



Coal Combustion Inc.
Understanding the business of coal

“It’s the coal”

Rod Hatt

859-873-0188

rod_hatt@coalcombustion.com

Measuring Coal Quality

Power plant operators rarely get CQ info

Coal Sales Data

Actual ASTM Analyses

On-Line information

Lots of Confusion

Major impacts . Design and
Operation of plant

Measuring Coal Quality

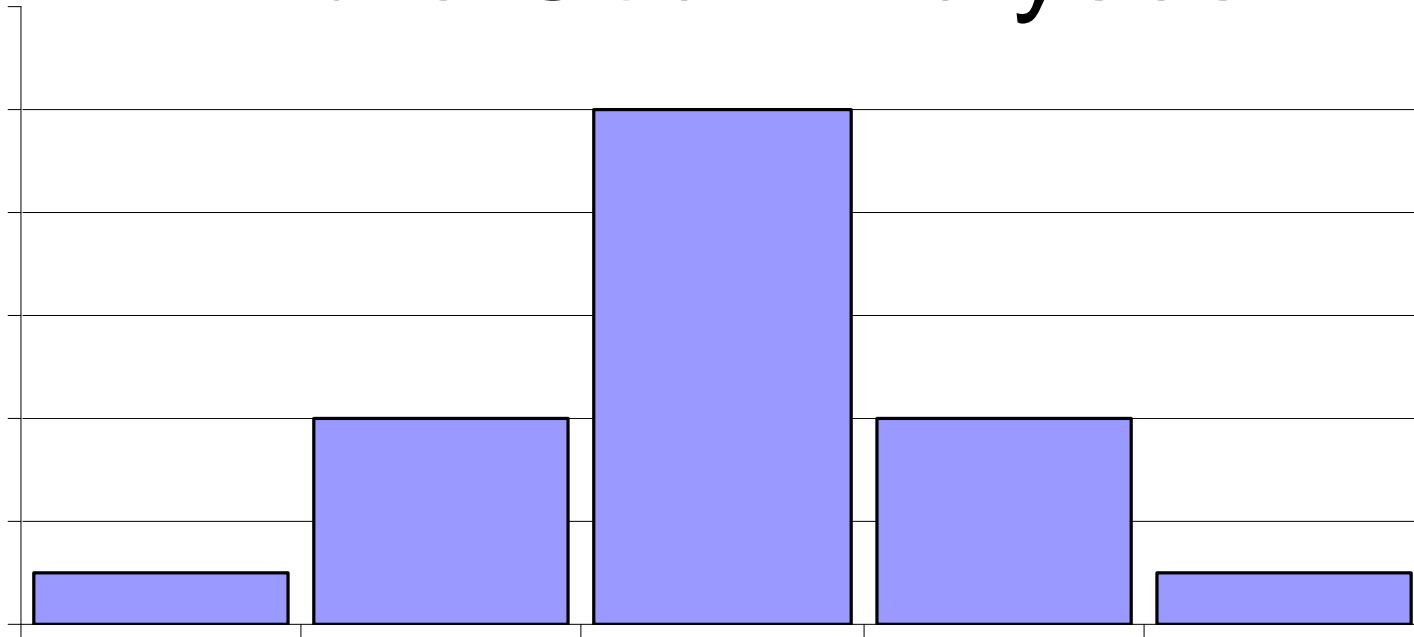
**ASTM only produces
average data**

**Power plants respond to
swings in quality**



**What
makes
coal
people
different**

Pure Coal Analyses



Ash

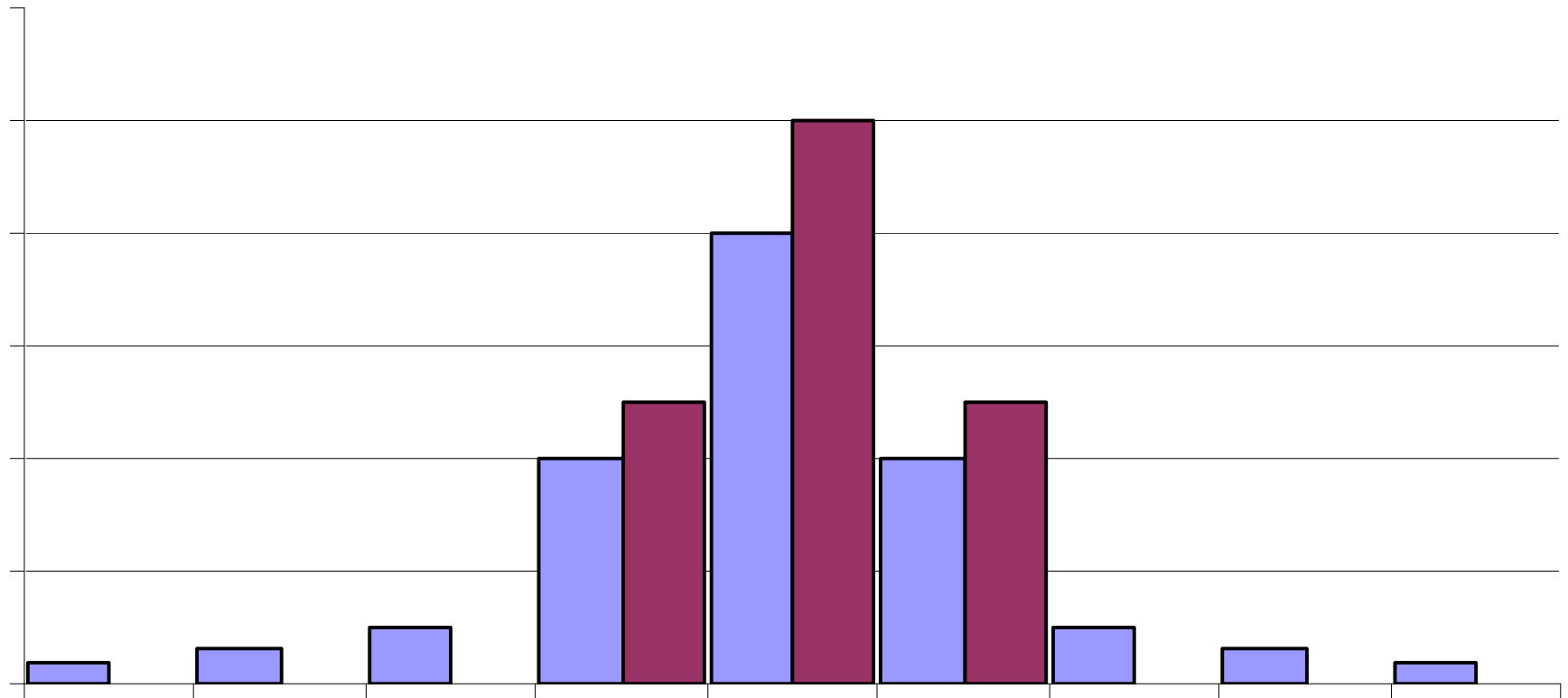
