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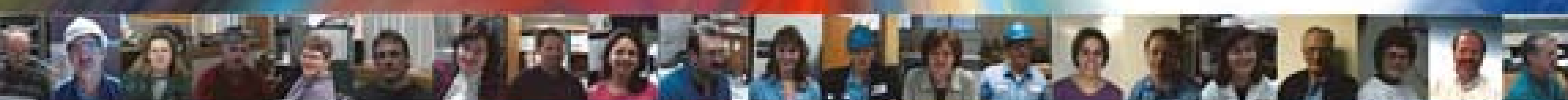
EERC Technology – Putting Research into Practice

Mercury Control Technologies for Electric Utilities Burning Subbituminous Coals

Steve Benson, Don McCollor, Jill Zola, Mike Holmes, and John Pavlish



U.S. DOE/NETL's
Mercury Control Technology R&D Program Review
Pittsburgh Airport Hyatt Hotel
July 14-15, 2004

Members of the Subbituminous Consortium

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Project Goal

- The overall objective is to test advanced, innovative mercury control technologies to reduce mercury emissions from subbituminous-fired power plants by >50% at costs of one-half to three-quarters of current estimated costs.

Specific Objectives

- Mercury oxidation for increased Hg capture in dry scrubbers.
- Incorporation of additives and technologies that enhance Hg sorbent effectiveness in ESPs and baghouses.
- Use of noncarbon sorbents for Hg capture.
- Impacts of blending subbituminous and bituminous coals on elemental Hg oxidation.

Project Plan

- Task 1 – Mercury Control Enhancement for Unscrubbed Systems
- Task 2 – Mercury Control in Dry Scrubbers
- Task 3 – Blending of Subbituminous and Bituminous Coals to Enhance Mercury Oxidation
- Task 4 – Reporting and Management

Preliminary Data

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Project Status

- Pilot testing and data analysis is ongoing.
- Results of ESP-only testing will be presented today.

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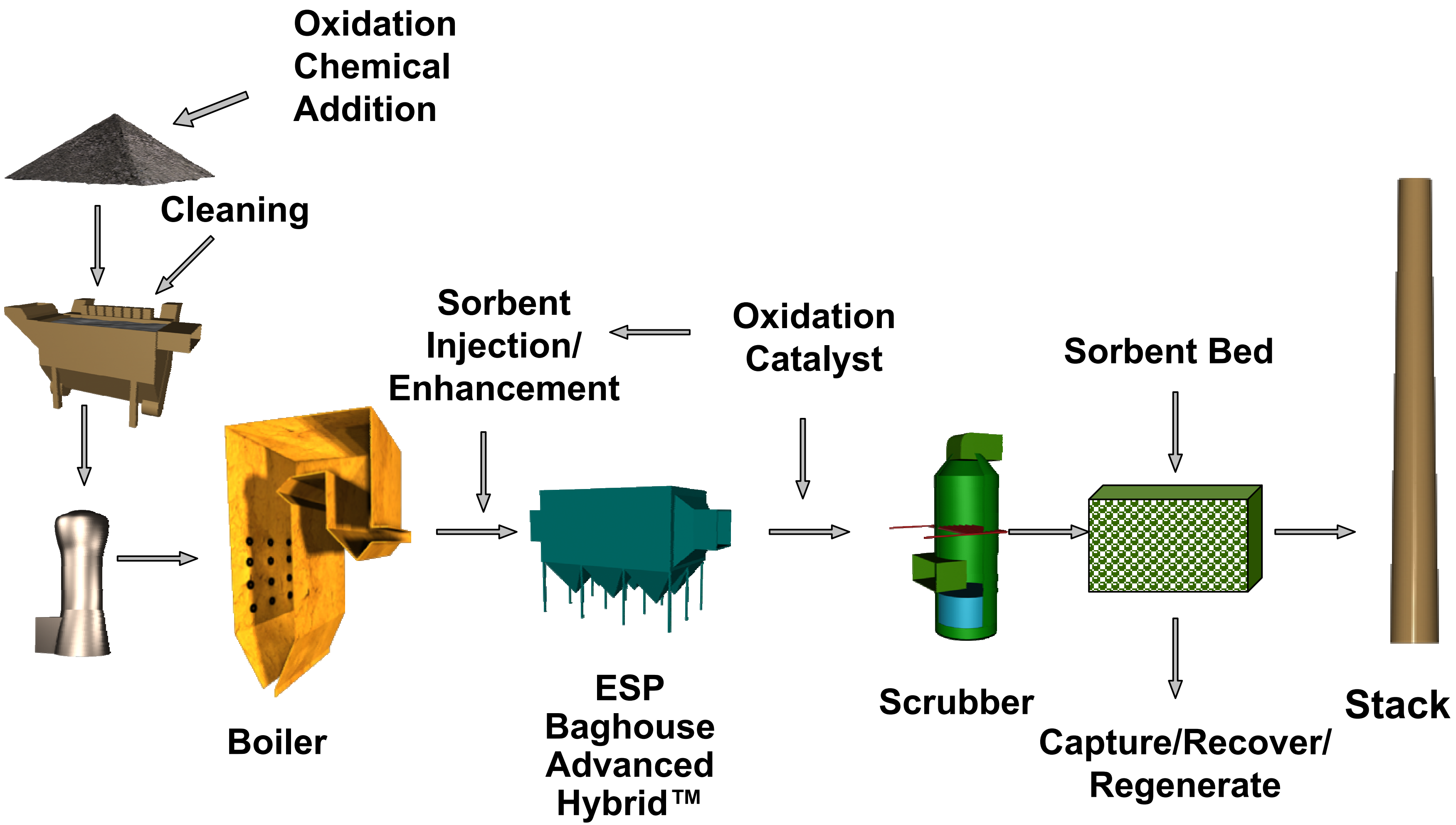
Mercury Control Options



Potential Mercury Reduction Technologies to be Tested

- NORIT FGD
- EERC treated carbon
- Sodium tetrasulfide
- Washington University (TiO_2)
- WRI heat-treated coal
- Demeter Systems – IPE treated coal
- Solucorp additive
- SEA1 – $CaCl_2$ or NaCl
- SEA2 – Confidential oxidizing agent

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Pilot-Scale Test Equipment and Analytical Capabilities

- Combustion system and environmental control equipment
  - Particulate test combustor (PTC)
    - ESP
    - Baghouse
    - Spray dryer
- Measurement
  - Ontario Hydro (OH)
  - Continuous mercury measurement systems
  - Trace element analysis

