Coal Combustion Inc.
Understanding the business of coal

Understanding Wall Slag
SPLAT FACTOR
Quantified

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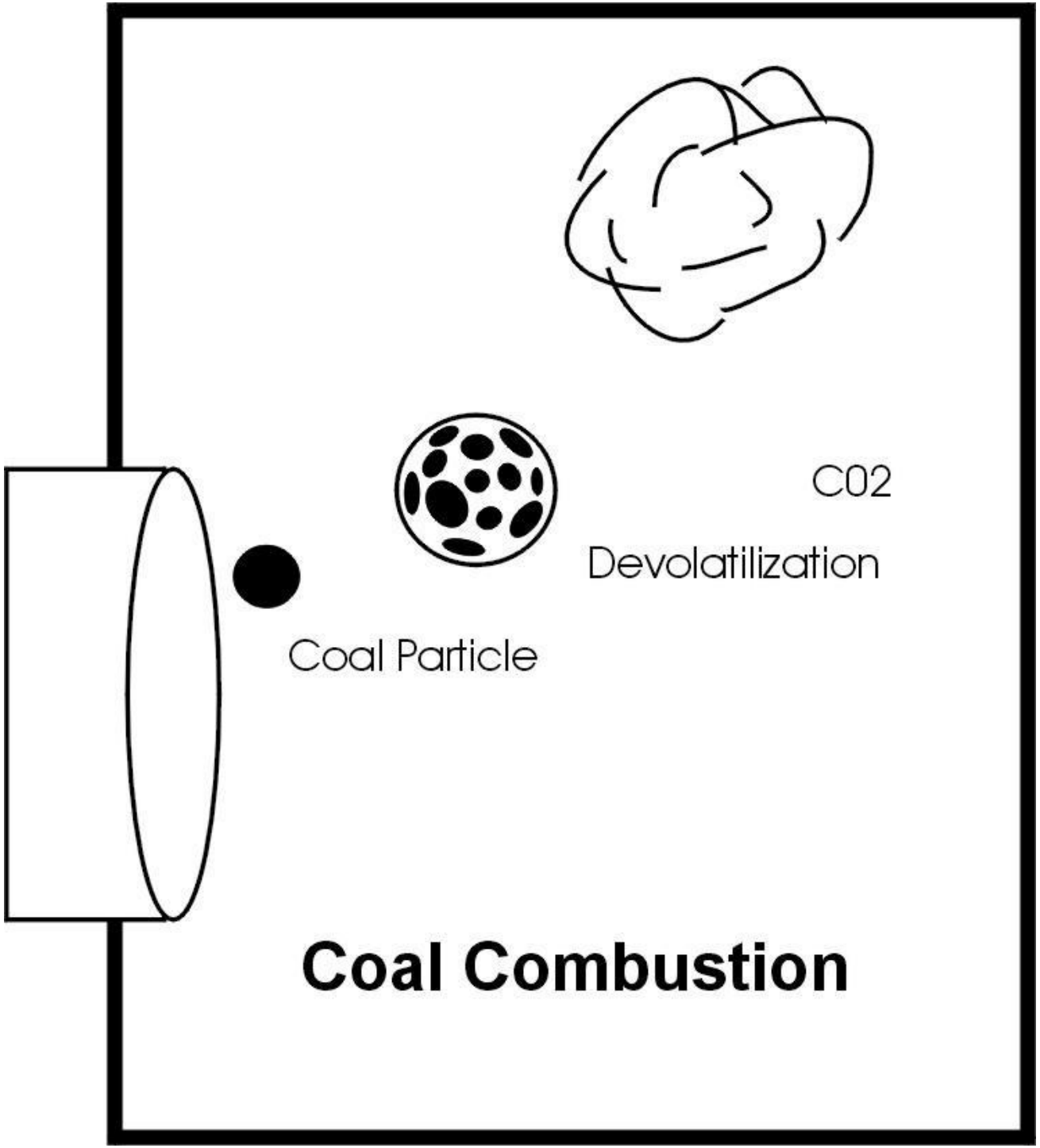
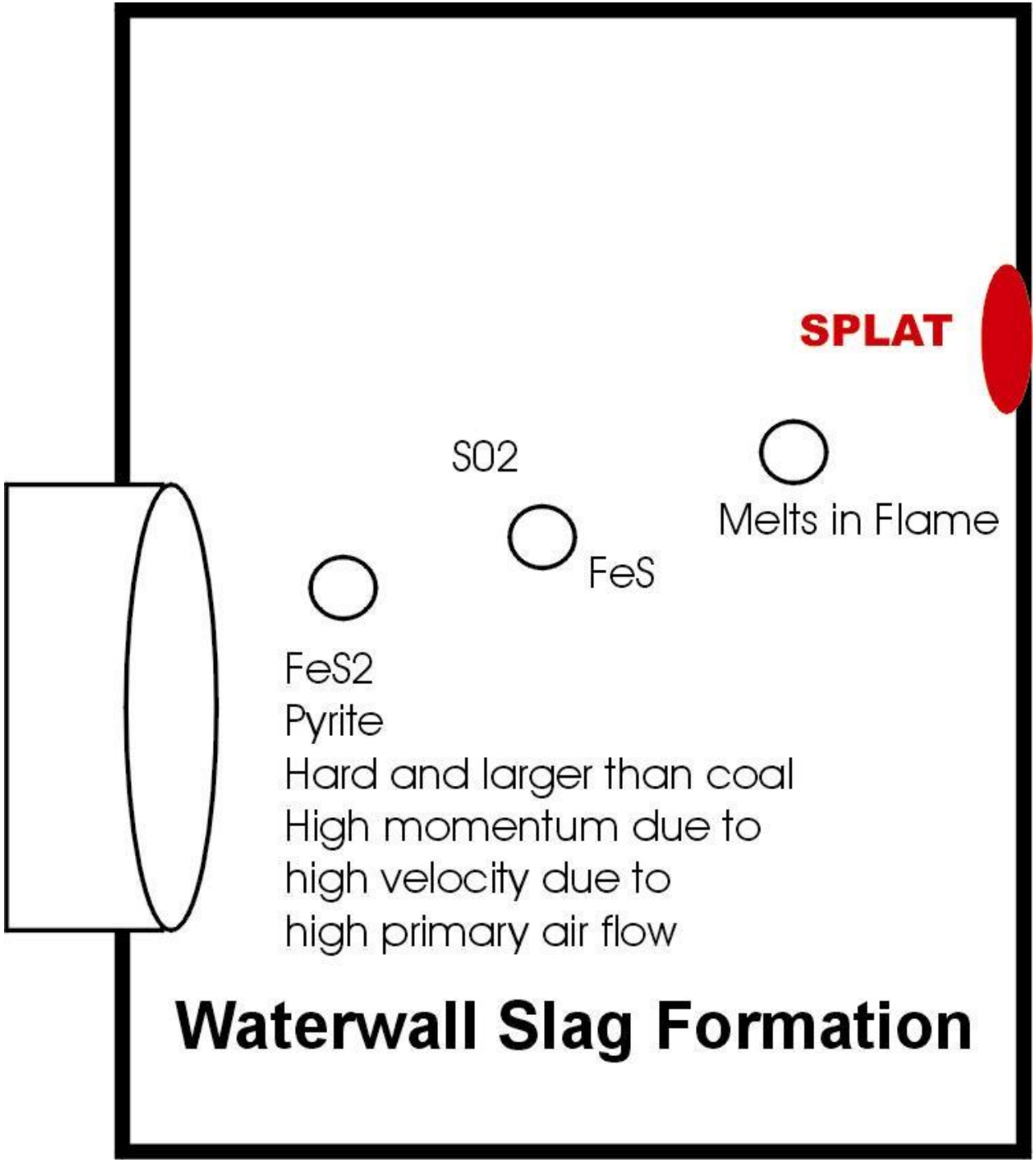

