

REINHOLD ENVIRONMENTAL Ltd.



2016 APC-Wastewater Round Table & Expo Presentation

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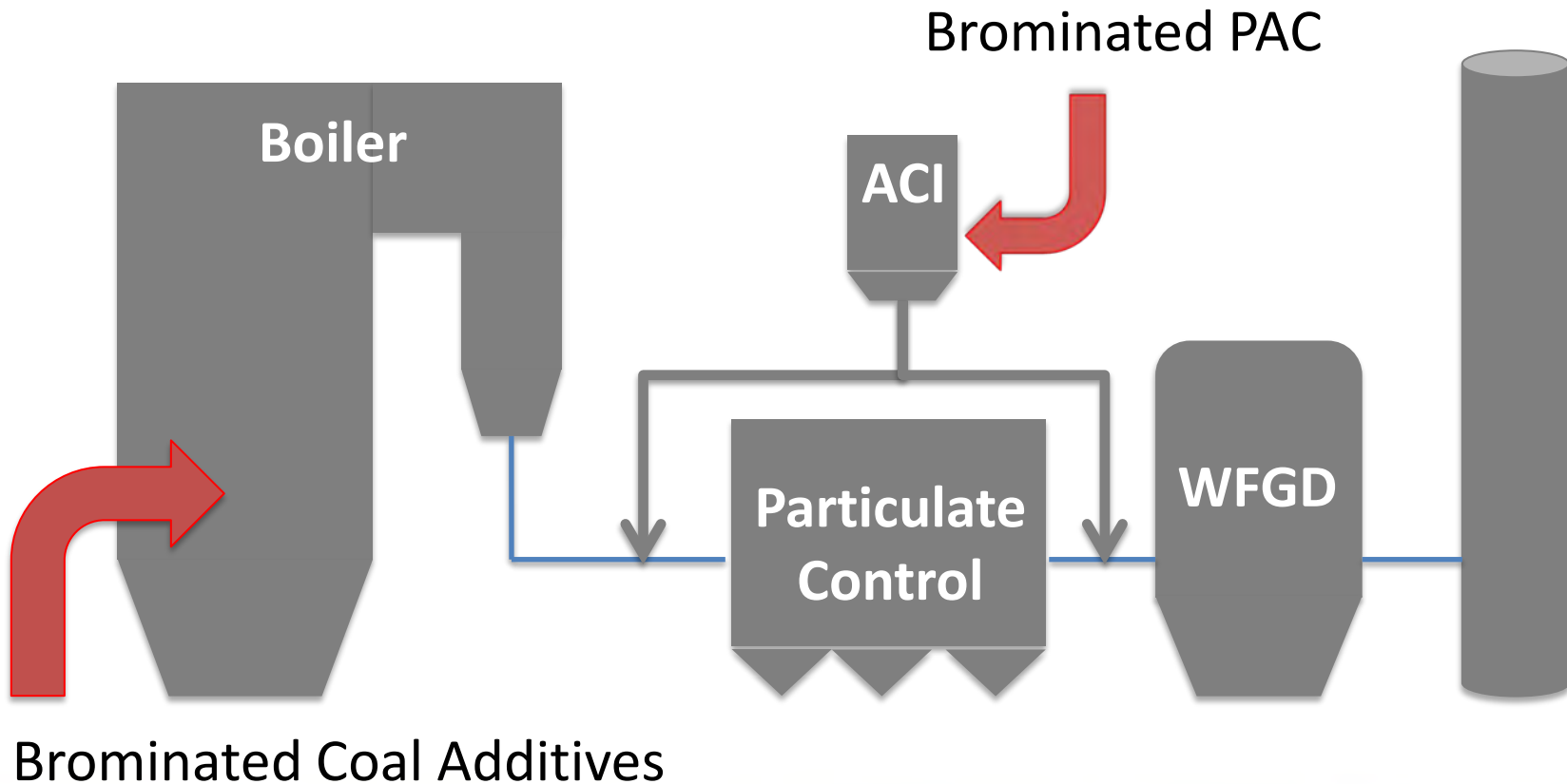
***ADVANCED
CARBON PRODUCTS***

APC | July 18, 2016

Do Bromide and DBPs Affect Your Future?

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The Use of Brominated Products



Potential Risks from Bromine Use



Corrosion



ELG Compliance



Disinfection Byproducts

**Units with
WFGDs at a
greater risk.**

CORROSION

Where Can Corrosion Occur?

