REINHOLD ENVIRONMENTAL Ltd.

2010 APC Round Table

& Expo Presentation

July 18-20, 2010, in Concord, NC / Hosted by Duke Energy

Alstom's Mercury Control Technologies

2010 APC / PCUG Conference

Tom Pearson

Concord, NC, 20 Jul 2010

POWER | ALSTOM

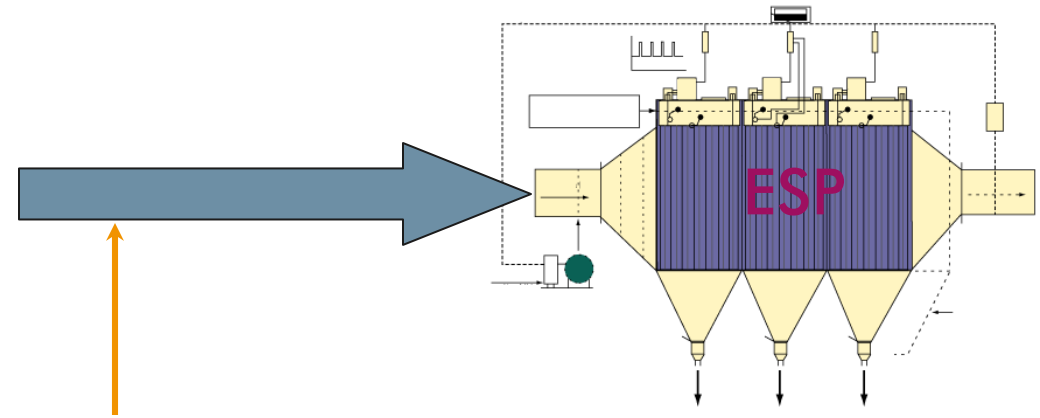
Mercury Control Technologies – There is no "One Size Fits All"

- **Activated Carbon Injection (Alstom Filsorption™)**
  - Proven in WTE and well demonstrated for utilities
  - Significant materials handling and storage requirements
  - Contaminates ash with carbon making reuse difficult
- **Advanced PAC (Alstom Mer-Cure™)**
  - De-agglomerates activated carbon
  - Reduces carbon particle size, injects with longer residence time
  - Reduces carbon consumption rate
- **Chemical Addition (Alstom KNX™)**
  - Small amount of chemical added to coal prior to combustion
  - Enhances mercury oxidation, facilitating capture
  - No impact to ash
  - Greatly reduced materials handling and storage

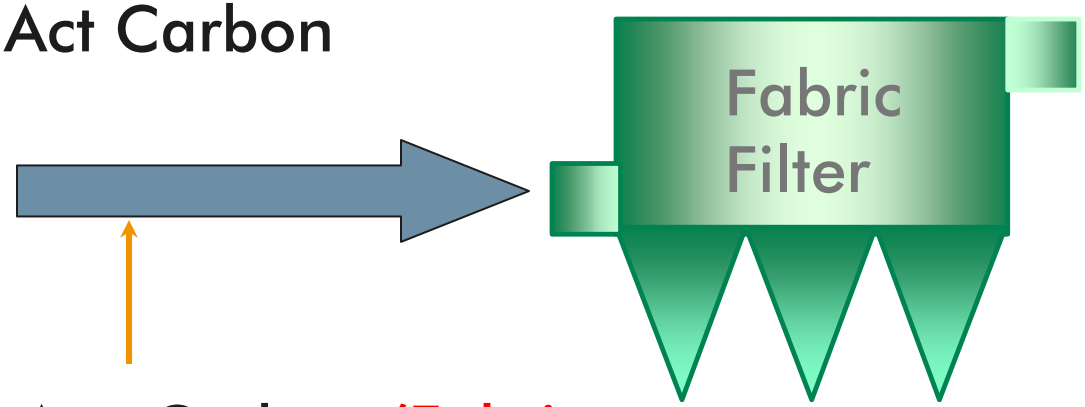
Filsorption™

aka, Activated Carbon Injection (ACI)