C02
Devolatilization
Coal Particle
Coal Combustion

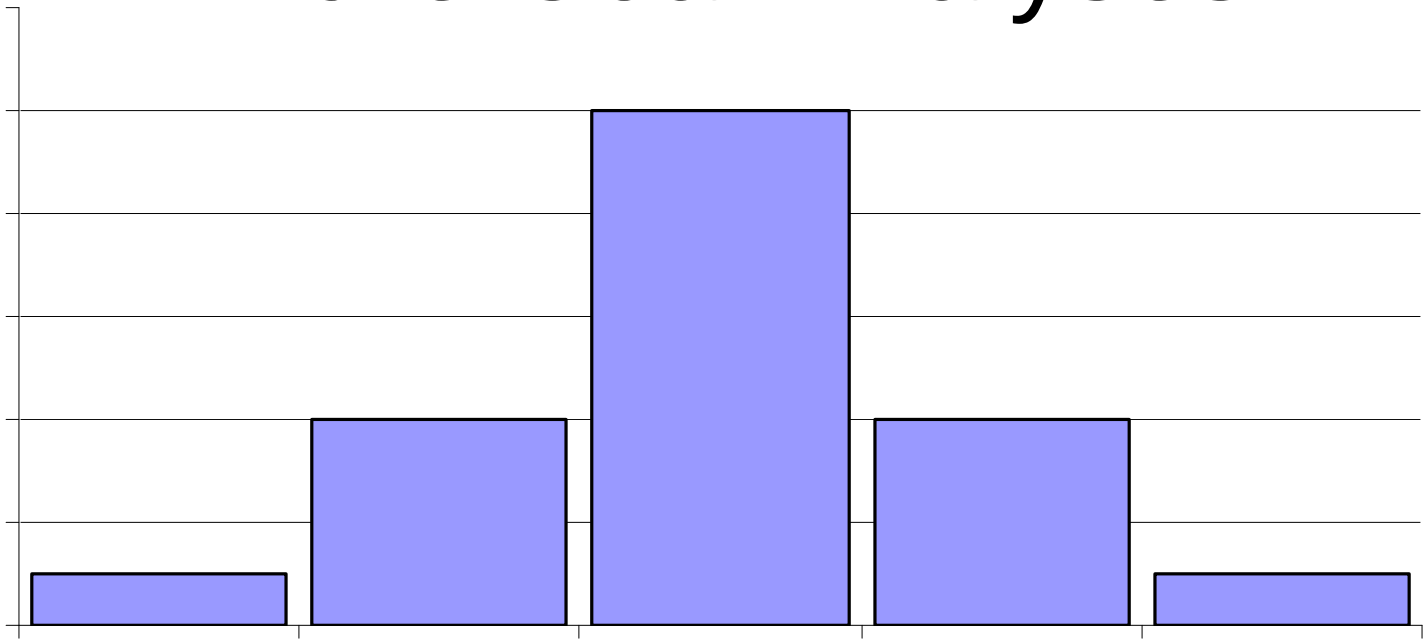

SPLAT
SO2
Melts in Flame
FeS
FeS2
Pyrite
Hard and larger than coal
High momentum due to
high velocity due to
high primary air flow
Waterwall Slag Formation