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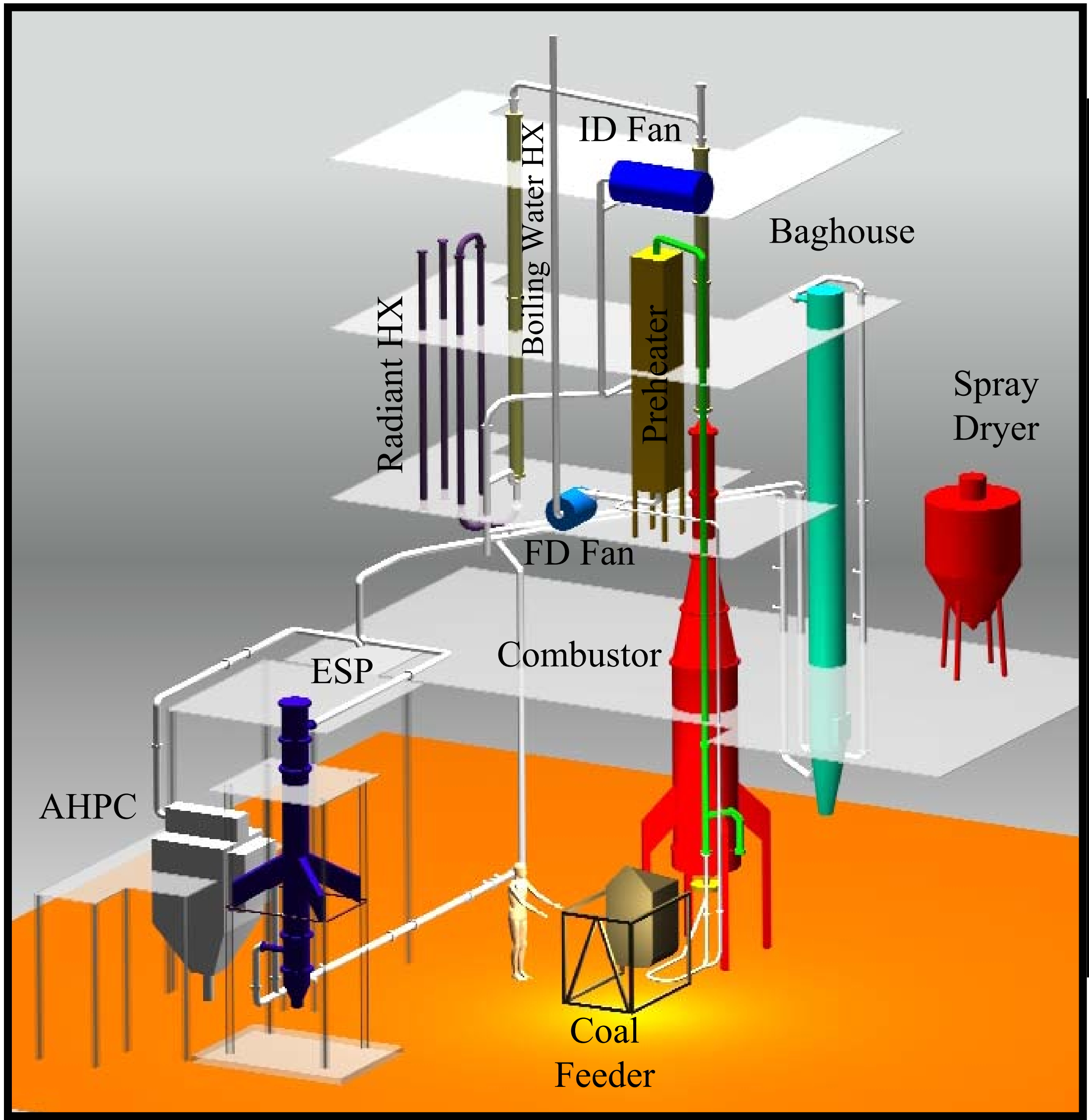
PTC Suite



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Mercury Control Enhancement for Unscrubbed Systems – ESP-Only

- Evaluate and further the ability to control Hg emissions in subbituminous-fired power plants equipped with an ESP
- Two subbituminous coals with sorbent and enhanced sorbent injection
- Oxidation agents – Hg oxidation and sorbent enhancement agent

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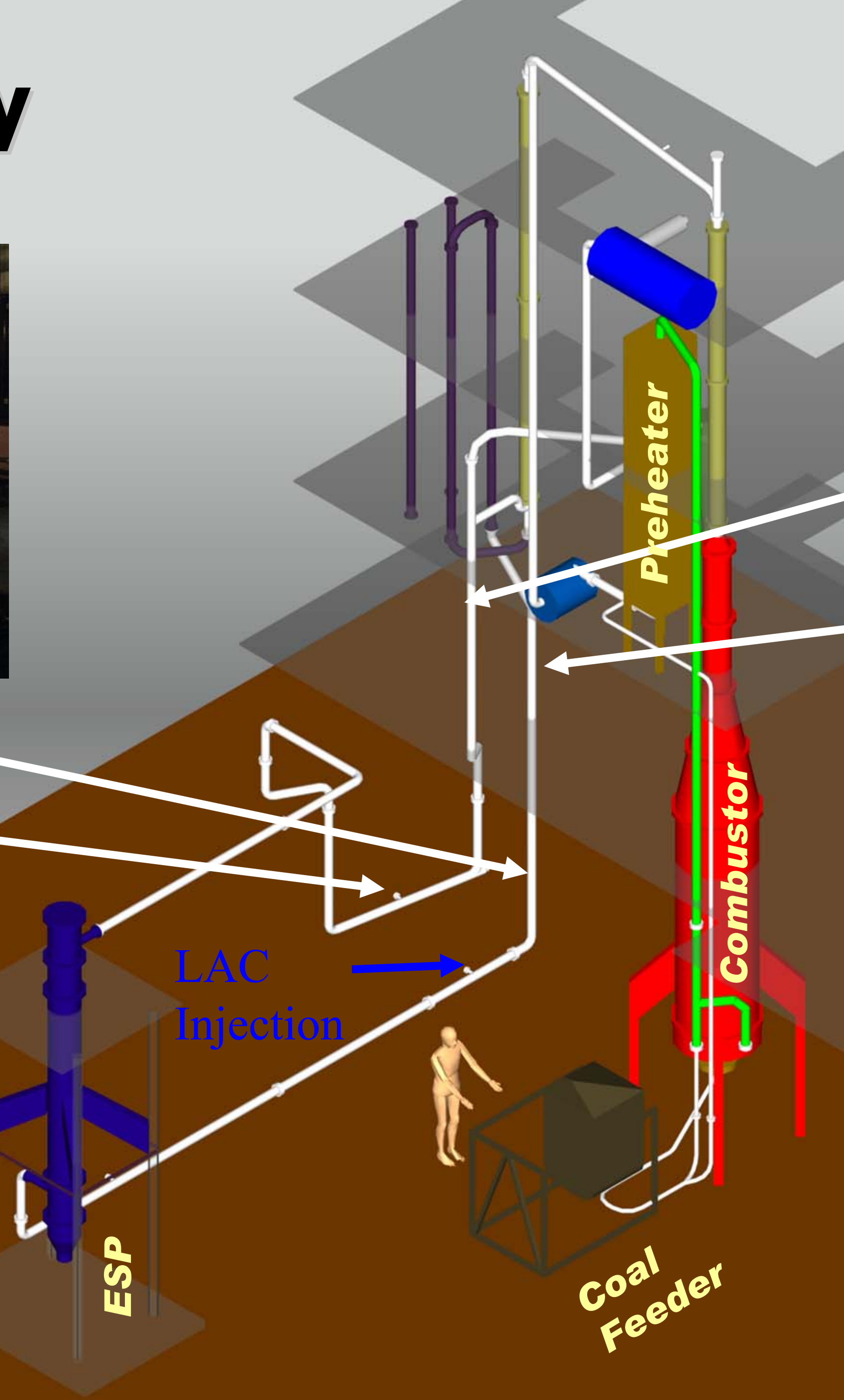
PTC ESP-Only