Simple Hg Sorbent Injection

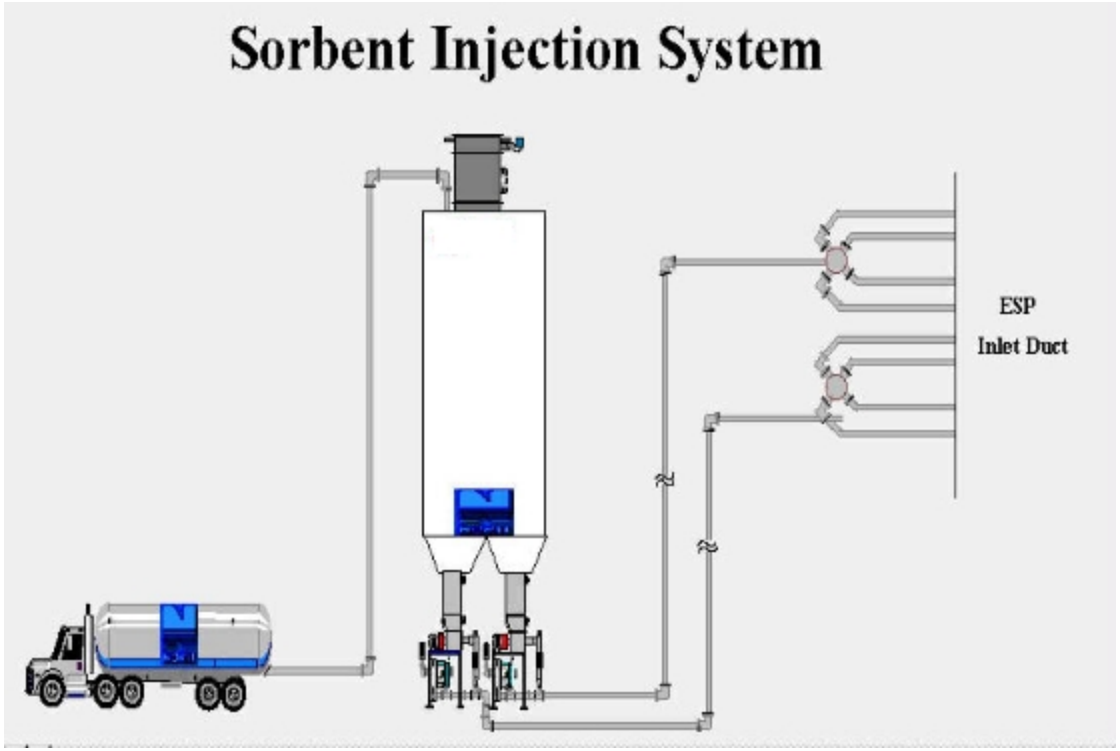


Act Carbon



Act. Carbon (Fabric Filter is 1/10 ESP Injection Rate)

Filsorption™ for Mercury Control

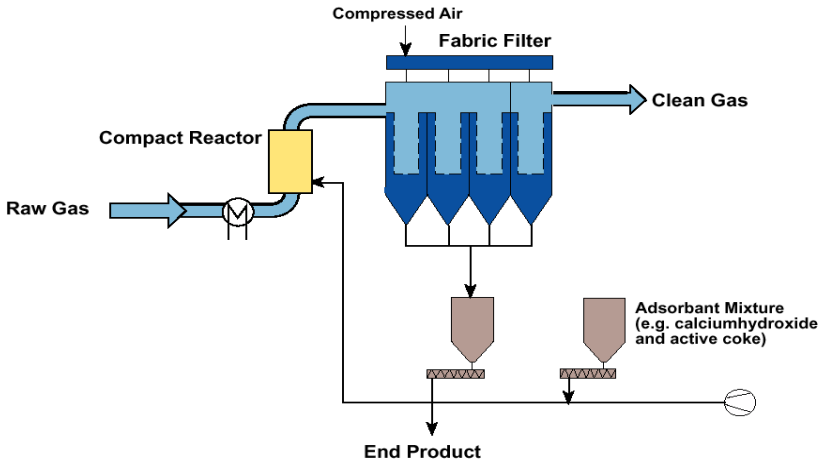


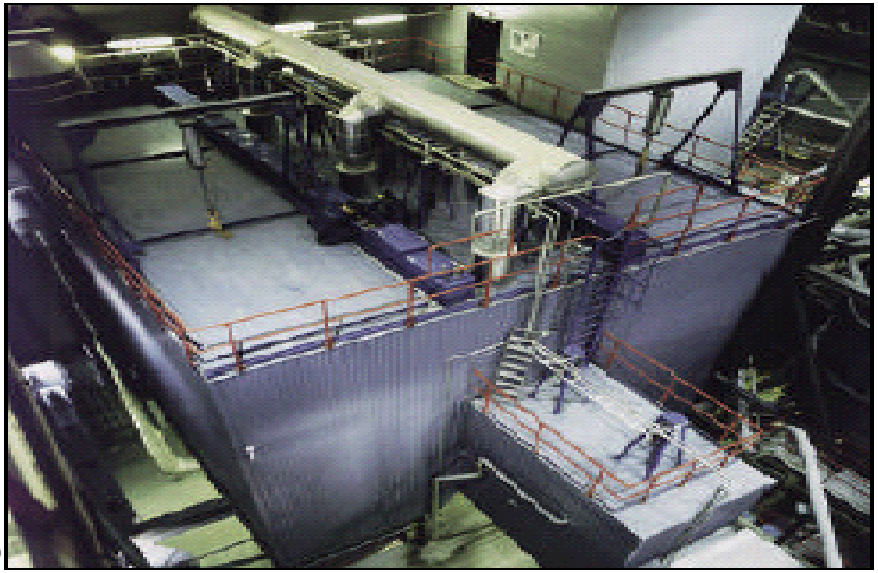
Filsorption™ Experience

•Commercialized mercury removal technology for the European WtE industry

- Installed 19 systems during early 1990s
  - Utilize activated carbon
  - ALL have operated reliably for more than 10 years
  - ALL achieve between 70 - 90% mercury removal
  - ALL capture both elemental and oxidized mercury

• Recent experience includes units where PAC is injected upstream of DFGD systems for mercury control.