Measuring Coal Quality

ASTM only produces average data

Power plants respond to swings in quality

Pure Coal Analyses



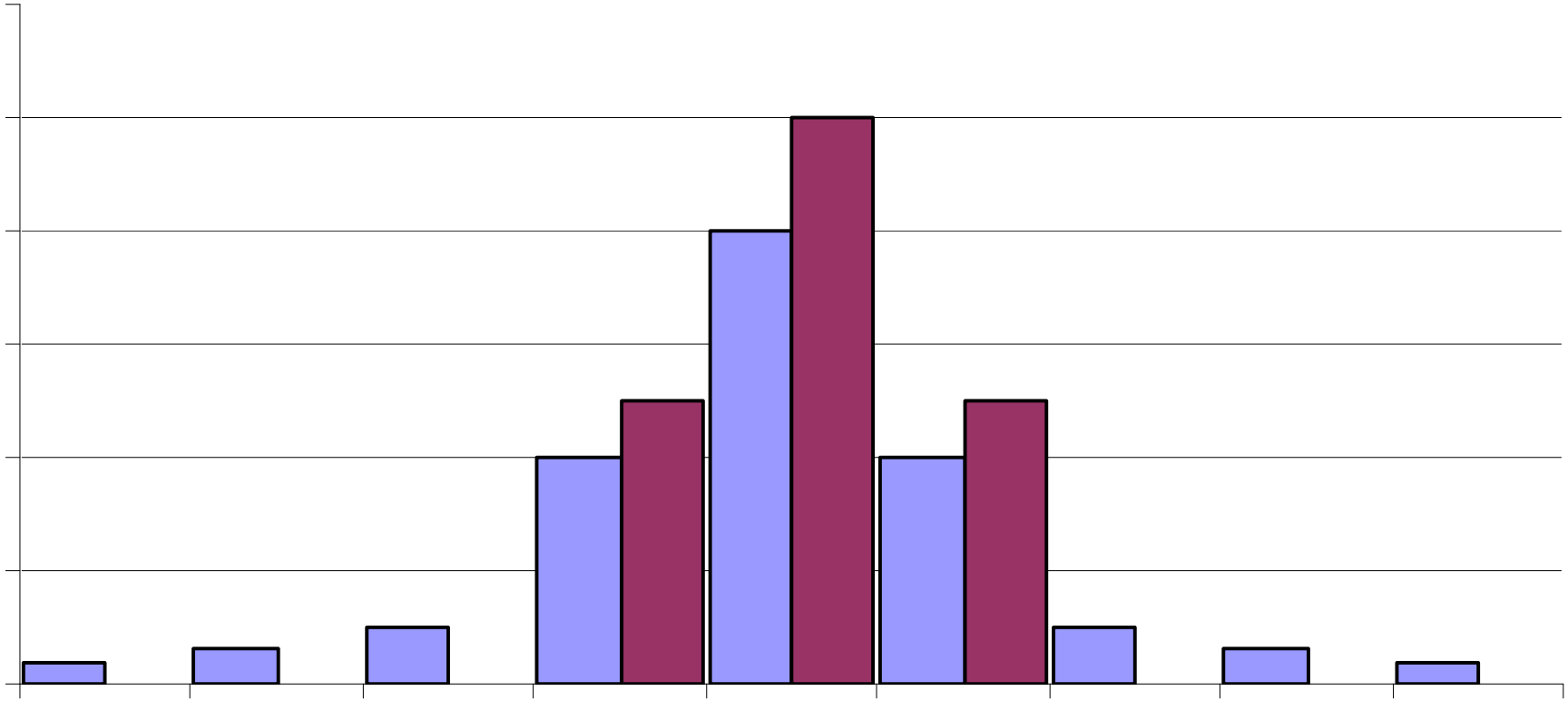
Ash

What is Easy to sell

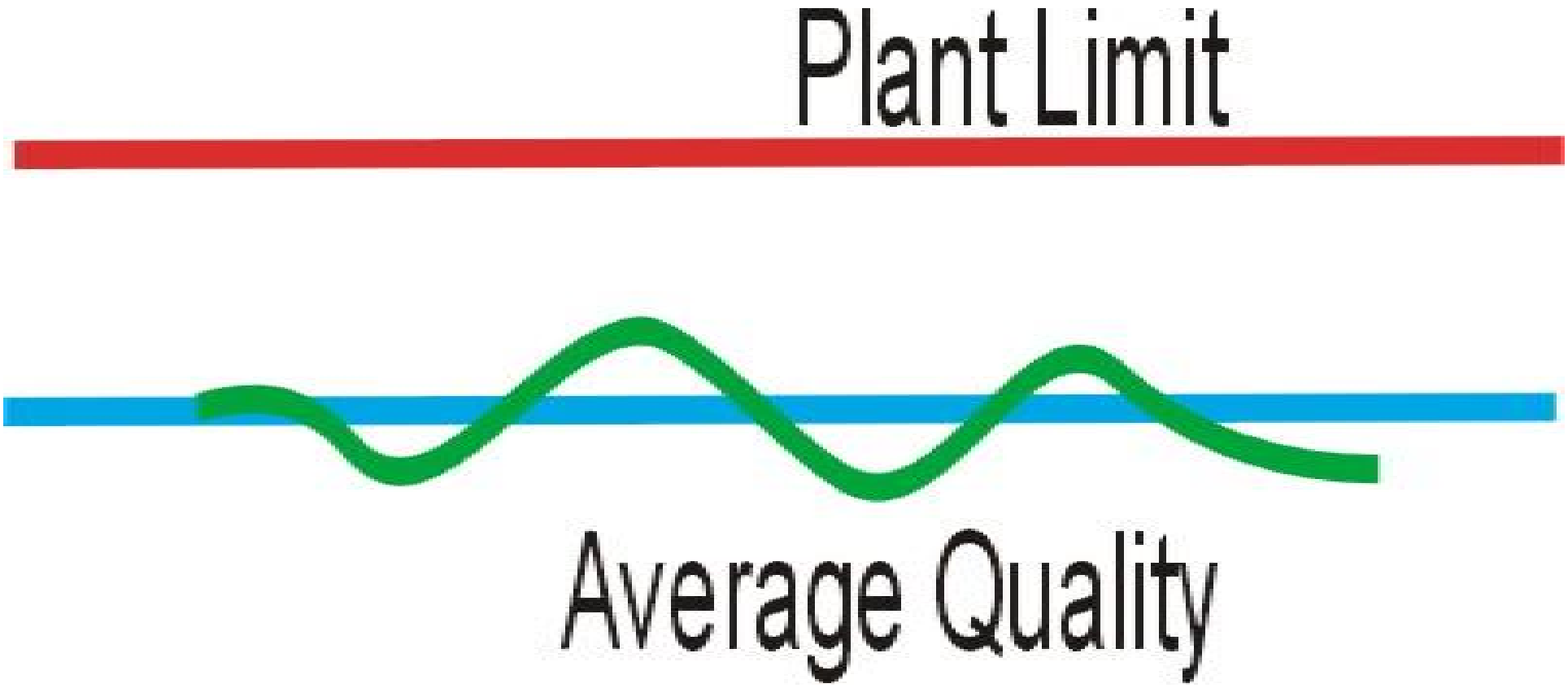
What causes plant problems


Lowest cost coal
is always raw.

Small and Large Variability



ASTM reports same ash level



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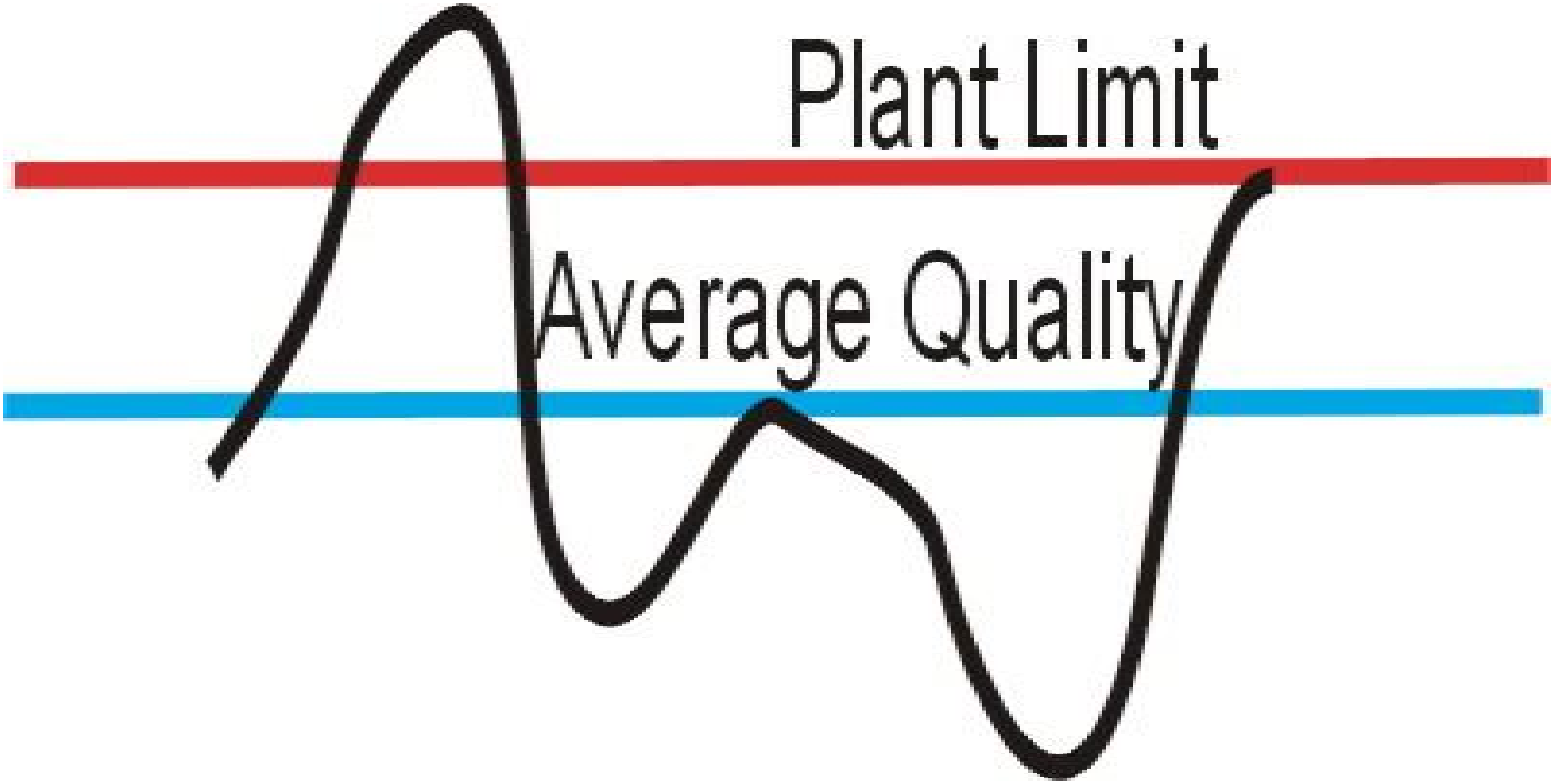

