WATER TREATMENT NEWS

Filtration - The Key to Clean Water-using Systems

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An article in the Winter 2008 edition of *The Water Treatment News* quoted an effective tagline on a billboard ad for a brand of home water softeners. The tagline read, "You can live without soft water, but it's hard." The ad promoted the advantages of a water softener for home use; the article went on to detail how a properly operating softener is even more critical to the reliable and efficient operation of a steam boiler system. The article concluded with the assertion that a properly operating softener system provides the highest return on investment of any piece of equipment in the boiler room. A softener is arguably the first and most important recommendation for ancillary equipment in the boiler room operation.

A softener is critical to successful scale prevention in a steam boiler system because heat is a primary driving force in hardness precipitation and boiler scale formation. At the high water temperatures encountered in even a low pressure boiler, it is impossible for a conventional chemical program to keep feedwater hardness in solution in the boiler. Preventing scale formation under hard water make-up conditions requires excessive chemical feed and blowdown rates, which greatly increase energy, water and chemical costs.

Cooling tower and closed loop water systems present different challenges to building operations and engineering personnel. While cooling tower systems are also subject to scale formation, their lower water temperatures allow cooling water inhibitor chemicals to prevent scale by keeping hardness salts in solution. In many cases, a softener is not required for effective and efficient cooling system scale control.

But many cooling tower systems, and virtually all closed loop systems, present another problem for maintenance and engineering personnel in their efforts to maintain system cleanliness and efficiency – fouling due to particulate matter in the circulating water.

Closed loop systems are especially susceptible to fouling. Many closed loops are not properly pre-cleaned at start-up, or are not pre-cleaned at all. Mill scale, dirt, and other construction debris present on pipe walls and other water-washed surfaces are released into the system as the water circulates. As there is no outlet in a closed loop for the water and the solid material it carries, the solids eventually deposit and build up on heat exchange surfaces and in narrow passages, reducing system efficiency and causing plugging and even complete loss of flow.

Particulate matter deposits also promote under-deposit corrosion of pipe walls and other metal surfaces. The resulting corrosion products are picked up by the circulating water and cause further deposition.

Deposited material provides both habitat and nutrients for bacteria, which multiply and form gooey masses called biofilm. This material causes further fouling and a particularly damaging form of corrosive attack called microbiologically in-

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duced corrosion (MIC), which exacerbates fouling and can result in pipe failure.

The entire chain of events triggered by the deposition of particulate matter results in a vicious cycle of deposition, corrosion and fouling that, if not stopped, can result in leaks, loss of heat transfer efficiency and eventual failure of the entire closed loop system.

Fortunately, a well-designed, correctly applied treatment program can prevent this cycle from developing. Volume 17 of *The Water Treatment News* outlines the basics of a good closed loop treatment program, which, if correctly applied and maintained, will go a long way toward preventing the vicious cycle of problems from developing in a closed loop system. Volume 42 details the procedures required for clean-up of a loop that is already fouled.

Just as a softener is an important component in the treatment program of a steam boiler system, a correctly designed and installed filter is critical in keeping a closed loop system clean and operating efficiently. Closed loop water filters are typically installed on a by-pass around the circulating pump. Cartridge- or bag-type filters are most commonly used for closed loop systems.

Cartridge filter housings are available in a wide variety of sizes, from single-cartridge units to large multi-cartridge configurations. The cartridges are insertion-type, usually designed to be discarded after a single use, though some can be rinsed and reused once or twice.

The cartridges come in various mesh sizes. It is recommended to start with a larger mesh size; if the openings are too small, the filter will plug too quickly, requiring frequent removal and replacement. 50 microns is a good starting point; gradually reduce the mesh size as replacement dictates. In most cases, five micron cartridges will provide good results for long-term maintenance.

A simple single cartridge housing like this one is all many small closed loops require for good filtration. A unit like this can provide good results in loops up to 5000 gallons or greater total water volume if the loop was adequately cleaned and a good chemical treatment program is in place.

In some instances, a significant amount of particulate matter smaller than five microns may be present in the loop water. Iron oxide particles are common down to sub-micron size.

For larger loops or for smaller loops being cleaned using filtration, a multiple cartridge unit such as that shown here can be a good choice. Multiple cartridge filter housings come in an array of configurations and sizes.