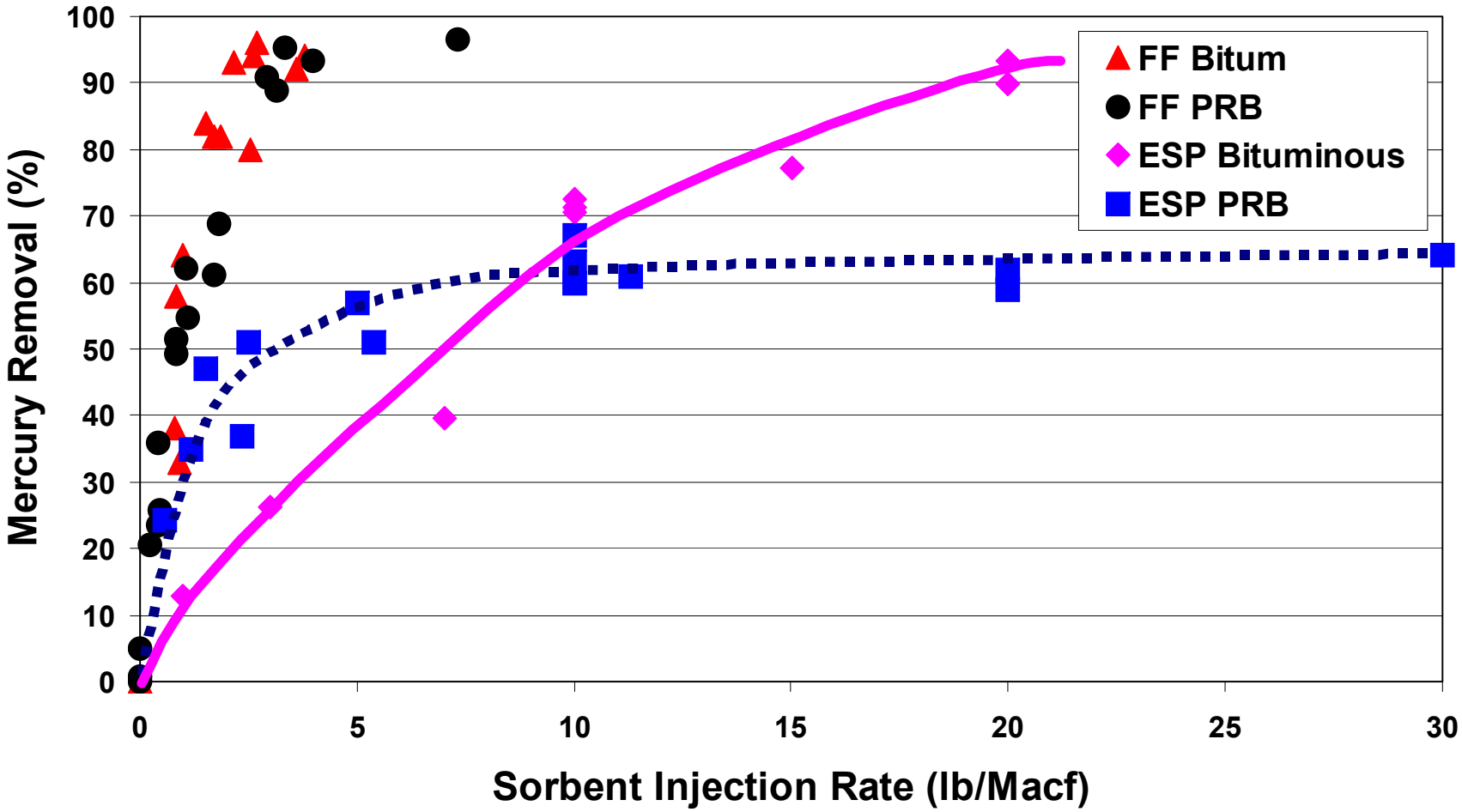
Recent Filsorption™ References

Unit	Size	Year	Configuration	Coal	Hg Control
Nebraska City 2	660 MW	2009	SDA/FF	PRB	B-PAC
Plum Point	665 MW	2010	SDA/FF	PRB	B-PAC
Springerville 4	400 MW	2009	SDA/FF	PRB	B-PAC
Mercer	2 x 325 MW	2010	SDA/FF	BIT	PAC
Hudson	650 MW	2011	SDA/FF	BIT	PAC

Recent additions:

