

CONDENSATE POLISHING: ESSENTIAL TECHNOLOGY FOR COMBINED CYCLE GAS TURBINE PLANTS

Condensate Polishing Protects Assets, Stabilizes Cycle Chemistry and Optimizes Operation

With natural gas at historic low prices and a forecast abundance in the near future, utilities are rapidly planning and constructing combined cycle gas turbine (CCGT) plants. Other factors push the CCGT growth curve as well. "Renewable energy is becoming a significant source in several geographies – the United States and Europe, for example – and CCGT flexibility facilitates that emerging energy mix on cloudy, calm days, or at

night," says Anand Harohalli, Graver Technologies' director of business development. They're also increasingly tapped for affordable base load – the plants are economical to site and build, too – as coal-fired plants face constraints like environmental regulation and aging infrastructure.

Significant new CCGT capacity is under development in a number of areas, with industry watchers labeling much of it "early phase." That's the time to plan an essential element of CCGT construction: condensate polishing (CP). Many historic CCGTs, planned and constructed as peaking units with low utilization rates, lack CP systems; about six percent of existing U.S. CCGT facilities have them, for example. But high usage patterns and

CCGTs constituted about 56 percent of capacity additions in the United States alone between 2002 and 2012.

Source: Power Magazine, October 1, 2012

frequent cycling without CP cause serious consequences: accelerated corrosion, inefficient operations, higher insurance rates and prohibitive future expenditures to replace damaged equipment.

"CP systems – whether specced in during development or retrofitted to an existing plant – are vital to long-term performance," says Gil Royal, Graver Technologies' North American Utility sales manager, who says that air-cooled condenser systems, once through steam generators or those with more than 100 annual startups definitely need condensate polishing. "CP safe-guards assets, stabilizes cycle chemistry, protects the steam turbine and HRSG, and optimizes operations."

Graver Water Systems and Graver Technologies – Marmon Group companies owned by Berkshire Hathaway – have pioneered CP and high purity water treatment for decades. Together they make the world's most complete solutions for CCGT CP and filtration systems. The two companies offer the equipment, technology, products, experience and capabilities to manage CP and filtration needs at any CCGT plant. "Facility size, footprint, location, equipment type, flow rates, unusual chemistry profiles, different condensers – we create CP systems tailored to handle any circumstance," says Bob Applegate, Graver Water Systems sales manager.

This historic 1963 photograph shows one of the first two Powdrex® systems ever installed. Two 48-inch diameter vessels treated 2,000 gpm of high purity condensate at a 325 MW U.S. power plant.



Utilities are currently planning 83,831 MW of CCGT capacity in the United States. About 25 percent is in the earliest “announced” stage of development while 34 percent is in early development. About 11,000 MW of CCGT capacity is under construction.

What type of CP system best suits CCGT CP needs? See below for a review of several alternatives: precoat demineralizers, disposable and backwashable filtration, and deep bed ion exchange systems. ■

PRECOAT FILTER DEMINERALIZERS: THE PREFERRED CP CHOICE

Efficiently Removing Suspended and Dissolved Contaminants with Low Maintenance Systems

Graver Water and Graver Technologies invented the precoat filter demineralizer technology more than 50 years ago, installing the first Powdex® system. For most CCGT plants, a precoat filter demineralizer is the best solution for a number of reasons:

Effective, nearly turnkey custom systems stand the test of time: Graver Water’s complete custom Powdex system includes skid-mounting, all vessels, the required number of precoat septa, piping, state-of-the-art process controls, and the ion exchange resins necessary for system startup. This equipment demonstrates reliable operation and uniform flow



pattern through mechanically strong septa – typically needing replacement at long intervals of five to seven years – that withstand repeated backwashing.

Further, these systems often handle high flow rates up to 6,000 gallons per minute per vessel.

Innovative products remove a wide range of soluble and suspended contaminants:

Graver Technologies’ ion exchange products combine ion exchange and suspended solids filtration in one process. They remove iron, copper silica, activated corrosion products and salts, whether contaminants are soluble or suspended.



Graver chooses from an extensive line of Powdex® product choices – including Ecodex® cation and



anion exchange resins uniquely blended with a cellulose fiber filter aid, and Powdex® Premix anion and cation exchange resins – to suit any CCGT CP system parameters or needs: chemistry, flow rate, particulate type and more. Resin selections are easily modified to handle different condensate chemistries including unusual heavy metals.

Equipment and products are designed to work together: Graver Water and Graver Technologies designed the state-of-the-art equipment and ion exchange products in tandem for optimum performance and durability. “Competitors offer septa and ion exchange products for Powdex equipment but they are trying to accommodate a system they didn’t design. That may compromise performance,” remarks Charlie Mosser, Graver Technologies’ technical service manager.

Equipment and products are compact and easy to use: Skid-mounted for quick installation and rapid start up, Powdex is easily specced into facility designs and retrofitted into compact spaces at existing sites.



Preferred over standalone filtration or deep bed ion exchange systems, state-of-the-art Powdex precoat filter demineralizers suit new or retrofit installations.