Cartridges capable of 0.45 micron and smaller removal are available for these situations. A filter mesh size that provides completely clear loop water with a total iron content of ≤ 2.0 parts per million (ppm) should be used on an ongoing basis to maintain loop water cleanliness.

Bag filters are also suitable for use on closed loop systems. Bag filters are installed on the same type of bypass configuration as cartridge filters, and are also available in various sizes. Filter bags are constructed of a felt material and come in various micron ratings. Most bags are available in mesh sizes down to five microns, which is sufficient for maintaining clean loop water conditions in most instances.

In cases where it its necessary to remove particles smaller than five microns to maintain desired loop water conditions, another option exists for bag filter users or for those with cartridge filters who don't want to use sub-micron cartridges. Chemical additives have been developed that enhance filter media's particle removal capabilities.

International Chemtex Corporation (Chemtex), a Lakeville, MN based producer of water treatment chemicals recently introduced a filtration aid chemical that enables five micron media to remove particles down to sub-micron size. The chemical, a polymer-based flocculent/coagulant, agglomerates small particles, building them into larger ones that can be removed by the five micron or larger filter media.

According to Lynn Shaw, Chemtex Technical Director, soaking the filter bag or cartridge in the filtration aid chemical before installation in the filter housing enables removal of sub-micron particles with five micron-rated media, providing excellent loop water cleanliness. "It's often less expensive to use the filtration aid with five micron media than to use the more expensive sub-micron media. And, we frequently see more complete particle removal and better loop water cleanliness," Shaw notes. "The important thing to remember, though, is that *all* closed loops should have filters to help insure efficient, trouble-free operation."

A typical bag filter. This unit has a filter basket that holds the filter bag. Bag filters provide an alternative to cartridge filters. Most filter bags can be cleaned and re-used several times, saving on replacement costs.

Cooling tower systems can also be subject to particulate matter fouling. Though cooling tower systems have an outlet for particulates and other solid material through regular system blowdown, many tower systems become fouled due to unusually heavy particulate loading from dust, dirt and other debris that the tower washes from the air. Towers operating in dusty environments can become heavily fouled with dirt and other airborne particulates. As in closed loops, fouling leads to under-deposit corrosion, microbial growth and the development of biofilm, MIC, loss of flow and other problems – the vicious cycle referred to earlier.

A different type of filter is generally used in cooling tower systems for suspended solids removal. Because cooling towers often face a continual influx of suspended solids in the form of airborne dust, dirt and other matter, a bag- or cartridge-type filter would quickly become plugged, creating a maintenance problem of constant filter replacement. Filters using sand or other granular material as the filter medium are generally recommended for cooling tower systems requiring filtration. Granular media filters are available in capacities suitable for even very large cooling tower systems, and with media capable of removing particles down to sub-micron size.

Granular media filters are a good fit for cooling tower operation, as the media does not have to be replaced when it becomes fouled, rather it is simply backwashed, which lifts off the particulate matter and sending it to drain.

Granular media filters like the one shown here are good options for cooling tower systems with heavy particulate loading. The unit automatically backwashes a preset pressure differential when the media bed becomes fouled.

Centrifugal separators provide an alternative for solids removal in cooling tower systems. Cooling system blowdown can be used to purge solids from the bottom of the separator, minimizing or eliminating unnecessary water loss.

In most cases, particle removal down to five, ten or even 20 microns is sufficient for maintaining acceptable tower water cleanliness. In these cases, another option for suspended solids removal is a centrifugal separator. A centrifugal separator removes particulates using centrifugal force and has no media to remove or clean. Units are available that are capable of removing particles down to five microns, making them suitable for use on many cooling tower systems. Precipitated particulate matter, which collects at the bottom of the separator, is removed by purging the solids to drain, using relatively little water. Automatic system blowdown can be routed through the separator purge, thereby using a water stream that goes to drain anyway for removal of the precipitated solids, effectively eliminating unnecessary water loss.

A well-designed and administered chemical program is the primary defense against scale, corrosion and uncontrolled microbiological growth in cooling tower and closed loop systems. A suitable filter, from a simple single element cartridge- or bag-type unit, to a more complex granular media filter or centrifugal separator, complements the treatment program by minimizing or eliminating fouling, allowing the program to maximize system efficiency and operating life.

Closed loop or cooling tower system fouling a problem?

Ask your Chemtex Representative for help - a good filtration system may be the solution!