Sandy Creek	800 MW	SDA/FF
Brayton Point	430 MW	NID/FF
Indian River	450 MW	NID/FF

Mercury Removal by Carbon



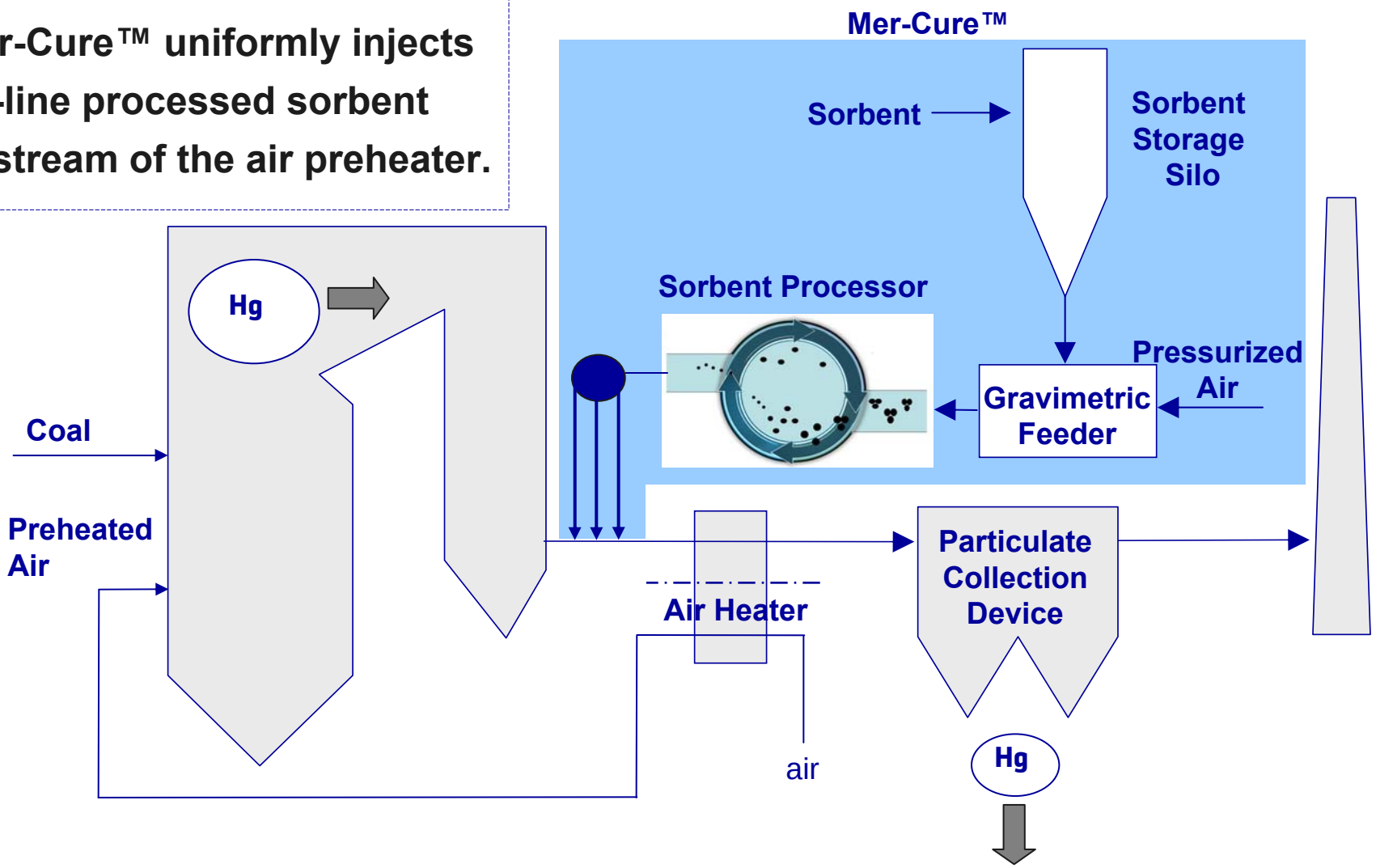
Mer-Cure™

What is Mer-Cure™?

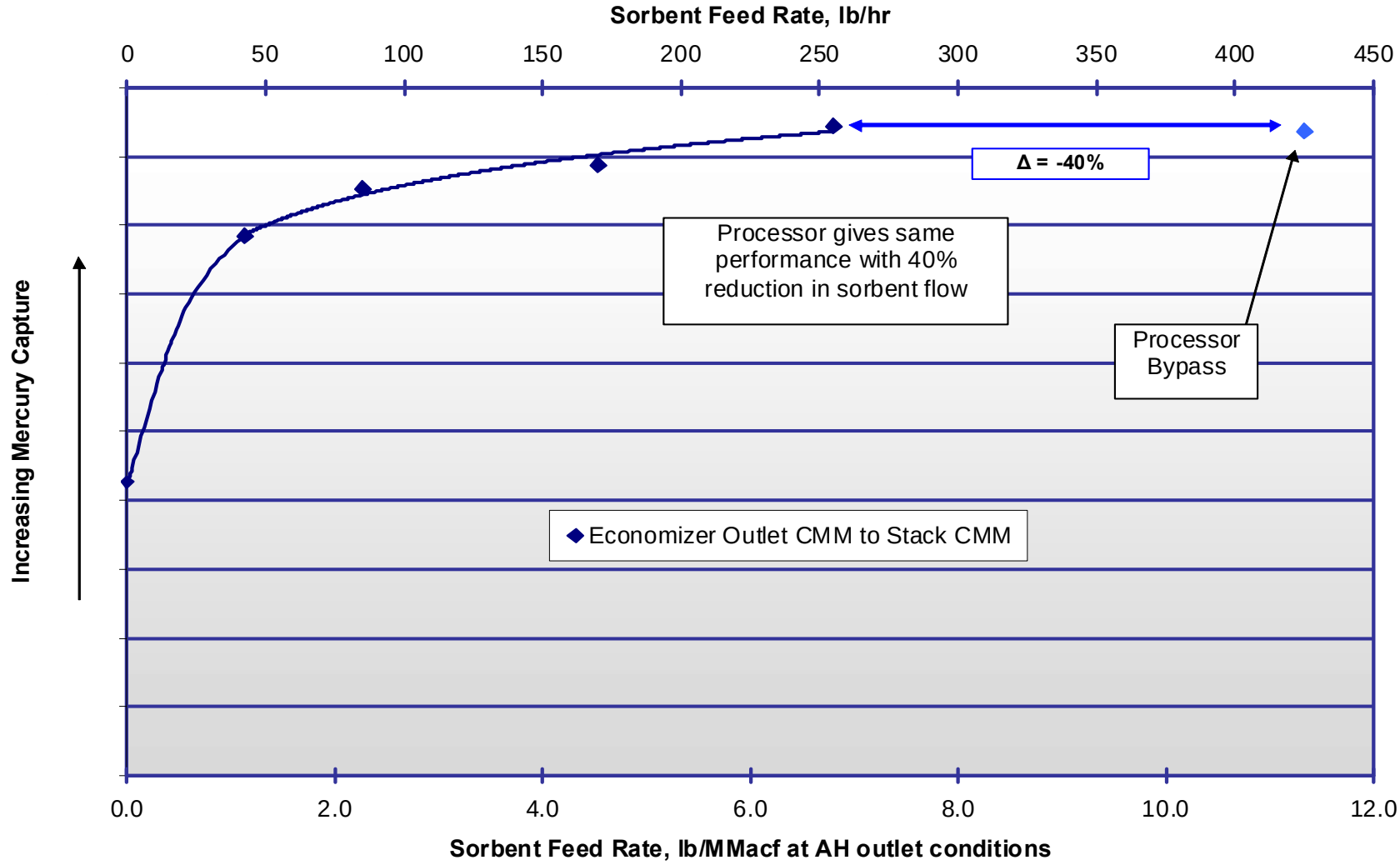
- **An advanced activated carbon injection system providing highly efficient performance…**
  - On-line processing of sorbent
  - De-agglomeration
  - Uniform dispersion
  - Maximum surface area
- **Injection upstream air heaters**
  - High temperature
  - Longer residence time
  - More internal duct area

