GE Power & Water
Water & Process Technologies

FAQ

Polyamine Boiler Treatment Technology

A Discussion in Question & Answer Format

What is "Polyamine" technology?

Polyamine is a term commonly used in the technical and commercial literature to describe both a relatively new class of boiler treatment technology, as well as one of the key active components in the program, specifically a multifunctional, volatile, organic amine corrosion inhibitor.

As a boiler treatment, a Polyamine program is designed to provide protection against metallic corrosion throughout the boiler system, including the feedwater, boiler and steam condensate surfaces when fed at a single point in the system, normally to the boiler feedwater in the deaerator storage section.

What are the benefits of using a Polyamine program?

The benefits of using a polyamine program include:

Simplicity - Complete system coverage and distribution from a single liquid treatment fed at a single feed point.

- This includes system-wide protection against both dissolved oxygen and acidic corrosion from the blend of volatile corrosion inhibitors without the feed of multiple products.
- Polyamine products are designed to be used in combination with standard internal boiler treatments, including polymeric dispersants, phosphates, and combination products.

Polyamine can handle stressed conditions - Water beads on low carbon steel test coupons exposed for seven days to 10 ppm of polyamine product, 100 ppb of dissolved O_2 and 110°C (230°F) in deionized water. The average corrosion rate measured for them was 0.23 mpy (0.0060 mm/y).

Convenience - Program simplification in that two, or in some cases, three, separate products can be replaced by a single Polyamine product.

- Simplified, lower-cost single product feed system
- Reduced chemical inventory and handling

Dependability & Assurance

- Polyamine technology reduces the potential for both dissolved oxygen and carbonic acid corrosion failures in the boiler feedwater and steam condensate systems. Our re-

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search has demonstrated that the Polyamine's dual mechanisms of surface adsorption and neutralization of acidic contaminants provides highly effective protection of metal surfaces throughout the steam generating system.

Reduced Total Cost of Ownership

- While treatment cost benefits are very system-specific, a Polyamine program can often reduce overall treatment costs by eliminating the need to feed, inventory and monitor separate oxygen scavenger and neutralizing amine products.
- The basis for cost savings is very simple – Polyamine technology is designed to replace both the oxygen scavenger and neutralizing amine products in the majority of applications. In many cases, overall boiler treatment costs versus competitive programs can be reduced by 10 to 20%.
- A significant aspect of the cost reduction equation is the efficient recycle of both the Polyamine and neutralizing amine corrosion inhibitors with the steam condensate when that stream is returned as boiler feedwater. Many dissolved oxygen scavengers, such as sodium sulfite, are entirely non-volatile. Thus, they provide no protection of the steam condensate surfaces, and are lost entirely to the boiler blowdown.

How does it work?

The basic program consists of the multifunctional organic amine corrosion inhibitor - the Polyamine - in combination with a specific blend of volatile organic neutralizing amines. The primary function of the Polyamine component is to adsorb at the metal or metal oxide surface, restricting the access of aggressive species such as dissolved oxygen, carbonic acid, chloride and sulfate anions, to the metal surface. The volatile neutralizing amines in the Polyamine treatment perform their normal function, neutralizing acidic contaminants, and elevating the pH into the alkaline range, where the protective metal oxides are most stable and adherent.

Thus, a Polyamine program can provide "dual protection" against both dissolved oxygen and low pH (acidic or carbonic acid) corrosion with feed of single product to a single feed point in the boiler feedwater circuit. This offers the potential for program simplification, reduction in traditional chemical inventories, and in many instances, improved economics.

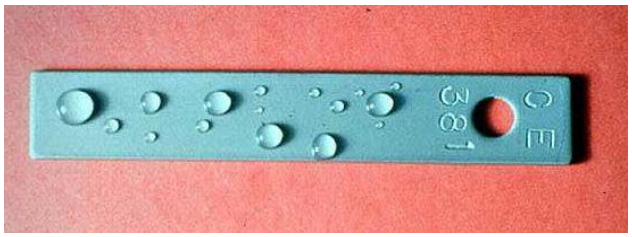
Second, and very importantly, most filming amines, as well as non-amine filming corrosion inhibitors, are not appreciably volatile under boiler conditions. If fed to the deaerator, feedwater system or boiler itself, the filming inhibitor will not leave the boiler in measurable quantities, and thus will not provide protection of the steam condensate circuit. This limitation may be overcome by feeding the product directly to the steam header, but it is sometimes difficult to find a suitable injection point in complex, multiple boiler systems that ensure even distribution of the treatment and effective, full system coverage. In addition, this limitation may require that multiple products be fed to several points in the feedwater and steam condensate system to achieve effective coverage and corrosion protection of the entire system.

