Coal Combustion Inc.
Understanding the business of coal

Coal Performance Engineering Class

by Rod Hatt

Class Outline

Introduction of Attendees and Instructors

Review of Basic Coal Quality

- Ultimate
- Forms of Sulfur
- Ash Fusion Temperatures
- Major and Minor Ash Chemistry
- Hardgrove Grindability Index
- Equilibrium moisture

Combustion Tune-up Procedures

- Air Flow and Balancing
  - Air Heater Leakage
  - Other Leakage
  - Balancing
    - O2 levels
    - Temperature
    - Flows
    - Opacity
    - NOx

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Pulverizer Performance

- Coal Sizing
- Air and Fuel Flow
- Clean and Dirty Coal Pipe Measurements
- Pyrite Rejects
- Primary Air Flow
- Adjustments include:
  - Roller and journal pressure, alignment, air flow, Classifiers, temperature, ball charge, ball size,

LOI Testing and Combustion Verification

- LOI Test
- Carbon in Ash
- Sampling Location
- Sampling Methods
- Operator Feedback
- CO Analyses
- NOx Analyses

Results Engineering

Boiler Efficiency Testing

- Output/Input
- Heat Loss Method
- Problem areas

Improving Boiler Efficiency

- Improving Combustion
- Optimizing Combustion
- Optimizing NOx

Unit Heat Rate

- Input/Output

Performance Diagrams

Ash Deposits

TABLE I - Major Causes of Ash Deposits

Fuel Related	Large pyrite particles that impact the furnace wall before they completely combust
	Clay minerals that contain significant amounts of iron, calcium, sodium or potassium causing them to have low melting temperatures
	Interaction of pyrite, clays and alkalis with alumino silicates to form low viscosity melts
	Extremely fine or organically bound alkalis
Equipment Related	Soot blowers not in operation or used improperly
	Poor pulverization of fuel
	Improper air to fuel ratio
	Burners damaged or improperly adjusted
	Changes in operation of boiler or other equipment
Design Related	Furnace size too small for fuel
	Tube material and/or spacing inadequate
	Soot blowing coverage inadequate
	No means provided to observe slag buildup

Most Slag begins on the Furnace walls and the proceeds up the furnace

Basic Analytical Procedures

Ash Fusion Temperatures
Major and Minor Ash Elements
Acid Oxides or Glass Formers
Basic Oxides or Fluxing agents or Gluing Elements

Basic Slagging factors

B/A ï Base to acid ratio, sum of total bases divided by sum of all acid elements
Slagging Factor ï
Ash and Elemental Loading

Advanced Methods for Slag

Mineral and Elemental Analyses of Coal

Computer Controlled Scanning Electron Microscopy (CCSEM)

Uses Energy Dispersive X-ray Analyses (EDAX) to size and quantify elemental composition.

Low Temperature Ashing

Microscopically identify minerals present

Chemical Fractionation

Provides information on Organically Bound elements

Elemental Analyses of float sink and/or size fractions

Can be performed by ASTM coal laboratories
Pounds of iron per million Btu

Pounds calcium, sodium, and other elements

Ash Deposit Analyses

Sampling Procedure for Ash Deposits
Polarized Light and Scanning Electron Microscopy
Forms of Iron by chemical fractionation
Mossbauer spectroscopy

Fouling Deposit Formation

Electrostatic Precipitators

Basic Operation Principles
High Voltage DC ï Transformer Rectifier Sets
Voltage Control ï Controlling the wave from and sparking rate
Sizing ESP ï Plate area (fixed) and Flue gas volume (operational variable?)
Migration Velocity or why the particle goes to the plate
Ash Resistivity concerns
Gas Velocity ï impacts ESP size and treatment time
Rapping ï important equipment that can be high maintenance
Hopper Evacuation ï useful for determining ash partitioning
Dust Collection and Storage

Advanced ESP Methods and Tune-up

Combustion Influences
Calculating and Measuring Fly Ash Resistivity
Correlating and making sense of resistivity data
Rappers
High Voltage controls
Measuring gas flows and particular loadings
ESP Inspections
Tune-up Procedures