Low maintenance is easily handled by limited personnel: CCGTs help utilities reduce manpower and precoat filter demineralizers require minimal upkeep. There is no need for dosing chemicals. Further, easy-to-handle product bags are simply opened and poured into the system while backwashing procedures are nearly automatic. If condensate chemistry changes, resin adjustments are easily accomplished. Precoat septa are typically replaced at very long intervals of five to seven years.

Graver continues intensive CP innovation: Graver Technologies and Graver Water continue to collaborate on further improving Powdex systems and products for CCGT plants. “We think it’s the best system on the market for both ion exchange and filtration,” Royal says, “created by companies who specialize in CP, commit significant R & D resources to it and work closely together on system design, installation and service.”

To further discuss the advantages of customized precoat demineralizer systems for CCGT CP needs, please contact your Graver representative. ■

“Our Powdex system allows us to better control water chemistry parameters after shutdowns, which permits shorter startup periods.”

– Plant manager, 900 MW CCGT Facility

DISPOSABLE AND BACKWASHABLE FILTERS: COST-EFFECTIVE FOR SHORT-TERM USE

Filters Trap Suspended Solids, Have No Ion Exchange Capacity

Two types of filters are available for CCGT condensate treatment: disposable and backwashable. Brian Raab, Graver Technologies' Utility Filters product manager, discussed this technology choice.

Q: Is filtration a suitable standalone technology for treating CCGT condensate?

A: Filters, which trap suspended contaminants such as copper and iron oxides but don't affect dissolved contaminants, are cost-effective solutions for short-term use and are better than no condensate treatment at all. The filters can provide significant improvements in condensate quality. They're affordable and relatively easy to maintain. When CCGTs had lower utilization rates, filters made more sense. Today's heavier usage patterns and constant cycling, however, demand precoat filter demineralizers to better protect CCGT assets, stabilize chemistry, control lifetime costs and optimize operations. Plants with air-cooled condensers, in particular, need more than just filtration because oxidation and degradation begin almost immediately upon shutdown.

Q: What types of filters are available for CCGT CP treatment?

A: Filters can be either disposable – AEGIS® TurboGuard® Pre Filters, for example – or backwashable, such as AFA® Pleated Backwashable Filter Elements. Installed in custom housing manufactured by Graver Water, TurboGuard filters exhibit very high dirt-holding capacity before replacement is required and low pressure drop at specified flow rates. They're available in a variety of micron ratings and are easily replaced by plant operators.



AEGIS® TurboGuard® Pre Filter

AFA filter elements require Powdex housings and will last many years if backwashed properly. However, if you're electing AFA filters, you can install a full precoat demineralizer system without much additional investment. That's what we recommend.

For more information about TurboGuard and AEGIS AFA filters, please contact your Graver representative. ■

DEEP BED ION EXCHANGE SYSTEMS: NOT OPTIMAL FOR CCGT CP APPLICATIONS

Higher Maintenance, Less Resin Flexibility

Graver Water and Graver Technologies have made great strides in regenerable deep bed ion exchange equipment and technology. These systems are often ideal for CP at fossil and nuclear facilities. However, deep beds are rarely the right CP choice at CCGTs for a number of reasons:

Thermax, Graver Water and Graver Technologies recently collaborated on a state-of-the-art CP pre filtration system for Areva Solar's 125 MW concentrated solar plant in Pokharan, India. A twin plant is slated for 2014.

System cost is high: Ongoing deep bed system costs include regenerant chemicals as well as the cost of disposal – precoat filter demineralizer systems use no regenerants. Further, an economic

comparison of the two systems, featuring both on and off-site regeneration, of deep bed units for a once-through supercritical unit with oxygenated treatment are nearly twice as expensive as a precoat system. Graver Water presented a paper discussing this data at the annual International Water Conference in October, 2006.

High level of operator attention required:

Maintaining deep bed ion exchange systems requires regular application of regenerant chemicals, disposal management, periodic resin replacement and system adjustment. The manpower for this maintenance is rarely in place at CCGTs.

Resin composition is difficult to modify:

Replacing resin products in precoat filter demineralizers is a simple process entailing backwashing the precoat septa and preparing a new resin precoat from easy to handle bags. Should condensate chemistry and/or composition change, Graver designs tailored resin mixes that are easily inserted into the system. Conversely, a deep bed system does not offer similar flexibility.

Precoat demineralizers exhibit comparable performance to deep bed ion exchange in CCGT applications:

Rarely, CCGT condensers experience problems that flood condensate with high levels of dissolved solids that would be more easily handled by deep bed systems. Though not desirable, precoat demineralizer systems can handle this situation by precoating on a very compressed schedule. In sum, these issues are rare and do not offset the many disadvantages of deep bed systems for these applications.