What is Easy to sell

What causes plant problems



**Lowest cost coal
is always raw.**

Small and Large Variability



ASTM reports same ash level

Nuclear On Line Analyzers

Over the belt

**Most Measures Ash and Sulfur
Chemistry**

This is valuable information

**Measures chemistry
not Moisture, Btu/lb**

Needs regular calibration

Needs prior knowledge of coal

Good for coal mining industry



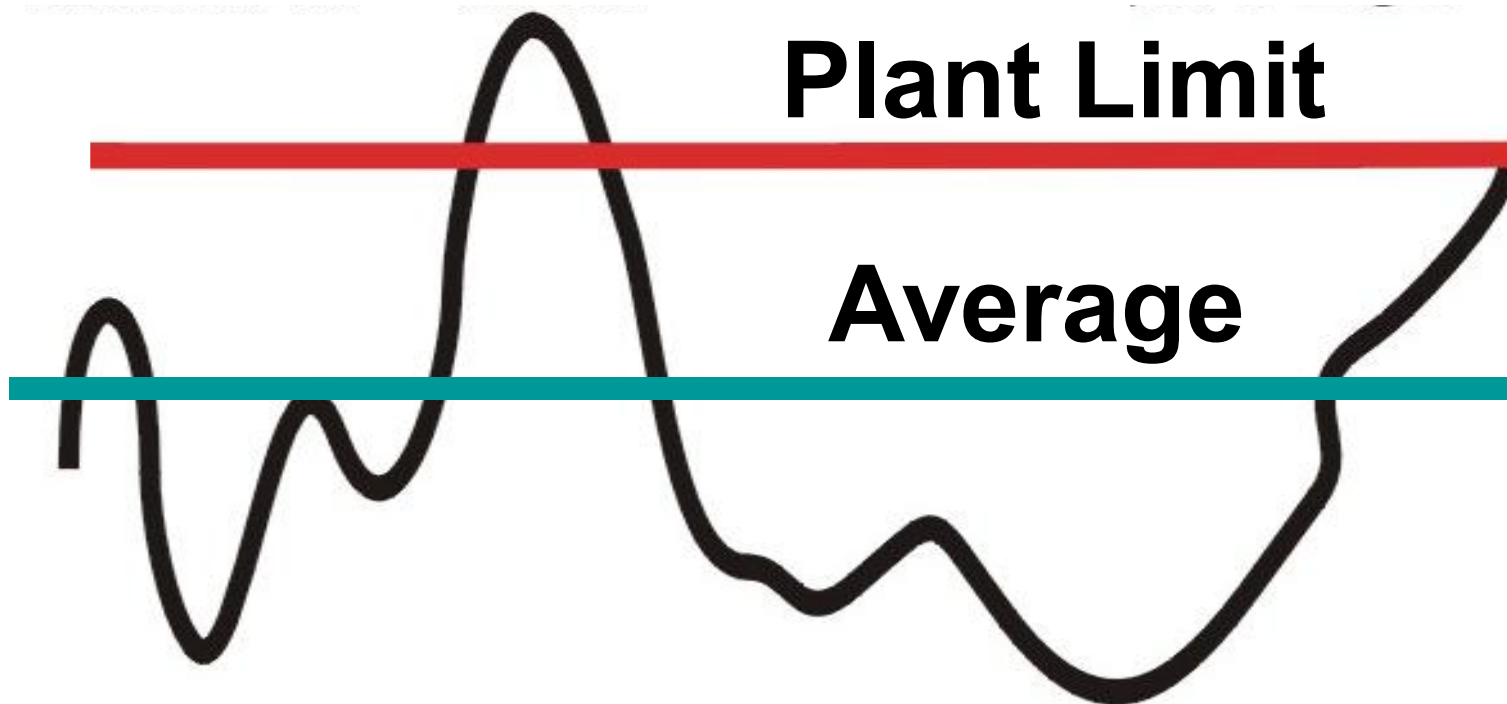
New technology measures

Carbon and Oxygen

No Prior Knowledge of Coal

**Maybe this or some other
analyzer that measures
C, O will provide what
