



Continuum™ AEC Programs

A discussion in question and answer format

What are Continuum™ and Continuum AEC™ programs?

Continuum programs are treatments for alkaline cooling water. GE Betz, the leader in cooling water treatment, provides Continuum programs which are environmentally preferred corrosion/deposition control for cooling water systems operating above pH 7.8.

Continuum AEC programs are the newest development in these alkaline cooling water treatments. Continuum AEC programs combine a novel calcium carbonate scale/corrosion inhibitor and a superior phosphorus-based steel corrosion inhibitor package. Compared to conventional alkaline treatments, Continuum AEC programs provide the highest level of safety and environmental acceptability.

What is AEC?

Alkyl Epoxy Carboxylate, or AEC, is the first major breakthrough in calcium carbonate deposit control in more than 25 years. AEC is patented, non-phosphorus, organic scale inhibitor that is exclusive to GE Betz. AEC functions as a threshold inhibitor and is the only non-phosphorus deposit control agent that provides scale control superior to phosphonate technology.

In addition to its deposit control properties, AEC is an effective steel corrosion inhibitor when used with low levels of inorganic salts (phosphate, zinc, etc.). AEC is effective at high pH, high M-Alkalinity, and high calcium concentrations. It is not degraded by halogens or temperature.

What is an Alkyl Epoxy Carboxylate?

Alkyl Epoxy Carboxylate, or AEC, is a generic name for the three organic reactants used to manufacture this GE Betz-synthesized scale and corrosion inhibitor. The AEC molecule contains only carbon, hydrogen, and oxygen. AEC contains no residual epoxides.

What can a Continuum AEC program do for me? Optimize Production Rates

Continuum AEC programs help keep heat exchanger surfaces clean by preventing deposition of calcium carbonate scale, even in high calcium waters. Clean surfaces are needed to achieve peak heat transfer rates and are essential for production units to meet output goals.

AEC is the first non-phosphorus calcium carbonate inhibitor which is safe to apply in high calcium waters. Phosphonate inhibitors are susceptible to precipitation in high calcium waters. Calcium phosphonate precipitates settle on heat exchanger surfaces, resulting in reduced heat transfer and lower production rates.

Reduce Operating Costs

Because of its high calcium tolerance, AEC allows cooling towers to operate at higher cycles of concentration without the risk of treatment-related fouling associated with calcium phosphonate. Operating at higher cycles reduces makeup water and tower blowdown volumes, and provides water and chemical savings:

Save Water

- lower costs for purchased makeup water
- lower costs for discharged tower blowdown
- easier compliance with discharge regulations

Save Chemicals

- lower costs for influent water treatment
- lower costs for cooling water treatment
- lower costs for wastewater treatment

Improve Operator Safety

Because Continuum AEC programs are designed for use in alkaline waters, acid feed for cooling water pH

control can be reduced or eliminated. Consequently, safety hazards associated with acid handling and acid feed equipment maintenance may be eliminated.

Reduce Acid Feed Costs

In addition to minimizing safety hazards associated with acid use, the reduction or elimination of acid use at the cooling tower provides savings in several areas:

- cost of purchased acid
- parts and labor for acid feed equipment maintenance
- materials and labor to repair or replace equipment damaged during acid overfeed
- improved production rates through reduced unscheduled downtime and lower fouling cleanup costs if and when acid feed is lost

Avoid Increased Biocide Costs

AEC does not degrade in the presence of halogens (chlorine or bromine) or non-oxidizing biocides, so systems treated with AEC are not limited to a particular type of biocide. With AEC programs, biocide selection can be based solely on what works most cost-effectively in your system. There is no need to switch from your present biocide program to ensure the performance of your corrosion/deposition control program.

What does AEC contribute to Continuum programs?

GE Betz Continuum programs provide reduced s discharge compared to other phosphate programs. With AEC, total phosphorus is further reduced by 30 to 50%. The AEC molecule does not contain phosphorus and replaces organic phosphonates used for scale control such as AMP, HEDP, and PBTC. Lower phosphorus means easier compliance with discharge regulations.

Improved Safety and Reliability

Organic phosphonates have been the primary calcium carbonate scale inhibitors. These inhibitors can precipitate as calcium phosphonate and cause fouling if system upsets or product overfeeds occur.

Phosphonates also degrade in the presence of halogens or at high temperatures, which can result in scaling. AEC solubility and stability are superior to phosphonates, making AEC safer than organic phosphonates.