CCI

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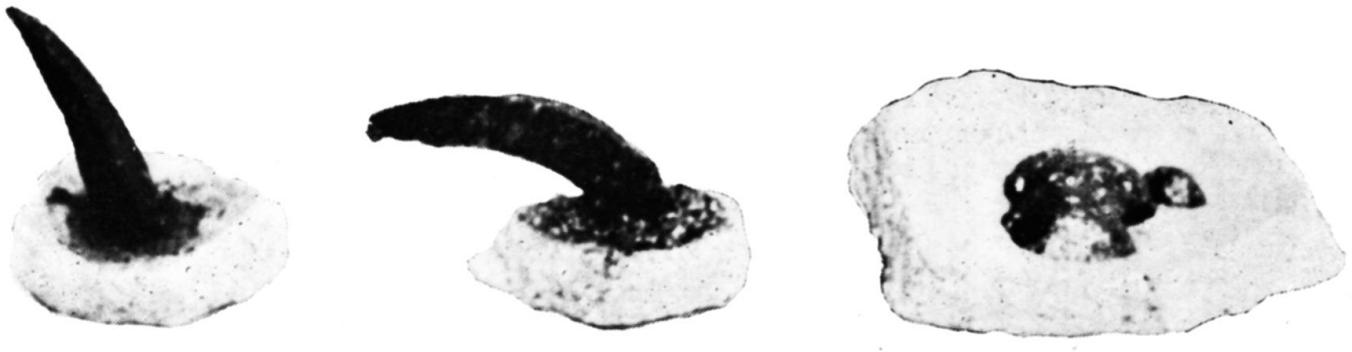
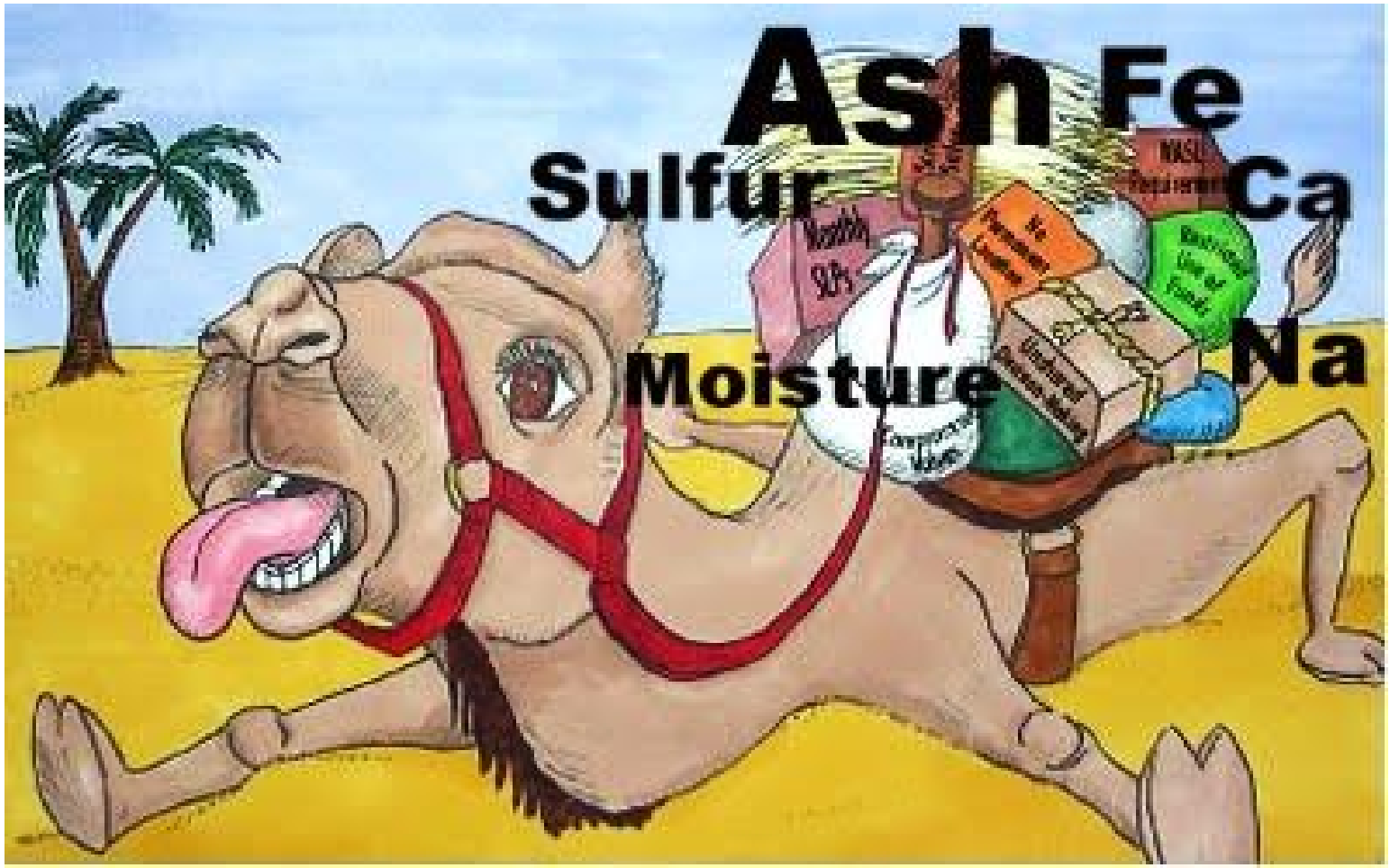
Why are we using fusion temperatures?



Test for stoker type boilers
No mineralogical data
Not the same reactions for all coals

Lets look at all boiler related coal qualities on a heat basis; lets put all percentages on a per million Kcal basis

LOADING LEVELS



Your plant has limits.
How close are you?

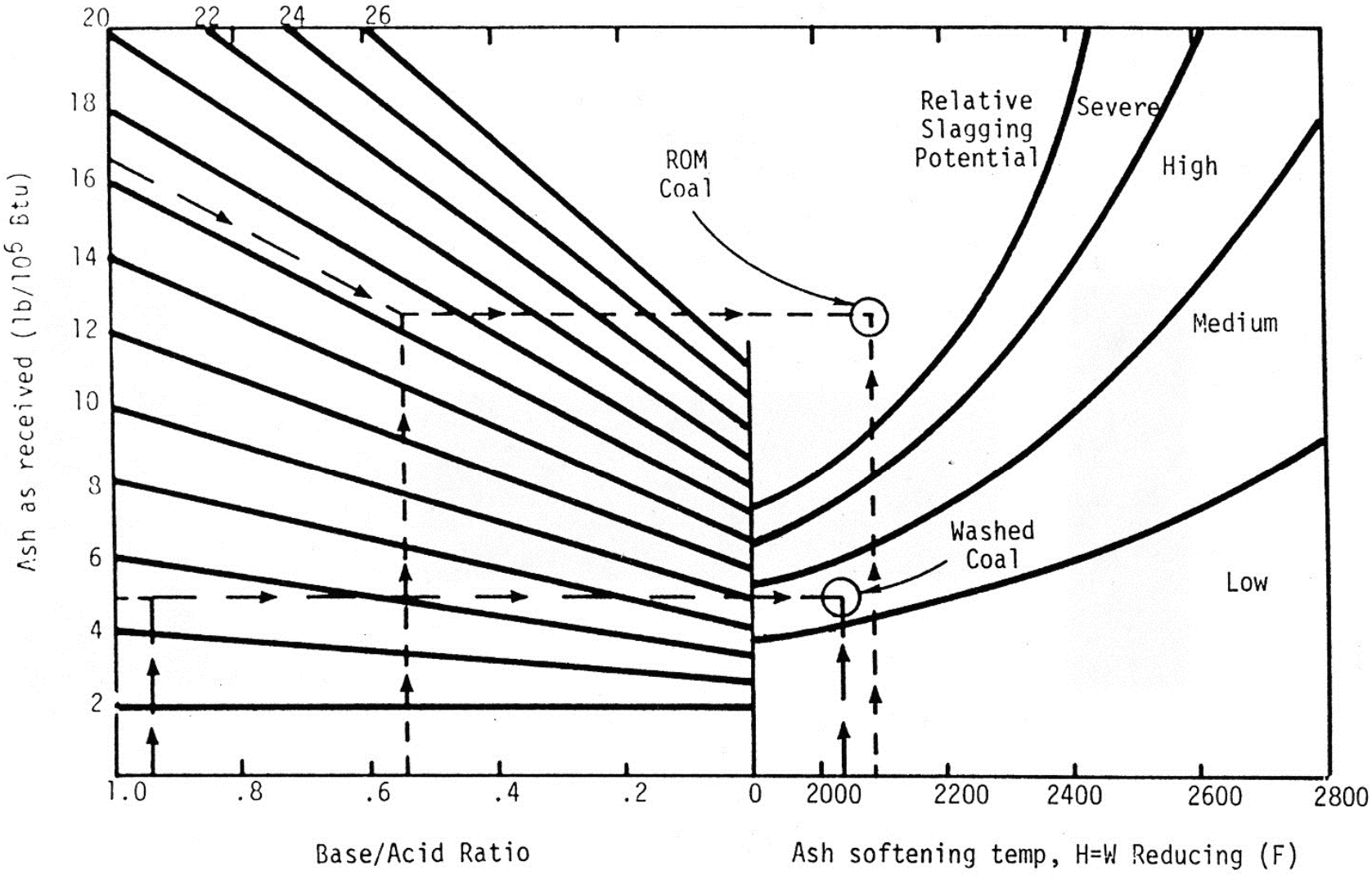


Figure 2-23. AEP slagging index (31).