Mer-Cure™ System Technology

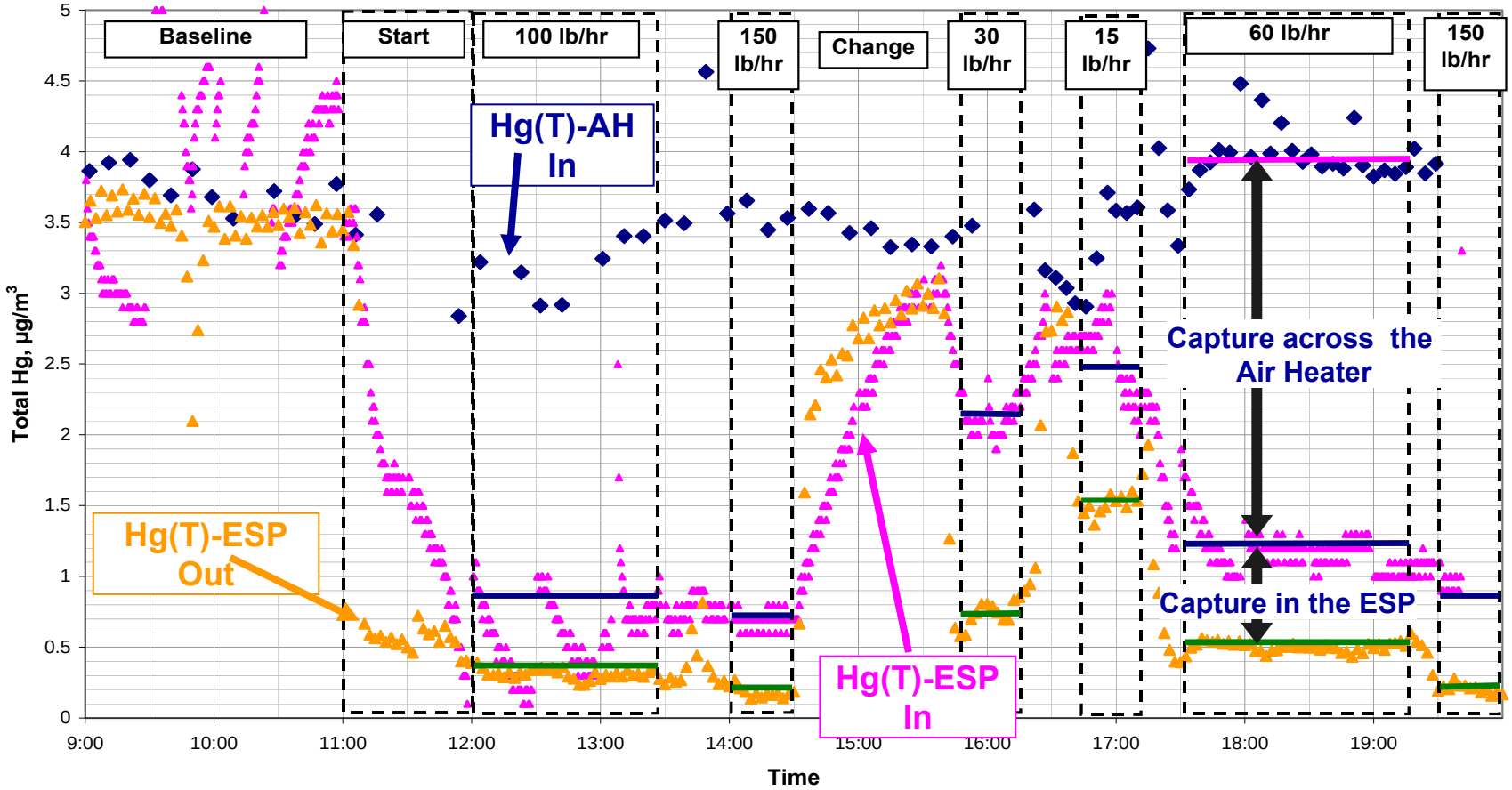
Mer-Cure™ uniformly injects on-line processed sorbent upstream of the air preheater.



Hg Reduction vs. Sorbent Injection Rate with & w/o Processor



Significant Portion of Mercury Captured Across the Air Heater



- **Enhanced utilization of on-line processed sorbent with Mer-Cure™ technology combined with high temperature injection before the air heater**

Aerial View – Erected Mer-Cure™ Silos At Colstrip Power Station (2100 MWe)

Pre-Retrofit Total Stack Hg Levels at Colstrip

- Units 1 & 2 – 3 to 8 lbs/Tbtu
- Units 3 & 4 – 5 to 10 lbs/Tbtu

Summary of Total Stack Hg
Colstrip Units 1, 2, 3 and 4 (Feb. 2010)

	U1	U2	U3	U4	Site Average
Total Hg lb/TBTU	0.88	0.69	0.85	1.01	0.86

Conclusion : Colstrip meeting state of Montana compliance limit of 0.9 lb/Tbtu total stack Hg with Mer-Cure™ using approximately 50% of PAC required by traditional sorbent injection systems

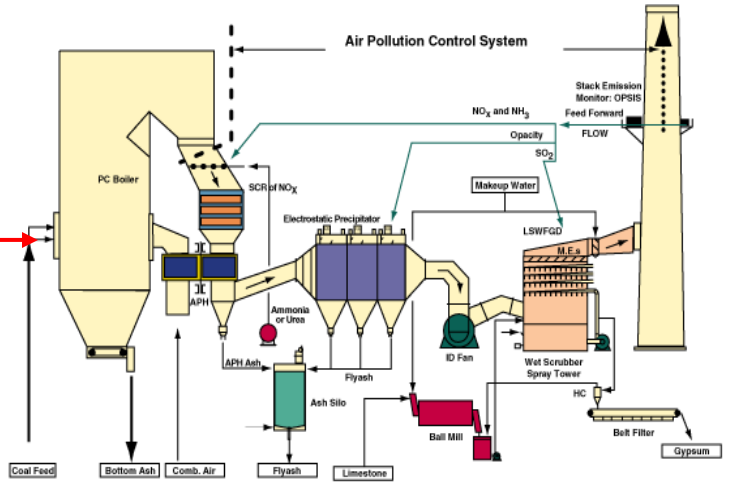
KNX™

KNX™ for Hg Removal

- "KNX™" is the ALSTOM trade name for a technology where a bromine-containing chemical is added to the coal, prior to the combustion process, to enhance mercury oxidation
  - Invented in Germany by Professor Vosteen
  - Protected by US and German Patents
- ALSTOM has licensed exclusive rights to the technology from Vosteen Consulting of Germany to market to the power generation industry in the US and Canada. Alstom charges one-time License fee