Simplified Response to Upsets

No matter how diligent the surveillance of the cooling system or how capable the control equipment, system upsets will occur. Upsets resulting from loss of acid feed or over-cycling cause scaling. Acid overfeeds or low cycle upsets result in corrosion.

Continuum AEC programs are formulated to provide maximum safety and flexibility when responding to either scaling or corrosive upsets. Recovery procedures when using Continuum AEC programs are easily implemented and ensure minimal disruption of system operation.

AEC is the first calcium carbonate deposit control agent which is safe to use at high treatment levels during periods of system upset. When alkaline pH or high hardness excursions occur, feeding high doses of AEC safely control calcium carbonate.

Because Continuum AEC programs combine an effective corrosion inhibitor package with a polymeric dispersant, the same high treatment level response during low pH or low cycle upsets will repassivate system metallurgy while preventing equipment from fouling with corrosion byproducts.

How does AEC improve current water treatment programs?

Phosphonate-based calcium carbonate treatments lose efficacy and pose a fouling risk under the following conditions:

- a high pH/high M-Alkalinity
- high calcium
- high free halogen
- high cycles/long retention times

AEC is the only available calcium carbonate inhibitor to give undiminished performance under all the above conditions.

AEC has superior solubility and stability, which reduces the potential for calcium carbonate fouling or fouling by precipitated calcium phosphonate complexes. Phosphonate-based programs may require extra dispersant to cope with these fouling species.

Phosphonate degradation in the presence of halogens may necessitate higher product feed rates. All of these result in higher treatment costs. By contrast, AEC's outstanding solubility and stability characteristics provide both cost and performance advantages.

What are the components of Continuum AEC programs, and how do they function?

Alkyl Epoxy Carboxylate

AEC inhibits calcium carbonate scale and provides steel corrosion protection. This unique, environmentally acceptable, all-organic calcium carbonate inhibitor provides scale control by maintaining calcium carbonate solubility. AEC is safer to use than phosphorus-based scale inhibitors because it does not form insoluble fouling complexes with calcium. AEC also inhibits mild steel corrosion in alkaline waters.

Polymeric Dispersant

Polymeric dispersants prevent fouling due to suspended solids. In systems containing phosphate, this latest generation polymer extends calcium phosphate solubility.

The polymer also contributes to calcium carbonate scale control.

Because AEC does not form insoluble precipitating complexes with calcium carbonate as phosphorus-based scale inhibitors do, polymer requirements and resulting program costs are lower than conventional alkaline phosphate programs.

Azole

Azole provides copper alloy corrosion inhibition. Both yellow metal and mild steel corrosion rates benefit from the alkaline conditions under which Continuum AEC programs are applied. Azole films ensure low yellow metal corrosion rates when oxidizing biocides are used when low pH swings occur.

Phosphate

Continuum AEC programs utilize low levels of phosphate for added mild steel corrosion protection in moderately alkaline waters. These phosphate levels are 30 to 50% lower than alkaline phosphate programs utilizing phosphonates. Low phosphate levels provide a real advantage when meeting strict phosphorus discharge limits. Where phosphate discharge is altogether banned, low levels of zinc can be fed to provide supplemental corrosion protection.

Is AEC affected by halogens used for cooling water disinfection?

AEC is unaffected by chlorine or bromine. Phosphonate-based calcium carbonate scale inhibitors revert in the presence of halogen residuals, resulting in loss of fouling control. That is, the organic core molecule degrades, inorganic phosphate is released, functionality is lost, and scale control is compromised. AEC is the only calcium carbonate inhibitor which does not degrade in the presence of halogen, even at high levels of chlorine.

Some calcium carbonate inhibitors sold by GE Betz competitors are so sensitive that chlorination must be replaced with bromine chemistry in order to reduce reversion and prevent loss of fouling control. AEC is resistant to halogenation and will provide effective calcium carbonate scale control regardless of the halogen used for cooling water disinfection.

Does system retention time affect AEC?

AEC is hydrolytically and thermally stable and is unaffected by long retention times. Organic phosphate scale inhibitors undergo reversion. High temperatures, free chlorine residual, and long residence times increase the extent of reversion. AEC is the only deposit control agent which addresses the specific needs of systems with high retention times. This makes Continuum AEC programs an excellent choice for scale control in modern, water-conserving, high cycle cooling systems.

How do system upsets affect Continuum AEC program performance?