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

Kg of ash/MKcal

= %ash / (Kcal/10,000)

Kg of Element/MKcal

= %ash / (Kcal/10,000) X (%Element/100)

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Pyritic

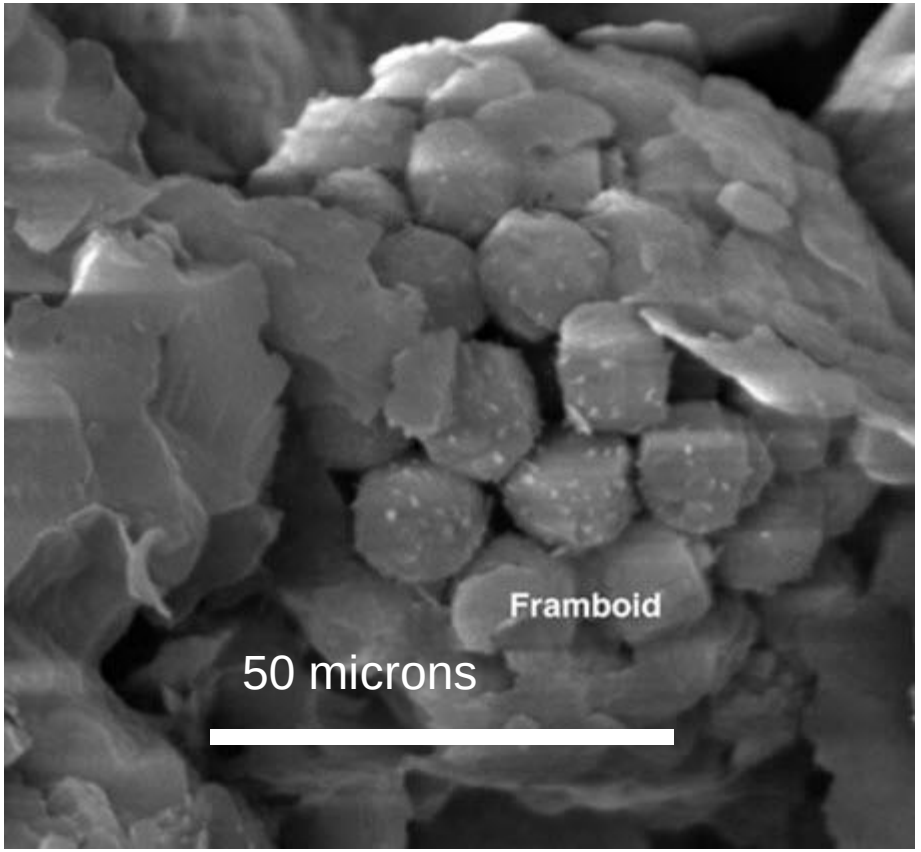
FeS_2

sulfur is attached to iron in fool's gold


FeS_2

Large sulfur balls can be washed out or rejected by pulverizers

Small framboids (raspberries) of pyrite are mixed in with the coal



Cleat

pyrite has to be ground up

Pyrite

Kg Pyrite per MKcal =

1.38 x Kg Fe_2O_3/MKcal

Raask Quartz

%Quartz ~ SiO_2–1.5x Al_2O_3

% Quartz X Kg ash/MKcal =

Kg Quartz per Million Kcals

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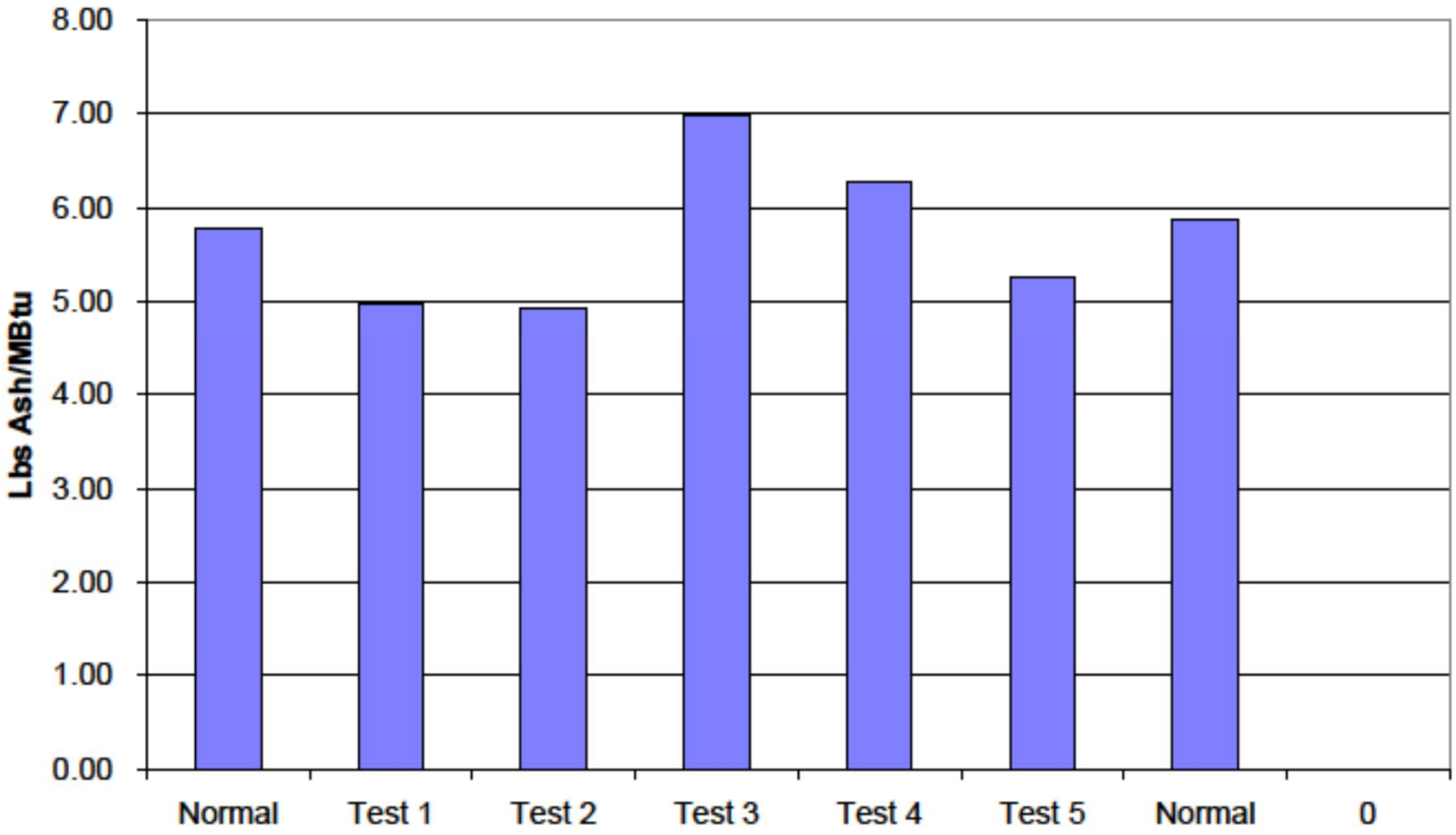
Lbs Ash/ MBtu