power plants and buyers need**

**Now we can measure
variability in coal quality**



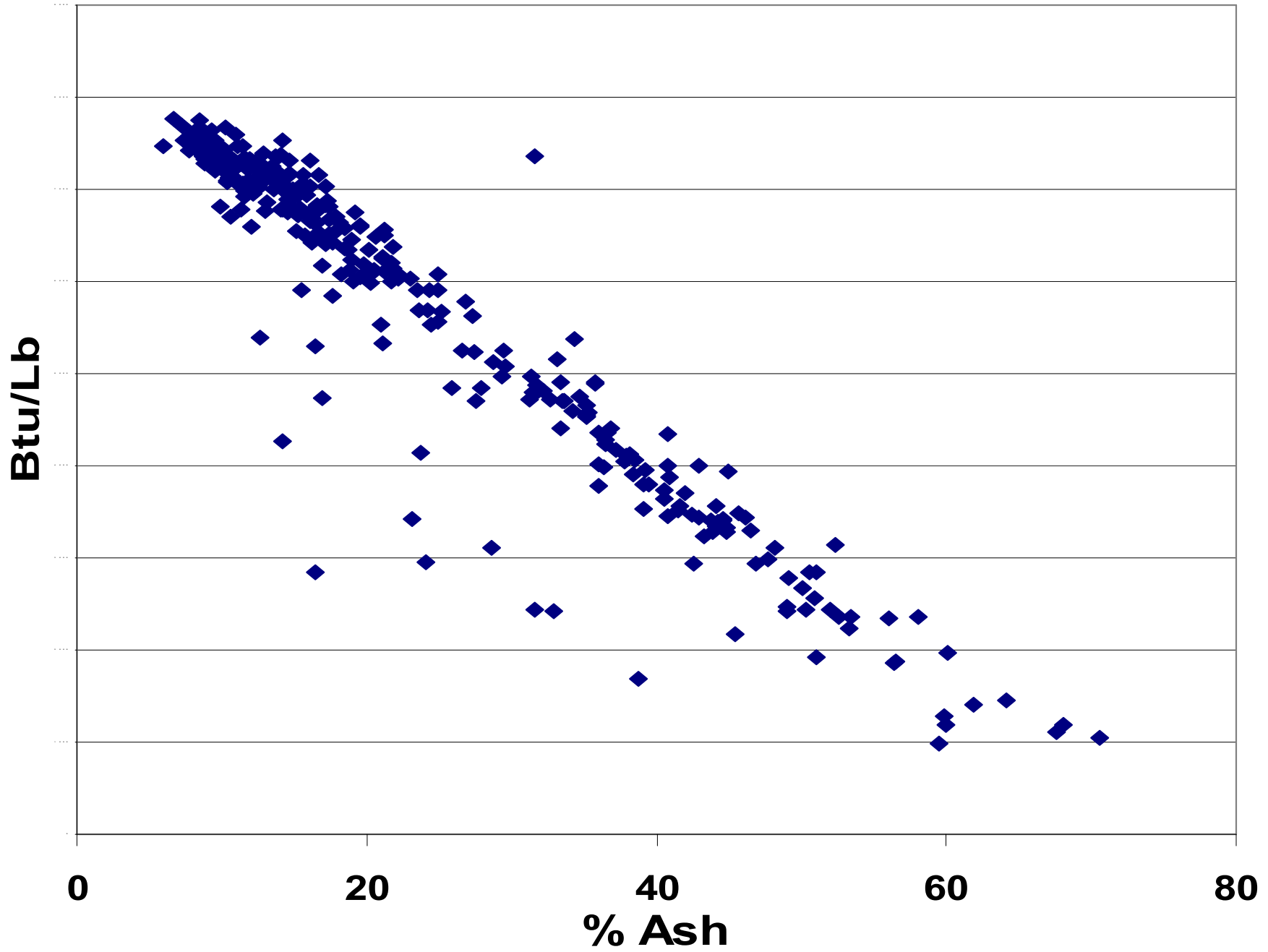
Does this coal met spec?



Coal Combustion Inc.
Understanding the business of coal

**Training – Action - Plans
and software for
Power Plants to use
On-Line
and other
Coal Quality
information**

Ash Btu



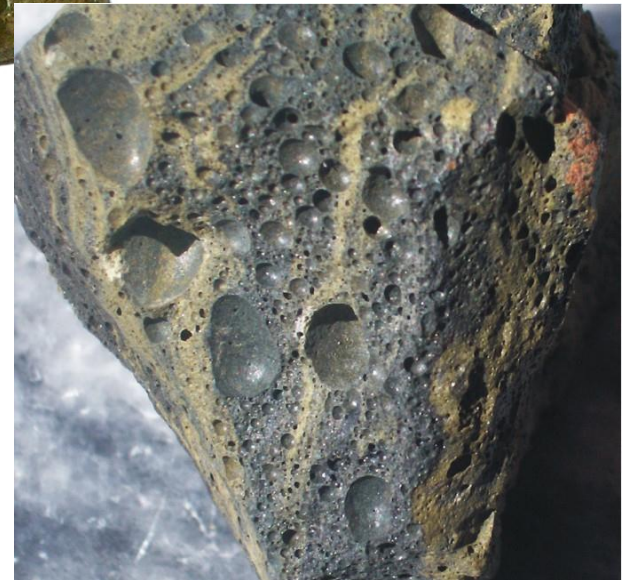
The Many Faces of Slag



Kansas Style



Ohio Style



Texas Style

Slag

Related to:

Coal Quality – Getting Worse?

Plant Equipment – Boiler/Mills Fixed

Combustion Process -

This we can control:

Superior Mill Performance

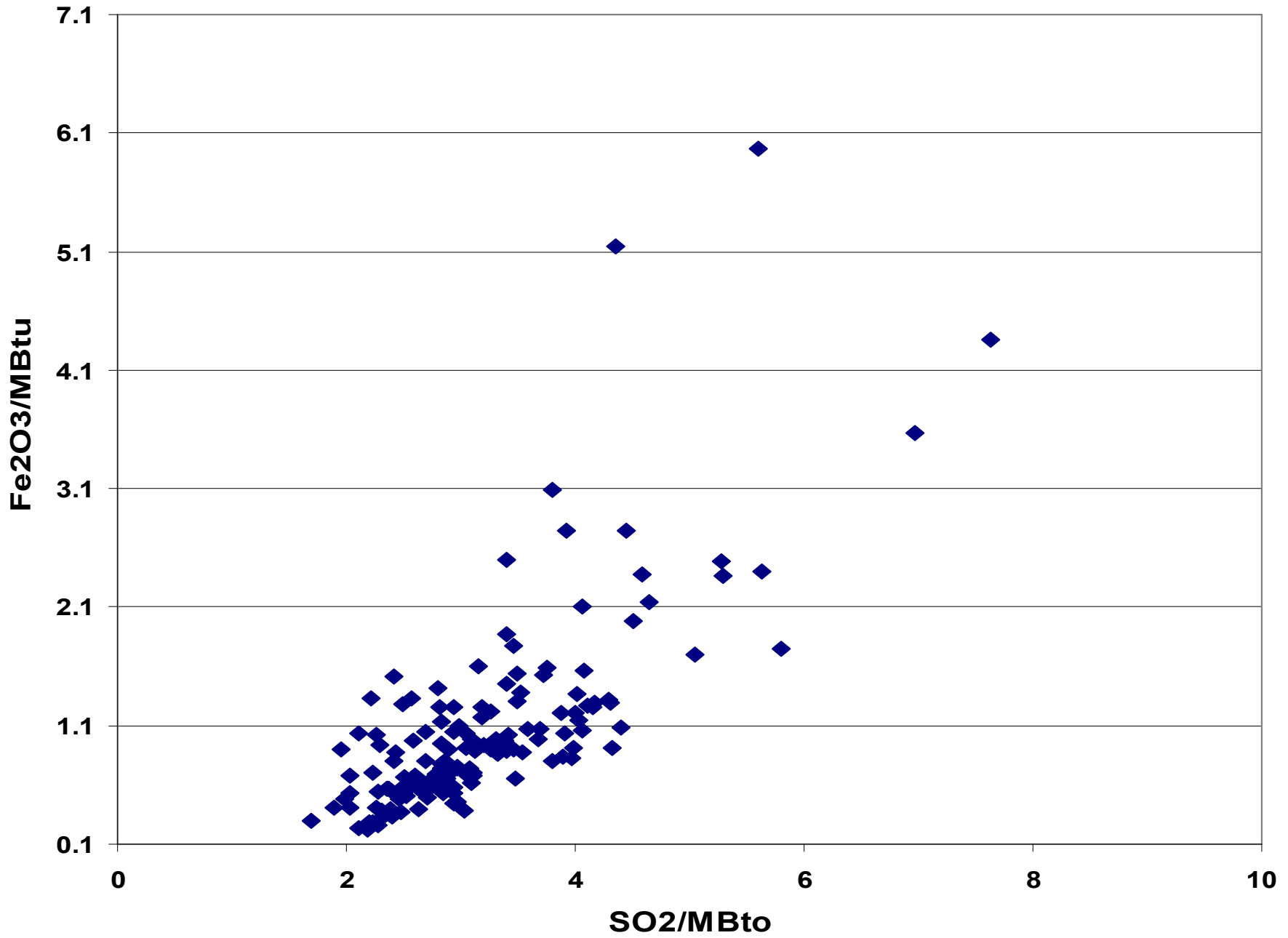
Maintain Mills to Preserve

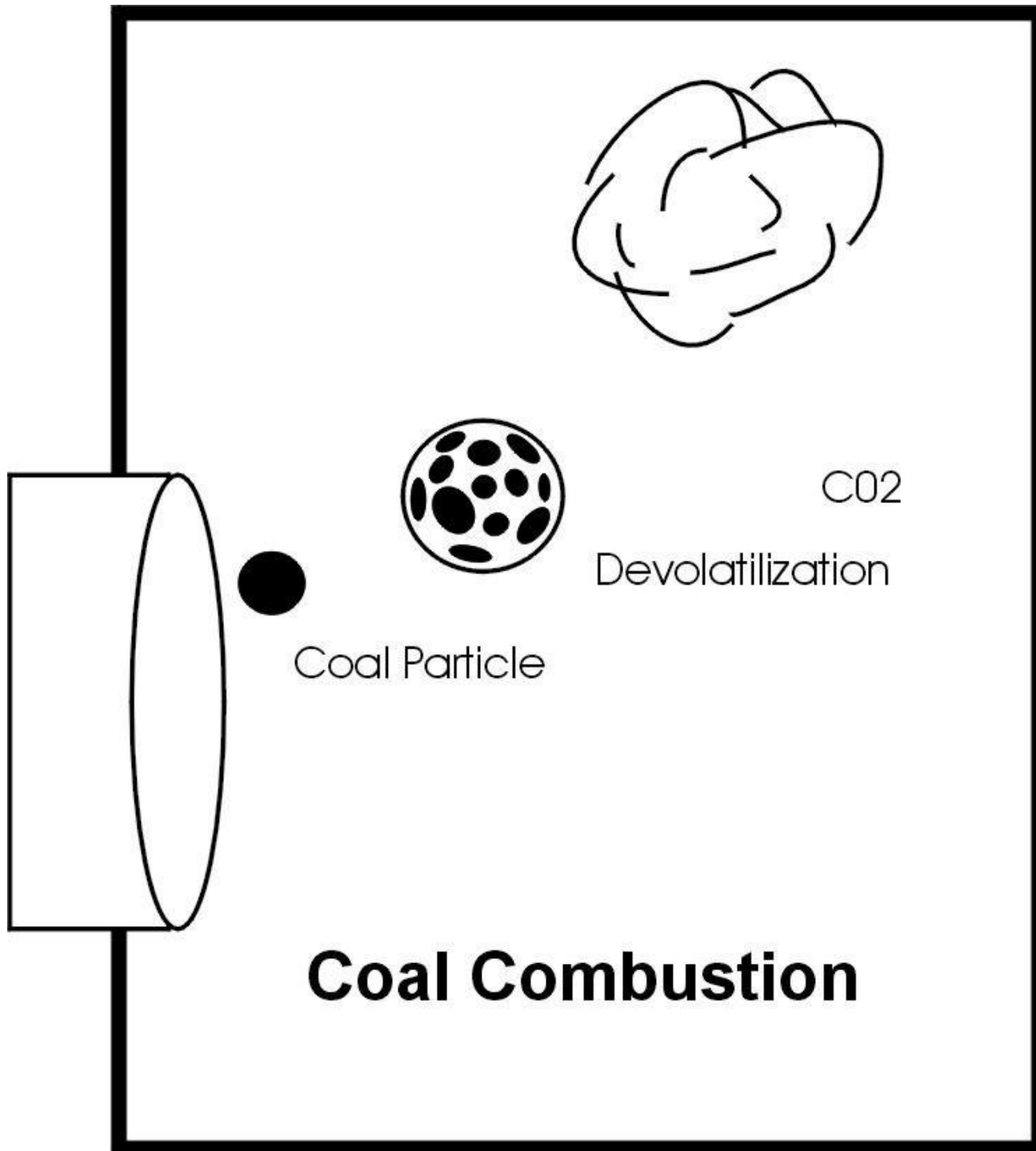
BOILER – Lower F.O.R.

