Large-Scale Control

Electronic descaling devices offer increased cost savings with decreased maintenance

By Jan de Baat Doelman

Boil a kettle of tap water in a hard water area and two undesirable observations are made: A fine but harmless scum appears on the surface of the water and a hard white encrustation develops on the heating element. The latter is calcium carbonate and is usually referred to as limescale. The limescale that deposits on the heating element will, if untreated, reduce the efficiency of the kettle, induce corrosion of the heating element and ultimately lead to appliance failure. However, it is not just domestic appliances that are affected—boilers and steam generators also can develop limescale deposits, which will lead to similar problems if left untreated.

Limescale can form wherever water is heated. This is because source waters (potable water or groundwater) contain dissolved mineral salts, which have low solubility in water. When heated, the water can no longer hold these salts in solution and deposition occurs.

What Can Go Wrong?

Limescale deposits are an insulating layer on heat transfer surfaces. This leads to more power being consumed or to the need to install heavier duty equipment to compensate. It is estimated that 40% more energy is needed to heat water in a system fouled with ¼ in. of limescale.

Scale in water lines reduces the available cross-section area and the throughput. Eventually, the line will become completely blocked. Equipment then needs to be shut down for cleaning, increasing costs. Safety valves or emergency process sensors, such as those that operate deluge systems, may not operate in an emergency. Overheated boilers can be dangerous.

Stagnant conditions can develop in void spaces beneath deposits, encouraging corrosion of steel and other metallic surfaces. The results can be potentially dangerous fluid leaks and equipment failure. Scale surfaces also are excellent growth sites for bacteria, which can create hazardous health conditions (e.g., production of *Legionella pneumophila*).

In order to determine if you have a scale problem, answer these questions:

- Do appliances such as water-fed equipment contain white scale?
- Are there signs of unexpected deposit formation around valves or at pipe outlets?
- Are boilers/heat exchangers performing below design?
- Is corrosion a problem in the plant?
- Is the water throughput less than expected?

If a means can be found to control scaling, then there is potential to save energy, prevent equipment failure, reduce maintenance and save money. Some effective options are considered below.

Physical Methods

A range of physical methods can be used to remove scale deposits. Water jetting, sand or plastic bead blasting can be used in accessible locations. Such methods are expensive and can cause surface abrasion.

Unlike other preventative techniques, these devices do not stop precipitation, but alter the shape of the crystals to reduce the adherence and buildup of deposits on the pipe wall. These devices can affect descaling downstream of the point of installation; a softening and loosening of existing scale several weeks after installation is commonly reported.

To understand the mechanism, some knowledge of mineral scale precipitation is necessary. In order to form a scale deposit, three conditions must be met:

1. The solution must be supersaturated.
2. Nucleation sites must be available at the pipe surface.
3. Contact/residence time must be adequate.

To prevent scale, it is necessary to remove at least one of these preconditions. Clearly, contact time is not an alterable factor. Therefore, to be effective, any device must affect either the supersaturation value or the nucleation process.

The direct effect of electronic devices is on the nucleation process, in particular on enhancing initial nucleation through the creation of new nucleation sites within the bulk fluid flow. Crystal growth then occurs at the points of nucleation and not at the pipe wall. Suspended solids increase with a corresponding drop in the level of supersaturation, and these effects have been observed in the field. The localized pH increase

near the pipe wall caused by hydroxyl radicals formed by electromechanical interactions is one mechanism that drives the changed nucleation characteristics.

A Lorenz force (F) is experienced by charged particles that flow through a field, F = qE + q (V x B), in which q is the charge on the particle, E is the electric field vector, V is the particle velocity and B is the magnetic field vector. Electronic devices operate at very small residual magnetic fields whereas magnets need high field strength (greater than 1,000 gauss) for optimum performance. The flow dependency of magnetic devices is explained by the velocity parameter, V, and E = 0. The flow non-dependency of electronic devices is explained by the fact that the magnetic component approaches zero, but the electric component is essentially constant. This suggests that the key performance parameter is the total value of the Lorenz force acting on the charged particles, rather than the individual magnetic and electric field vectors.

Electronic devices are not flow-rate dependent and can be built to fit pipe diameter up to 60 in. The units are lightweight, easy to install, can be retrofitted and produce no significant magnetic field. They are usually effective on calcium carbonate, are claimed to reduce iron fouling, and appear to prevent fouling by various other substances.

The patented Scalewatcher electronic scale control system, originally launched in 1989, is now sold throughout the world. It provides a non-intrusive, chemical and maintenance-free method of removing limescale from pipes and equipment.

It functions by means of an electronically applied field generated by a solenoid coil wrapped around the outside wall of the pipework to be treated. Using this technology, an induced electric field causes crystals to grow out of the dissolved mineral ions. These crystals remain suspended in solution and no longer contribute to the buildup of hard pipe wall deposits. Existing scale deposits are softened and erosion processes then remove loosened scale crystals from the system. **iWWD**

Jan de Baat Doelman is president of Scalewater North America Inc. Doelman can be reached at sales@scalewatcher.com or 610.932.6888.

Limescale deposits can form wherever water is heated.

Physical methods to remove deposits can be maintenance-heavy and expensive.

Electronic devices cause existing scale deposits to soften and subsequently be removed from the system.