

# KNX Technology for mercury control from coal-fired boilers

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# Outline

- KNX.....What is it?
- How does it work?
- Field demonstration results
- Conclusions

# ALSTOM Technology Portfolio

- There is no “one-size-fits-all” solution for mercury control
  - Each plant has its own unique opportunities
- ALSTOM has developed diverse mercury control options in order to meet unique challenges of customers
  - Particulate control + activated carbon injection - **Filsorption™**
  - Enhanced sorbent injection - **Mer-Cure™**
  - Coal additive for Mercury oxidation - **KNX™**

# What is KNX Technology?

- “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 by Dr. Bernhard Vosteen in Germany and commercially applied to waste incineration plants since 2001.
- Protected by US, Canadian and European Patents

# KNX Technology

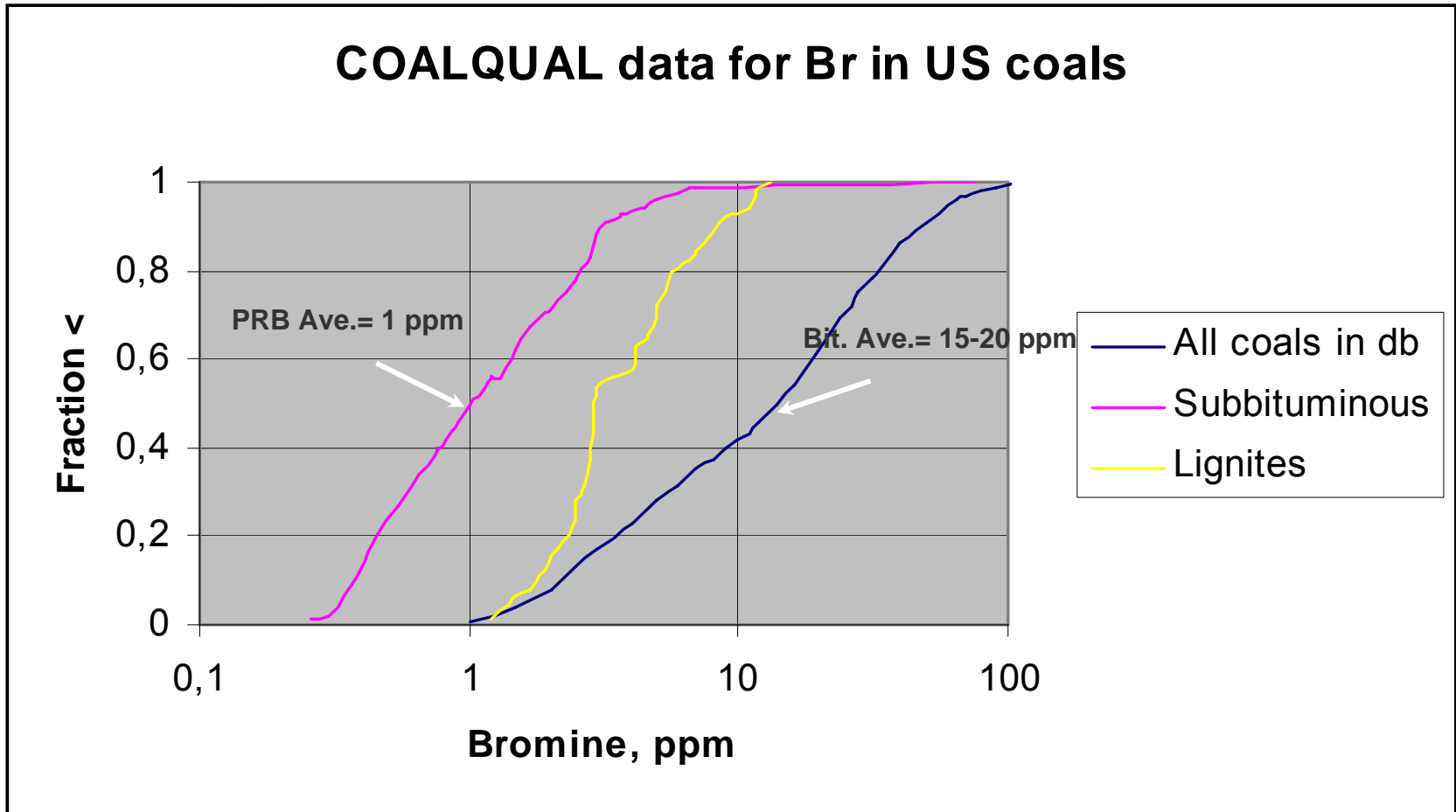
- ALSTOM has licensed exclusive rights to the technology from Vosteen Consulting of Germany to market to the power generation industry in the US and Canada.
- The chemical is readily available on the commercial market from 3 different suppliers.
- Its use must be licensed from Alstom....one time license fee
- Provides high levels of mercury oxidation which facilitates mercury capture.

