



Coal Combustion Inc.
Understanding the business of coal

“It’s the coal”

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Coal Combustion Inc.

Understanding the business of coal

Member:

American Society of Mechanical Engineers

American Chemical Society

Society for Mining, Metallurgy, and Exploration

North Carolina Coal Institute

sponsor



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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

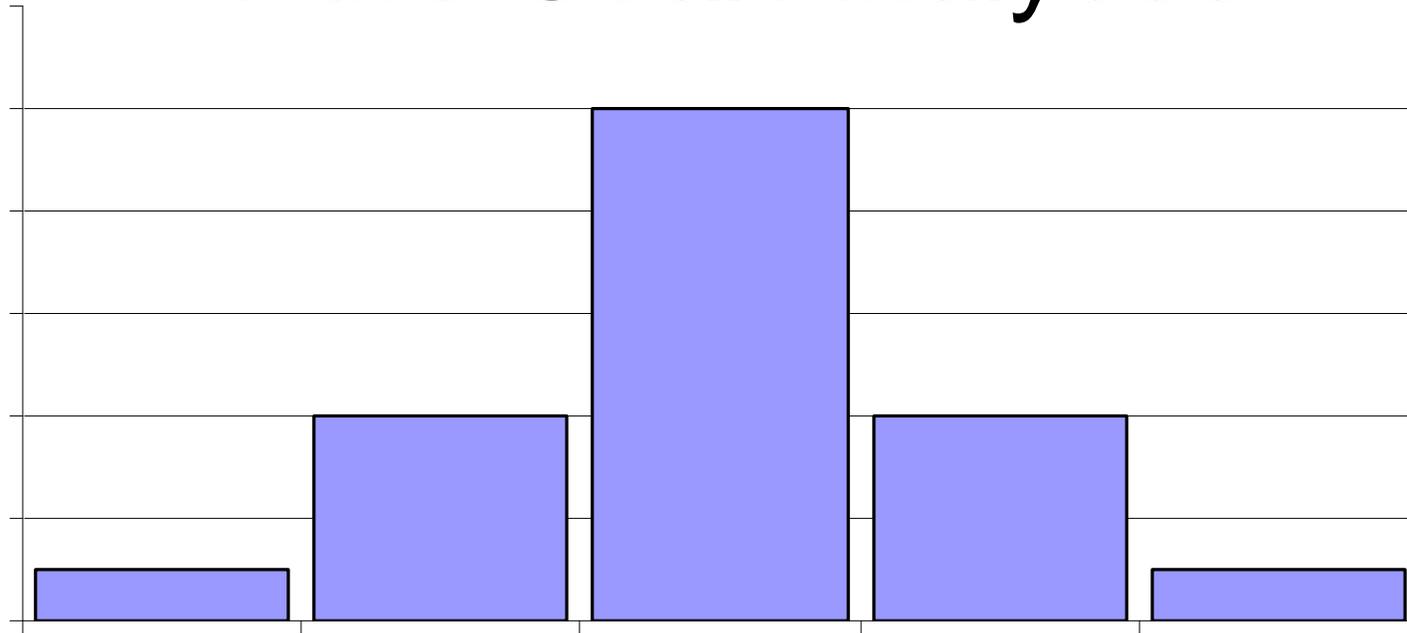
**ASTM only produces
average data**

**Power plants respond to
swings in quality**



**What
makes
coal
people
different**

Pure Coal Analyses



Ash

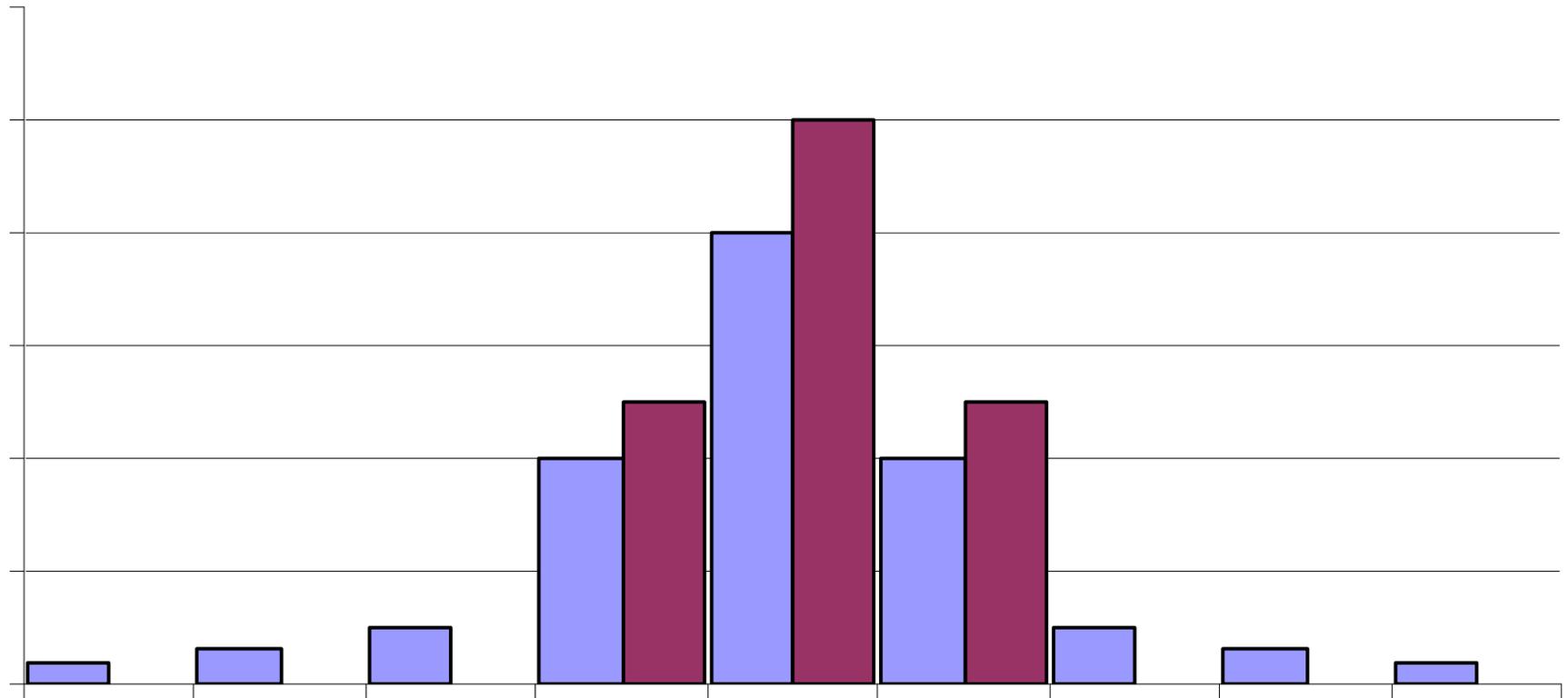
What is Easy to sell

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



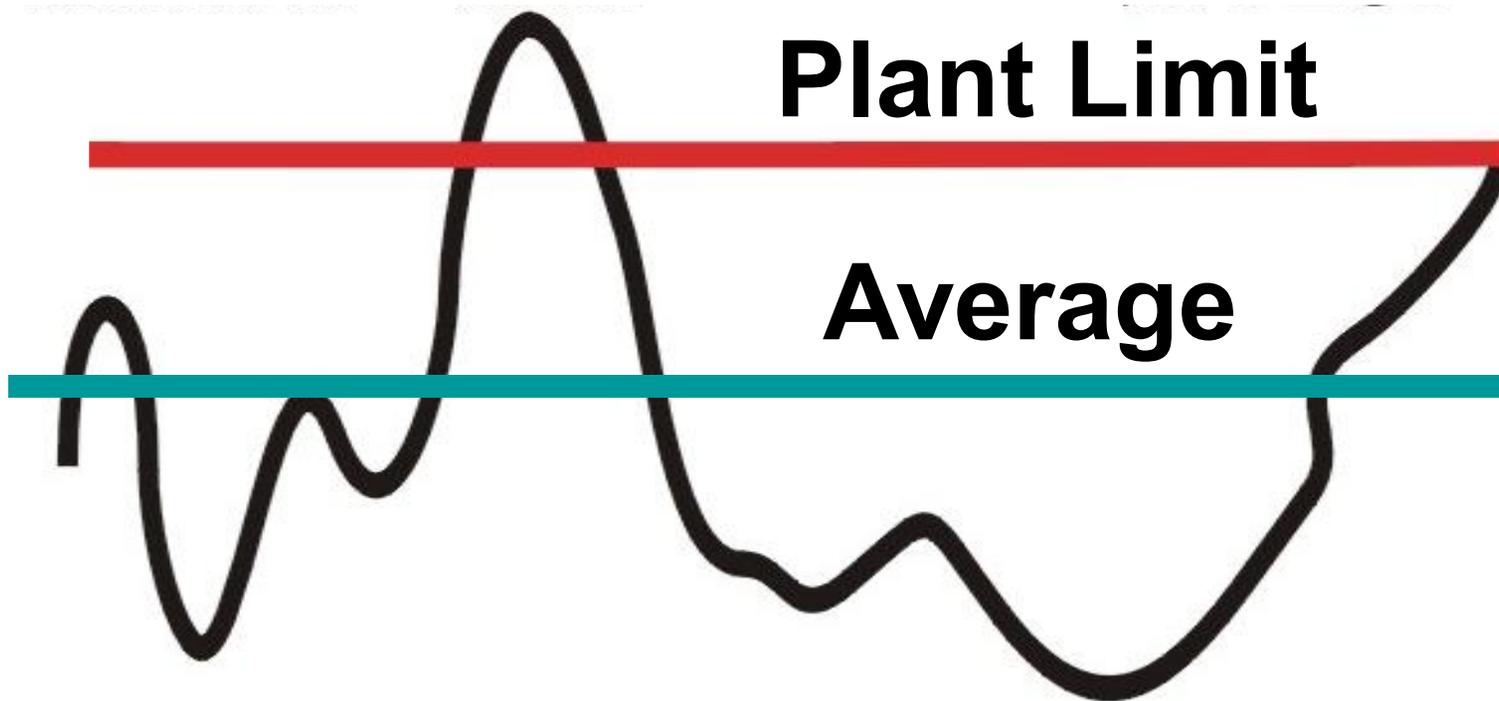
New technology measures

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**



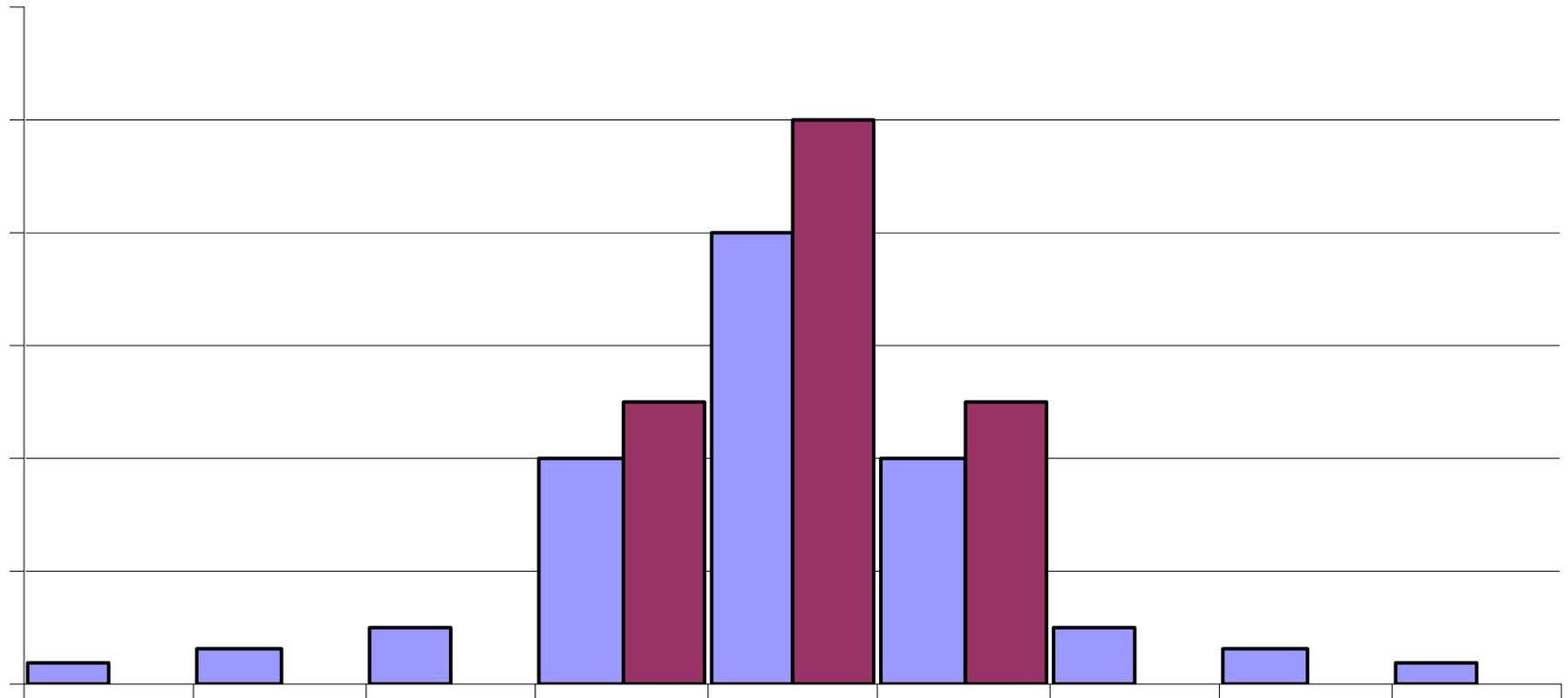
Does this coal met spec?