Most discussed location for corrosion: *air heater cold-end baskets*.

- EPRI's Balance of Plant Effects Study of Bromine -Based Mercury Controls
- 34 out of 69 units surveyed reported corrosion
- All units reporting corrosion burned PRB or Western Bituminous coals

Location	# of Units
Pulverizer	3
Boiler Tube	2
Air Heater	33
Air Heater Outlet Duct	7
ESP	2
FGD	2
ID Fan	4

Recent Reports of Corrosion

Plant Configuration	Report of Corrosion
250 MW, Bit., DSI, ACI, ESP, WFGD	Corrosion of rotary airlock in ACI system after a couple of weeks testing a brominated PAC.
750 MW, PRB, ACI, WFGD	Brominated PAC collected in the WFGD. Corrosion of scrubber modules.
790 MW, PRB, SCR, ACI SDA, FF	Thinning of silo wall – can see light through the silo
550 MW, PRB, CaBr ₂ , SNCR, trona, ACI, ESP	Had to replace major ACI system valves, weigh hoppers, and lines. Requires continued maintenance around the clock.

How Does Corrosion Occur?

1) HBr condensation on equipment

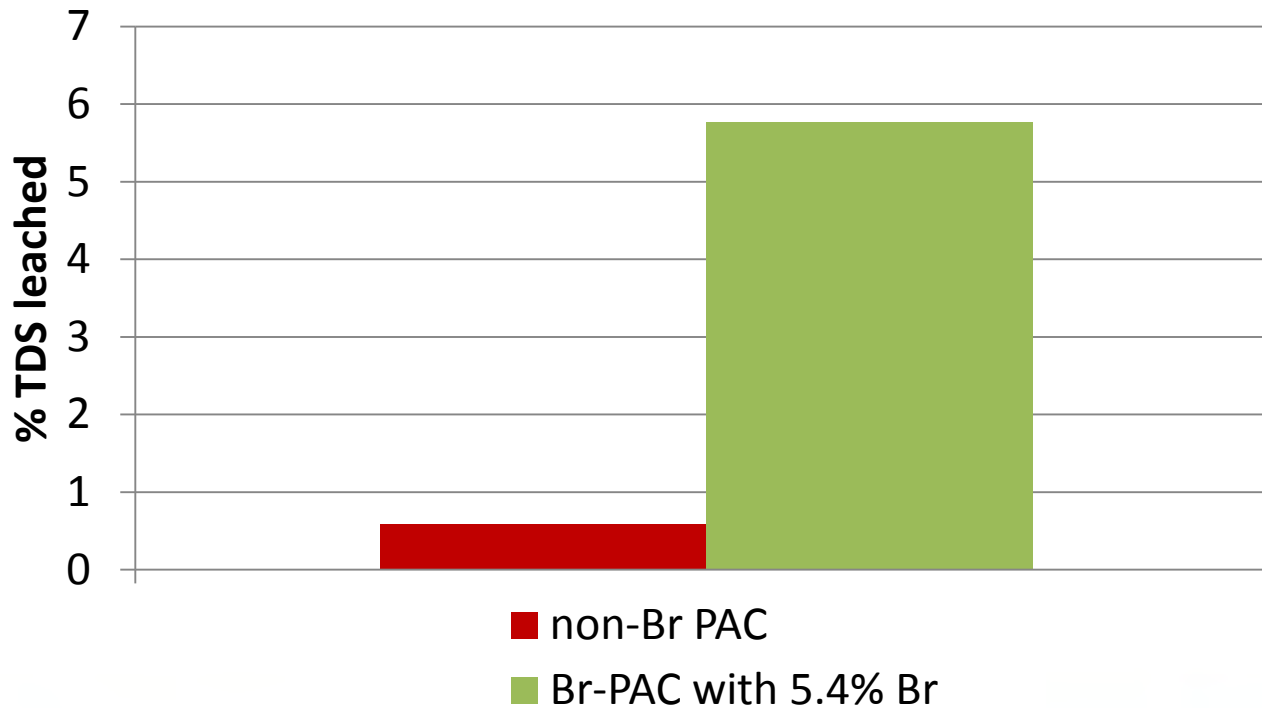
- Occurs at lower temperatures (130 F)

2) Deliquescent corrosion

- Brominated salts (calcium bromide, ammonium bromide, etc.) can easily absorb water from air.
- Salts will liquefy when the air's relative humidity is greater than the salt's deliquescent relative humidity.
- Corrosion can occur at temperatures higher than dew point

Bromide Salts are Water Soluble

- Brominated and non-brominated PACs mixed in de-ionized water for 30 minutes, filtered, and the discharge water was analyzed for total dissolved solids (TDS).

