top) blockage by scale buildup, tubes cracked due to corrosion caused by repeated acid cleaning, and clean tubes after water treatment.

PHOTOS COURTESY POWER ENGINEERING CO.

Small doses, big results

Bob Manookin's Geneva Rock Products plants have to produce concrete in cold weather. With 10 plants supplying concrete in the Salt Lake City area throughout the year, cold-weather concreting is a business necessity. As assistant equipment manager working out of the Orem, Utah, office, Manookin concentrates on plant maintenance. "Water in our area is highly mineralized, so scale buildup has been a constant concern for me," says Manookin.

According to Manookin, one of his best decisions was installing a PECO treatment system for his batch water. "I had tried magnets and other chemical treatments, but they either weren't effective or were too expensive."

Manookin chose a liquid chemical injection treatment system that used a chemical mixture developed by area chemists familiar with the local groundwater's mineral problems. "We knew our treatment chemicals would prevent scaling, but we weren't certain if they would have any effect on concrete performance," says Bryon Tarbet, the researcher who formulated the additive. The results of concrete tests conducted by an independent concrete-testing lab in Salt Lake City indicated the chemicals had no effect on concrete strength.

Other producers in the Salt Lake City area have begun to use the system with good results as well. Tarbet reports that producers who use the system generally pay about 2¢ per cubic yard of concrete they produce.

Straining away scale

Gary Lowell of Pre Mix Concrete Corp. points to several treatment housings mounted on the waterline just upstream from the boiler's intake valve, explaining his new relationship with the boiler repairman. Each treatment housing consists of a media delivery head and a translucent housing.

The housings are part of the Hydroblend treatment system. The cartridges contain a chemical that distorts the almost-perfect cube shape of each calcium carbonate molecule, keeping scale particles separate instead of allowing them to combine. The compound in the cartridges contains another chemical that forms a protective coating on metal surfaces. The chemical also combines with calcium, keeping it more soluble. With the treatment housings in place, Lowell has noticed a significant reduction in scale buildup.

Lowell used the model SC-1.5 unit. The manufacturer rates each unit to handle a minimum flow rate of 12 gallons per minute.

Lowell found the units easy to install. The units aren't powered by electricity, nor do they require control wiring for chemical metering. "All it took was some plumbing, and since the units are on the hot-water intake line, we installed them during the summer," says Lowell. Since the treatment chemicals are approved for use in potable water, the installation requires no special permits for use or storage.

During the busy winter season, Lowell reports, the units are also operator-friendly. Lowell's plant operator merely checks the cartridge's remaining life through the translucent housing. Each cartridge insert can treat up to 500,000 gallons before replacement. "We normally make it through a season with only one change," says Lowell.

—Rick Yelton

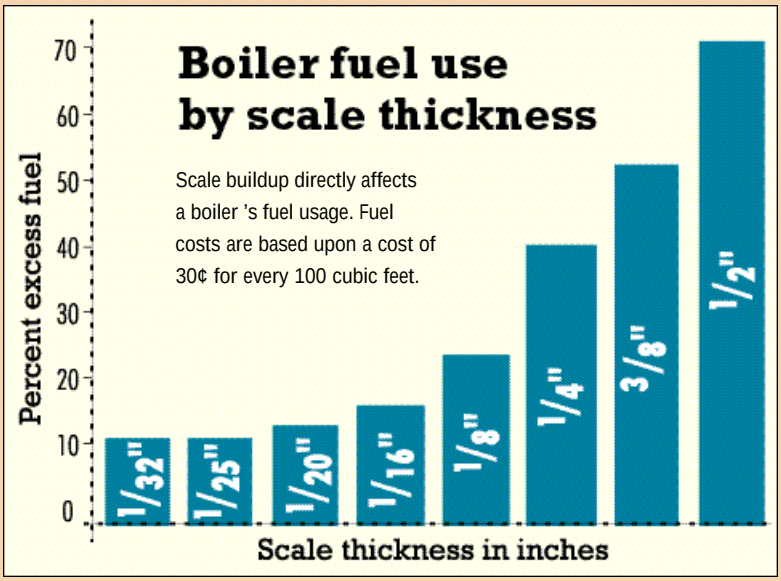
(continued)

What is scale?

Scale describes the buildup that occurs on the inside surface of water pipes and boiler tubes. As untreated water containing naturally occurring soluble minerals such as calcium carbonate, magnesium carbonate, and others passes through, tiny individual crystals attach themselves to the pipe's or tube's inner surface.

The amount of soluble minerals water can carry is temperature-dependent. For example, water drawn from wells located in limestone rock strata can carry mineral concentrations as high as 1,000 parts per million. When water is at room temperature, it can carry about 500 to 1,000 PPM of minerals. As producers raise the water's temperature close to 100° F, its ability to carry soluble minerals drops off rapidly, so that water heated to 180° F can carry only 25 PPM.

Freed from heated process water, the minerals form small crystals. Calcium carbonate crystals are shaped like small sugar cubes and tend to pack together. In time, calcium and magnesium in water are attracted to the deposited crystals, causing rapid growth of the deposits.



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