Outlet CMM
Inlet CMM
Inlet OH
Outlet OH
LAC
Injection
Preheater
Combustor
ESP
Coal
Feeder

Coal A Characteristics (Week 1 Test Composite)

- Proximate analysis (as received)
  - Moisture 28.3%
  - Volatile matter 34.4%
  - Fixed carbon 32.6%
  - Ash 4.7%
- Heating value: 8739 Btu/lb
- Hg 0.099 ppm
- Cl 18 ppm

- Ultimate analysis (as received)
  - Hydrogen 6.6%
  - Carbon 48.7%
  - Nitrogen 0.9%
  - Sulfur 0.4%
  - Oxygen 38.7%
  - Ash 4.7%

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Coal B Characteristics

- Proximate analysis (as received)
  - Moisture 20.7%
  - Volatile matter 33.4%
  - Fixed carbon 37.4%
  - Ash 8.5%

- Heating value: 9020 Btu/lb
- Hg 0.04 ppm
- Cl 5.7 ppm

- Ultimate analysis (as received)
  - Hydrogen 5.7%
  - Carbon 52.2%
  - Nitrogen 0.9%
  - Sulfur 0.6%
  - Oxygen 32.0%
  - Ash 8.5%

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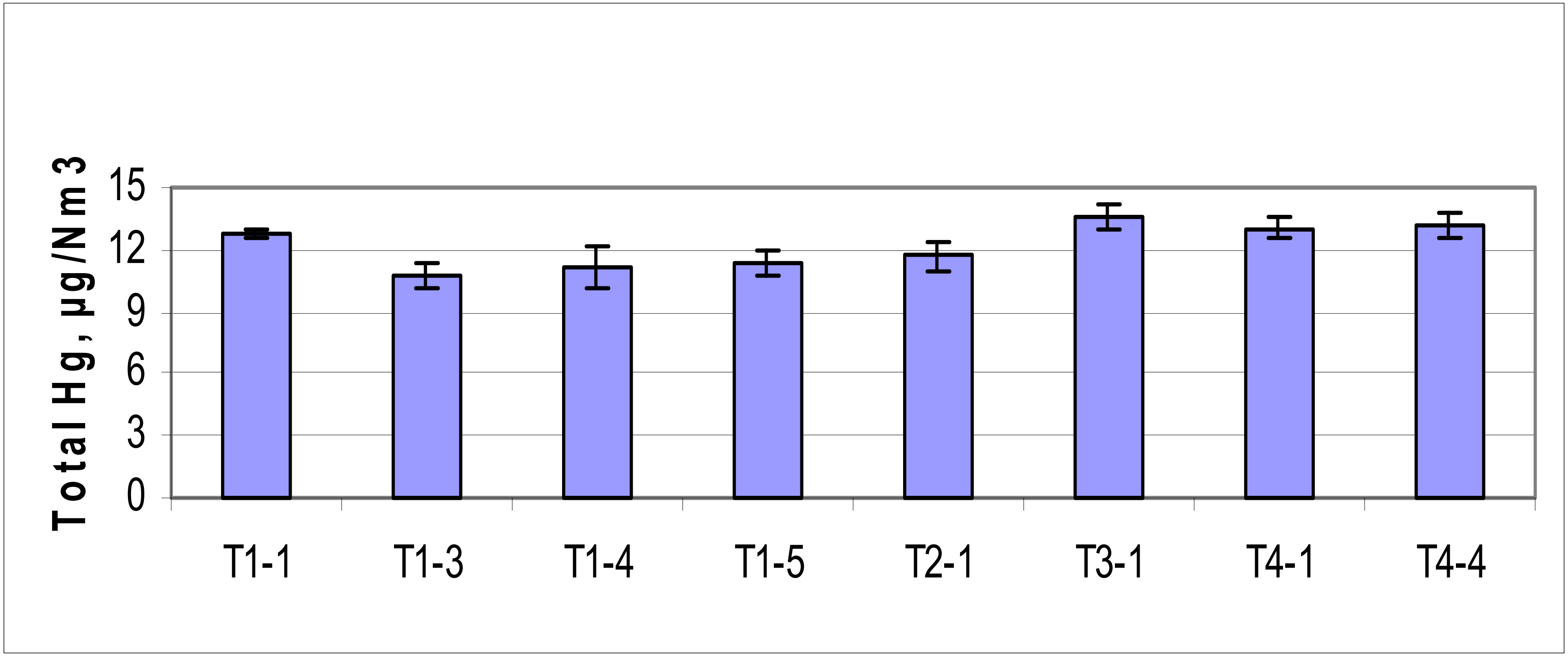
Baseline Total Mercury – Subbituminous A