# The KNX™ Technology

## What makes it unique?

- Pre-combustion bromide addition is the most effective method to enhance mercury oxidation from coal-fired boilers and industrial processes
- Bromide compounds are already used by the power generation industry; they are cost-effective and readily available in the US
- The KNX Technology presents no adverse impacts on the performance of the boiler or downstream air pollution control equipment
- The KNX Technology is simple and inexpensive to retrofit to any boiler

# Coals vary widely in Inherent Bromine Content



Low Bromine in some coals makes Hg capture difficult

# Mercury Oxidation Chemistry

➤ In the flame all Hg is Hg(0) and Cl and Br form HCl and HBr.

➤ On cooling (starting around 1000 deg F):



➤  $\text{Cl}_2$  (but not  $\text{Br}_2$ ) is consumed by  $\text{SO}_2$



➤ Result is that although total Cl  $\gg$  total Br,  $\text{Br}_2 > \text{Cl}_2$

➤ And that  $\text{Hg} + \text{Br}_2 \rightarrow \text{HgBr}_2$  dominates oxidation when  $\text{SO}_2$  is present

**Therefore: In low Chlorine coals (e.g. PRB)**

**Bromine is the critical factor for Hg oxidation**



# How is KNX added?

- Simplest way is to spray KNX solution on the coal on the conveyor belt during silo charging.
- Another way is to spray the KNX solution on the coal stream from the coal feeders to the mills
- Process Requirement: Uniform distribution of additive in boiler flue gas in order to provide uniform Hg oxidation of all flue gas.

