Enhancing NO_x and Mercury Emission Control Using Coal Wastes

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By

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Quinapoxet Solutions

Breen Energy Solutions

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Project Objectives

- Use waste coal to enhance NO_x and Hg emissions control
  - Used coal fines from a washing plant
  - Renewable resource in Pennsylvania
- Show feasibility and define limits of the concept

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Coal Waste Characteristics

- **Bituminous**
- **13 % moisture**
- **Sulfur only 0.38 lb/MBtu**
- **Coking coal (FSI = 7.5)**
- **Size**
  - **32% + 50-mesh**
  - **36 % - 200-mesh**

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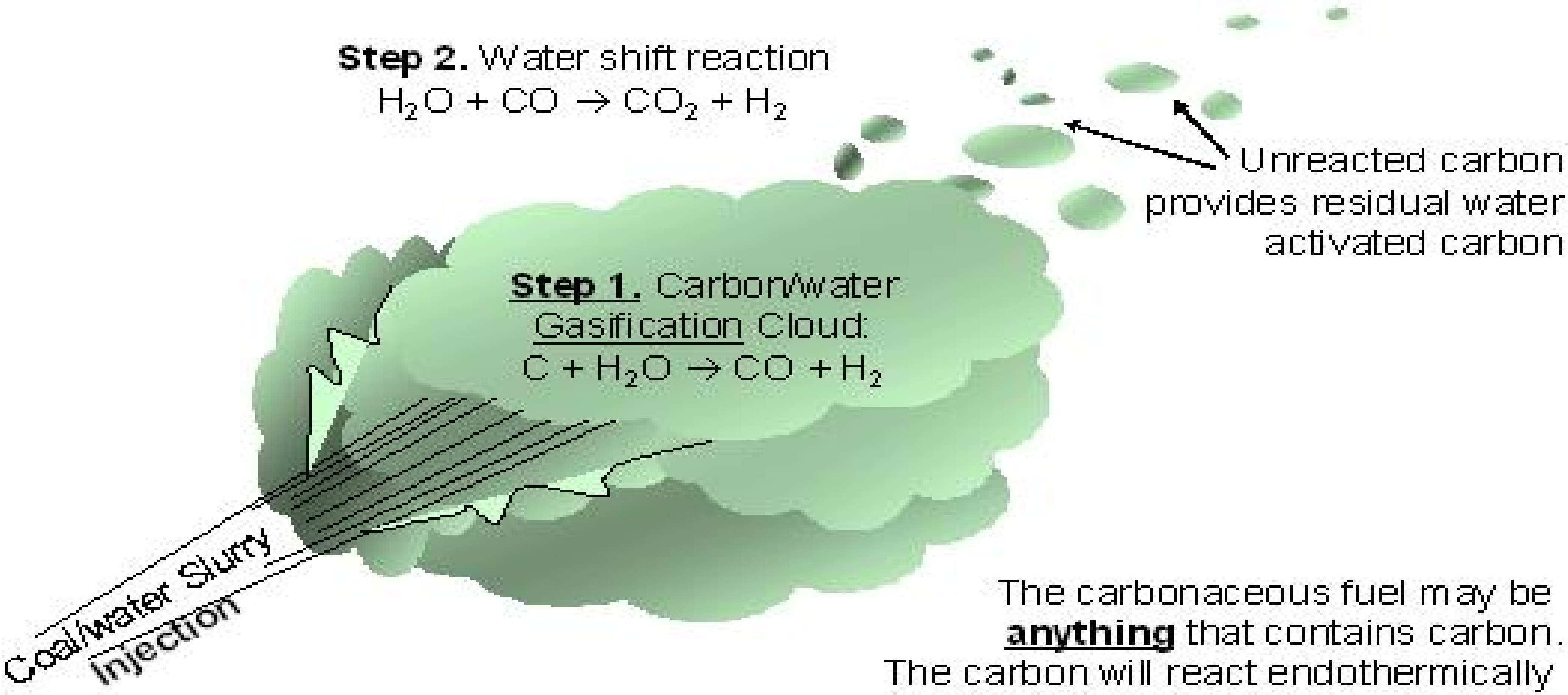
Figure 1. Coal-Water Gasification Reaction



The carbonaceous fuel may be **anything** that contains carbon. The carbon will react endothermically with water at temperatures above 1,000°F to form CO, CO_2 and hydrogen.

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NO_x Chemistry Enhancements

- **Additional hydrogen initiates NO_x destruction via fuel-lean reburning**
- **Dissolve urea in the slurry to destroy more NO_x via SNCR**
- **Coal injection enhances SNCR at higher temperatures by scavenging oxygen.**

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Hg Chemistry Enhancements

- Coal is converted to "reactive" carbon through reaction with steam.
- Reactive carbon (RC) absorbs chlorides in the convective section.
- Chlorinated RC may be an effective Hg sorbent at precipitator temperatures.
- Adding other halogens to slurry may offer further improvements.

