POWERLINE®

Graver Technologies

KEEPING THE LINES OF COMMUNICATION OPEN | FALL 2014

# COMBATTING ANION KINETIC IMPAIRMENT

## Graver pilot tests a new solution to anion kinetic impairment.

Anion kinetic impairment (AKI) in condensate polishing systems continues to be a significant problem at a number of PWR plants. Experts have posited various theories to explain why AKI occurs. Some believed that high condensate temperatures in hotter climates caused the issue, but that does not appear to be the case; some plants in hotter areas do not experience AKI and some cold water plants do.

Other hypotheses suggest that AKI results from small pieces of broken polystyrene sulfate oligomers and maybe other organics that diffuse out of the gel cation beads. Diffusion time is variable, perhaps throughout years of condensate flow, and diffusion may be accelerated in condensate service with ETA chemistry. The following approach held promise: using highly cross-linked cation resins, which are more resistant

> ***Anion kinetic impairment in condensate polishing systems continues to be a problem at PWR plants.***

to degradation and may better retain oligomers in a tighter polymer matrix, combined with macroporous anion resins (macroporous anion resins are easier to clean if they do become fouled). Unfortunately, this approach didn't produce consistent or strong results. Other attempts to stabilize the cation proved marginally successful but not economically viable.

### Diverse Attempts to Combat AKI

The industry has tried diverse approaches to combat AKI without resolving it at its source. Resin replacement, for example, was an alternative, albeit prohibitively expensive. "Years ago, one power plant replaced its anion exchange resin every four to six months at very high cost compared to a four to six year normal resin life," says Al Tavares, Graver's ion exchange product manager. Cleaning the anion resins offsite was partially successful at extending the life but would still require additional resin charges to rotate through the process. This presented difficult logistics for frequent unloading, resin shipping and reloading the vessels. Soaking the anion resins in hot water, followed by rinsing, rejuvenated the resins and allowed them to be re-used for short periods; this process is still in use today. However, not all plants possess the capabilities for the hot water soaks.

### Pilot program thoroughly cleans cation prior to use.

Experts are again considering AKI's causes and now suspect that in-situ leaching of the cation due to ETA

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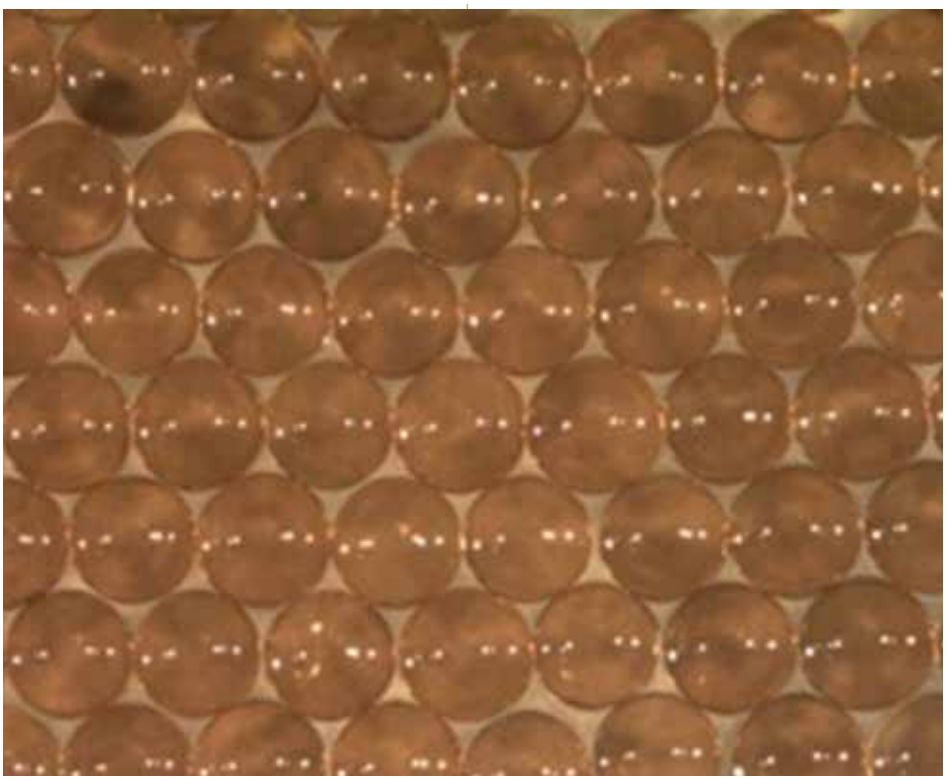