Unlike conventional filming inhibitor technology, the Polyamine is significantly volatile under the full range of boiler pressures, and when added to the feedwater, it will readily enter the steam phase, even at pressures below 100 psig (< 7 barg), providing effective corrosion protection in combination with the program's neutralizing amine components to the entire steam condensate system. In addition, uniform levels of Polyamine will reach all points in the steam system based on the distribution and mixing that occurs in the boiler.

Will the Polyamine program provide protection against dissolved oxygen corrosion in the absence of oxygen scavenger?

Yes. Polyamine technology will provide very effective protection against dissolved oxygen corrosion in boiler systems equipped with an efficient thermal deaerator, which may also be referred to as a pressure deaerator. Thermal deaerators are typically rated to produce effluent dissolved oxygen levels below 10 ppb (µg/l) as O_2 when operated according to manufacturer's specifications and design limits. However, our experience has demonstrated that the expected range of performance of deaerators in industrial and commercial boilers in the absence of an oxygen scavenger is typically between approximately 5 and 40 ppb as O_2. We have found that a Polyamine program produced superior corrosion control even at these

higher levels of dissolved oxygen. It is important to emphasize that Polyamine technology is not recommended for application in systems which are not equipped with a thermal (or pressure) deaerator.



Can a Polyamine program be fed to a system with a superheater and steam turbine?

Yes, Polyamine chemistry has been successfully applied in systems with superheaters and steam turbines.

Will the Polyamine chemistry impact condensate polisher resin performance or operation?

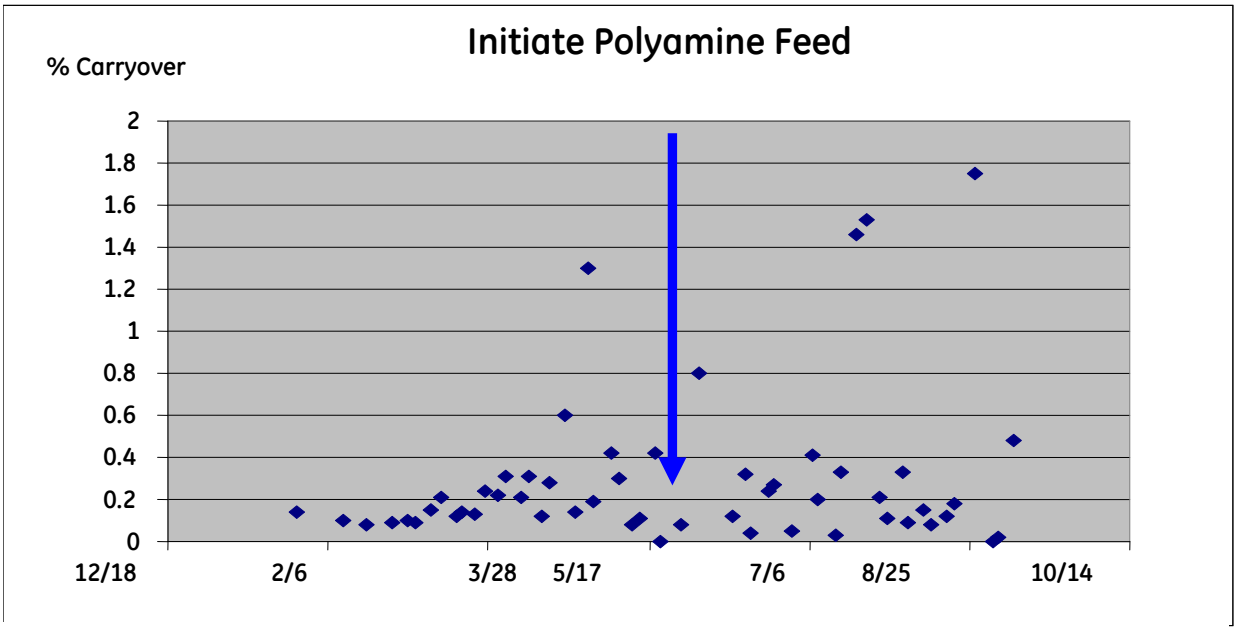
No. Our testing has indicated there was no loss in capacity or performance of standard cationic condensate polisher resins exposed to Polyamine treatment.