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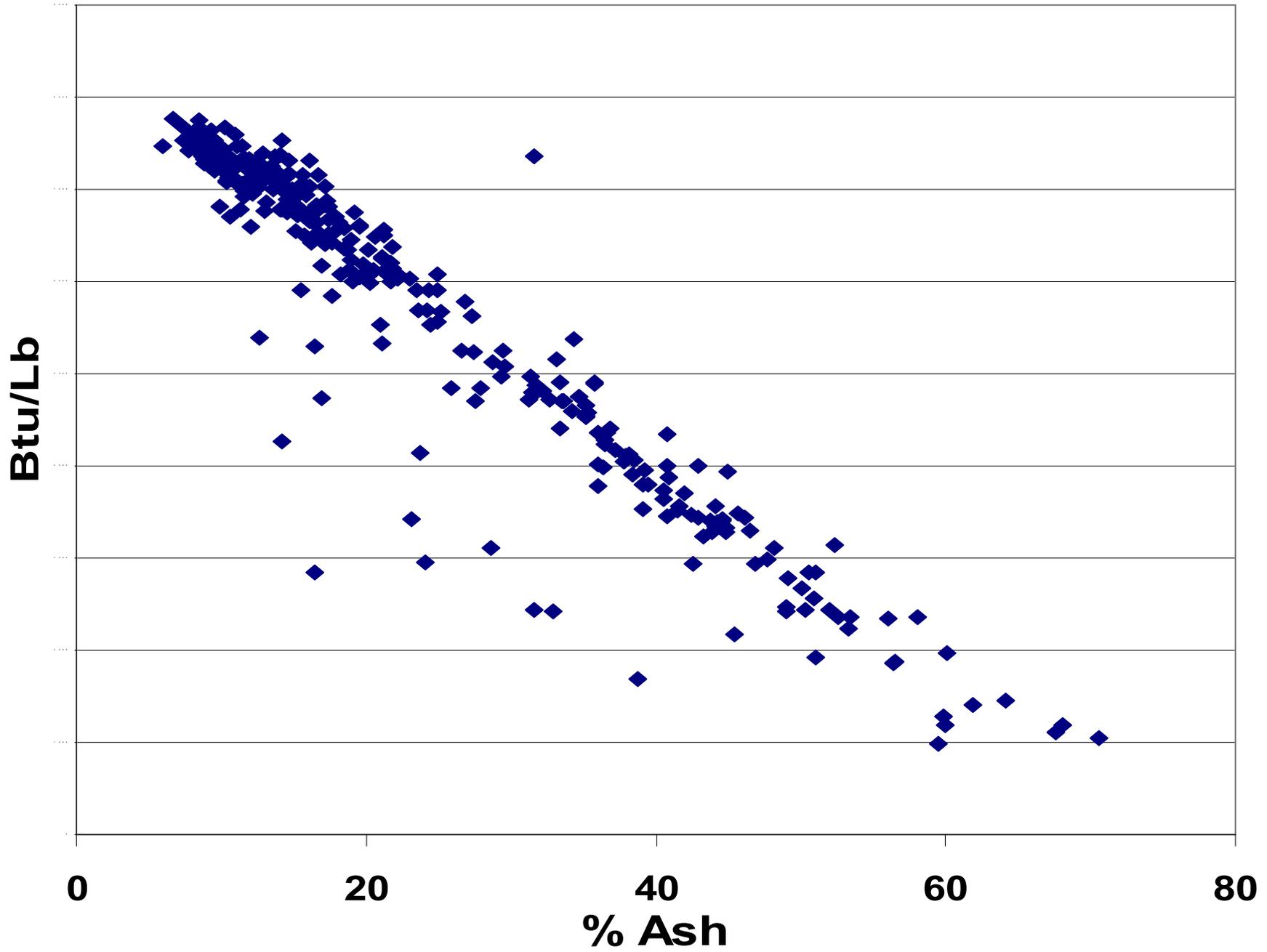
**Training – Action - Plans
and software for
Power Plants to use
On-Line
and other
Coal Quality
information**