**Specially processed Gravex® condensate cation**

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in the cycle may cause or exacerbate AKI (some believed the ETA chemical itself caused fouling, but that does not appear to be the case). Eliminating ETA is not a favored fix because the amine treatment boasts many other advantages. "ETA as an alternative to other amines is desirable because ETA inhibits corrosion very well," Tavares says. "It would be ideal to stop AKI and facilitate increased ETA use at the same time."

Graver recently launched a pilot program to test a promising solution: very thoroughly cleaning the cation to remove as many contaminants as possible prior to shipment and installation. There are tantalizing clues that this approach may combat AKI.

"Some plants began using ETA when their cation had already been in service for a number of years," Tavares explains. "They did not experience anion kinetic impairment until after it was replaced with new resin. It is possible that many years of condensate polishing service had slowly cleaned the cation at a low leachable rate that did not impair the anion." Similarly, excellent condensate performance was achieved – in which AKI did not occur – from Gravex® macroporous cation that had been rinsed and processed with high quality water at a volume that was orders of magnitude beyond typical rinses. In sum, rinsing cation with extremely large volumes of water prior to use seems to be an effective process.

### Initial Results Expected in Six Months

In addition to cation cleaning, Graver plans laboratory testing to evaluate differences in leachable contents of resin with and without the process treatment. "Lab testing may take some extended period of time especially as we look to conduct shelf life studies," Tavares concludes, adding that pilot testing data may be available in six months. "But if we solve AKI while using ETA as the amine treatment, the time and energy and investment will have been well worth it."

## BASICS FOR POWDERED PRECOAT DEMINERALIZERS: BACKWASHING

### Proper backwashing ensures high performance, reduces operating costs and extends element life.

Powdered precoat demineralizer (PPD) systems are the gold standard technology for removing dissolved and suspended impurities from fluid streams in fossil fuel and nuclear power plants. These advanced systems rely on correct operation and maintenance for optimal performance.

As part of our series on PPD basics, this issue discusses backwashing, or reversing flow across the precoat septa or elements and slurrying precoat solids to waste. Backwashing is indicated upon exhaustion of ion exchange resin or high differential pressure due to accumulated solids. Proper backwashing – complete removal of depleted precoat – is very important for maintaining system performance, obtaining uniform precoats, minimizing precoat consumption, reducing operating costs and extending septa life. Improper backwashing fouls septa, shortens runs and reduces effluent quality.

"About five different backwash techniques exist," says Charlie Mosser, Graver Technologies' senior technical representative. "Graver's specific recommendations and troubleshooting

**Condensate polisher vessel bottom with Graver septa after several years operation with proper backwashing.**

> *Proper backwashing is critically important to assure powdered precoat demineralizer system performance.*

tips vary accordingly. But some essential steps are common to all techniques."

**1. Conduct backwashing on schedule.** "PPDs are relatively trouble-free for the first five to seven years," Mosser notes, "so sometimes plants are lulled into thinking they're maintenance free and are confused when problems arise. Avoid issues by conducting regular maintenance beginning at installation."

**2. Backwash according to specs and best practice recommendations.** Minimize particulates in backwashing water; many plants use clean condensate or demineralizer mixed bed makeup. Adhere to manufacturers' recommended volumes, supply rates, pressures and backwash run lengths.