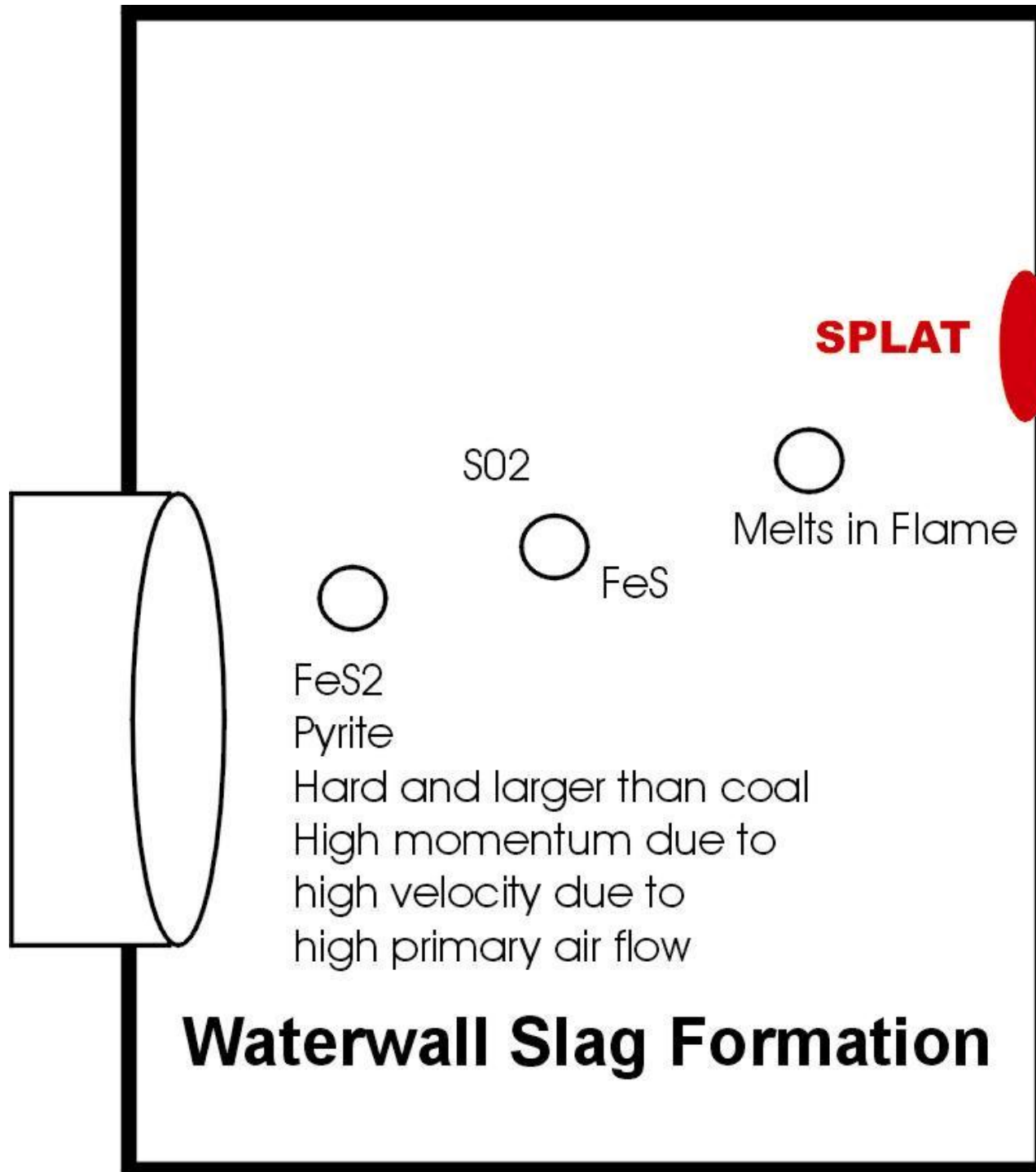
FeS_2



SO2 vs Fe2O3







Waterwall Slag Formation

Waterwall Corrosion . Tube Leaks



Pulverizers

Coal Flow

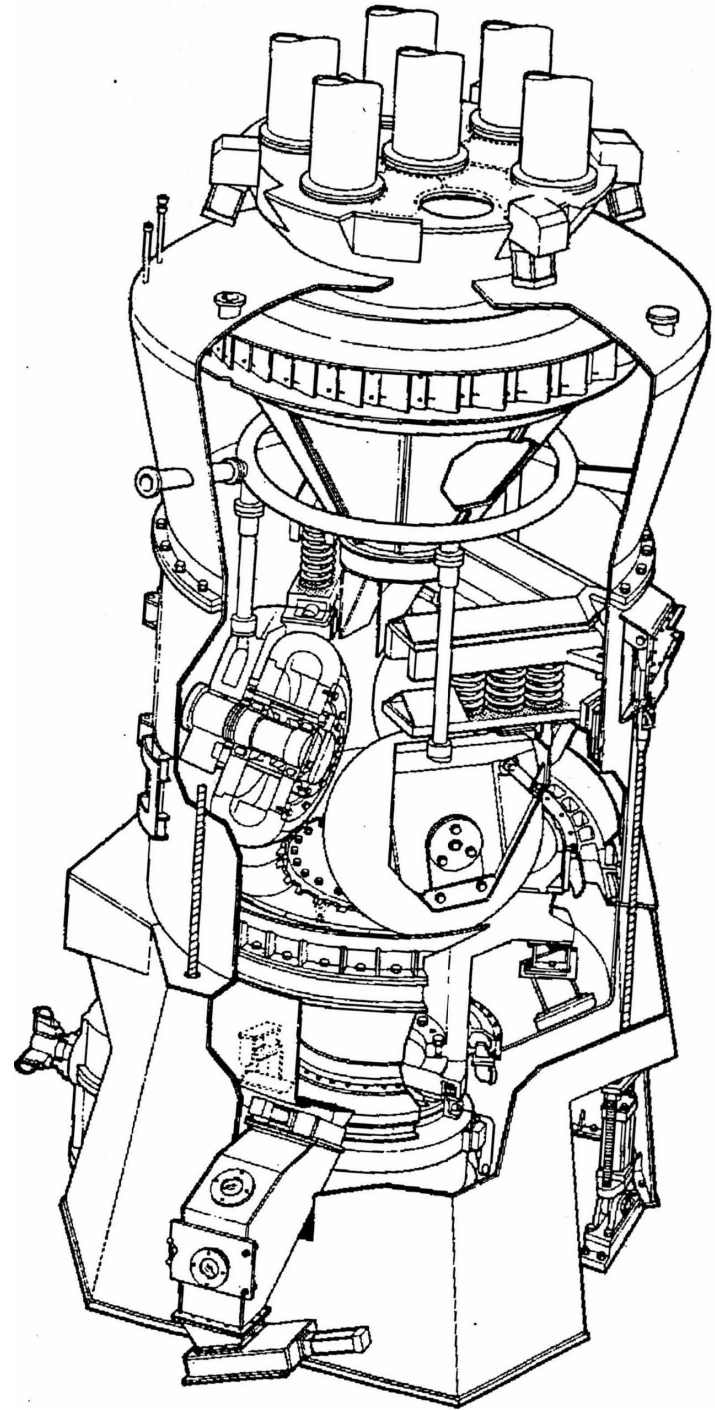
Air Flow

Coal Pipe Velocity

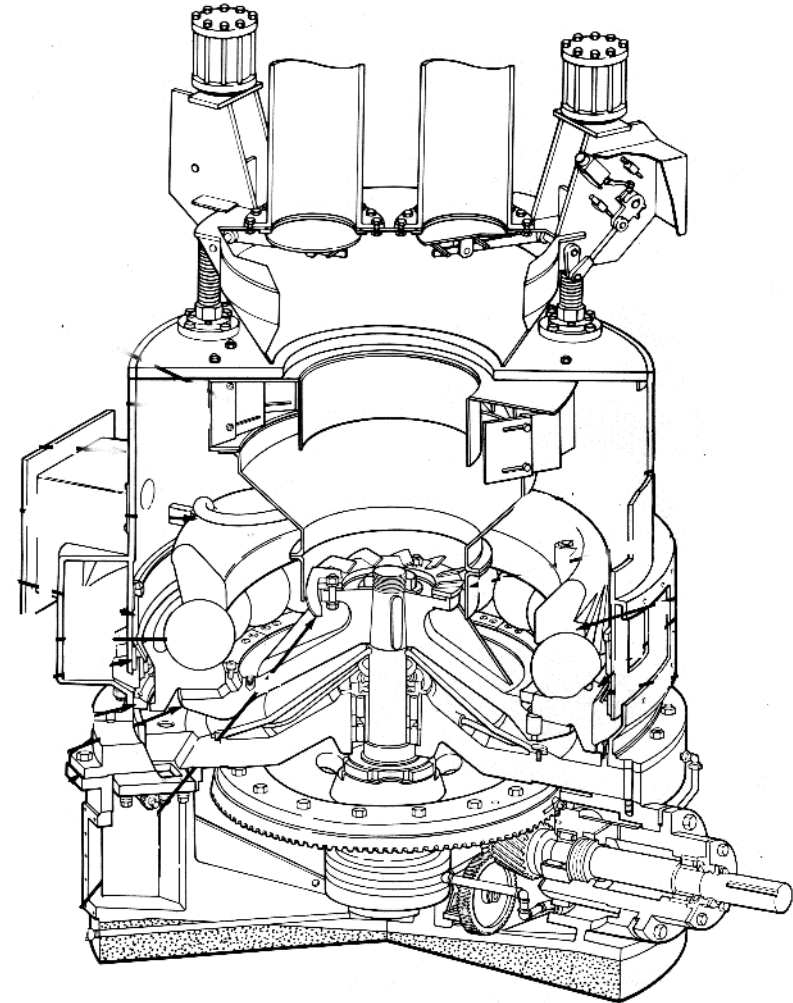
Outlet Temperature

Coal Fineness

Reject Material



Ash Wears Them Out



**Impacts load
High Maintenance
Performance Testing**

Pulverizer Performance

70 % passing a 200 mesh screen

**Minimum
or Maximum**

Need 75% for high pyrite low NOx

Acid Oxides Basic Oxides

SiO₂