When compared to conventional alkaline programs, Continuum AEC programs provide an unsurpassed margin of safety under system upset conditions.

Continuum AEC programs also simplify response to upsets.

High pH or high cycle conditions resulting from loss of acid feed or blowdown control can cause scaling. Increasing tower blowdown to reduce cycles or pH frequently results in corrosive water chemistry during recovery. Continuum AEC programs generate lower levels of phosphate so there is less risk of calcium phosphate or iron phosphate fouling when pH or blowdown control is lost.

Further, the AEC component of these programs does not form precipitating complexes with calcium. In high pH/high cycle upsets, product feed can be increased safely to prevent scaling. Tower blowdown does not

have to be drastically increased, and corrosive conditions usually encountered during recovery are avoided.

Are Continuum AEC programs toxic to aquatic organisms?

Continuum AEC programs are truly environmentally compatible. Based on toxicity values for a variety of aquatic organisms, Continuum AEC programs can be described as "practically non-toxic" to "slightly toxic". These descriptions represent some of the lowest toxicity ratings possible.

Those products which are practically non-toxic had no effect on aquatic organisms even when fed at levels three to five times normal use rates. Specific aquatic toxicity information on the Continuum AEC program recommended for your system is available from your GE Betz representative.

Do Continuum AEC programs have potable, FDA, or USDA approvals?

No, these programs were not designed for use in potable systems or systems requiring FDA or USDA approvals. GE Betz has a product line specifically for these applications.

What key considerations guide program selection?

Continuum AEC programs should be considered for any alkaline cooling water application. These programs are custom designed to provide excellent corrosion and deposit control for a variety of water chemistries and operating conditions. Consider a Continuum AEC program for any system where low fouling potential and extended run lengths are important.

Continuum AEC programs provide options for situations where conventional programs are no longer suitable, such as in the treatment of low velocity, high temperature equipment currently experiencing fouling with calcium carbonate or calcium phosphonate. Systems which are restricted to limited phosphorus discharge and systems where the use of acid has become a safety concern are also prime candidates for a Continuum AEC program.

Your GE Betz field representative can recommend specific treatments, feedrates, and operating parameters which best suit your water chemistry, system metallurgy, and plant goals.

Do Continuum AEC programs require acid feed?

Continuum AEC programs are designed for alkaline waters so acid feed can be reduced or eliminated. In fact, if you want to discontinue acid use in your cooling system, consider a Continuum AEC program as the first choice treatment. In other systems using high alkalinity or high calcium makeup water, some amount of acid must be fed in order to operate at economical cycles. A Continuum AEC program can still be used to treat these systems.

How are Continuum AEC programs applied?

Continuum AEC programs are stable, easily handled, and are fully compatible with most manual and automated feed systems. Continuum AEC programs are applied as are most standard cooling water treatments. These products should be fed to a point in the cooling system where they can rapidly mix with the bulk cooling water. For best results, Continuum AEC programs should be fed undiluted. Dilution, if necessary, is best done with low hardness water.

Is a Continuum AEC program compatible with existing feed systems?

Tanks, pumps, piping, and valves should be made of stainless steel, polyethylene, or PVC. Equipment recommendations for specific blends are available upon request. GE Betz computerized feed and control equipment, such as the PaceSetter Plus™ system, are compatible with all Continuum products. Computerized feed equipment can be used to reduce system variation and optimize treatment performance, thereby reducing overall costs and ensuring consistent results.

How are Continuum AEC programs monitored?

Monitoring Continuum AEC programs should include provisions for tracking treatment residuals as well as program performance. Conventional orthophosphate testing provides a widely familiar method of program control. The AEC molecule itself can be measured at use levels. Some Continuum AEC programs contain a tracer to simplify tracking product feed rates and maintain program control.

Program performance can be monitored by following corrosion and fouling rates. Standard metallurgical coupons can be used to evaluate corrosion protection. Given the wide variety of available fouling monitoring techniques, your GE Betz field representative will establish a fouling monitoring program best suited for your system.

How are Continuum AEC programs delivered?

GE Betz AEC programs are liquid materials and are available in a wide variety of customized containers and delivery methods. Contact your GE Betz representative for details.

Are Continuum AEC programs exclusive to GE Betz?

Yes, Continuum AEC programs are exclusive to GE Betz. GE Betz holds several patents for the use of AEC to control corrosion and deposition in aqueous systems.