Coal Combustion Inc.
Understanding the business of coal

Coal Quality and Combustion Workshop

Class Outline

By Rod Hatt

Boiler Basics

Major components of PC - fired boiler

- Plant, Boiler, Pulverizers, Air Heater, Pollution Control
- Where does heat go
- Major coal issues

What is Coal

Coal Formation

- What is Coal -
- Coal Rank
- Where are the different coals located?

Coal Mining

- Surface
- Deep
- Out of seam dilution
- Coal Washing
- Drying coal
- Transportation Impacts
  - Time and Climate
  - Barge Coal tends to gain moisture

Sampling coal and coal analyses

- Sampling methods
  - The Good, The Bad and the Ugly
  - Good sampling is hard work

- ISO, ASTM Sampling
  - Guidelines

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Hand samples
- Feeder and belt
- Car top

Mechanical Sampling
- Sampling systems
- Augers
- Core holes

Terms

Proximate – Moisture, ash, volatile, fixed carbon (by difference)
Short Prox – Moisture, ash, sulfur, Btu/lb
Ultimate – Moisture, ash, sulfur, + carbon, hydrogen, nitrogen, oxygen (by difference)

Coal Cost

Sold by the ton - $/ton
Boilers want Calorific Value not tons
Evaluated by the Kcal or millions of Kcal (MMcal.)

Follow Coal Through Plant

Coal Handling

Moisture plays a dominant role
Fines
- What sizes are important?

Clays and mineral matter
Chemical additives
Liners

Spontaneous Combustion

Combustion

Time, Temperature, Turbulence - The three T's in practice

Size the coal and add air!

Coal Reactivity

The Story of NOX

To minimize the formation of NOx
Post Combustion Control

Pulverizers

Coal properties
Coal fineness
Measurement Surface moisture HGI Coal size Heating value

Combustion Process

Coal Rank
Air to fuel ratios
Balancing furnaces
Balancing burners
NOx formation
CO analysis

Boiler Efficiency

Boiler efficiency vs. excess oxygen
Moisture and hydrogen impacts
Higher vs. Lower heating value

Ash Deposits - Introduction

Types of Ash Deposits
- Wall Slag
- Superheater Slag
- Convection Pass Fouling
- Low Temperature Deposits

Causes of Ash Deposits

Fuel Related
Equipment Related
Design Related

Analytical Procedures for Slags

The ASTM Fusion Temperature Test.
Ash levels
Slagging and fouling indices.

Elemental loading
Pounds of iron per million Btu
Pounds calcium, sodium, and other elements

Slagging with Bituminous Type Ash - High Iron

Ash fusion temperatures
Advanced ash fusion techniques.

Ash Chemistry

Base to acid ratio
Slagging index
Dry sulfur x B/A
Iron squared term

Computer Controlled Scanning Electron Microscopy provide some of the best mineralogical information but has not come into common use.

Cyclone and Wet Bottom Furnaces

Ash Viscosity –
Calculating T-250
Measuring T-250
Temperature verses Ash Viscosity Curves

Fouling Deposits

Chemical Fractionation
Active alkali
Water soluble
Ammonium Acetate soluble
Weak acid soluble
Micro crystals

Deposit Analyses

- Chemical
- Microscopic

Pollution Control

- Electrostatic Precipitator
- ESP Operation
- Equipment
- Airheaters pluggage and leakage
- Resistivity
- Opacity

Trace Elements

Coal Specifications

- Computerized Evaluations
- Test Burns
- Online Coal Analyzers

Conclusion