Small and Large Variability



Quality Parameter

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

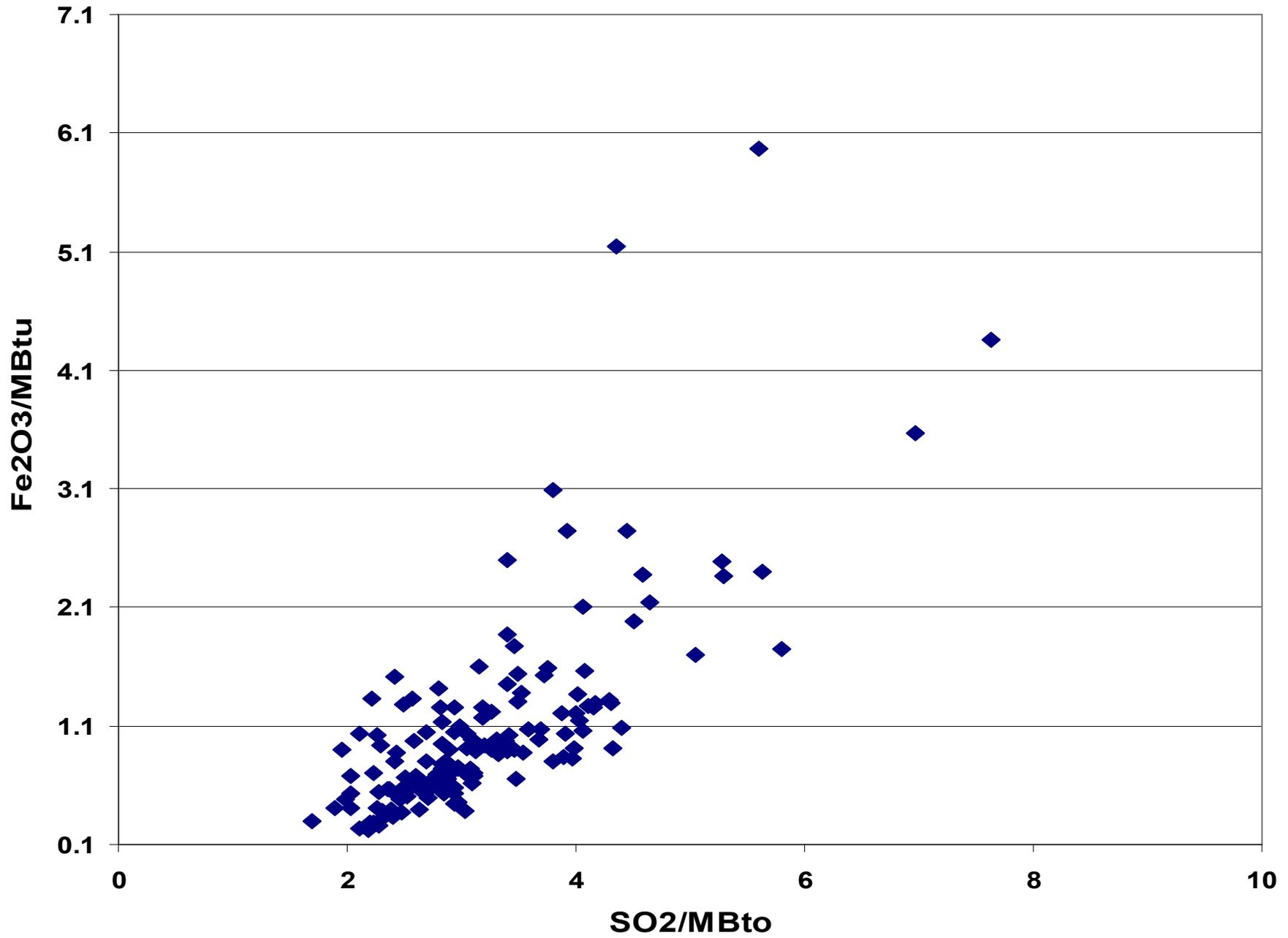
Maintain Mills to Preserve

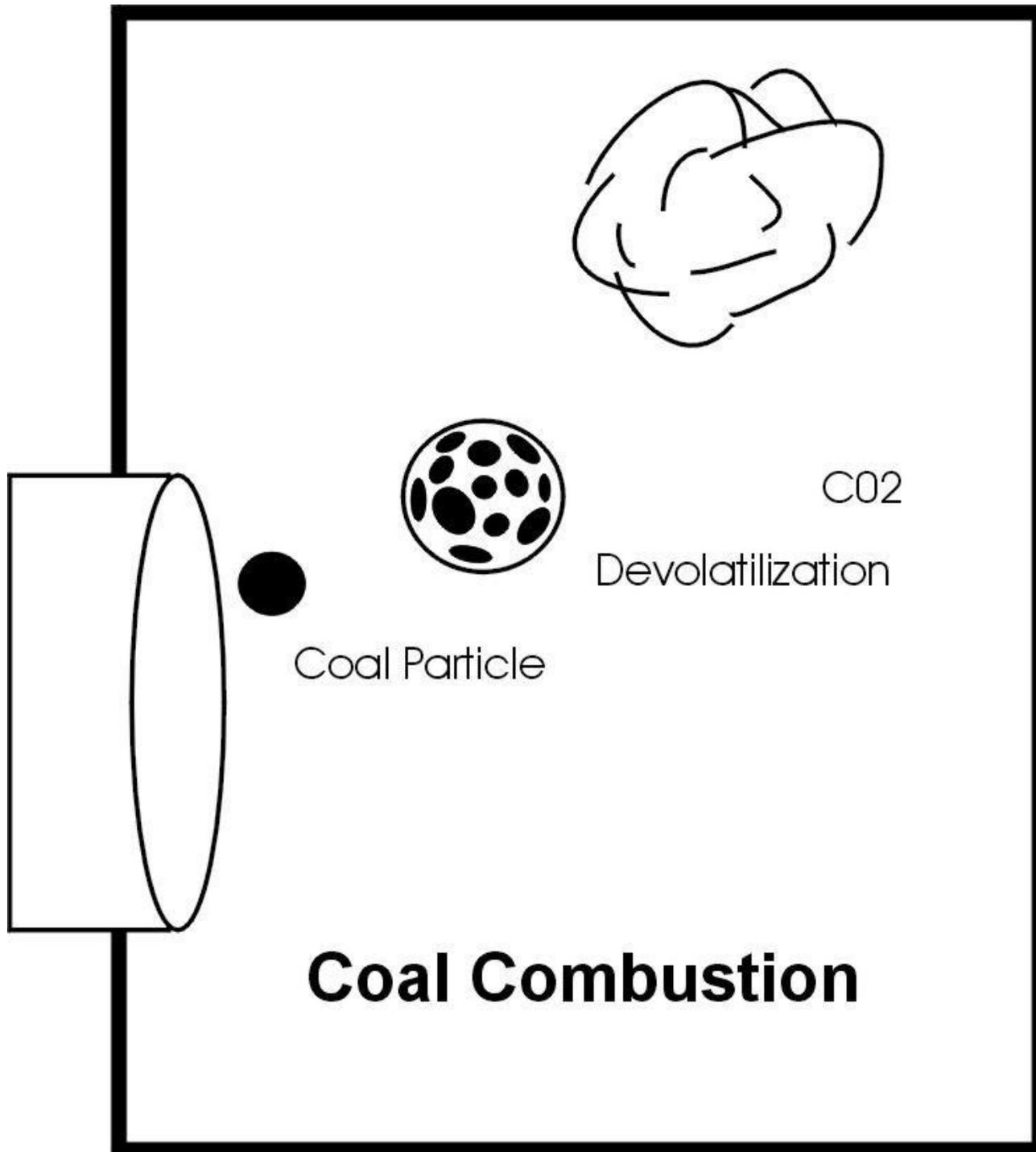
BOILER

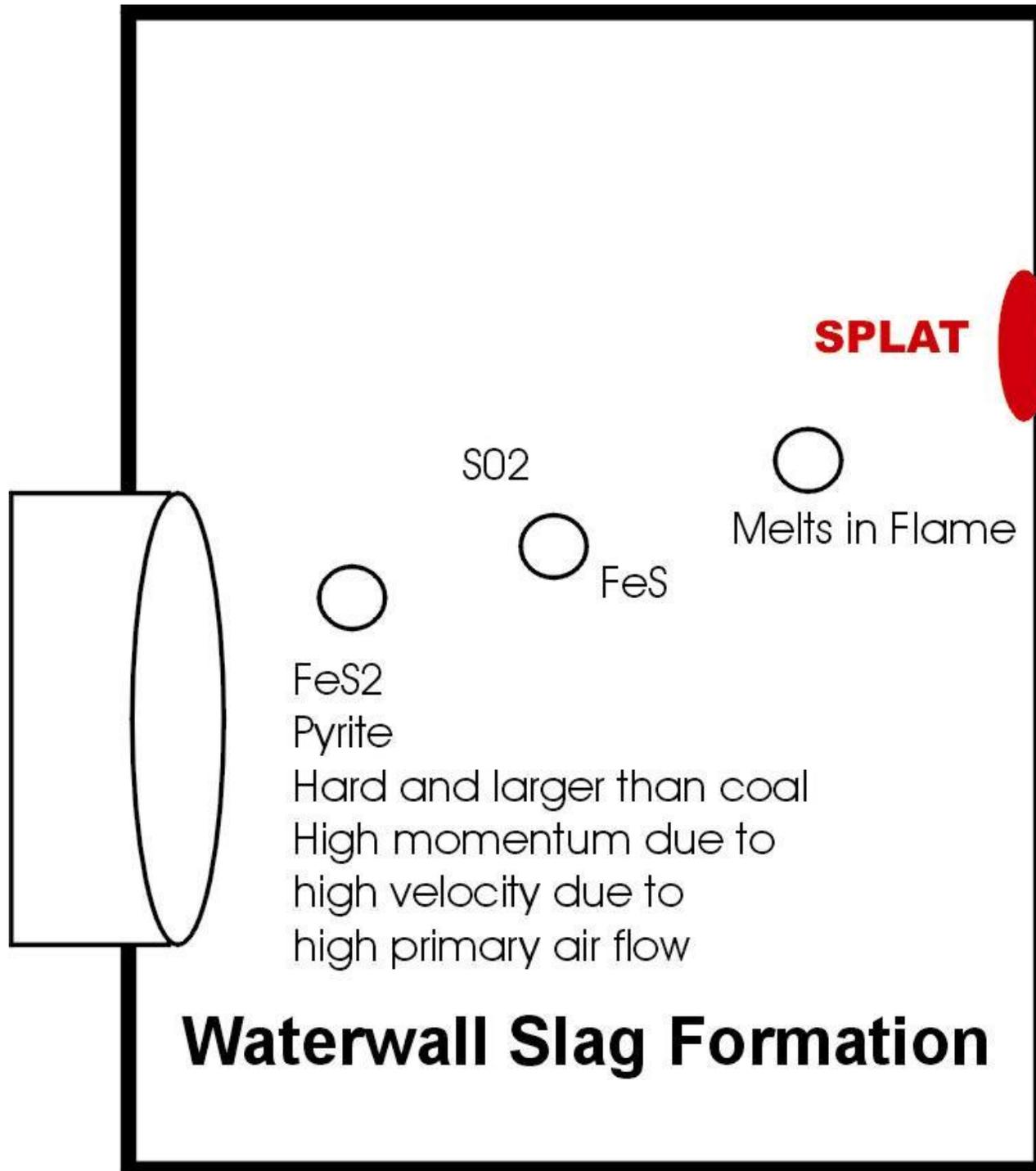
FeS_2



SO2 vs Fe2O3







Waterwall Slag Formation