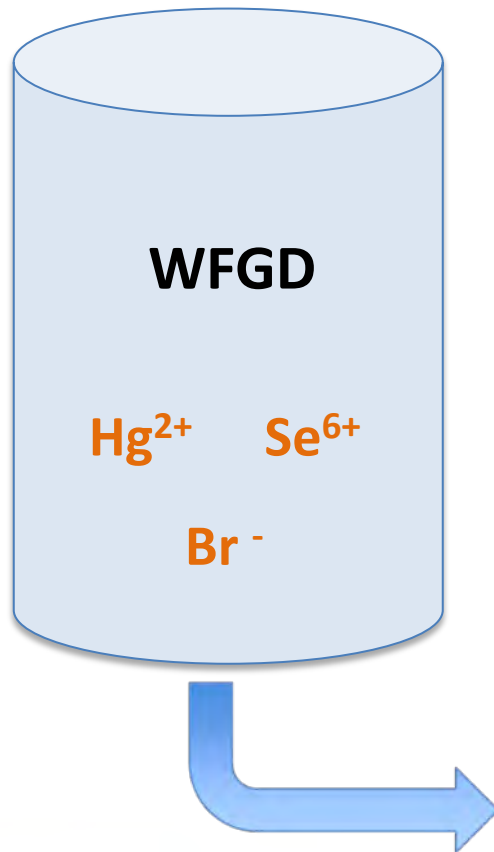


Effect on WFGD Systems

- Water soluble bromine will accumulate in the WFGD.
- Increase in ORP results in decrease in pH, requiring more reagent
- Increased corrosion potential as ORP approaches 500 mV. Oxidized manganese species will precipitate accelerating alloy corrosion.

ELG COMPLIANCE

What is the risk to ELG Compliance?



- Increased loading of Hg into the WFGD
- Increased discharge of Se with the use of bromine:
 - Se^{4+} is more predominant in reducing environments
 - Se^{6+} is more predominant in oxidizing environments

ELG Limits:
Hg = 356 ppt
Se = 12 ppb

Precipitation and Biological Treatment

Chemical precipitation for reduction of mercury and arsenic combined with biological treatment of selenium and nitrates/nitrites.

Pros	EPA's best available technology
Cons	Requires high capital and O&M costs. "Bugs" are sensitive to operational changes High halogen content in wastewater acts as a disinfectant

ZLD: Brine Concentrator/Crystallization

Utilizes steam to evaporate FGD wastewater and concentrate the salts

Pros	Produces a high purity water stream that can be reused within the plant
Cons	Requires high capital and O&M costs, including significant power consumption requirements. The concentrated salts may require additional conditioning before disposal in a landfill.

ZLD: Waste Fixation

Stabilization and chemical fixation by mixing a blend of FGD wastewater, gypsum, ash and lime for disposal in a landfill.

Pros	Relatively inexpensive
Cons	Concern about the long-term stability and the failure keep the waste constituents from releasing into the environment. No long-term data since the technology has only been practiced for about 20 years.

Where Regulations Apply

Total dissolved solids (TDS): metals, minerals, salts, cations or anions dissolved in water.

Existing Sources	No limit for TDS Voluntary incentive program with TDS limits available that awards extended compliance time States are authorized to implement TDS limits to protect against DBPs
New Sources	Subject to TDS limits

DISINFECTION BYPRODUCTS (DBP)