Al₂O₃

TiO₂

Fe₂O₃

CaO

MgO

K₂O

Na₂O

Glass Formers

Fluxes

Role of Iron

Acid

Base

Fe₂O₃

FeO

Fe₃O₄

Oxidized

Reduced

Good

Poor

$$\begin{aligned}\text{Slag Index} &= \text{dry S} \times \text{B/A} \\ &= \text{dry S} (\sim 1/3 \text{ to } 2/3 \text{ pyrite}) \times \text{B/A} \\ &= \text{dry S} (\text{FeS}_2) \times \text{Fe}_2\text{O}_3 + \text{CaO} + \dots / \text{SiO}_2 + \dots\end{aligned}$$

Traditional Slagging Index

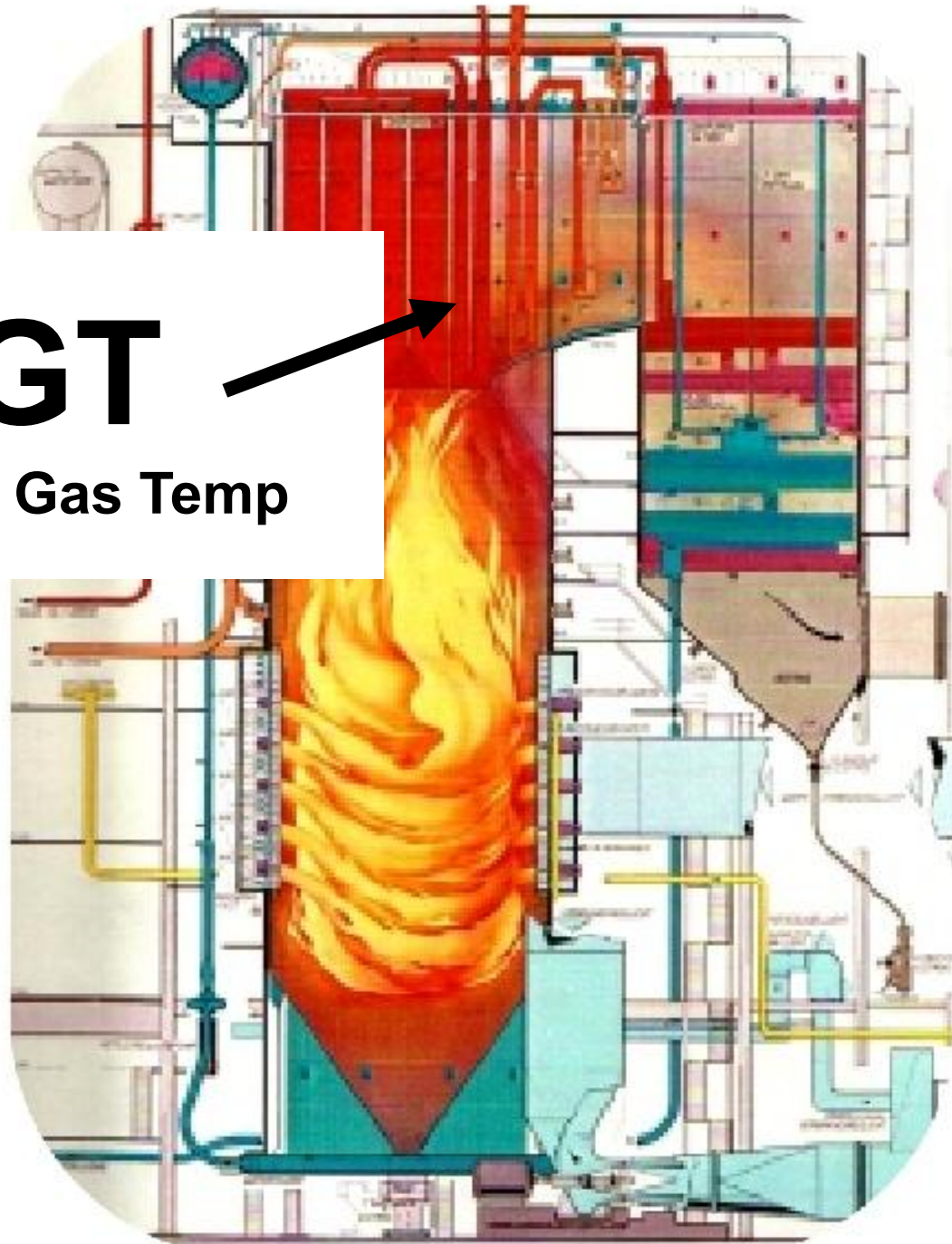
$$\text{SI} \sim (\text{Fe})^2 \quad (\text{iron squared})$$

