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Technical Topics

Closed Loop Water Systems

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A closed recirculating system is one in which the water is recirculated in a closed loop without evaporation or exposure to the atmosphere. The only make-up normally required is that needed to replace small water losses from leakage at pump packings (seals), expansion tank overflows, or surface evaporation from system vents.

These types of systems, though easy to treat, can cause serious problems if neglected. The most common problems are excess electrical costs as a result of lost heat transfer, and major downtime due to piping and heat exchanger leaks. A Midwest firm recently experienced a failure in a 2" pipe. The water that leaked from that failure destroyed a $3 million dollar mainframe computer!

Many times these systems are neglected since leaks take time to develop, heat transfer efficiency isn't always easy to monitor and the internal system itself is not visible. With a little effort, proper precleaning and initial treatment, a new system can continue to give good service decades after it is installed. An existing system, dirty due to negligence, can often be restored to an acceptable working condition that is relatively problem free with minimal effort and expense.

New Systems

A preoperational cleaning of closed systems is recommended to remove contaminants before start up. With all areas open to flow, an alkaline solution should circulate for 24-48 hours to remove cutting oils and greases. The system should then be flushed. (Federal, State and Local guidelines should be observed during the flushing or draining of any chemical(s) from a system.) An appropriate chemical inhibitor, such as nitrite, molybdate or a combination of the two, should be added to sufficient levels to maintain corrosion protection.

If the new system contains excessive amounts of mill scale, an acid based cleaner would follow the alkaline cleaning.

Existing Systems

An analysis should be performed to identify existing or future problems within the system. This analysis should include pH, conductivity Phenolphthalein and Methyl Purple alkalinity, hardness, iron (and any metals specific to the system), Sulfate, Nitrate and Ammonia. The specific corrosion inhibitor used should also be identified. If a freeze protection solution such as glycol is incorporated, a baseline analysis to include reserve alkalinity, freeze protection point and percentage glycol should be performed. With this information a sound recommendation can be made as to the best course of action to prevent future problems or correct existing problems before they reach the point of failure.

If the analysis indicates past corrosion has occurred and is still on-going, it will be necessary to chemically arrest the problem and clean-up existing deposition and byproducts. A mild acid, specifically designed for this application should be introduced to the system to slowly remove and clean the corrosion byproducts. After the chemical cleaning is complete, the solution should be flushed from the system. (Federal, State and Local guidelines should be observed during flushing or draining of any chemical(s) from a system.) When the entire residual chemical has been flushed from the system an appropriate chemical inhibitor, such as nitrite, molybdate or a combination of the two, should be added to sufficient levels to maintain corrosion protection.

After chemical treatment is added to a system a baseline water analysis should be performed. This analysis should include pH, conductivity, Phenolphthalein and Methyl Purple alkalinity, hardness, iron (and any metals specific to the system), Sulfite, Nitrate and Ammonia, along with the specific corrosion inhibitor used. From then on, routine tests should include, at a minimum, pH, iron levels and chemical residuals. Many problems will manifest itself through one of these tests; then a more in depth analysis can be performed to help identify the source of the problem. By performing tests on a

routine basis, many problems can be identified long before they progress to the point of failure.

It is also recommended that corrosion monitoring with the use of corrosion coupons be performed on a routine basis. This inexpensive method of corrosion monitoring can provide valuable insight as to system integrity. Side-stream filtration is often employed to maintain system cleanliness especially with previously fouled systems. The unit should be sized to filter the entire volume of the system 3-5 times per day. The filter media should be appropriately sized to match the foulant. Sized too small in the beginning, filters will plug often, causing not only a maintenance problem, but increased costs due to filter replacement.

Any closed system has the potential to become contaminated with microbes. These microbes can be introduced to the system in many ways. Whatever the cause, microbiological corrosion in a closed system can become a serious problem in a very short time and should be addressed immediately.

Various microbes will produce acidic by-products that will suppress pH and increase corrosion. Others can produce ammonia that will increase pH and cause corrosion. By establishing baseline data as previously mentioned, a determination can be made with good assurance as to the exact process taking place; thereby allowing proper adjustments in the treatment of the system to be made.

If a closed system becomes contaminated with microbes, the system should be sanitized with a biocide. Quaternary Ammonium/Tin biocides have been shown to control most types of microorganisms found in closed systems. However, the use of these products may lead to foaming problems unless an anti-foam is incorporated along with them. Carbamates and Isothiazalone based biocides have proven to be effective in closed systems and are not prone to foaming. Sometimes it might be necessary to change treatment programs to help reduce microbial problems, ie; replacing nitrite with molybdate to alleviate nitrifying bacteria problems.

This paper does not cover the subject of water treatment for closed systems in its entirety. It does contain some basic steps that will, under normal circumstances provide answers to most situations and allow for relatively trouble-free systems for years to come.