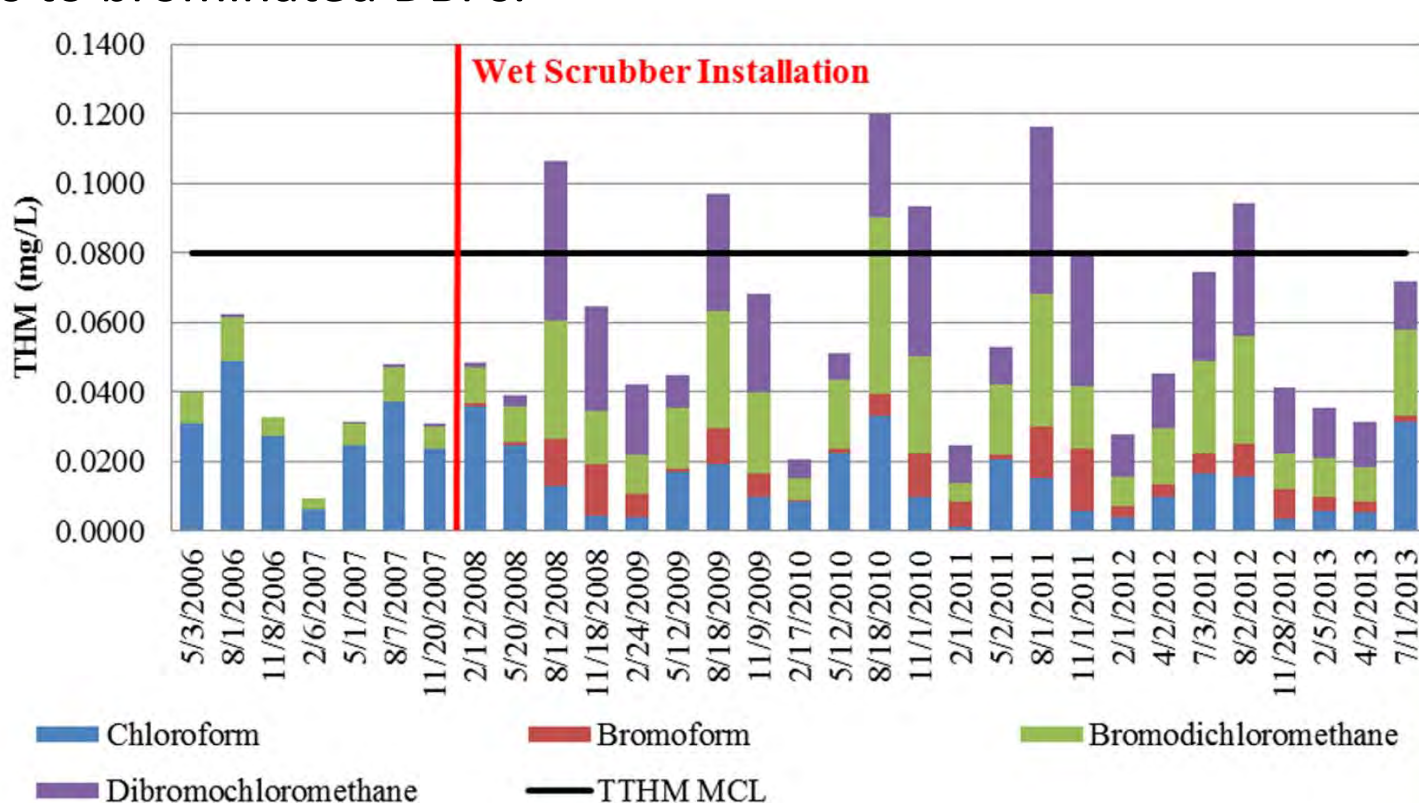
DBP Formation

- Discharged water will affect municipal water treatment plants downstream
- Halogens + organic matter = trihalomethanes (THMs)
- Limit for Total THMs = 0.08 mg/L



WFGD Role in DBPs

After a WFGD installation at a coal-fired power plant, 3 WTPs reported increases in overall THMs and speciation shifted from chlorine-based DBPs to brominated DBPs.



Roth, Damon, David Cornwell, Nancy McTigue, and Richard Brown. *Impact of Increased Bromide in Water Sources on Drinking Water DBPs*. N.p.: EE&T, Inc., 2015. PDF.

