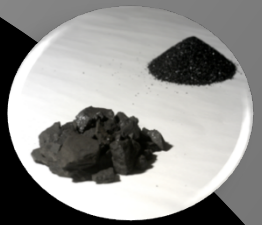
Advanced Carbon Products

Flyash Ponds and Coal-Fired Power Plant Wastewater Treatment Issues

May 4, 2012



Carbonxt Advanced Coal Products

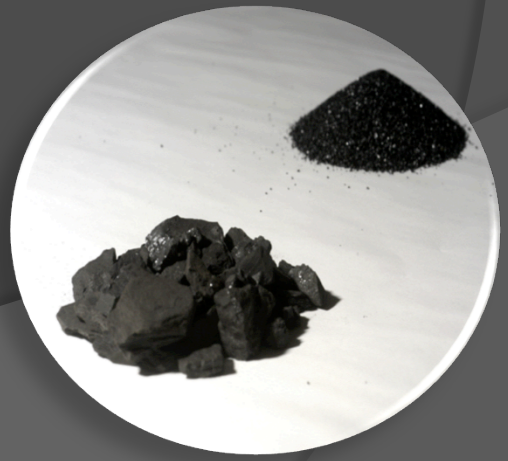
Clear Carbon Innovations

Coal-Fired Power Plant Wastewaters & Treatment Issues

CCI Results

Carbonxt

- Australian company with US Operations in:
  - Charleston, WV (Plant Operations)
  - Gainesville, FL (R&D Operations)
- Premium carbon products from coal
- Activated carbon for mercury capture
  - Non-halogenated
  - Tailored based on flue gas chemistry
  - Suitable for all coal types



Clear Carbon Innovations

- 100% Owned Subsidiary of Carbonxt, Inc.
- Development of Activated Carbon for Mercury Removal
  - Portable Testing Services Via ACI Skid
    - Testing with Multiple Utilities
  - Product Development and Customization
    - Proprietary Processes & Patented Solutions

Water Treatment Solutions

- Surface Mine Discharge Water
  - Aluminum and Selenium Removal
  - Pilot Study, Summer 2012
- FGD Wastewater
  - Mercury and Selenium Removal
  - Testing with Multiple Utilities

Coal-Fired Power Plant (CFPP) Wastewaters & Treatment Issues

CFPP Wastewater Treatment Issues

- Cooling Tower
- Coal Yard Runoff
- Flyash Ponds
- Wet Scrubber Wastewater

Coal Yard Runoff Contaminants

- CCI focus:
  - Selenium
  - Mercury

Wet Scrubber, CFPP

- Purpose: Flue Gas Desulfurization (FGD)
- Wastewater Constituents: focus
  - Selenium
  - Mercury
  - Arsenic
  - Boron
  - Bromide
- Challenges in Treating:
  - Large Flows (> 600 gpm)
  - Resilient dissolved metals
  - Complex matrix
    - High TDS
    - High Chlorides

New Regulations, CFPP

- EPA Mercury and Air Toxics Standards (MATS)
  - Finalized December 21st
  - Requiring about 90% mercury removal
- Effluent Limitation Guidelines (40CFR 423)
  - Guidelines: July 23, 2012
  - Final Rule: January 31, 2014

Scrubber Wastewater Treatment

- Methods
  - Physical/Chemical Processes
  - Biological Treatment (Se removal)

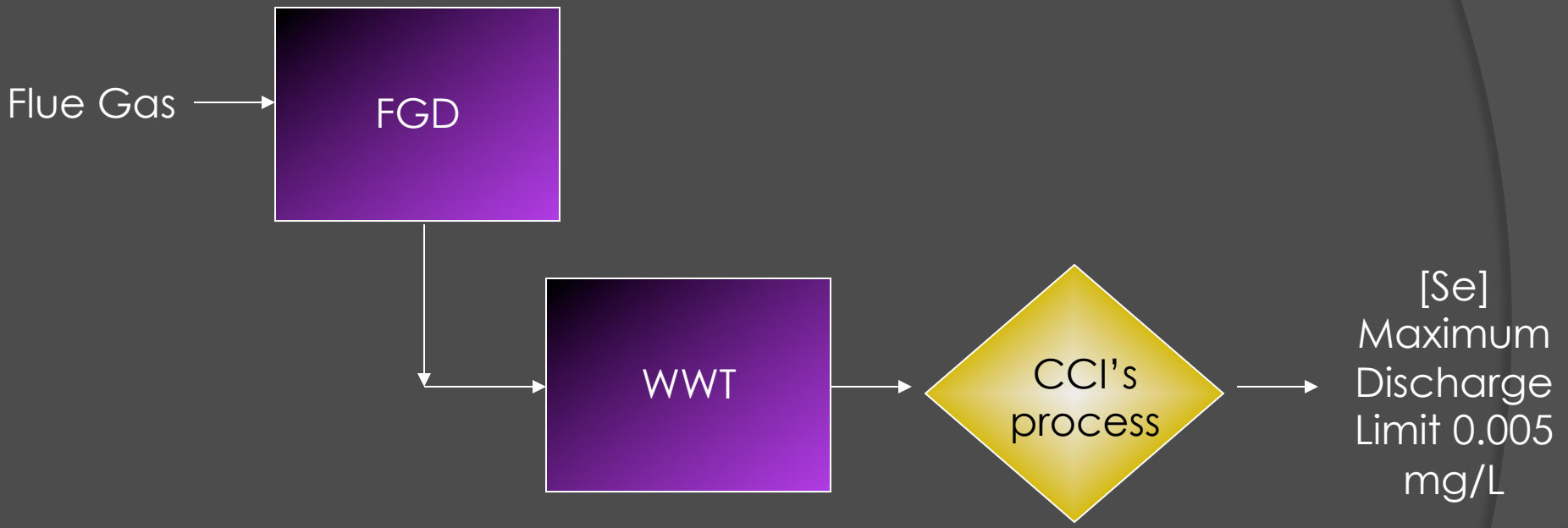
- Drawbacks
  - Ineffective in meeting discharge limits
  - Prone to upset with changing chemistry
  - Expensive
  - Not Comprehensive

Scrubber Wastewater Treatment

- Difficulty of Selenium Removal
  - Present in Multiple Forms
    - Selenate (SeO_4^{-2})
    - Selenite ($HSeO_3^-$ or SeO_3^{-2})
    - Selenide (H_2Se)
    - Elemental Selenium (grey/red solid material)
      - Color dependent on crystallinity
  - Selenate and Selenite: Very Soluble
- Typical Treatment
  - Reduction to elemental selenium (solid)

CCI Results

Se Removal from Secondary Treatment Effluent



CCI's proprietary process can be integrated following conventional waste water treatment to remove Se.

Bench-Scale Results: Scrubber Wastewater

Water Source	Initial Se Conc.	Final Se Conc.
	(mg/L)	(mg/L)
Utility A	0.3	BDL
Utility B	0.3	BDL
Utility C	1.94	0.005

*BDL – Below Detection Limit

Coal Cleaning Coal™