Jaytech, Inc. E- Newsletter

"A candid conversation about water treatment issues facing today's mechanical engineers."

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Pump Seal Failure? Check for Phosphate Inhibitor

There are likely many factors contributing to the false sense of security that phosphate-based system owners share. It may be because closed loop systems are out of sight and, therefore, out of mind. It may be because phosphate inhibitors are much more commonly used than sodium nitrite-based corrosion inhibitors. Or, it may simply be that phosphate-inhibited products such as DowTherm, NORKOOL, and Polychill, is specified on a majority of new and remodeled systems, and therefore, their sodium nitrite-based counterparts are simply never considered. Regardless of the reason, hydronic system water treatment programs utilizing phosphate-based corrosion inhibitors generally are less successful at stopping corrosion and require more vigilant monitoring of water quality than those using sodium nitrite-based corrosion inhibitors.

Phosphate inhibitors require a significantly higher quality of water than do sodium nitrite-based inhibitors. Therefore, the water quality in phosphate-based systems must be monitored to ensure that the impurity levels in the water do not exceed the guidelines and thus render the corrosion inhibitor ineffective. For example, the recommended guidelines for water purity when using a phosphate-based corrosion- inhibitor product is as follows:

Table 1: Water-Purity Guidelines for a Phosphate-Based Corrosion Inhibitor

Impurity	Level
Chlorides	25 ppm, max
Sulfates	25 ppm, max
Calcium	50 ppm, max
Magnesium	50 ppm, max

Helpful Links

www.bellgossett.com

www.taco-hvac.com

www.iiar.org

No such guidelines exist or are necessary for sodium nitrate-based corrosion inhibitors. Sodium nitrite-based systems do not become more vulnerable to corrosion when the water purity is not maintained, while phosphate-based systems experience significant degradation if the dilution water exceeds the levels outlined in Table 1. Simply put, systems using sodium nitrite inhibitors require less monitoring and maintenance than do systems using phosphate-based inhibitors.

Another problem associated with the use of phosphate as an inhibitor includes the formation of solids during the process of inhibitor degradation. When phosphate inhibitors break down, any calcium in the water will bond with the phosphate and create calcium-phosphate scale (solids). These solids are very abrasive and will erode pump seals, vales, and elbows. This is called "erosion corrosion." Dow Chemical advises the users of their products to maintain high water purity standards in order to prevent this scenario:

> ***"Impurities in dilution water can increase metal corrosion, aggravate pitting of cast iron and steel, reduce the effectiveness of corrosion inhibitors, increase inhibitor depletion rate, cause formation of scale and other deposits on heat transfer surfaces, and cause clogging of system components."***
>
> – Dow Engineering and Operating Guide

In contrast, sodium nitrite inhibitors do not form abrasive solids when water purity is not maintained. This drastically reduces the risk of damage to expensive hardware and seals.

It is generally accepted that upon cleaning and flushing a hydronic system, 20% of the system remains filled with water. In order to maintain the phosphate corrosion inhibitor, the remaining water needs to be of high quality: R.O., De-ionized, or, at the very least, softened. This is generally not the case in larger systems that flush thousands of gallons of water through the system before it becomes sufficiently clean. Additionally, these high quality waters are very aggressive, further hindering the cleaning process. Regardless, phosphate inhibited glycols require the aggressive waters, as stated in the NORKOOL product manual:

> ***"A preliminary chemical cleaning is recommended. Following cleaning, flush several times using high-quality dilution water."*** - NORKOOL Industrial Product Manual

A third pitfall when using a phosphate inhibitor involves makeup to the system. The makeup water supply to the vast majority of closed loop systems is city or well water. This water is generally not softened and is almost certainly not of the highest quality required for the phosphate inhibitor to be effective. Therefore the makeup water must be conditioned or from a different source. Care must be taken to ensure an adequate makeup water supply to any phosphate-inhibited system. Dow Chemical stipulates this in their product manual:

> ***"Good quality water must be used for fluid make-up. In addition, any flush water remaining in the system should be taken into account when introducing and diluting DOWTHERM fluids".*** - Dow Engineering and Operating Guide

A good illustration of this vulnerability of phosphate-based corrosion inhibitors is a situation I first encountered years ago and now see almost daily. A third-shift engineer at a production facility noticed that one of the hydronic systems was low on pressure, so he added water to raise it. He then checked the other six loops in the plant, and found that they were low as well. Before his shift was over, he had added water to every loop in the plant. It wasn't until nine months later when seals began failing that the loops were inspected. The inspection showed widespread corrosion, as well as "mud" and corrosion by-product, circulating in the loops. The hardness in the makeup water added by the unsupervised worker late that night (months earlier) rendered the phosphate corrosion inhibitor ineffective and created abrasive solids that circulated in the closed-loop system for months. Out of sight. Out of mind.