Design of the KNX™ Injection System

Control box



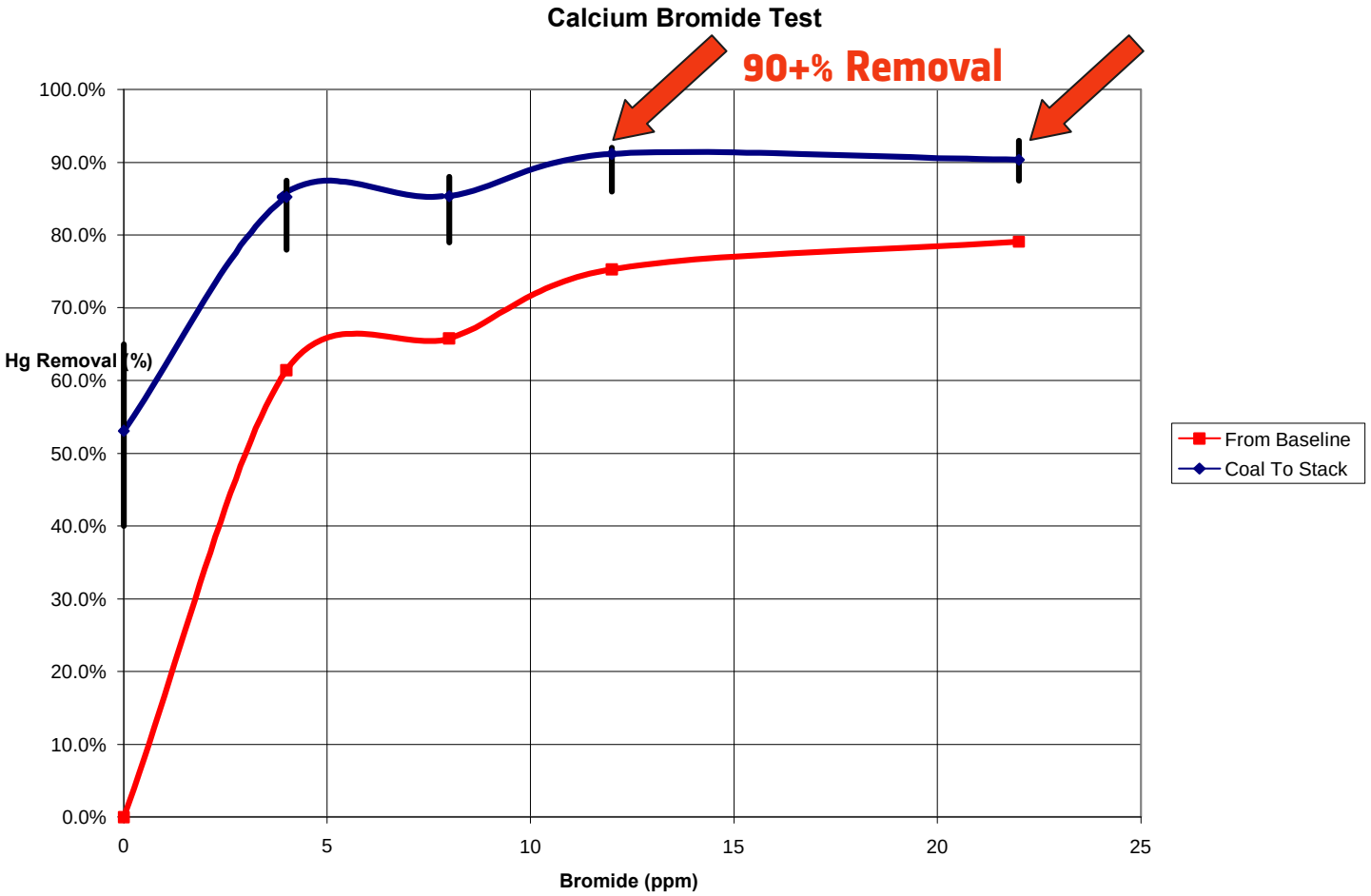
- $CaBr_2$ 52 wt% water solution
- Adjustable pumps and hosing
- Spray header with nozzles
- Control box