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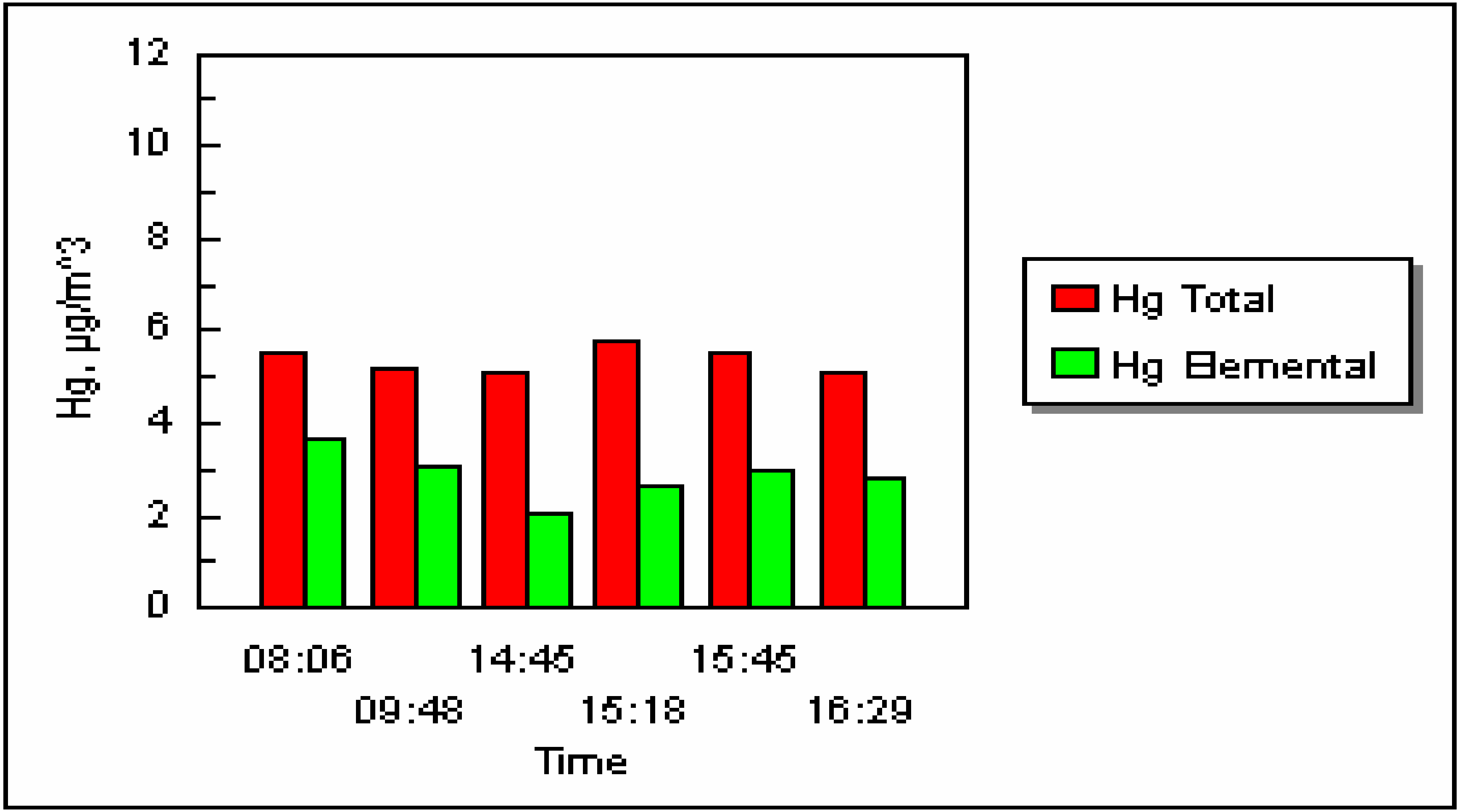
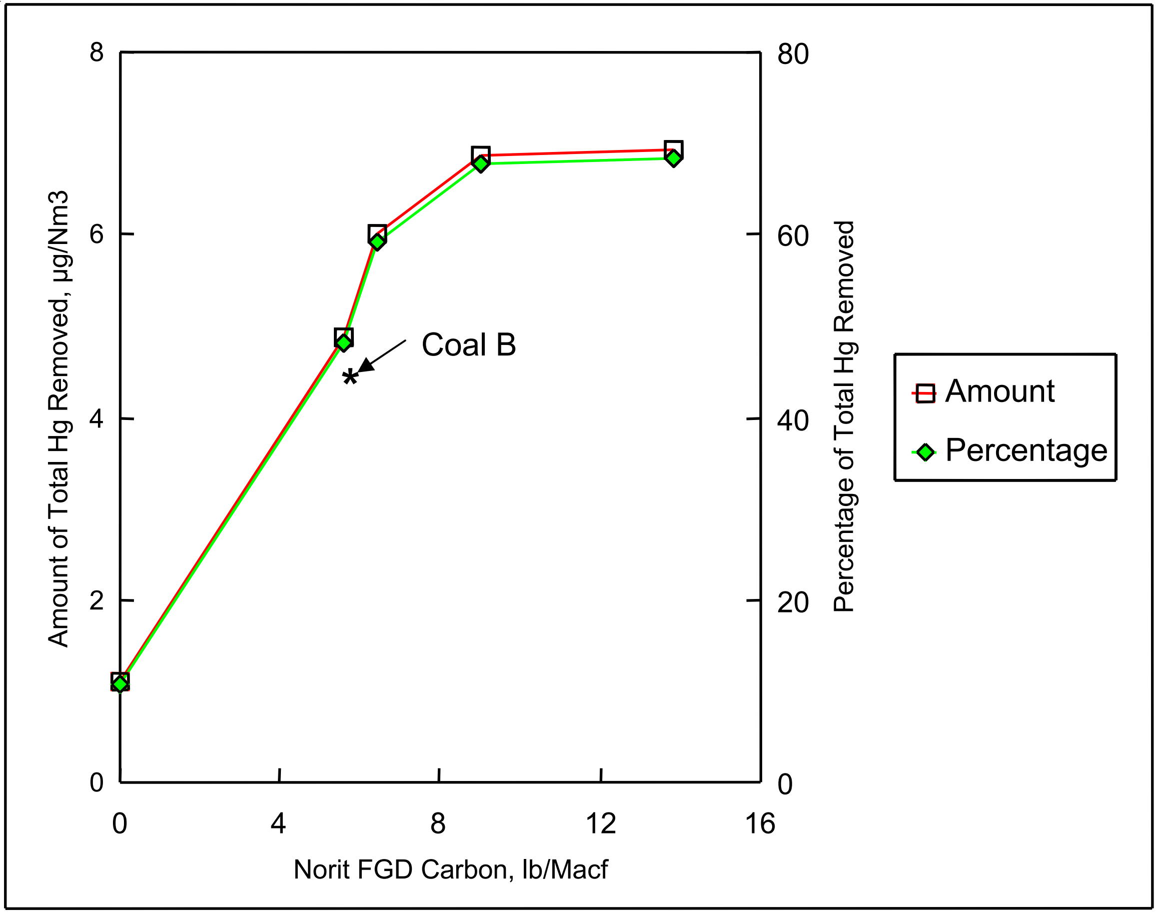
Baseline Mercury Forms – Subbituminous B