Pulverizers

Coal Flow

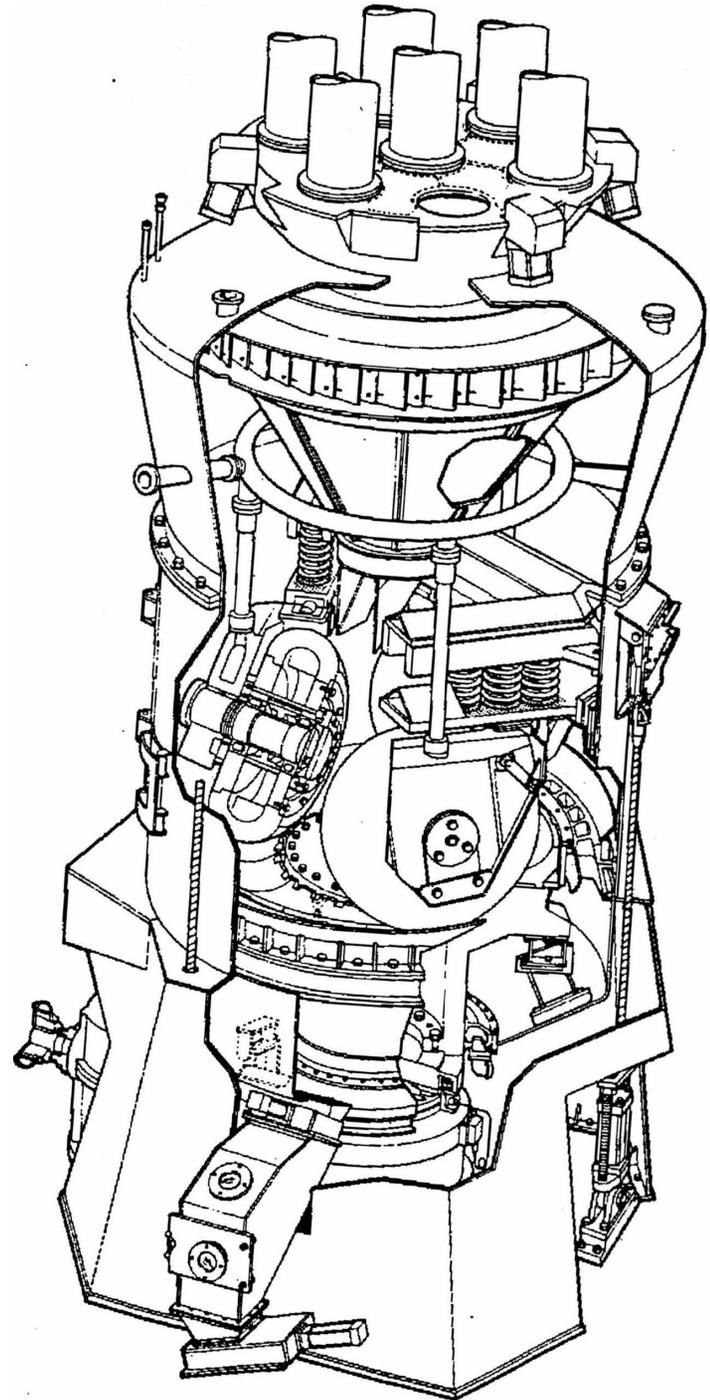
Air Flow

Coal Pipe Velocity

Outlet Temperature

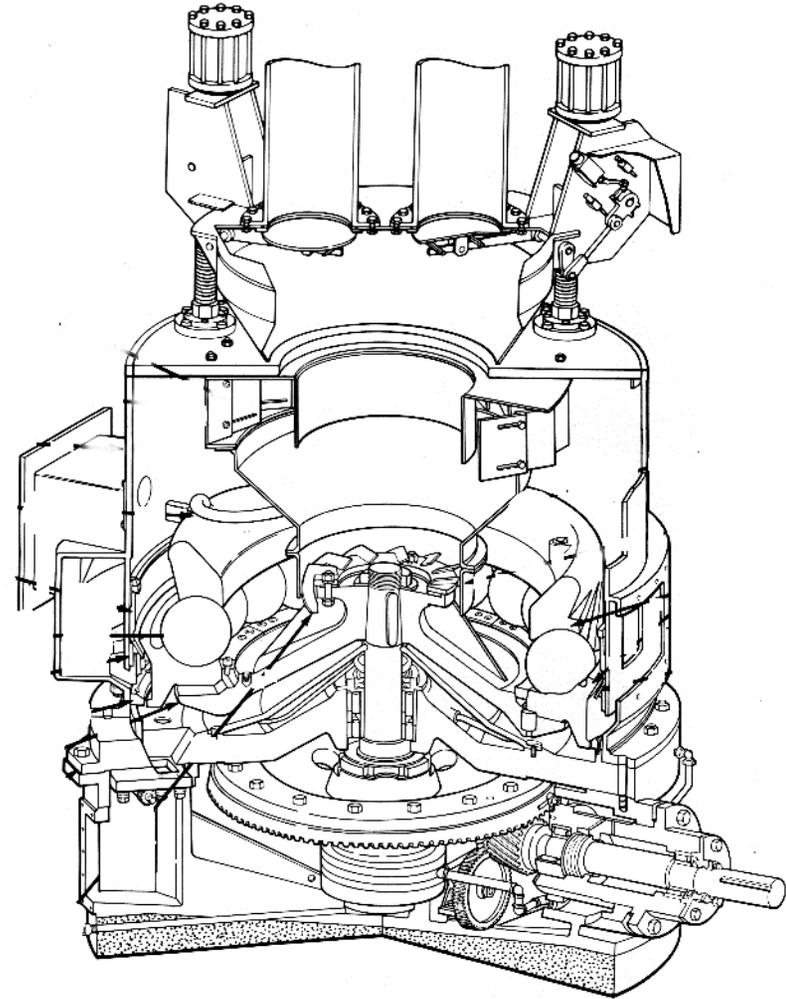
Coal Fineness

Reject Material



Ash Wears Them Out

Impacts load
High Maintenance
Performance Testing



Pulverizers

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.