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Project Team

- DOE Cooperative Agreement No. DE-FC26-06NT42807
- Breen Energy Solutions: Prime Contractor
- AES Beaver Valley
- Penn State University
- Headwaters

Boiler Description

- AES Beaver Valley Unit #2
- 35 MW
- B&W Design
- Wall Fired
- OFA and SNCR for NO_x
- ESP for particulate
- Wet FGD for SO_2

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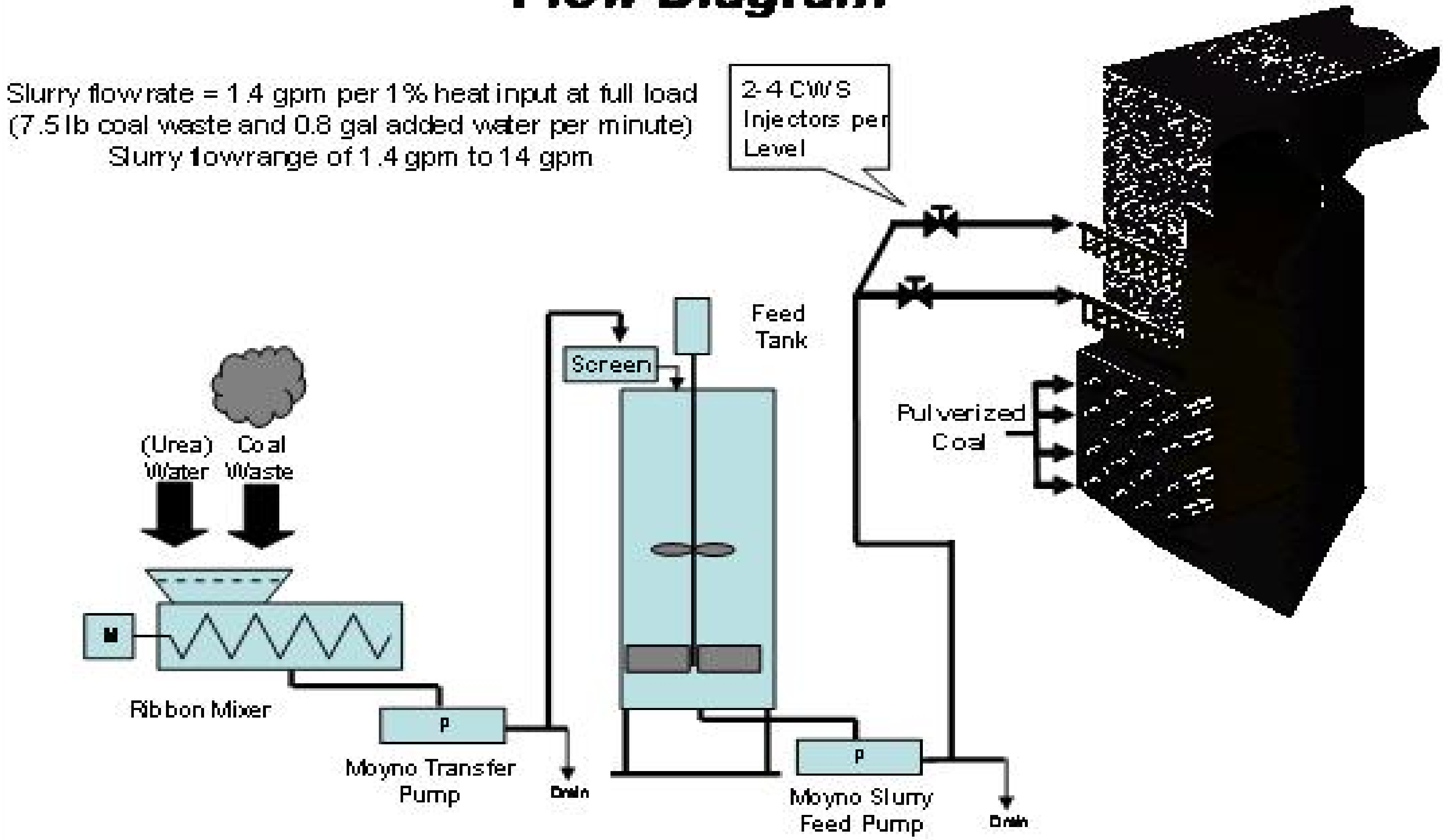
Figure 2 - Coal Waste Slurry Reburn
Flow Diagram



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Test Program

- Initial Shakedown in August
- NO_x testing in early September
- Hg testing in late September

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Hg Test Procedures

- Speciated Sorbent Traps
- Before and after precipitator
- 1-hour samples
- Traps analyzed on site by Ohio Lumex

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Slurry Injection

- 4 Nozzles sizes
- Air-assist
- Various spray angles
- 2 boiler elevations
- Rear wall

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Baseline Hg Results

- No Slurry Injection, ESP inlet temperatures 400-430 ºF.
- Coal Averaged 12 lb/TBtu Hg (wide daily variation)
- Consistent 40-50 % Hg reduction across ESP
- Further Hg reduction across wet scrubber
- Results similar to 2004

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Coal Slurry Results

- Slightly more oxidized Hg with coal slurry injection
- Similar 40 % Hg capture in the ESP
- Enhanced results with halogen in slurry
  - > 60 % capture across the precipitator
  - Remaining Hg was less oxidized
- LOI carbon catalyzes Hg oxidation, but halogenation allows oxidized Hg to stay with the carbon.

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Reactivity Tests

	Normal Fly Ash	Fly Ash with CWS Injection
LOI, %	9 to 20	14 to 26
BET Surface Area, m^2/g	15	59
Pore Volume, cc/100g	0.94	3.24
Trace Capacity, g/100cc	0.21	1.45

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Results Summary

- Promising way to increase Hg capture by 50%
- Limited by high CO and increased opacity
- Better CWS distribution to overcome those limits
- Slurry handling is a dirty business!


Questions?