Corrosion Control in Potable Water Systems

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The damage caused by corrosion within drinking water distribution systems is one of the largest problems for the water utility industry. The effects on the safety and health throughout a community, as well as the associated costs resulting from corrosion, are indeed a major concern for numerous water quality managers.

The by-products of this corrosion in the distribution system can protect bacteria, yeasts and other microorganisms by forming a glycocalyx. Over time a depressed pH forms, due to anaerobic conditions, beneath this glycocalyx causing increased corrosion in the form of pin hole leaks. Additional problems can also result causing odor, bad tastes and slime.

All of these corrosion caused problems add to the cost of water treatment thru increased pumping costs, loss of water or water pressure, and the need for the replacement of water heaters. Typically, an increase in customer complaints due to colored water, bad taste or staining also adds to the overall expense of a drinking water district.

All waters are corrosive to some degree. This corrosivity of the water affects the infrastructure of a distribution system by attacking the piping, concrete and pumps which are often very difficult to budget for a municipality. Factors that affect the corrosive nature of water are: pH, oxygen content, total hardness, total dissolved solids, temperature and alkalinity. The selection of the proper corrosion inhibitor is critical to resolve the corrosion tendency of a water system.

Corrosion Inhibitors

There are numerous corrosion inhibitors that have been used in water over the years, such as: chromates, zinc, molybdates, nitrite-borate blends, silicates and phosphates. From a drinking water standpoint only two of the above mentioned inhibitors are used, sodium silicates and inorganic phosphates, and usually phosphates are the obvious choice due to treatment costs. Silicates are used at a significantly higher treatment levels whereas a blend of phosphates can typically result in treatment levels as low as 1.0 ppm.

The success of a corrosion inhibitor is reliant upon controlling the system water chemistry in a consistent range. Care should be taken when starting up a treatment program and a step up program should be considered. Assuming a desired treatment level of 1.0 ppm, the initial treatment level should be 0.5 x the desired treatment range and allowed to run for 7 days. The next step is to increase the chemical feedrate to the desired treatment level x 1.25 and allow this to run for a 7-10 day period. After the system has had this sufficient pretreatment process, then the chemical feedrate can be decreased to the final control range of 1.0 ppm.

The consistent feed of the corrosion is essential to the success of a corrosion control program. Interruptions if chemical feed can result in the loss of the protective film established on the system piping. Finally, the flow rates of a system are critical in a reliable corrosion control program to provide continuously transport the inhibitor to all areas of the system metallurgy; otherwise an effective protective film will not be established on the metal surfaces of the piping.

Film Formation of Blended Phosphates

Blended phosphate technology has proven to be the most cost effective means of treating drinking water systems. The treatment levels for a successful treatment program are usually fed within a 1.0 to 2.0 ppm range. This technology provides a tenacious protective coating at the cathodic and anodic sites. This film forming action develops through a controlled deposition process via a "threshold treatment concept".

This controlled deposition process is a result of the water chemistry combining with the orthophosphate in the product formulation. The key in controlling this deposition is in blending in a variety of polyphosphate compounds. These polyphosphates provide a scrubbing action on the metal surfaces which limits the amount of protective coating being laid down. This is a terrific method of providing a strong protective film while scrubbing away old deposits and biofilm formations.

Some municipalities have tried to feed orthophosphate alone, in the form of phosphoric acid. The phosphoric acid typically has to be fed at a much higher concentration to achieve the same corrosion inhibition results of a blended phosphate program. In addition to this, there is no means of controlling the amount of deposition that will occur often resulting into an adverse effect on "C" factors or possibly increasing the potential for biofilm development. Blended phosphate technology eliminates the concern over these possible problems.

In addition to providing corrosion control of systems metallurgy, blended phosphate products also have the ability to sequester hardness salts, iron and manganese. The damage that can result from hardness, iron and manganese has been well documented over the years and is significant in terms of revenue while certainly adding to the frustration of a community. The proper sequestration of iron and manganese tremendously improves the appearance of the water preventing these metals from oxidizing and depositing/staining on fixtures and clothing. This ability of ortho and polyphosphates working together, results in stabilized water quality while minimizing color, scale, deposits, corrosion and chlorine demand in drinking water systems.

Benefits of Blended Phosphate Technology

- Inhibits corrosion of metallurgy within a distribution piping system.
- Decreases iron tuberculation within a distribution system.
- Reduces lead and copper levels in the drinking water to meet the 1991 Lead and Copper rule, allowing municipalities to maintain levels of lead < 15 ppb and copper < 1.3 ppm.
- Decreases biofilm development thereby increasing system life thru reduced MIC.
- Decreases chlorine demand which improves overall disinfection.
- Reduces discoloration, staining and mineral build-up on customer fixtures and clothing, resulting in fewer customer complaints.
- Decreases calcium scale deposits usually seen in hot water heaters.
- Municipality saves revenue thru reduced corrosion and scale which reduces system failures in terms of leaks and ruptures while also conserving water via reduced hydrant directional flushing.

Blended phosphate technology has been used for over 60 years within the drinking water industry. It remains one of the most cost effective means of controlling corrosion due to the low chemical feedrate required. With this low dosage rate the actual chemical cost may range from less than 1 cent to 10 cents per thousand gallons of water treated depending upon the systems water quality. These blended phosphate cost are offset by the operational and maintenance savings to the utility and consumer.

If additional information is needed regarding this Technical Paper, please contact your Viking Chemical representative.

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