Mercury Removal ESP-Only – Coal A NORIT FGD Carbon Injection



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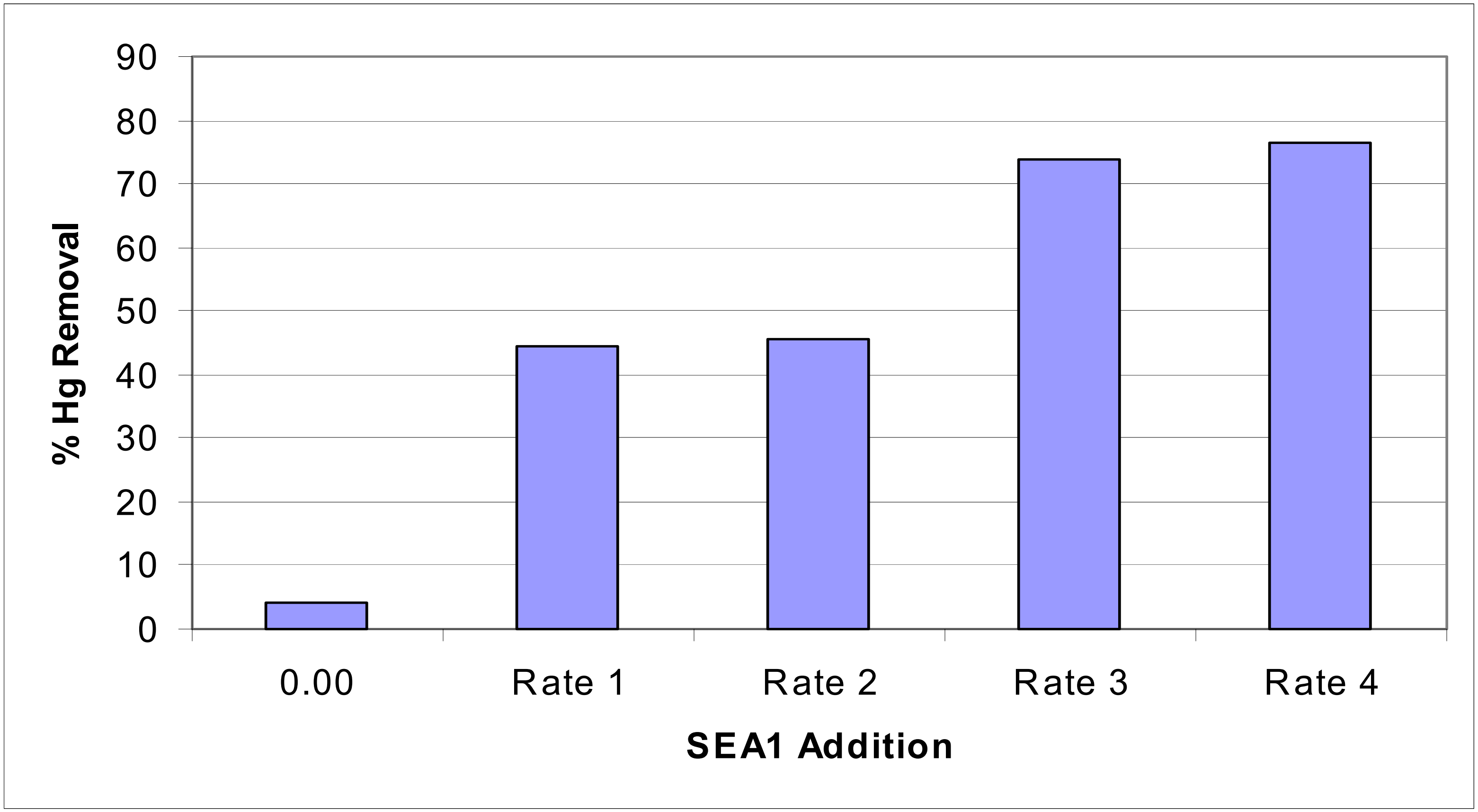
Mercury Removal ESP-Only – Coal A
SEA1 with Activated Carbon



SEA Rates: R2=2*R1, R3=3*R1, R4=4*R1

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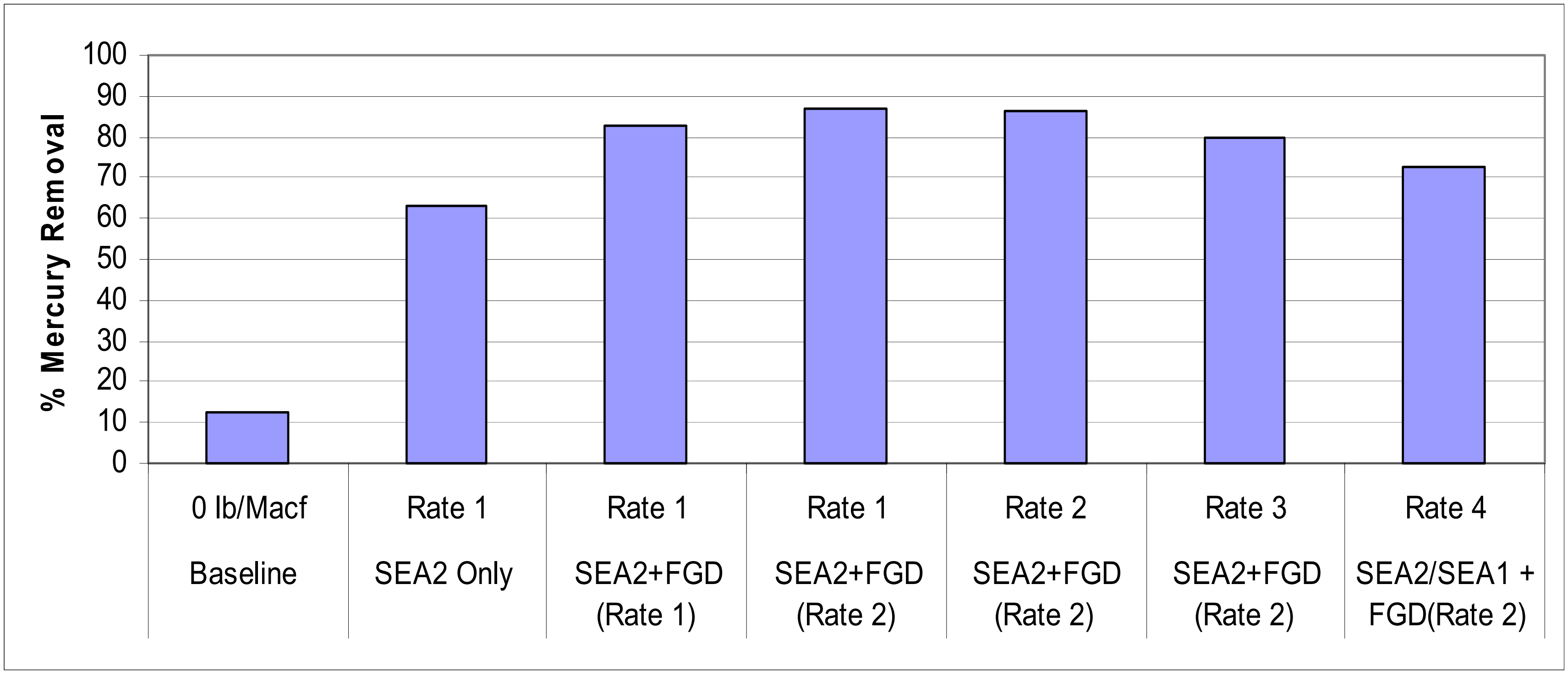
Mercury Removal ESP-Only – Coal A