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**These septa exhibit melt/blown issues, which can occur with poor quality septa that are improperly backwashed.**

> *Our Winter 2014 issue of Powerline® reviewed proper precoating procedures and common precoating inquiries. Click here to view this article.*

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"It can be difficult to tell if a backwash is a good one so operators must follow instructions," Mosser remarks, adding that one indication of an effective backwash is clean differential pressure that is within a half pound per square inch (PSI) of the differential pressure measured prior to backwashing.

**3. Ensure sufficient air supply.** "Air is a valuable commodity in power plants, but operators must maintain good air volume to get a good backwash," Mosser explains. Air bubbles provide the primary scrubbing action to scour resin off septa. Inadequate air volume leads to poor backwashes even if water pressure is in the target range.

**4. Eliminate back pressure during backwashing.** "Water runs best downhill," Mosser explains. "Backwash liquid should run to an elevation lower than the PPD system without any resistance and the container should have plenty of room to accommodate the large liquid volume." Because powdered resins settle, operators must ensure that lines and valves don't clog, drains are clear and storage tank openings aren't blocked.

**5. Assign a small, dedicated team to backwashing.** "With rotating operators, it's hard to assign dedicated staff to backwashing but it's worth the trouble," Mosser says, indicating that a team of four to five operators is suitable and even fewer is ideal. "A dedicated crew has experience and notices when back pressure occurs, air supply is inadequate, certain valves aren't opening or closing properly." Backwashing is a critical maintenance procedure and its effectiveness suffers when inexperienced staff members don't properly monitor the run or recognize problems.

Do you have a backwashing issue or question? Contact cmosser@gravertech.com or call 817.326.3626. ■

**Precoat should look like this when following proper backwash and precoat techniques.**

## WHEN DO YOU ORDER NUCLEAR GRADE HIGH PURITY PRODUCTS?

### Get top performance through smart order timing.

When should you order Gravex® nuclear grade high purity products? "Order these products for delivery shortly before their intended use – five to six weeks ahead at most," explains Al Tavares, ion exchange product manager. "We recommend rinsing leachable components out of these resins just prior to shipping so they are at peak condition for use as soon as customers receive them. Long-term storage increases the likelihood that they'll need rinsing again to attain peak performance." Most plants do not have the capability to perform on-site rinsing at the recommended flow rates and water volumes.

Tavares relates two customers who ordered nuclear grade products too far in advance. "One ordered a year and a half before using the products. Not surprisingly, rinse down performance wasn't as expected," he says. "Another received shipment and stored the resins for five months across the summer. Although stored in a controlled warehouse, temperatures can approach and sometimes exceed recommended limits. Again, difficulties ensued."

Leachables in ion exchange resins begin through an oxidation process acting on both the beads and on any residual small bits of the polymer chains including sulfate oligomers. The storage issue is not specific to Graver products; it occurs in all brands regardless of packaging and storage conditions. The solution is simple and effective: rinse prior to shipment and use these products soon after receipt: five to six weeks after delivery and even sooner if possible.

Contact your Graver representative for more information about ion exchange products and their proper use. ■

> ***Graver recommends rinsing leachable components out of Gravex® resins just prior to shipping so they are at peak condition for use as soon as customers receive them.***

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## NANODEX FILTER PAPERS TRACK SYSTEM AND PLANT PERFORMANCE BY MONITORING RADIONUCLIDE AND CORROSION PRODUCTS

Graver's patented Nanodex™ Ion Exchange Filter Papers enable diverse quantitative analyses in the power industry, especially nuclear, to monitor corrosion products, measure activity levels and satisfy fuel warranty requirements. Nanodex™ AX 100 anion exchange filter disks contain strongly basic, quaternary ammonium functional sites in the chloride form, which can be converted to the desired ionic form (i.e. hydroxide) as required. Nanodex™ CX 200 cation exchange filter disks contain strongly acidic, sulfonic acid functional sites in the hydrogen form. Contact your Graver representative for more information about these innovative filter papers. ■


*AX 100 product boxes contain 50 47-millimeter, durable, easy to handle and simple to use disks per box, with 10 disks per sealed polyethylene bag. CX 200 product boxes contain 100 47-millimeter disks, with 10 disks per sealed polyethylene bag.*

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