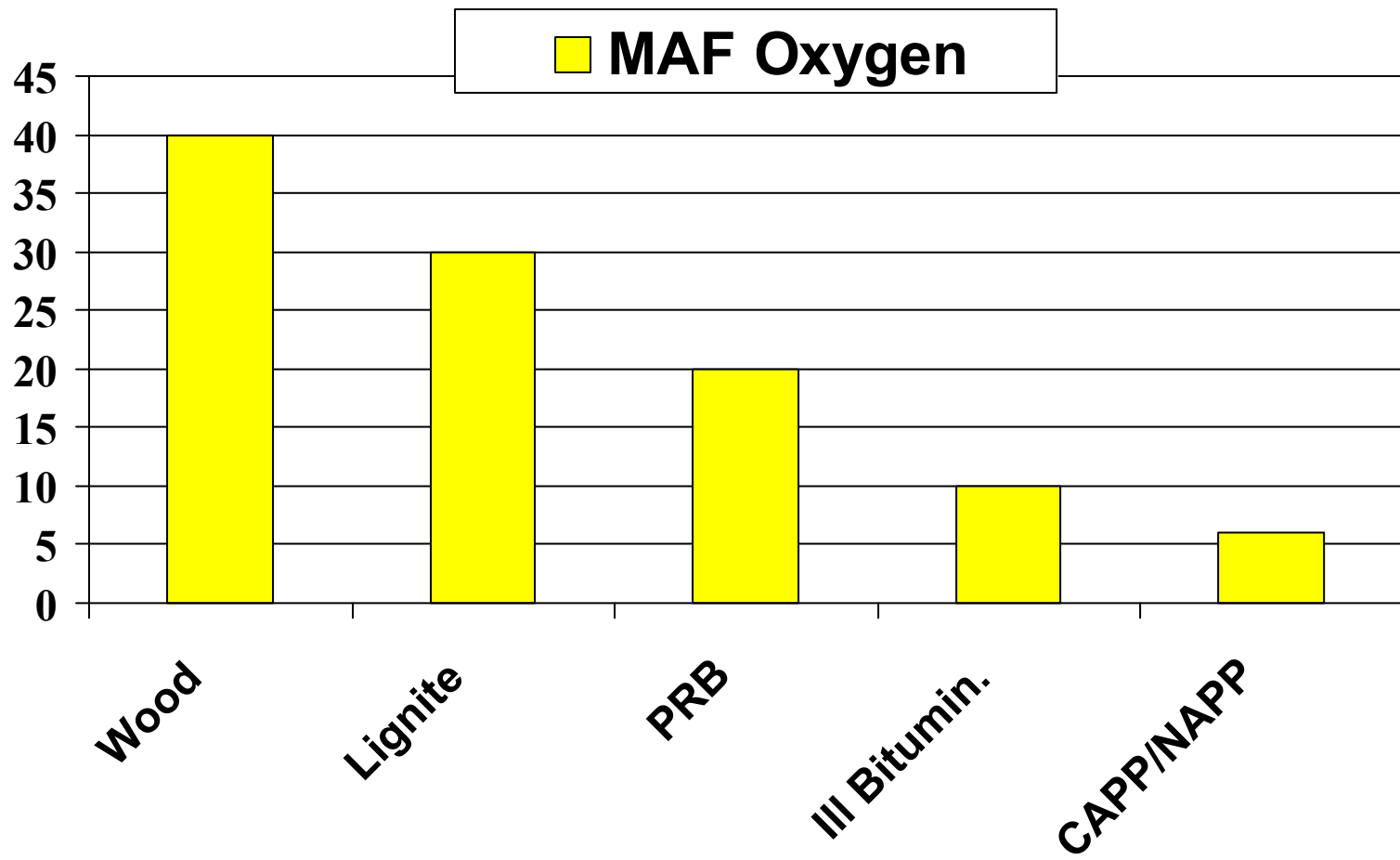
This means that as sulfur increases the slagging increases exponentially.