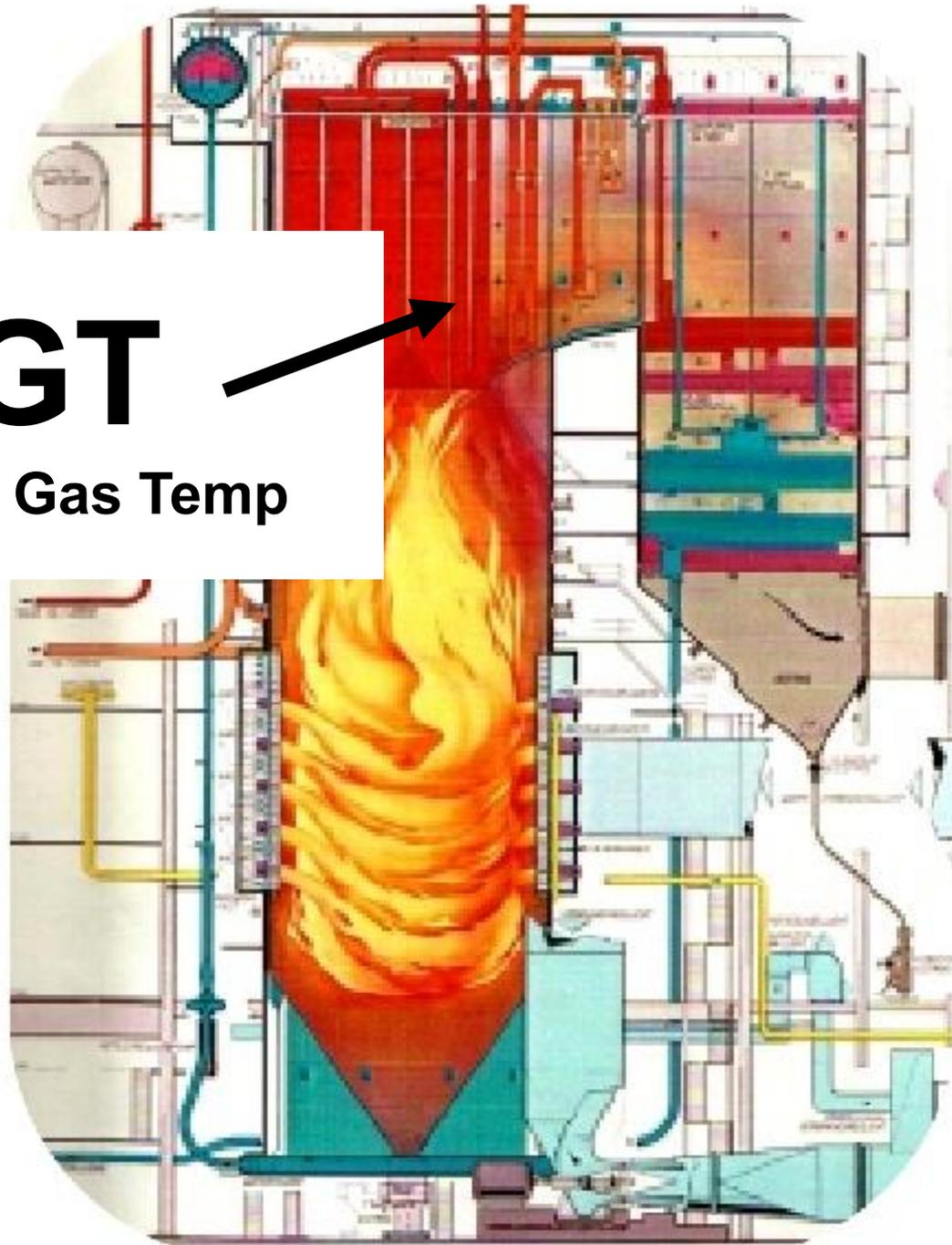


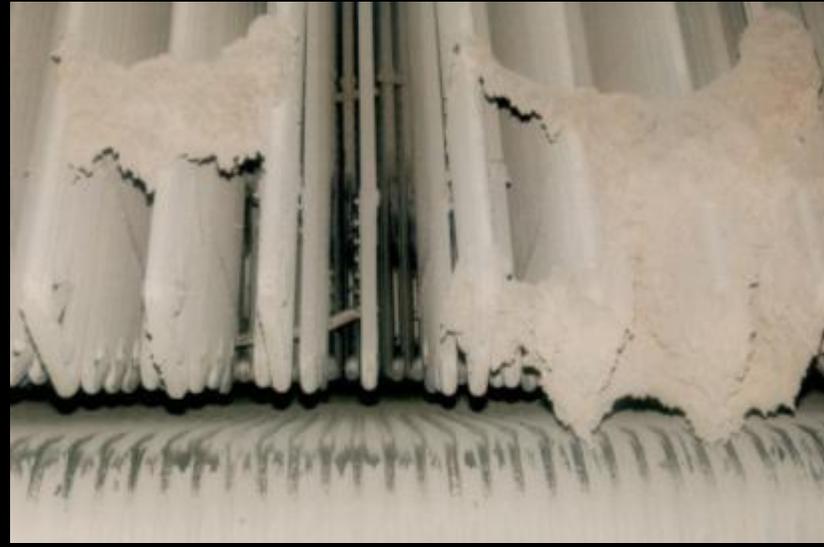
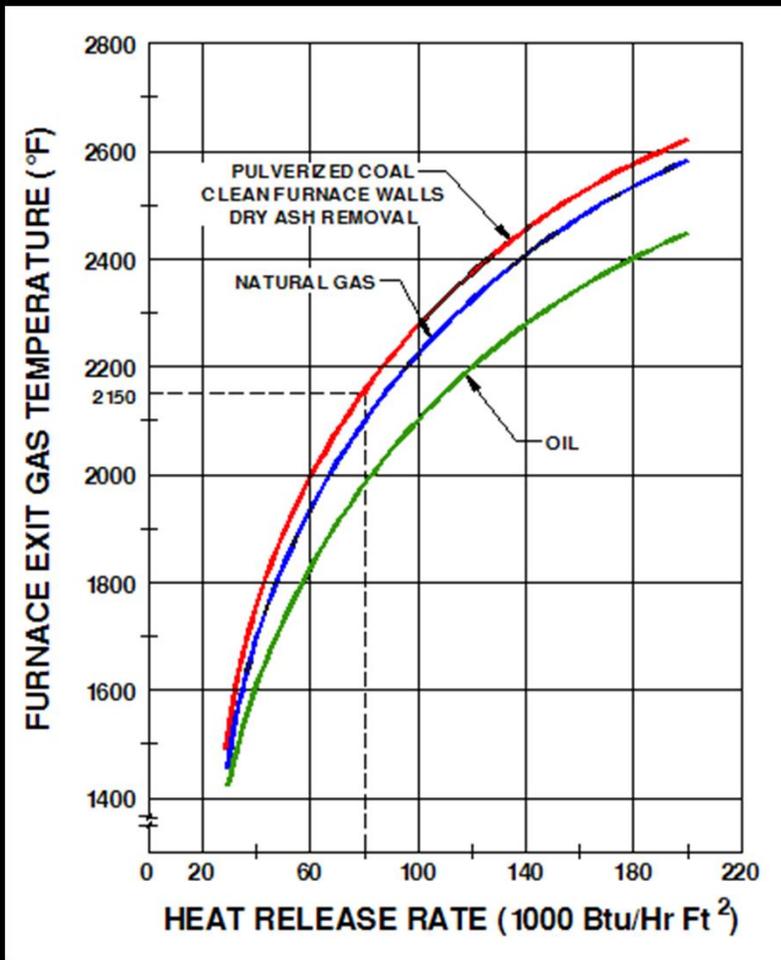
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Waterwall Corrosion . Tube Leaks