Brominated DBPs and Health Effects

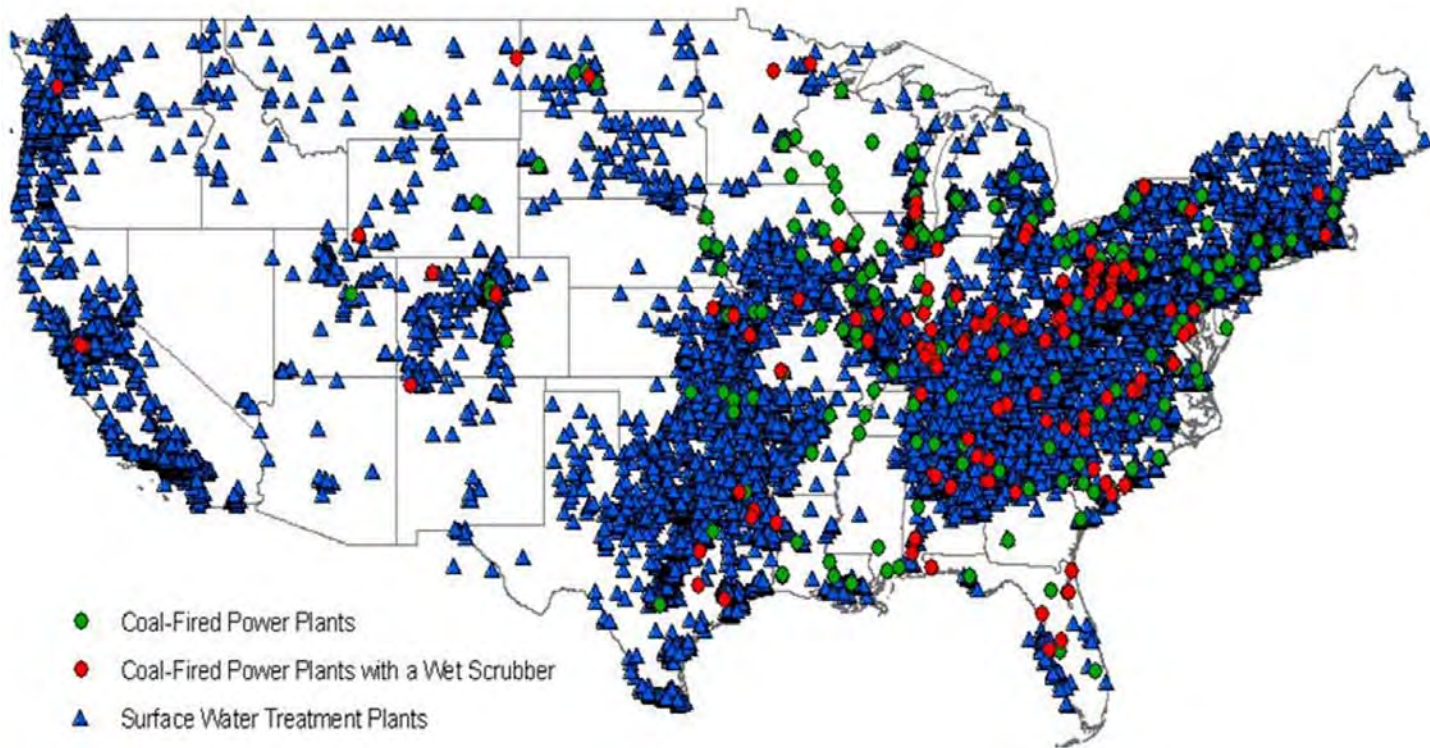
- More toxic than chlorinated DBPs
- Long term exposure can lead to bladder and kidney cancers.
- As a result of increased bromide concentrations, DBP speciation shifts from chlorinated to brominated in every class of DBP compounds (not just THMs).
- Increases in bromide as little as 50ug/L over the baseline could put water treatment facilities out of compliance for DBPs and customers at increased health risks.

Regli, Stig, et al. "Estimating Potential Increased Bladder Cancer Risk due to Increased Bromide Concentrations in Sources of Disinfected Drinking Waters." *Environmental Science & Technology* 49.22 (2015): 13094-. Web. May 2016.

McTigue, N.E., Cornwell, D.A., Graf, K., Brown, R., 2014. Occurrence and consequences of increased bromide in drinking water sources. *Journal AWWA*, 106:11:492.

At Risk Water Supplies

- 96 WTPs are downstream of power plants that are impacted by bromide discharge and increased DBPs.



Roth, Damon, David Cornwell, Nancy McTigue, and Richard Brown. *Impact of Increased Bromide in Water Sources on Drinking Water DBPs*. N.p.: EE&T, Inc., 2015. PDF.

A Dangerous Discovery in the Southeast

- Major utility employed brominated coal additives.
- The water treatment plant downstream found carcinogenic THMs were being produced from excessive bromine discharge into the local river.
- Utility paid \$2.3 Million in settlement
- Is your plant next?

Thank You!

Carbonxt in Partnership with UCC

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