

INNOVATION ALERT: NEW COBALT REMOVAL TECHNOLOGY

Get an early look at Graver's promising new cobalt removal precoat products: become a BWR pilot testing partner.

Radioactive dose reduction in BWR nuclear plants has long been an industry goal. One of the most prevalent source term radionuclides is cobalt. Cobalt can be present as both a soluble species and a small particulate or colloid.

During refueling outages, oxides and metals deposited on reactor surfaces can be released and form metal oxides. These oxides can be subsequently complexed with radionuclides, producing crud bursts of both colloidal particles and soluble ions. Both forms exist as ^{58}Co and ^{60}Co but the colloidal cobalt generally constitutes a larger portion of the ^{58}Co activity than the ^{60}Co activity. The relative fractions of soluble and colloidal cobalt are often unknown and can vary from plant to plant.

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PRIOR STRATEGIES FOR REDUCING COBALT

Several strategies have been implemented over the years to mitigate inter-granular stress corrosion cracking (IGSCC) and to minimize & reduce dose rates during shutdown, including the reduction of dose due to cobalt. Beginning in the 1980s, plants began using hydrogen water chemistry, depleted zinc injection, and noble metals application. Plants continue to use some combination of these methods today. Plants have also begun to replace cobalt-containing components within the plant cycle and reactor internal components. This reduces the amount of cobalt (^{59}Co) contributed to the reactor water that becomes activated to ^{60}Co , resulting in personnel dose.

RADEX® SHOWS EXCELLENT BENCH RESULTS

Graver Technologies is developing two new Radex® brand precoat products – for layering over a base precoat – to reduce cobalt in RWCU and other precoat systems:

Radex® GX304:

This precoat product is manufactured with high cation exchange capacity and contains a nanofiber component to further enhance fine particle filtration. Excellent cobalt removal from reactor water was demonstrated on a bench scale. Product is available for evaluation in operating RWCU vessels.



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Radex® GX307: This precoat product is a specially formulated blend of a cobalt selective media and nanofiber. Excellent cobalt removal performance on reactor water has been demonstrated on a bench scale. Product is currently undergoing manufacturing scale-up to process equipment.



Graver is seeking one or more BWR partners to evaluate GX304 in RWCU precoat systems.



The recommended base for these products is Ecodex® P-205-H, a 90 percent H/OH resin mix, stoichiometrically balanced, with 10 percent fiber that provides enhanced precoating characteristics.

HELP EVALUATE NEW COBALT REMOVAL PRODUCTS

Our bench scale results have met or exceeded bench scale results from competing commercially available cobalt removal products. Graver is seeking one or more BWR partners to evaluate GX304 in RWCU precoat systems. Contact your Graver representative for more information.

PowerGuard® Hub and Lateral Underdrains



BETTER POWER UPRATING WITH POWERGUARD® HUB AND LATERAL UNDER DRAINS WITH POROPLATE®

For a BWR facility, Graver's patent-pending under drain laterals helped complete a power uprate in record time.

Situation: A 30-year-old, single-unit BWR plant in a midwestern state launched a power uprate in mid-2015 and a concurrent differential pressure reduction program.

Challenge: Existing under drain laterals posed challenges to the condensate polisher and the overall power uprate project:

- Minimal hole surface area allowed high ΔP across the polisher.
- Wedgewire design – prone to breakdown itself – allowed resin beads to extrude into reactor.
- Lateral holes faced polisher bottom, allowing loose threaded connections to effluent header.
- Lateral replacement, complicated by galled threaded connections, posed exposure risks.
- Risk of pump cavitation due to high ΔP .

Process: Graver and the customer:

- Partnered to design new laterals that increased hole surface area, assembled easily and addressed resin leakage.
- Installed Patent-pending PowerGuard® Hub and Lateral Under Drain Strainers with Poroplate®.

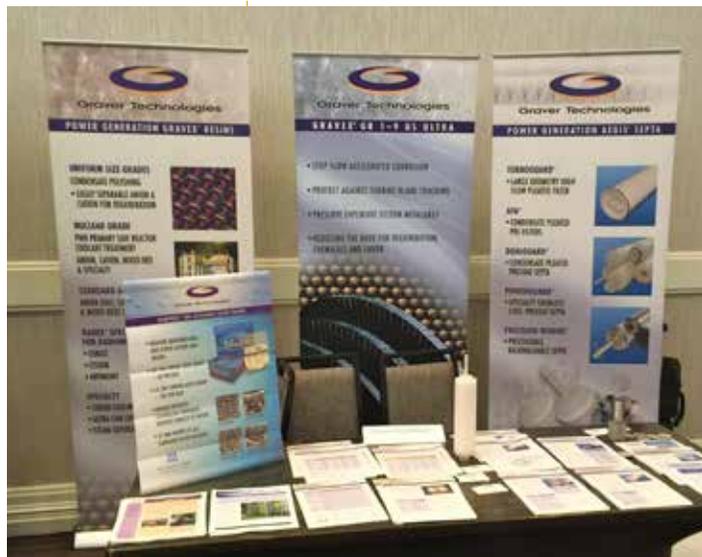
Payoff: Power uprate and differential pressure reduction programs are complete and yielding significant benefits:

- Increased open area, relieved back pressure.
- Resin extrusion eliminated.
- New horizontal under drain quick release mechanisms aid in alignment and reduce maintenance time.
- Help meet ALARA regulations.
- Protect costly equipment: changes reduce cavitation risk, improve efficiency and extend the life of \$25 million pump.

Graver and our customer presented these results jointly at the EPRI Power Plant Process Water Treatment Conference on February 18, 2016.

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Graver display at the annual EPRI conference



HAVE YOU ORDERED LITHIUM 7 HYDROXIDE MONOHYDRATE PRODUCTS?

Graver is carefully managing its lithium 7 ionic form ion exchange resins to make sure they are available for your scheduled outages.

Lithium 7 hydroxide remains in short supply due to plant upgrades at two primary manufacturing sources for this material.

Lithium 7, as it is often called, serves important functions in the utility industry. PWR plants add it directly to reactor water to maintain pH and balance the system's chemical makeup. Graver uses it to convert ion exchange resins to the lithium 7 ionic form; these resins are commonly employed in ion exchange vessels that treat reactor water.

Graver is managing its lithium 7 supply to ensure that customers have access to these resins as needed. "These resins are usually replaced during scheduled outages, so customers know when they'll need a new charge," says Al Tavares, ion exchange product manager, who says

"We are contacting customers to determine outage timing, assess resin requirements, and place orders. If you haven't already done so, please determine your future needs and complete a purchase order so your shipment is registered in our queue."

that Graver has a steady and secure supply but is allocating it carefully.

COMPLETE PURCHASE ORDERS NOW FOR LITHIUM 7 PRODUCTS

"We are contacting customers to determine outage timing, assess resin requirements, and place orders. If you haven't already done so, please determine your future needs and complete a purchase order so your shipment is registered in our queue." Tavares also asks customers to carefully consider their need for excess inventory. "We want to be careful that we are selling to customers with imminent needs instead of supplementing stored supplies," he says.

Please contact your Graver Technologies sales rep to discuss orders or learn more.

NEW PRODUCTS!

Graver recently introduced lithium 7 hydroxide mixed beds with ultralow chloride anion resins for enhanced operating characteristics. Customers opting for these mixed beds report better overall water quality. Graver offers an extensive selection of ultralow chloride versions of Gravex® nuclear grade resins:

- GR-1-9 NG ULC OH
- GR-3-9 NG ULC H/OH (mixed bed)
- GR-3-15 NG ULC H/OH (3:1 cation to anion ratio by volume)
- GR-3-16 NG ULC H/OH (includes high crosslinked cation)
- GR-4-9 NG ULC Li 7/OH
- GR-4-7 NG ULC Li 7/OH (includes high crosslinked cation)

Contact your Graver representative for more information.

PERSONNEL CHANGES AT GRAVER

Graver's employee ranks have changed! We welcome:



Michael Jacobs, vice president and general manager – Utilities.



Chuck Kozora, northern sales manager – Utilities.



Lois Tink, southern sales manager – Utilities.

Our deep appreciation for the service and dedication of Graver employees who retired recently:

- **Peter Yarnell**, group leader, Ion Exchange Development.
- **Mark Koster**, president, International Utilities. He will serve as a consultant moving forward.
- **Gil Royal**, sales manager, North America. He will serve as a consultant moving forward.
- **Seth Kauffman**, sales rep, key account regional manager, Midwest, Northwest and Canada.
- **Wayne Norwood**, key account regional manager, Southeast.

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GRAVER: YOUR BEST SOURCE FOR CCGT CP

For most CCGT facilities, precoat filter demineralization is the best CP technology for providing excellent water quality, economy, durability and asset protection.

Visit <http://www.gravertech.com/PDF/CombinedCycleBrochure.pdf> to download our new guide outlining precoat filter demineralizers, additional CP technology choices and key considerations for choosing the right system.



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A Marmon Water/Berkshire Hathaway Company

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