Bead resins used in deep beds degrade under extended contact with elevated condensate temperatures:

For plants with air-cooled condensers – an increasingly popular CCGT design element – high condensate temperatures can prematurely degrade anion exchange resins in deep bed systems, compromising functional capacity. ■

NANODEX™ FILTER PAPERS FOR NUCLEAR CUSTOMERS: TESTED AND QUALIFIED

Nanodex Tracks System and Plant Performance by Monitoring Radionuclide and Corrosion Products

Graver's patented Nanodex™ Ion Exchange Filter Papers perform diverse quantitative analyses in nuclear applications including monitoring corrosion products, measuring activity levels and satisfying fuel warranty requirements. Below we continue our Q&A discussion of AX 100 anion and CX 200 cation filter paper types. This is the fourth such article; three previous discussions appeared in *Powerline's* Spring 2012, Fall 2012 and Spring 2013 issues, reviewing filter disk

characteristics, types, applications and more. These issues of *Powerline* are located on Graver's website for further reference.

Q: What improvements do Nanodex papers offer over competing filter paper types?

A: They offer improved performance while retaining the benefits of the commercial ion exchange filter disks that many U.S. nuclear plants are accustomed to using. Nanodex filter papers feature patented fibrillated nanofibers that enhance the resins' ability to remove soluble species from aqueous feed and effluent streams. These nanofibers are loaded with finely subdivided ion exchange resin media, increasing the number of ion exchange sites and allowing very accurate quantifications of ionic species at low activity or concentration levels.



At the same time, Nanodex filter papers are easy and safe to handle, fit standard bench-top or in-line filter holdings and housings of 47-mm diameter, and offer good durability and stability.

Please contact your Graver representative for more information about Nanodex Ion Exchange Filter Papers. ■

SALES & SERVICES

UNITED STATES

Graver Technologies, LLC

200 Lake Drive
Glasgow, DE 19702
P (800) 533.6623
P (302) 731.1700
F (302) 731.1707
E info@gravertech.com
W www.gravertech.com

Anand Harohalli Director Business Development

P (302) 731.3543
C (302) 319.0353
E anand@gravertech.com

Seth Kaufman Regional Manager NW/Canada

P (704) 854.3422
C (704) 904.5168
E skaufman@gravertech.com

Charlie Mosser Technical Service Manager

P (817) 326.3626
C (817) 233.9358
E cmosser@gravertech.com

Wayne Norwood Regional Manager Southeast

P (301) 953.7731
C (301) 332.7934
E wnorwood@gravertech.com

Brian Raab Utility Filter Product Manager

P (302) 731.3512
C (443) 907.9113
E braab@gravertech.com

Gil Royal Utility Sales Manager, North America

P (302) 731.3554
C (302) 668.4163
E groyal@gravertech.com

Al Tavares Ion Exchange Product Manager

P (973) 690.5290 ext 2370
C (201) 787.3696
E atavares@gravertech.com

Maureen Vollinger Global Customer Service/Inside Sales

P (302) 731.3516
P (800) 533.6623
F (302) 369.8356
E mvollinger@gravertech.com

Dr. Peter Yarnell Ion Exchange Development Group Leader

P (302) 731.3529
C (302) 731.1707
E pyarnell@gravertech.com

Mark Koster President, International Utilities Division

P (302) 731.3513
C (302) 463.5896
E mkoster@gravertech.com

CHINA

Graver Technologies, LLC

RM 16D, Building B
No. 1118, Changshou Road
Shanghai, China 200042
P (86) 21.5238.6576.608
F (86) 21.5238.6579

Xiaoyun Huang Regional Sales Manager

C (86) 186.2800.1300
E xhuang@gravertech.com

Xiaoyun Li Customer Service

P (86) 21.5238.6576
F (86) 21.5238.6579
C (86) 139.1896.1206
E xli@gravertech.com

Qingyuan Liu Regional Sales Engineer

C (86) 136.2371.4398
E qliu@gravertech.com

Pei Tao Sales Representative

C (86) 187.2174.7242
E ptao@gravertech.com

Xiangdong Xu Regional Sales Manager

C (86) 139.1058.0025
E xuxd@gravertech.com

Erbao Zhang Chief Representative

C (86) 137.0188.2885
E ezbang@gravertech.com

EUROPE

Graver Technologies, LLC

Koenigstrasse, 10c
D-70173 Stuttgart, Germany
P (49) 711.3154.7160
C (33) 6.19.33.11.10
F (49) 711.3154.7170

Robert Schiedlbauer European Sales Manager

P (49) 711.3154.7160
C (33) 6.19.33.11.10
E rschiedlbauer@gravertech.com



Graver Technologies

The Marmon Group
A Berkshire Hathaway Company

All information and recommendations appearing in this newsletter concerning the use of products described herein are based on tests believed to be reliable. However, it is the user's responsibility to determine the suitability for his own use of such products. Since the actual use by others is beyond our control, no guarantee, expressed or implied, is made by Graver Technologies as to the effects of such use or the results to be obtained. Graver Technologies assumes no liability arising out of the use by others of such products. Nor is the information herein to be construed as absolutely complete, since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations. Powdex, Ecodex, Aegis, TurboGuard, AFA, PowerGuard, and Powerline are registered trademarks, and Nanodex is a trademark of Graver Technologies.



Scan here to learn more
about Graver Technologies