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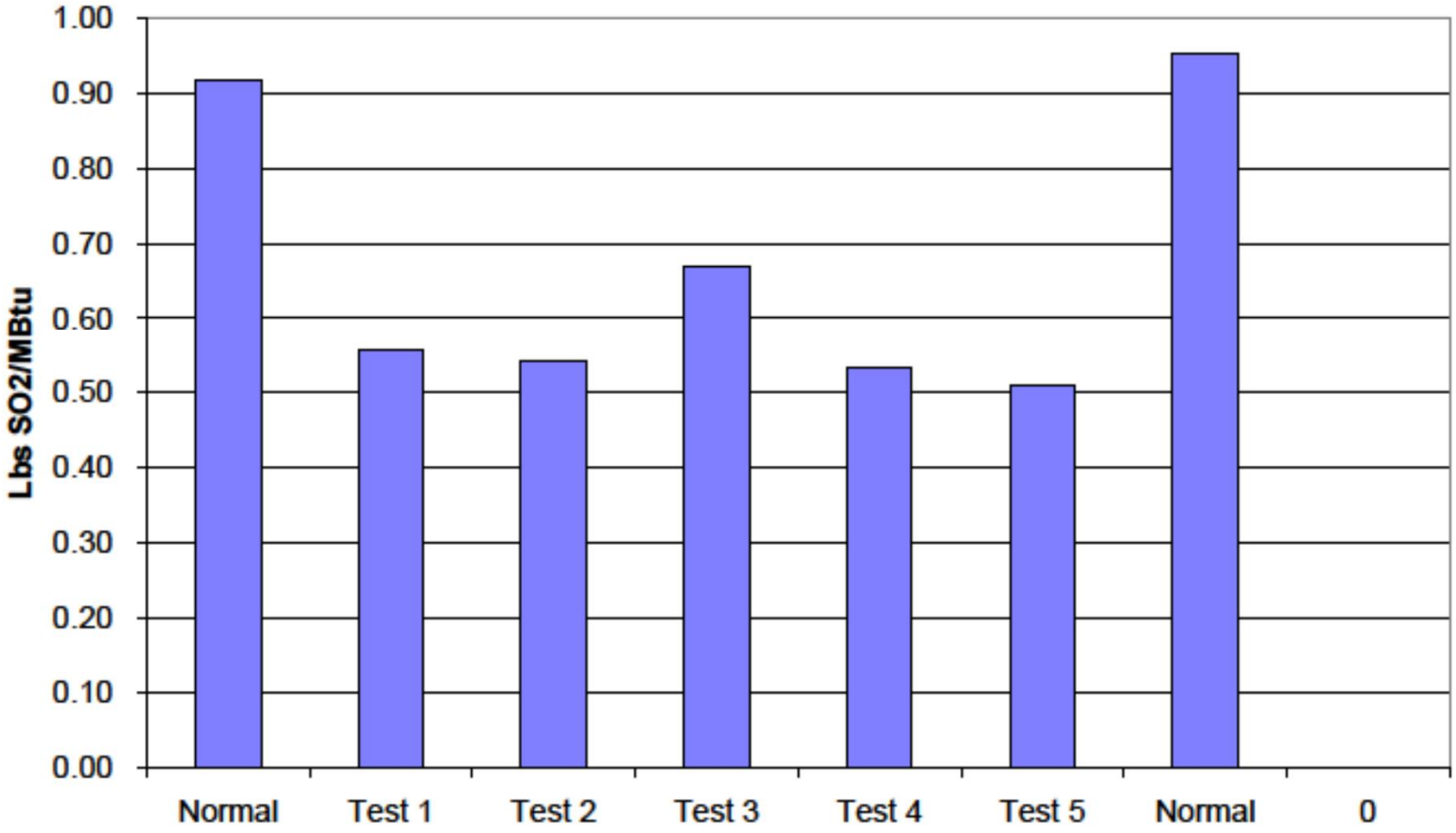
Lbs SO2/MBtu



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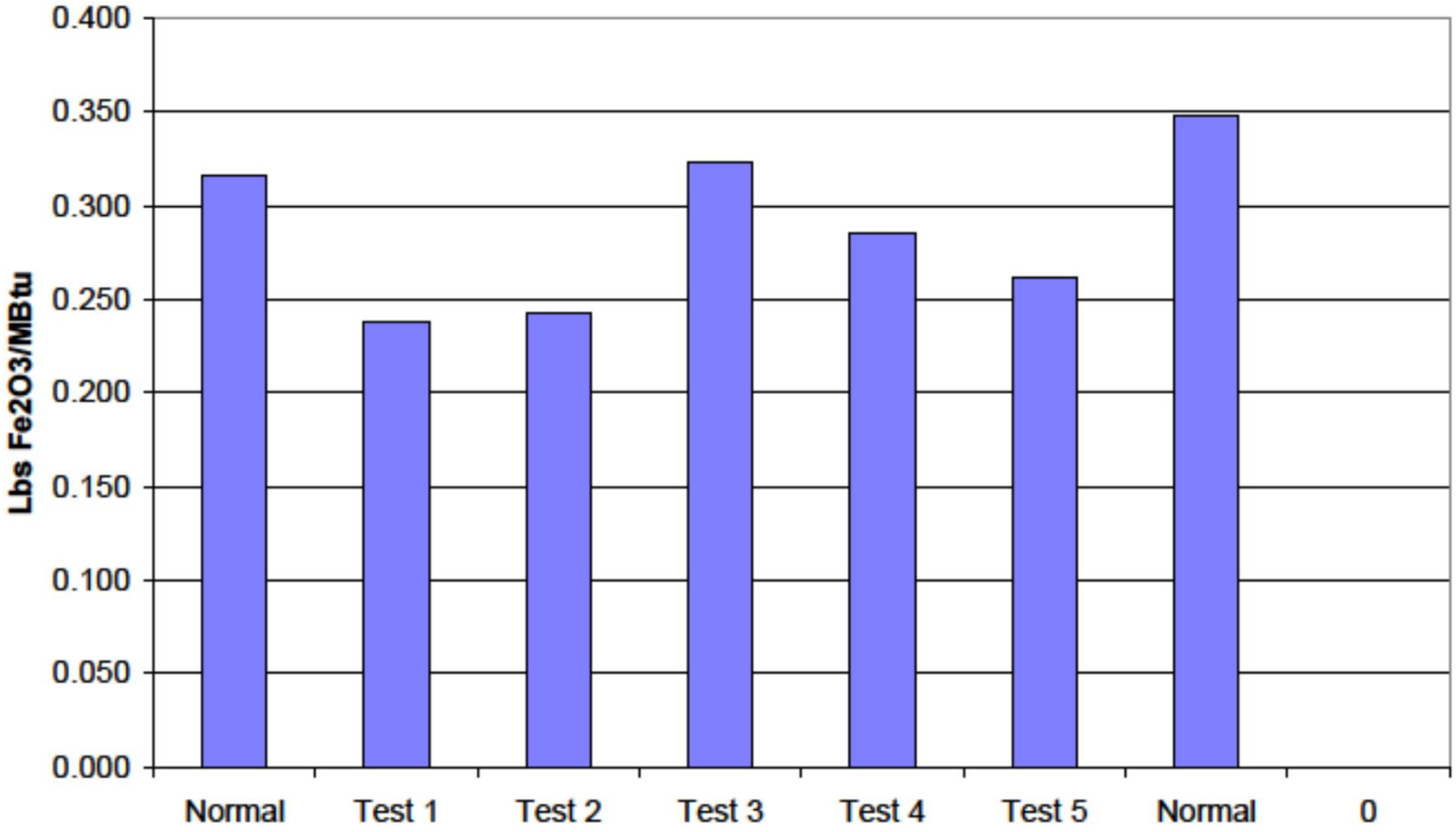
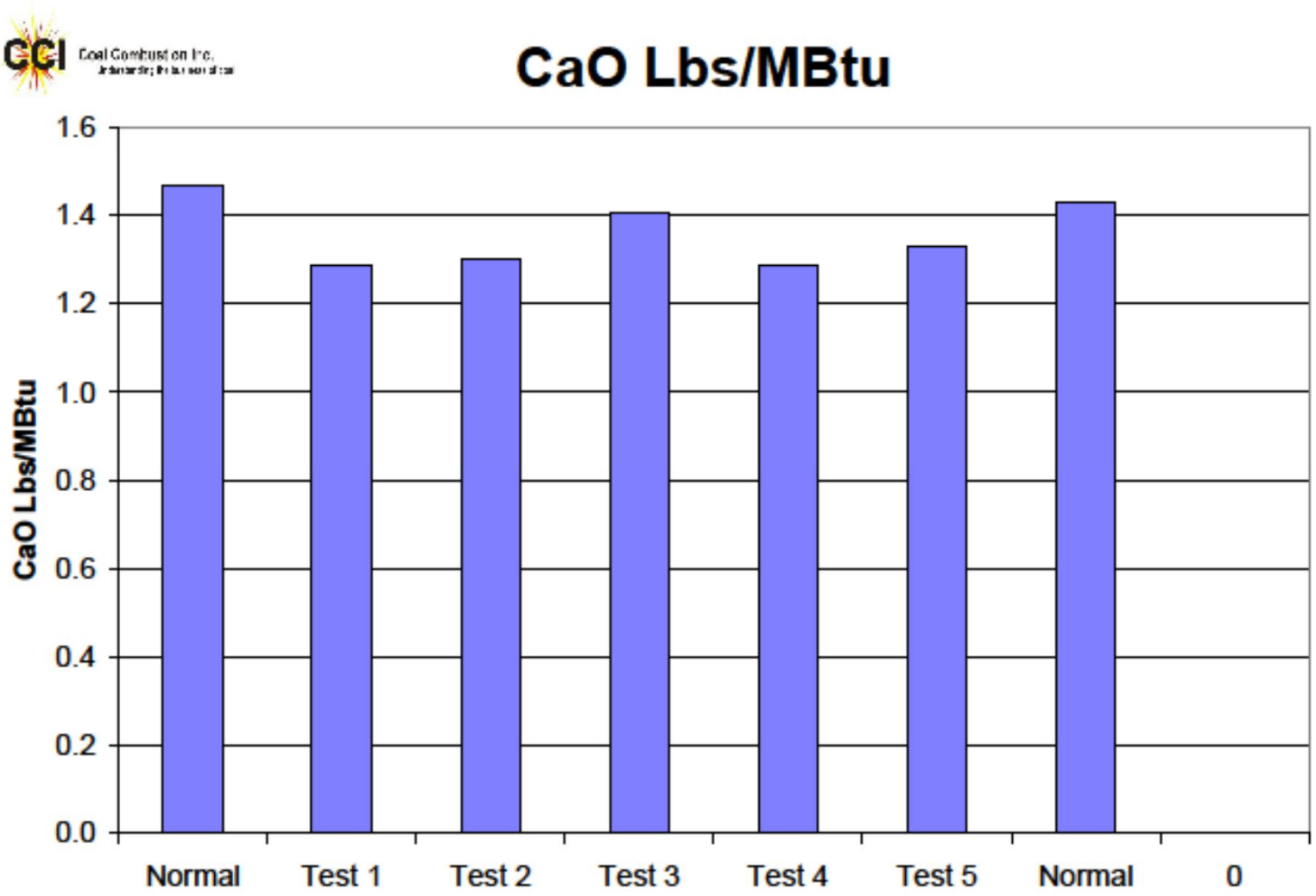
Fe203 Lbs/MBtu