SEA2-Only and with Activated Carbon and SEA1



SEA Rates: R2=.7R1, R3=.4R1, R4=.3R1

FGD Rates: R2=.7R1

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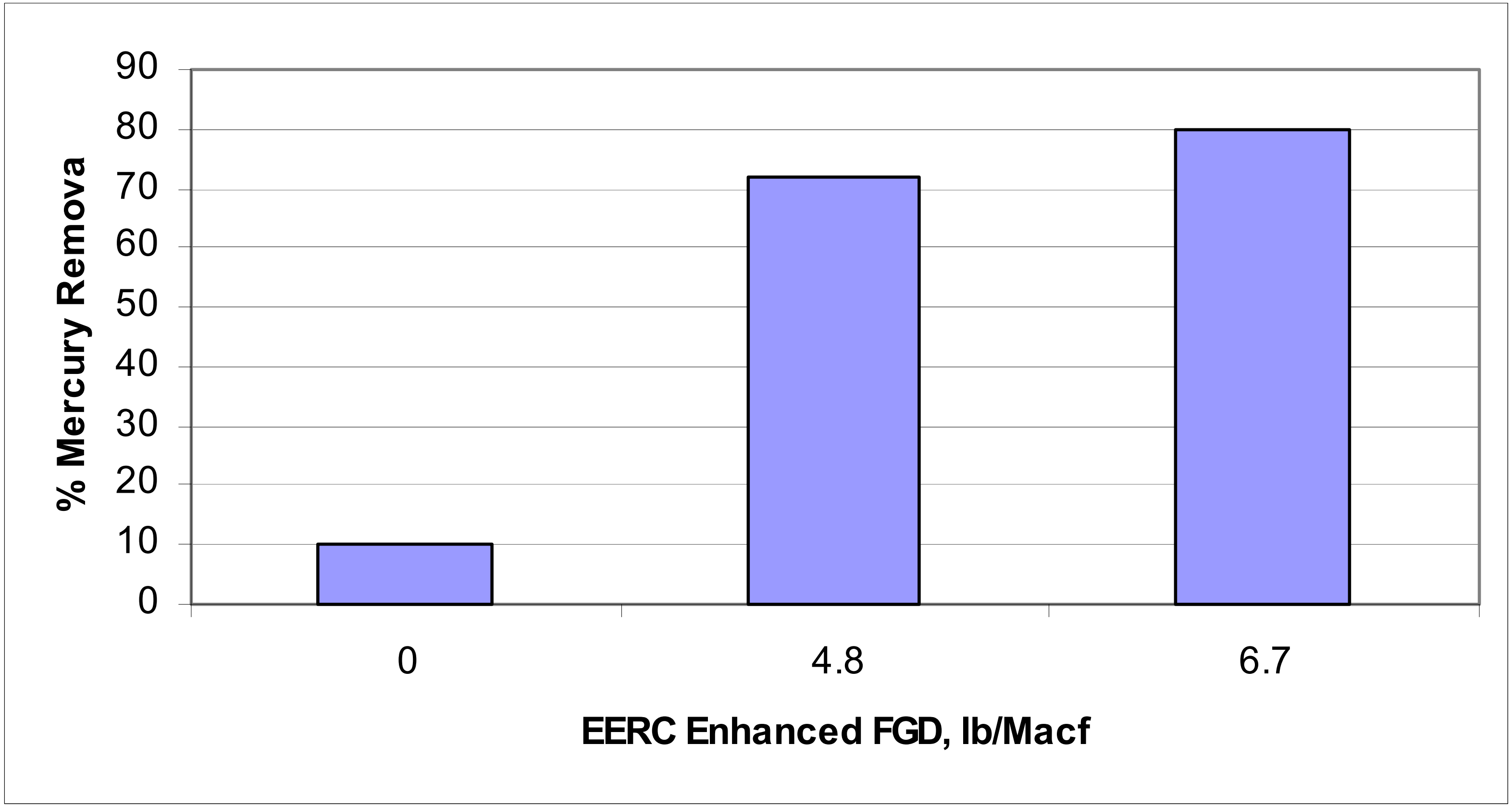
Mercury Removal ESP-Only – Coal A Enhanced Carbon



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Effect of NORIT FGD on ESP Performance

- Aerodynamic particle sizer operated at ESP exit
  - No significant difference in exit particle size distribution with and without NORIT FGD.
  - ESP cleanliness outweighs any effect of sorbent on particle-size distribution and loading.