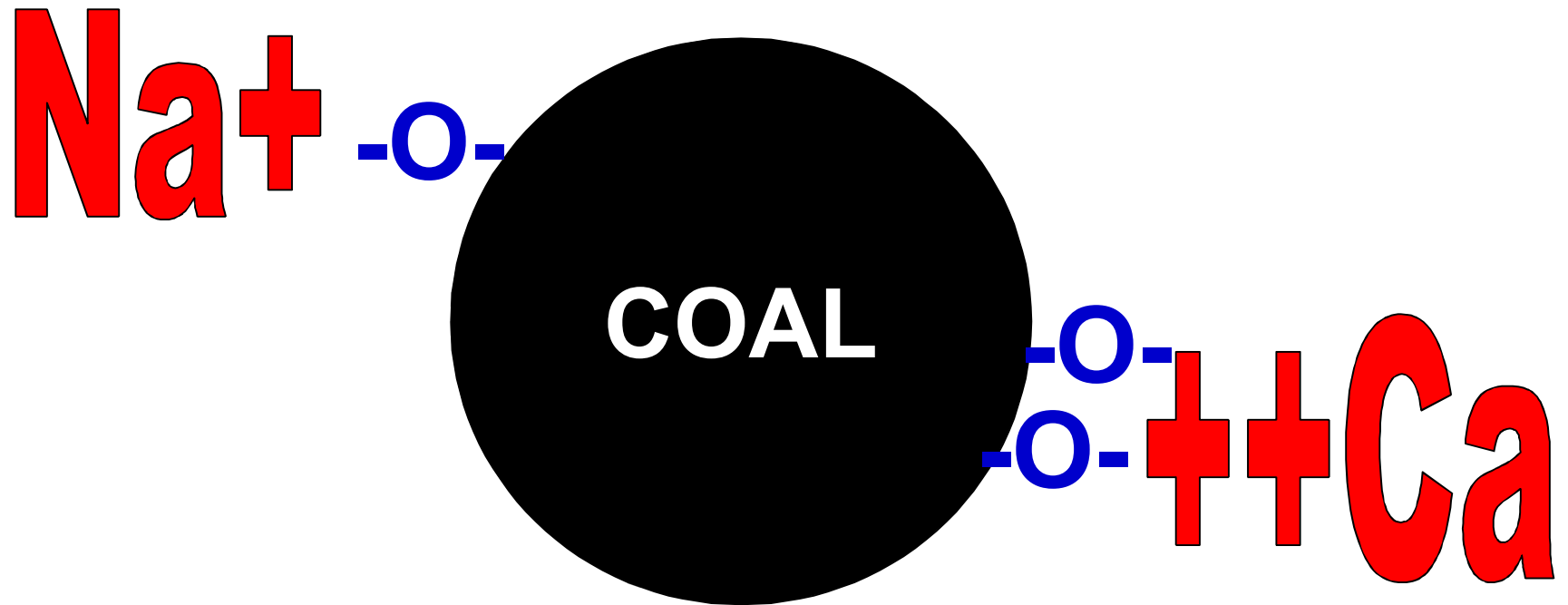
Coal Combustion Inc.
Understanding the business of coal

FEGT
Furnace Exit Gas Temp

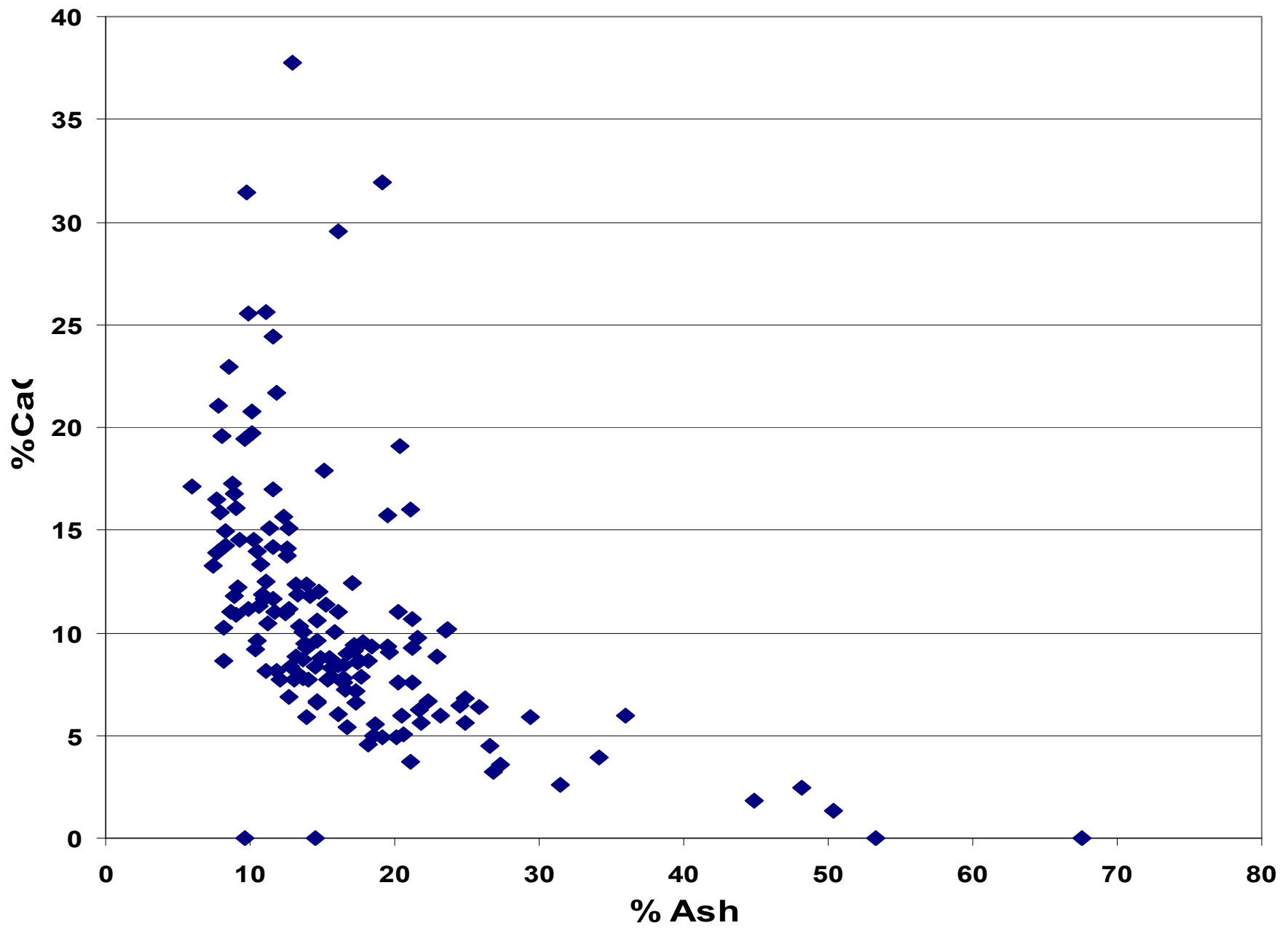




Organically Bound Alkalis



Ash CaO



Foul Index =

$\text{Na}_2\text{O} \times \text{B/A}$

~ Illinois Coal



Coal Combustion Inc.
Understanding the business of coal

**Slag is a build up
of rate process
so,
the amount of
ash should matter.**

Lbs. of ash/MBtu

$$= \%ash / (Btu/10,000)$$

Lbs. of element/MBtu

$$\begin{aligned} &= \%ash / (\text{Btu}/10,000) \\ &X (\%Element/100) \end{aligned}$$

**Many slagging concerns
have been addressed using
Ash Loading and Elemental
loading levels; especially**

Fe_2O_3 , CaO , Na_2O



Coal Combustion Inc.

Understanding the business of coal

Thank you!