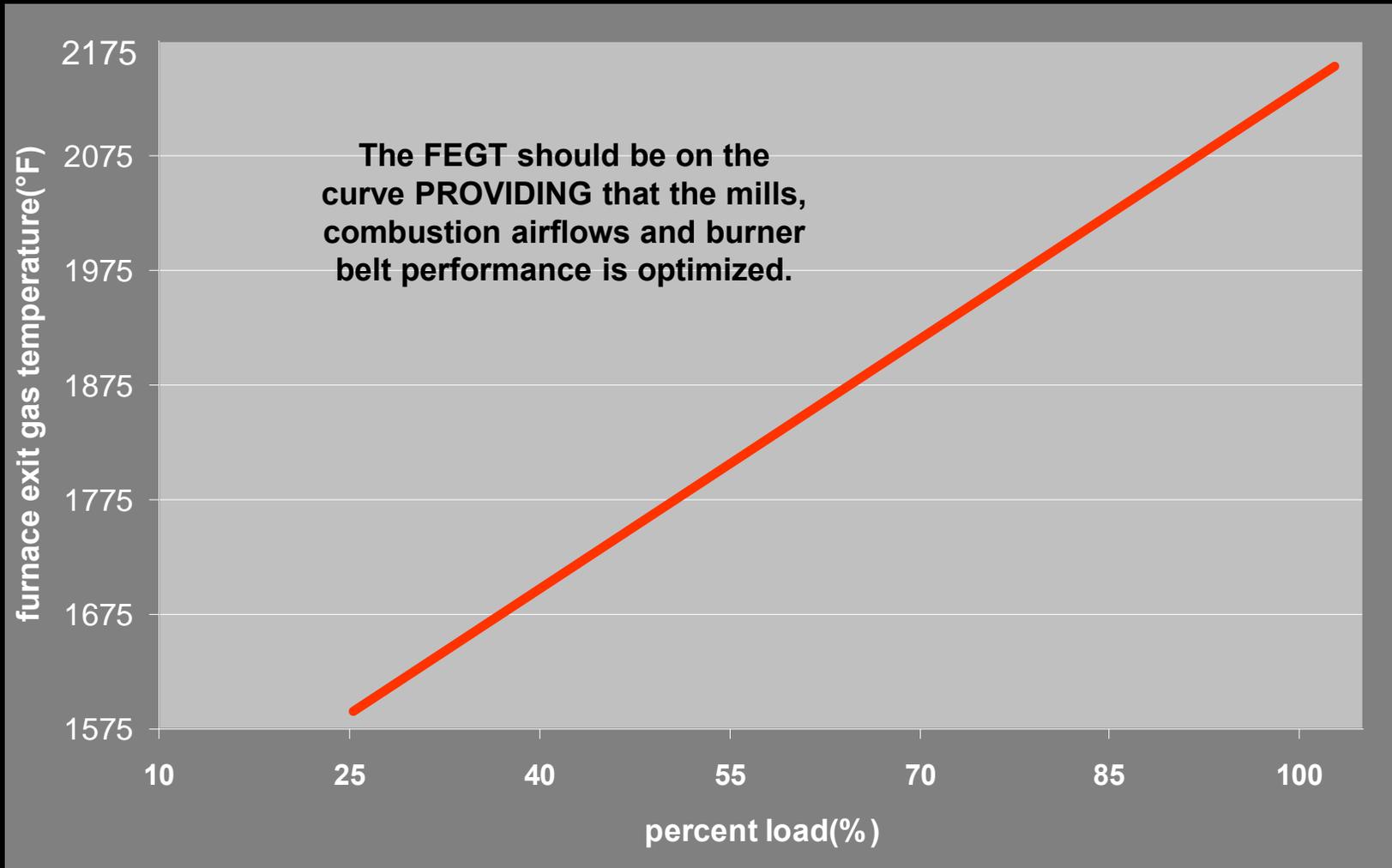


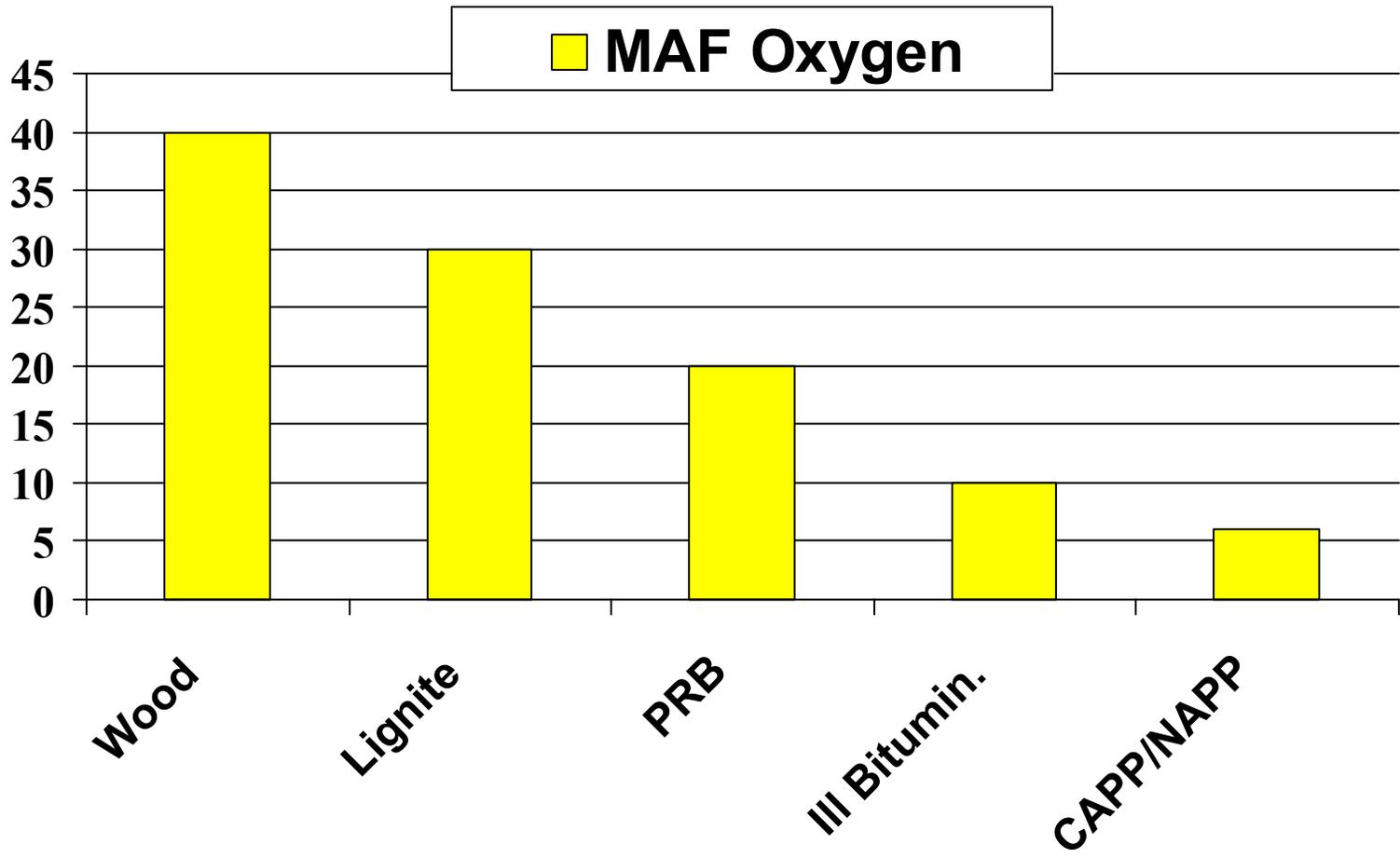
FEGT
Furnace Exit Gas Temp



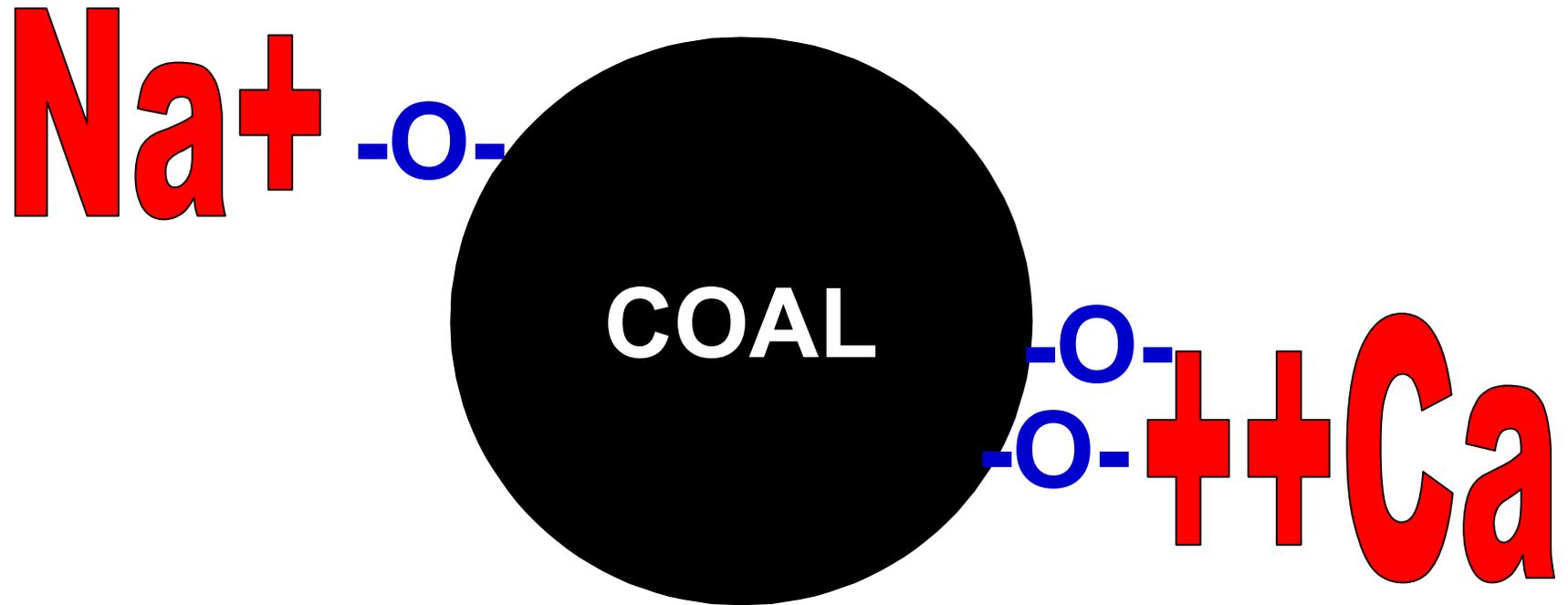


Combustion Optimization is a pre-requisite

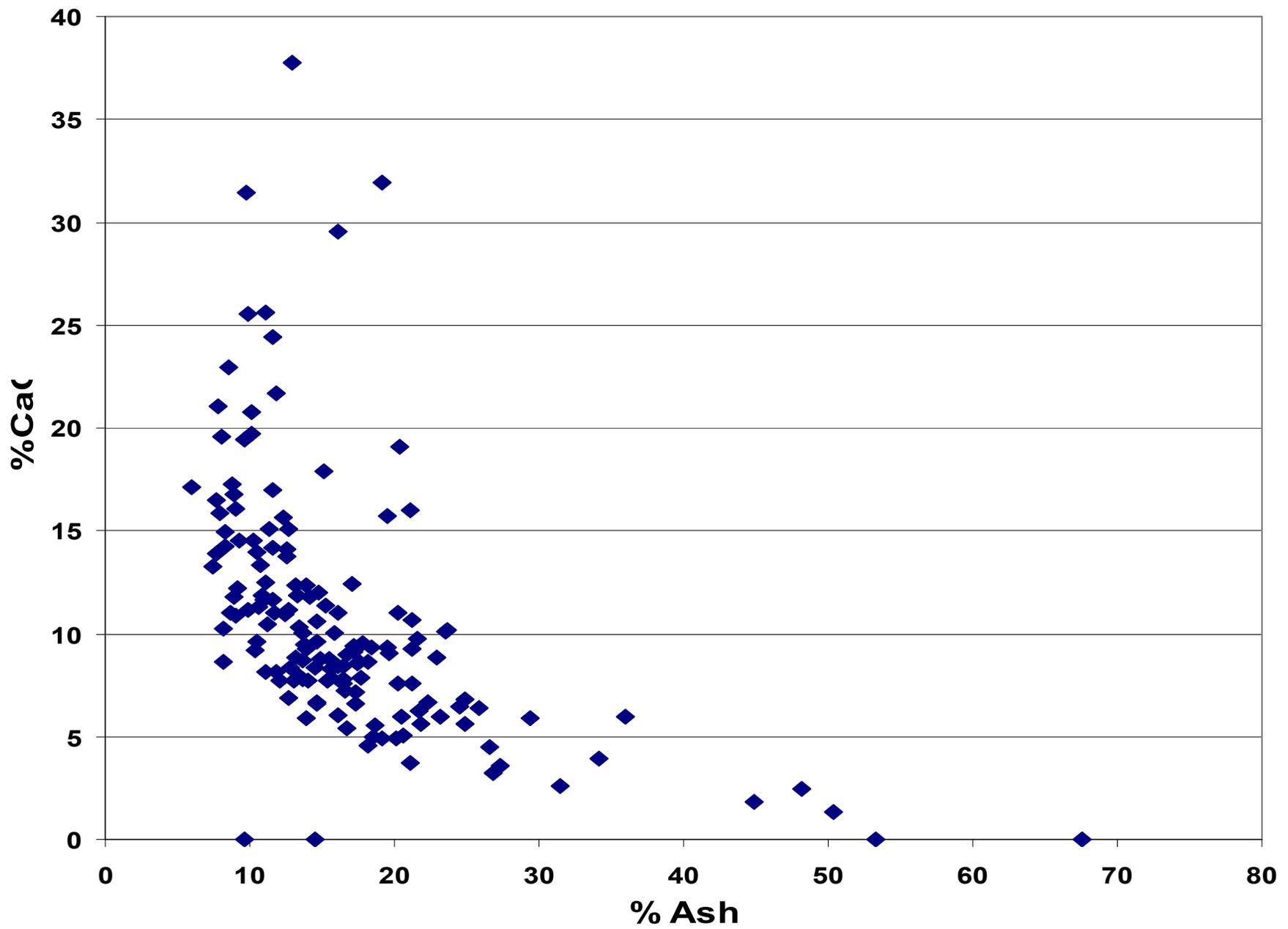




Organically Bound Alkalis



Ash CaO



Foul Index =

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

~ Illinois Coal



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**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

$$= \%ash / (\text{Btu}/10,000) \\ \times (\%Element/100)$$

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

Fe_2O_3 , CaO , Na_2O

No time tonight to mention:

Chlorine

Mercury

Arsenic

Iron

Clay minerals

Coal abrasiveness

Calcium

Sodium

Selenium

Ash Viscosity

Ash Fusion

HGI



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Thank you!