CaO Lbs/MBtu
CaO Lbs/MBtu
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Normal
Test 1
Test 2
Test 3
Test 4
Test 5
Normal
0

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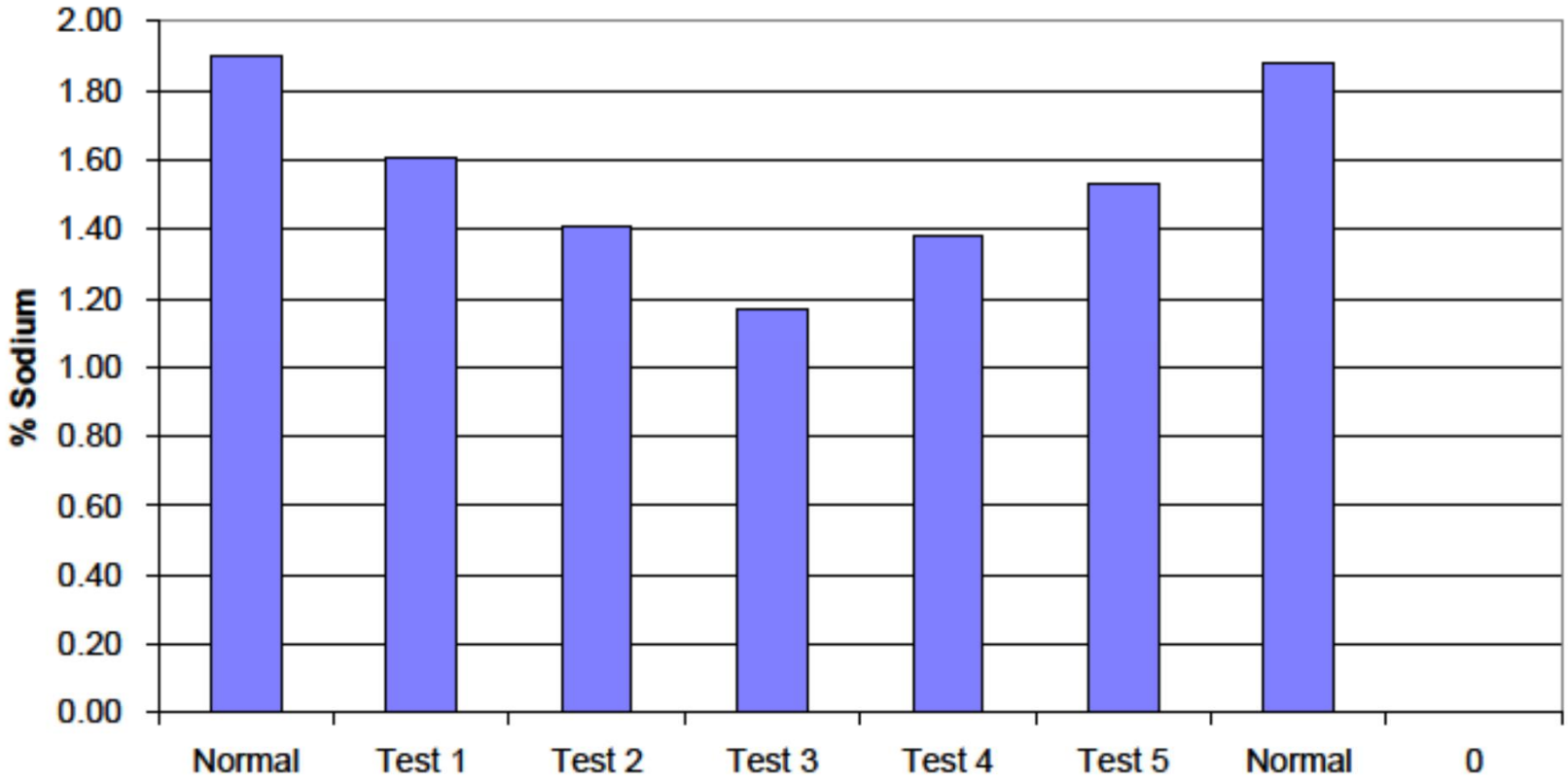
Percent Sodium in Ash as Na2O