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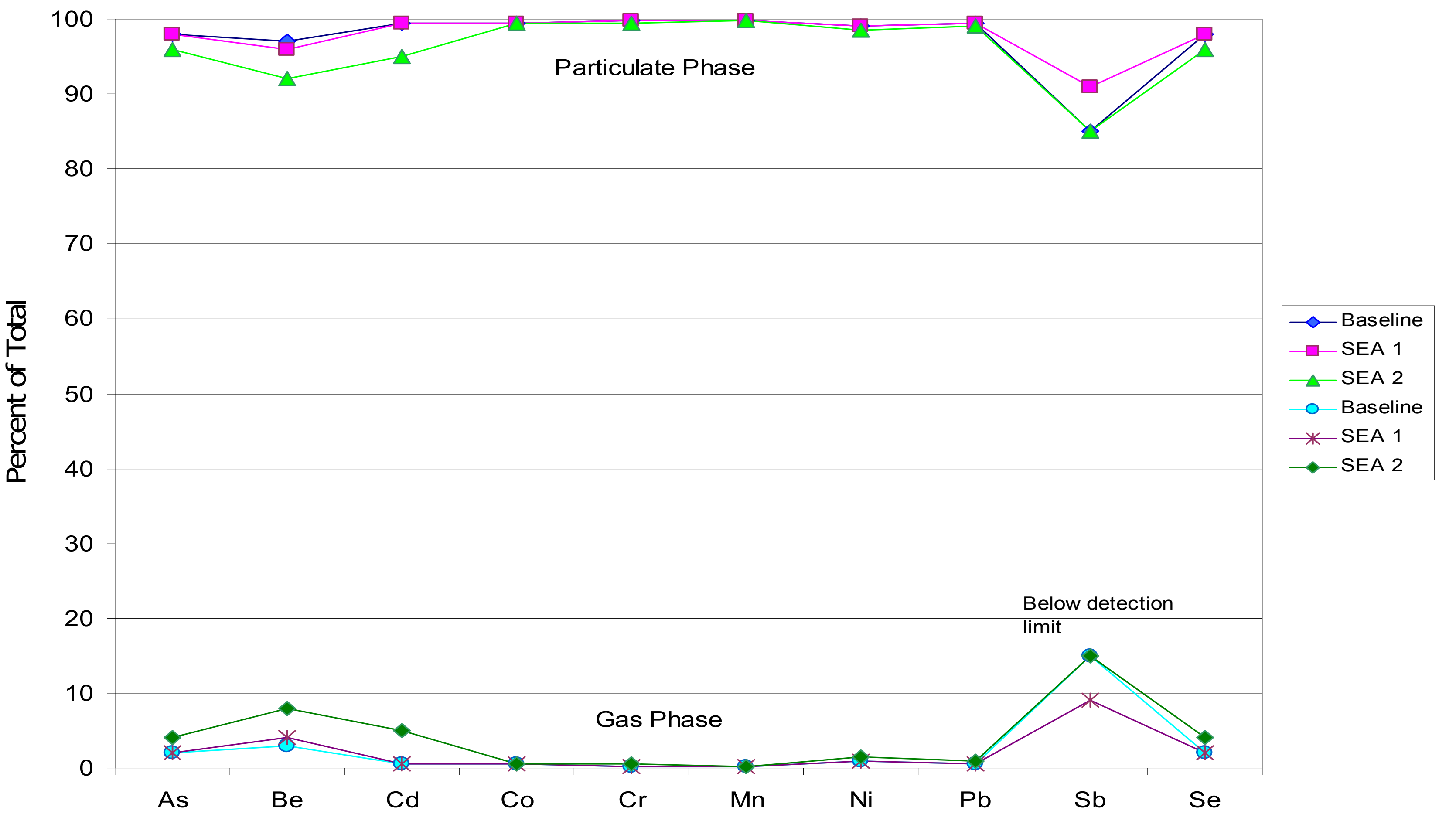
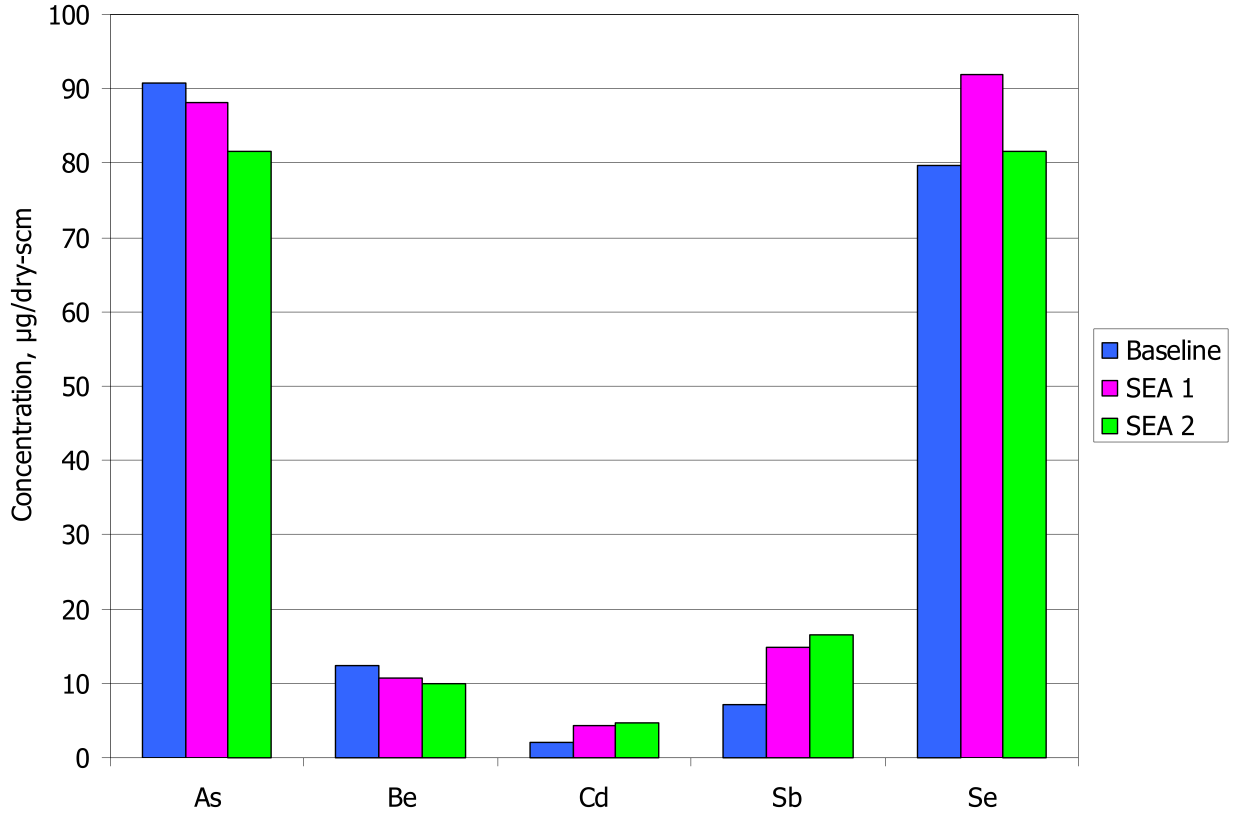
Partitioning of Trace Elements (Method 29 Samples)



Levels of Elements in Particulate Phase (Method 29 Samples)