KNX™ Injection System is simple and requires minimal capital expenditure

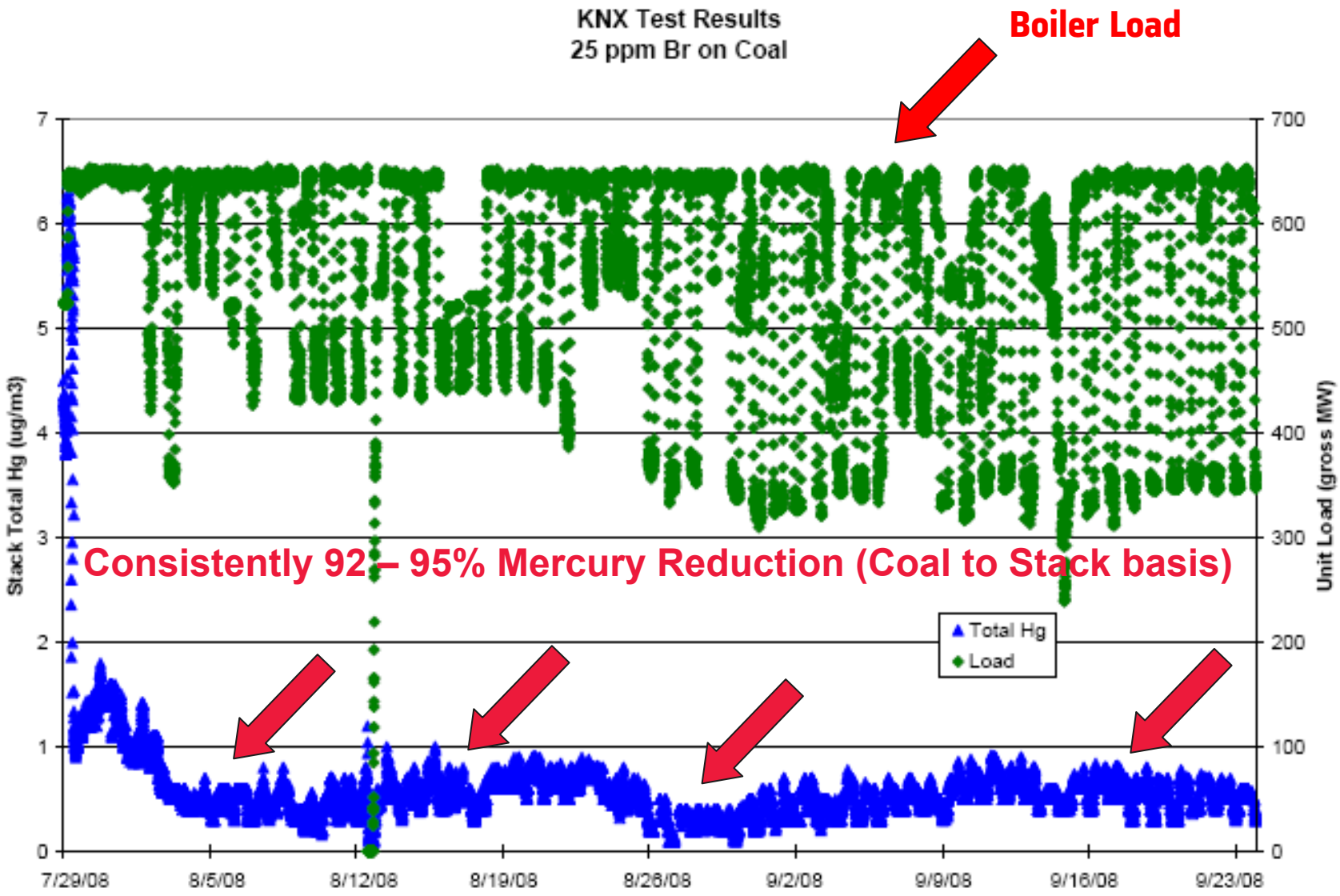
Any effects in the boiler?

- There are no known negative effects of the naturally occurring Br levels in US coals in the range 0-100 ppm.
- It is known that Cl content in fuel over 1000 ppm may increase high temperature corrosion of superheaters.
- Adjusting Br content of coal up to 100 ppm by KNX™ corresponds to less than 10% of lower threshold of high temperature corrosion.

Effect of KNX™ on both Incremental and Total Mercury Removal.