As a result of the limitations of phosphate-based corrosion inhibitors, the use of sodium nitrite-based corrosion inhibitors has come to the forefront as the prime alternative. Nitrite-based corrosion inhibitors are effective, safe to handle, cost effective, and compatible with glycol. In addition, they have an exceptionally slow depletion rate; they may be disposed of easily, and can be used with readily available water sources. Other corrosion inhibitor options, including phosphate-based inhibitors, have significant drawbacks such as: heavy metal status, discharge restrictions, requiring frequent application, and being cost prohibitive.

For more information about nitrite-based corrosion inhibitors, nitrite inhibited glycol solutions, or to request a closed system water analysis, contact your Jaytech representative or send me e-mail.

iiar Conference and Exhibition:

Stop in and say "hi" at the Jaytech booth during the International Institute of Ammonia Refrigeration Conference and Exhibition. This year's conference is being held March 19th – 22nd at the Reno Hilton. We look forward to seeing you there!

Next Issue:

The Many Benefits of Solid Polymer Water Treatments

The Industry Insider – by Dave Duncan, B.J. Mulcahy and Co.

Mechanical pump seals in chilled and hot water systems

The physical construction of a pump and seal is fairly straightforward. A typical mechanical seal is mounted behind the impeller. Constant pressure is maintained on the two seal faces by a stainless steel spring. Mechanical seals have a stationary ceramic ring with a rotating carbon ring and a Buna boot. This carbon ring is in contact with the ceramic ring.

Most systems we deal with have internally flushed seals, that is, the fluid pumped throughout the system is what lubricates the seal face. As the shaft turns, a small amount of fluid seeps on to the seal faces as the fluid is seeking the lower pressure. High pressure goes to low. As the fluid migrates to the outside of the seal face it is evaporated by friction before it reaches the atmosphere. This fluid not only lubricates the seal but also cools it. If you ever run a pump dry (Pumping Air) the seal will fail in short order due to high heat.

It is extremely important to check the condition of the fluid that is being pumped throughout the system periodically to make sure it falls within the tolerances of the pump manufacturer. It is also very important when using glycol to make sure the dilution water and makeup water to the system is within the tolerances of the glycol manufacturer.

New systems need to be flushed extensively to remove sediment. Welded pipe requires extra flushing and filtering due to weld slag left behind in the piping. We have seen many seals fail within a year of installation. Many times the cause was traced back to mixing city water with phosphate-based glycol such as DowTherm when the system was filled. Some glycol manufacturers offer premixed glycol, which is a good choice if you are not sure of the city water quality. A better option is to use a glycol with a corrosion inhibitor package that is unaffected by water quality issues, such as nitrite.

Dow recommends when using either DowTherm or DowFrost:

- Hardness less than 5 grains or 100ppm
- Chlorides and sulfates below 25ppm
- Calcium and magnesium hardness below 25ppm

B&G guidelines are far more practical for application. Standard mechanical pump seals require:

- Dissolved solids no more than 1000ppm
- Suspended solids no more than 20ppm
- Silica no more than 20ppm
- pH of 7-9

Seals are available that will handle impurities better than the standard seal. These are silicon carbide seals and are a bit more expensive. If system fluid is kept within listed recommendations it will greatly improve seal life.

For more info on mechanical seals go to the following link.
http://fhaspapp.ittind.com/NewsAndArticles/ArticleDetail.asp?ArticleID=316

Jaytech Tip

"Jaytech Tip-1" If you are losing seals and wondering why, have a Jaytech representative perform a Millipore filter test on the system fluid. The vast majority of closed system problems are directly related to corrosion byproduct and dirt in the solution.

"Jaytech Tip-2" Install a seal that is appropriate for the application and fluid that will be circulated. More expensive seals generally have built in quality. When replacing seals, request non-filled or pure carbon and graphite seals.

Have an idea?

If you have an idea or question you would like more information about, send me e-mail at mjuhl@jaytech.com and we'll answer it! Remember, it must be water treatment related and be of interest to other professionals such as you.

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