Normalized to baseline dust loading

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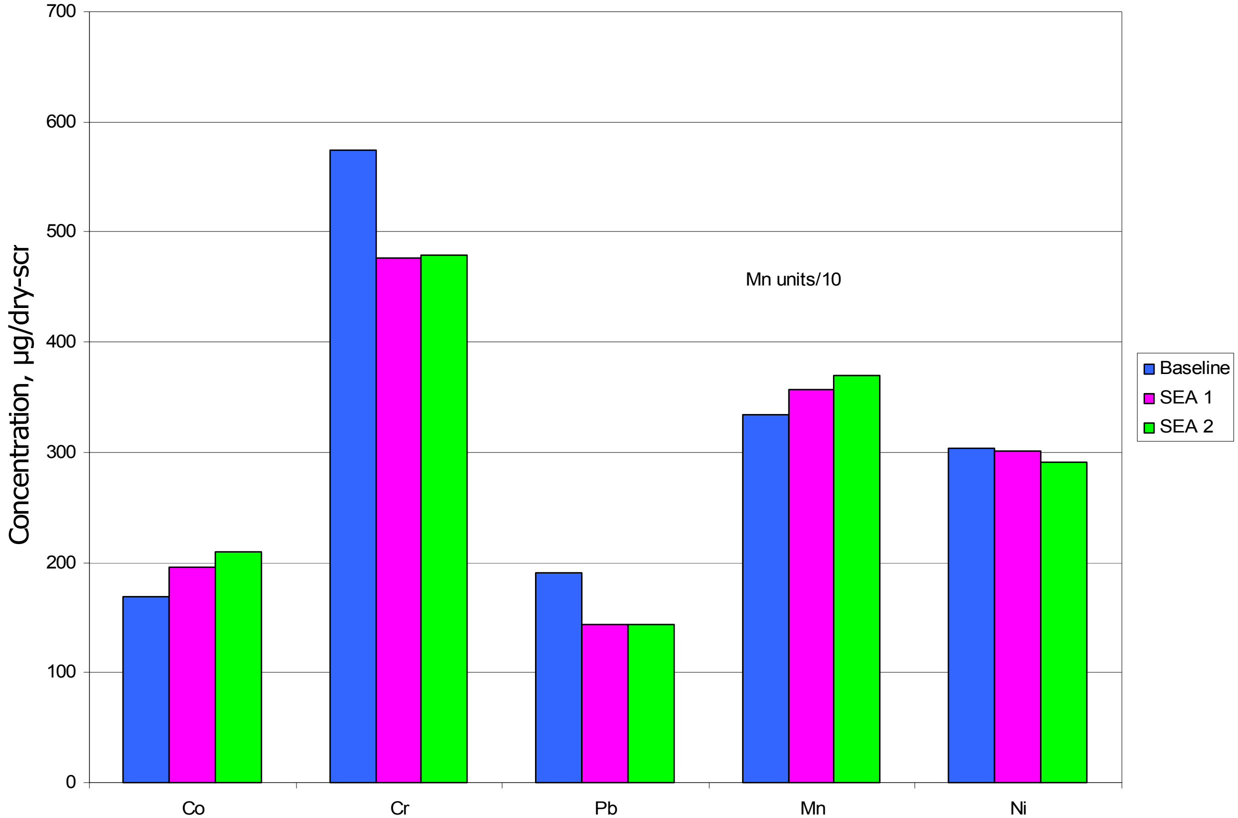
Levels of Elements in Particulate Phase (Method 29 Samples)



Normalized to baseline dust loading

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Trace Element Behavior

- Nearly all elements were associated with the particulate phase.
- SEA addition had little or no effect on total flue gas concentrations.
- SEA addition had little or no effect on flue gas partitioning between the gas phase and the particulate phase.

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Future Efforts

- Data analysis
  - SDA/FF, SDA/ESP
  - Blends
- Pilot testing
  - Toxecon^{TM} ESP/FF with sorbents and SEA for Coal A/blends
  - Treated coals
  - Additional additive and sorbents

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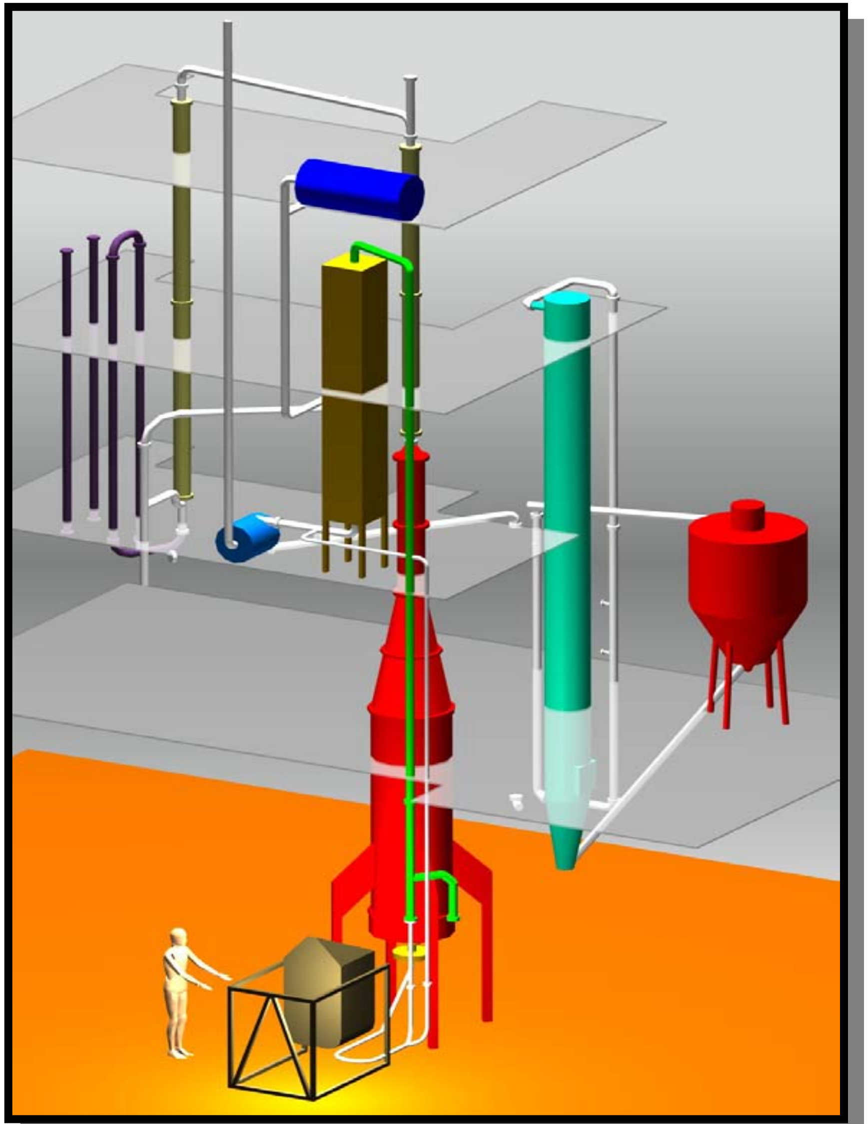
PTC Suite – SDA + BH Configuration



Niro Production Minor SDA

Acknowledgments

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Preliminary Data

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