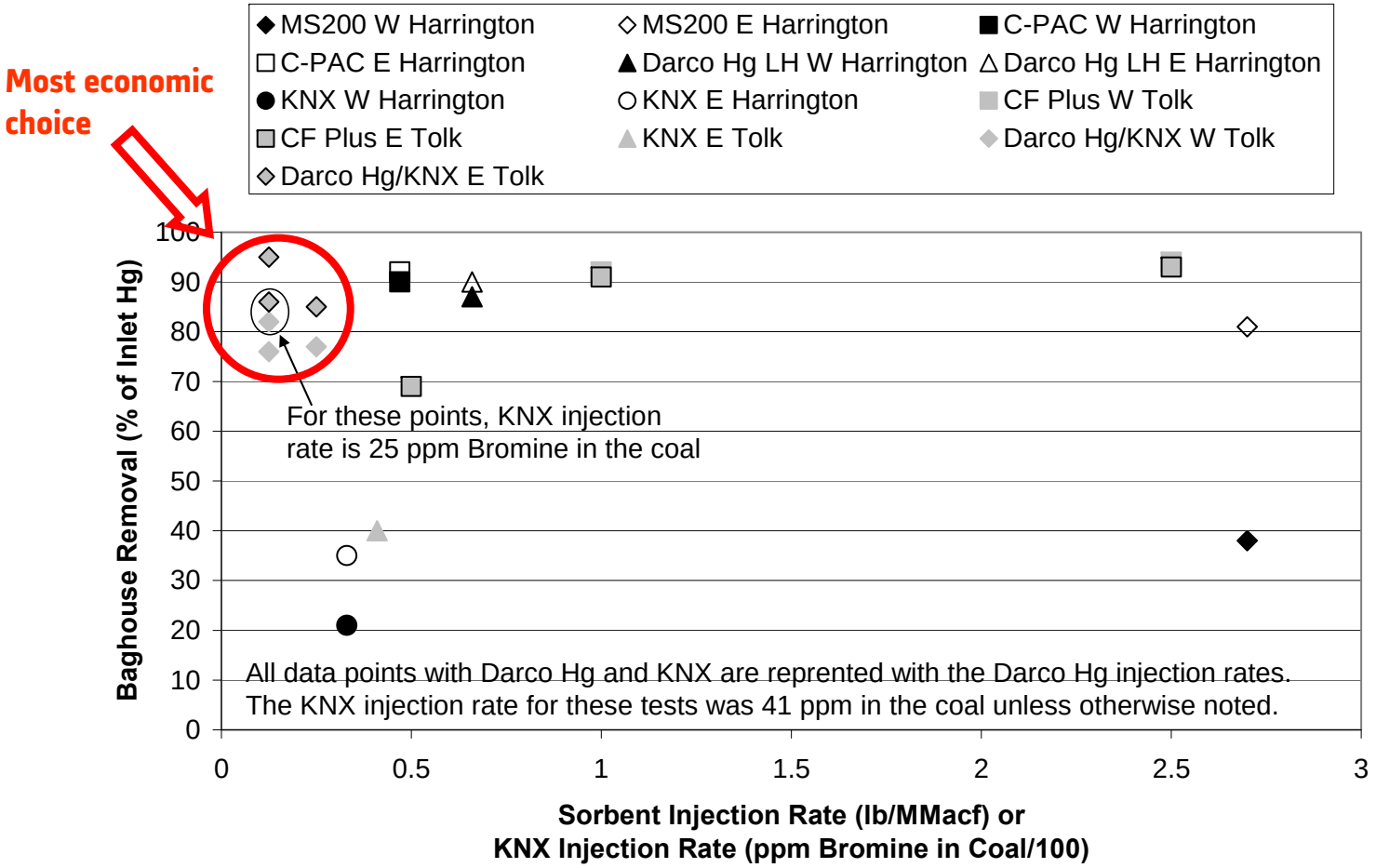


Long-Term KNX Test Results – 600 MW



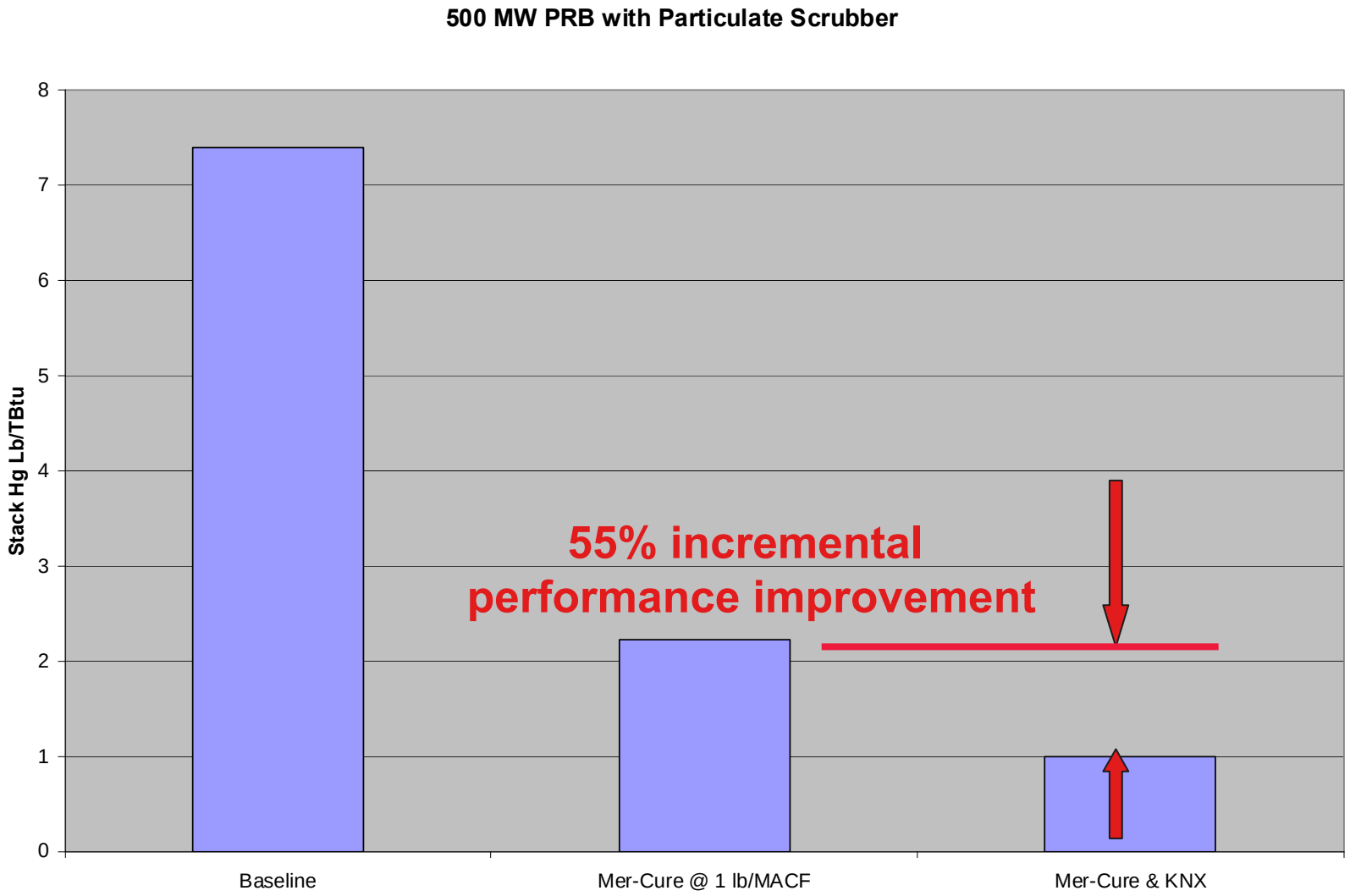
KNX™ + Limited ACI is Very Effective

350 MW PRB unit with FF only



Ref: Dutton, MEGA 2008

Synergistic Effect of KNX™ + Mer-Cure™



KNX™ Summary

- KNX™ is a cost-effective method to enhance mercury oxidation in flue gases from coal-fired boilers.
- The KNX™ technology is simple and inexpensive to retrofit to any plant.
- The KNX™ technology presents no known adverse impacts on the performance of the plant.

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