Will the Polyamine impact steam purity or increase carryover?

No. The Polyamine chemistry was evaluated based on steam sodium measurements in our Research-scale test boilers at pressures between 7 barg (100 psig) and 100 barg (1500 psig), as well as in a long-term test in an operating watertube boiler (see Figure 2 below). There was no measurable impact on steam purity, nor any operational issues associated with moisture carryover or foaming.

Will a Polyamine program impact steam cation conductivity?

In that the Polyamine products contain organic amine compounds, a slight but measurable increase in cation conductivity would be expected in high-pressure systems. This would be comparable to the effect observed with our standard neutralizing amine products.



Polyamine Steam Purity Study
% Carryover based on Steam/Boiler Water Sodium Levels

Will the Polyamine replace my current Boiler internal treatment/ deposit control program?

No. The Polyamine treatment is primarily designed for corrosion control, and does not directly replace the functionality of our internal treatment programs.

As discussed above, the Polyamine treatment may replace the dissolved oxygen scavenger and neutralizing amine products in boiler systems with efficient thermal deaerators.

With what internal treatment programs is the Polyamine compatible?

Based on extensive testing, our Polyamine treatments do not negatively impact the effectiveness of our deposit control chemistries, including polymer, chelant and phosphate-based treatments.

Will the Polyamine treatment impact a coordinated or alkaline phosphate-pH control program?

Our Polyamine products contain a low volatility amine component that will function as a pH buffer in the boiler, and which can serve as the basis of an All-Volatile Treatment (AVT) program. In high-pressure boilers utilizing some form of phosphate-pH control, such as coordinated PO_4-pH, this amine could elevate the boiler water pH independently of the phosphate product, and this should be considered in designing the program, specifically the PO_4-pH control range.

Is the Polyamine chemistry compatible with All-Volatile Treatment (AVT) control?

Yes. The Polyamine product can serve as a single-product AVT program by virtue of the combination of the volatile Polyamine corrosion inhibitor and specific blend of high-performance neutralizing amines. It will provide superior pH elevation and balance in the feedwater, boiler circuits and steam condensate versus ammonia treatment, especially in areas of two-phase (steam-liquid) flow.

The low volatility amine component also provides enhanced corrosion protection, along with the Polyamine, in the presence of aggressive contaminants, such as chloride, especially in areas of potential concentration, such as under porous deposits at boiling heat transfer surfaces.

The Polyamine treatment also includes a high volatility neutralizing amine component that provides effective corrosion protection of complex steam condensate systems.

Is there a Polyamine test?

Yes. There is a wet photometric field method for the DR-series photometers. The method is named for the two active polyamine products, Steamate* PAS6071 and PAS6074, and is based on a set of Bengal Rose reagents, which together react with the Polyamine corrosion inhibitor to produce a pink coloration. The intensity (absorbance) of the pink complex is measured at 560 nanometers, and is directly proportional to the level of Polyamine active in the sample. The results are expressed as ppm product, for example, ppm as Steamate PAS6074. The Rose Bengal Test is specific for the Polyamine chemistry, and the result does not reflect the neutralizing amine components of the product.

Measurement in the Boiler feed water and steam condensate allows verification of the presence of the Polyamine inhibitor. Please consult the Polyamine Field Analytical Procedure sheets for specifics on the field test method.

Where can I learn more about GE Polyamine boiler treatment technology?

Contact your local GE representative. You can find a contact near you by visiting www.ge.com/water and clicking on “Contact Us”.