# Typical addition points

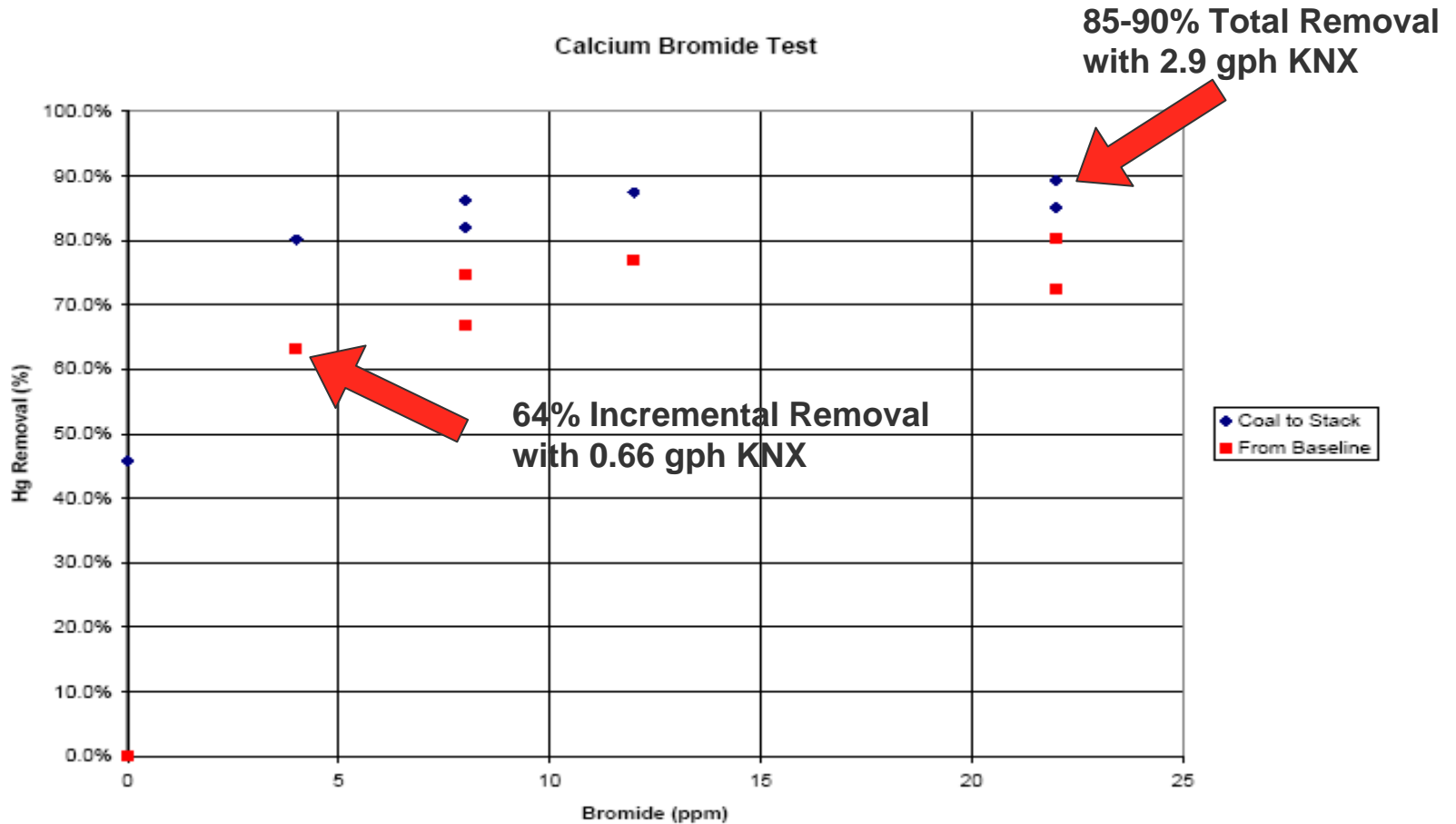


Coal Belt



Coal Feeder

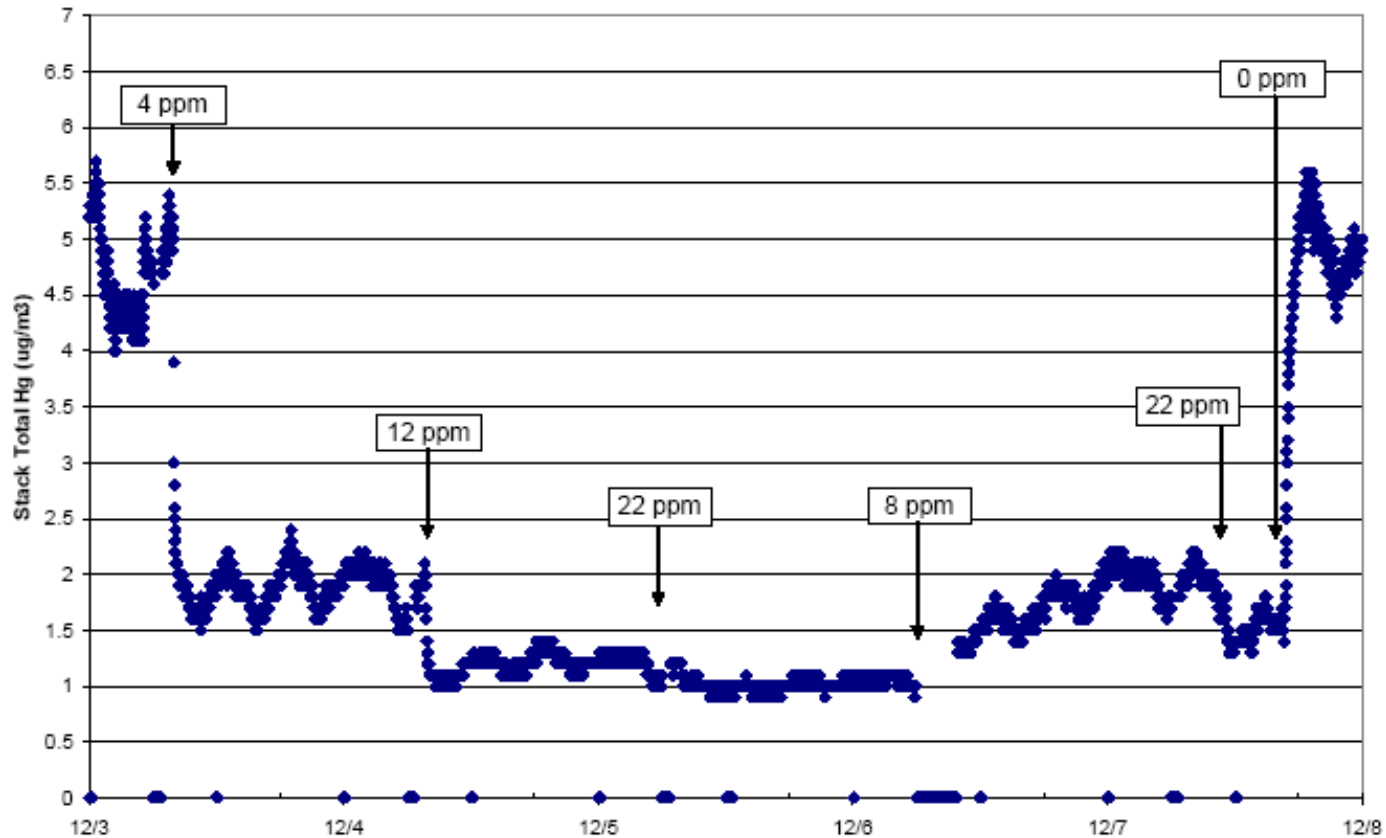
## 600 MW PRB/SCR/ESP/WFGD Results



Preliminary data

# 600 MW PRB/SCR/ESP/WFGD Results

## Calcium Bromide Injection Test

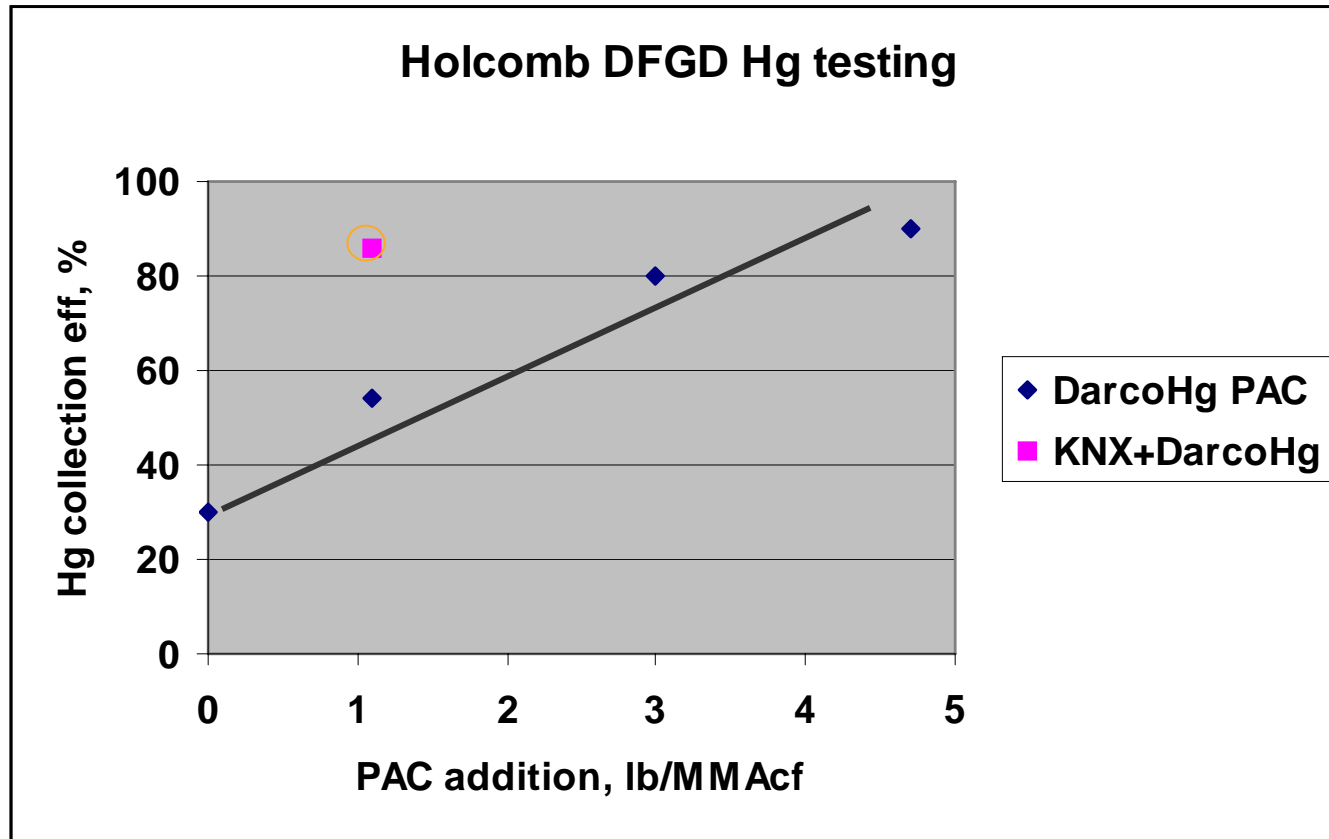


Preliminary data

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# KNX is also Effective in dry Collection Systems



For Units with LOI, KNX + a little ACI may be most economical solution

# Demonstrations of the KNX Technology

- Commercially applied on several WTE projects in Germany since 2001
- The KNX technology has been demonstrated under DOE and EPRI projects at numerous sites combusting PRB and Bituminous coals:
  - Sunflower Power, Holcomb Station
  - Ameren UE, Meramec Station
  - Basin Power, Laramie River Station
- Demonstrations at several potential customer sites.
- Other demonstrations of Br application (Southern Co/Plant Miller)
- The KNX technology will continue be demonstrated in full-scale at additional sites in the United States and Canada in the coming months
  - Covering a wide variety of coals
  - Covering a broad sample of APC configurations

# KNX to ACI Comparison

- Simplified handling and storage
  - small tank, pumps, flow measurement
- Simplified reagent distribution
  - uniform distribution in flue gas via the boiler
- Greatly reduced ash issues compared to ACI
  - does not add to carbon content of ash
  - no impact on AEA
  - need to test compressive strength

# Summary

- KNX addition 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.
- Mercury removal efficiency is in some cases limited by reemission of Hg. Additional research underway.



# For more detailed technical presentations

## ***KNX for Mercury Control***

J. Buschmann, L. Lindau, B. Vosteen

CoalGen Aug. 07, PowerGen, Dec. 07

## ***Mercury Control Evaluation of Calcium Bromide Injection into a PRB-Fired Furnace with an SCR***

Mark Berry, K. Dombrowski, Ramsay Chang

Air Quality VI, September 2007

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**Thank you**

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