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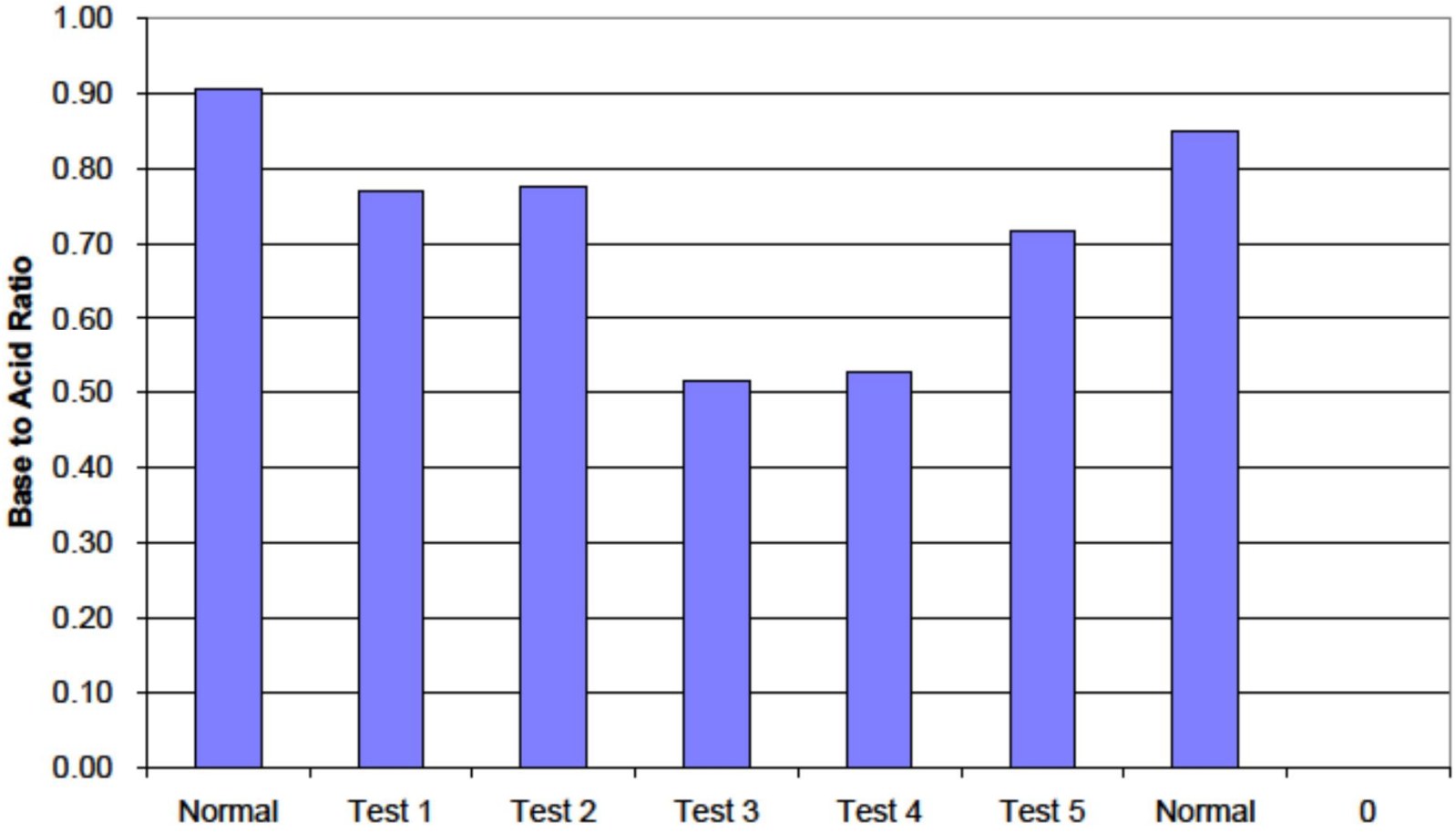
Base/Acid



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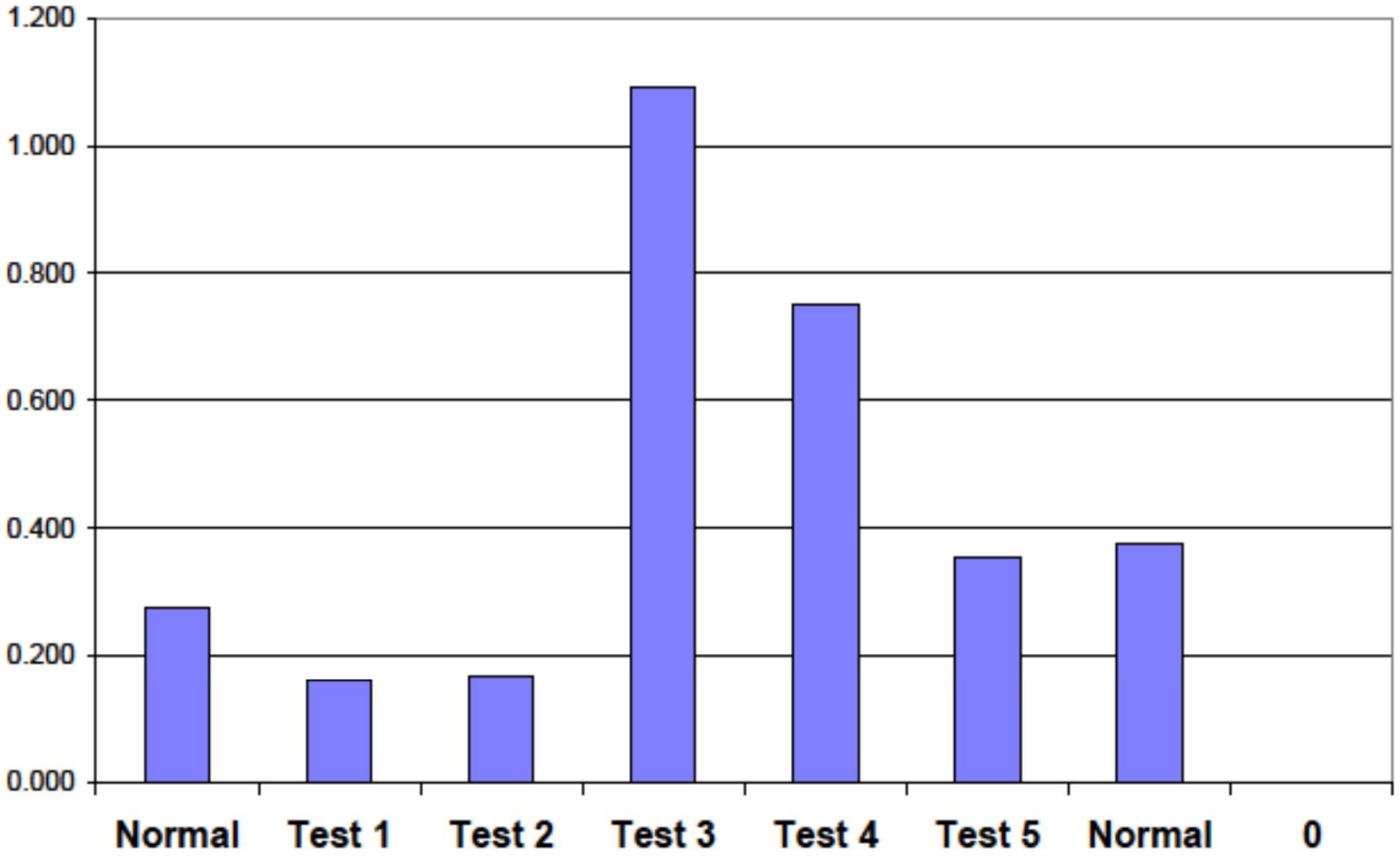
Lbs Quartz/MBtu



SPLAT FACTOR

Kinetic Energy

$$KE = \frac{\text{Mass} \times (\text{pipe velocity})^2}{2}$$

Mass is in 50 mesh (.3mm) quartz & pyrite particles

SPLAT FACTOR

1. Calculate KE for Quartz and Pyrite particles
2. Multiply KE times Q & P loading levels
3. Multiply result by % on 50 mesh screen (>300 microns)

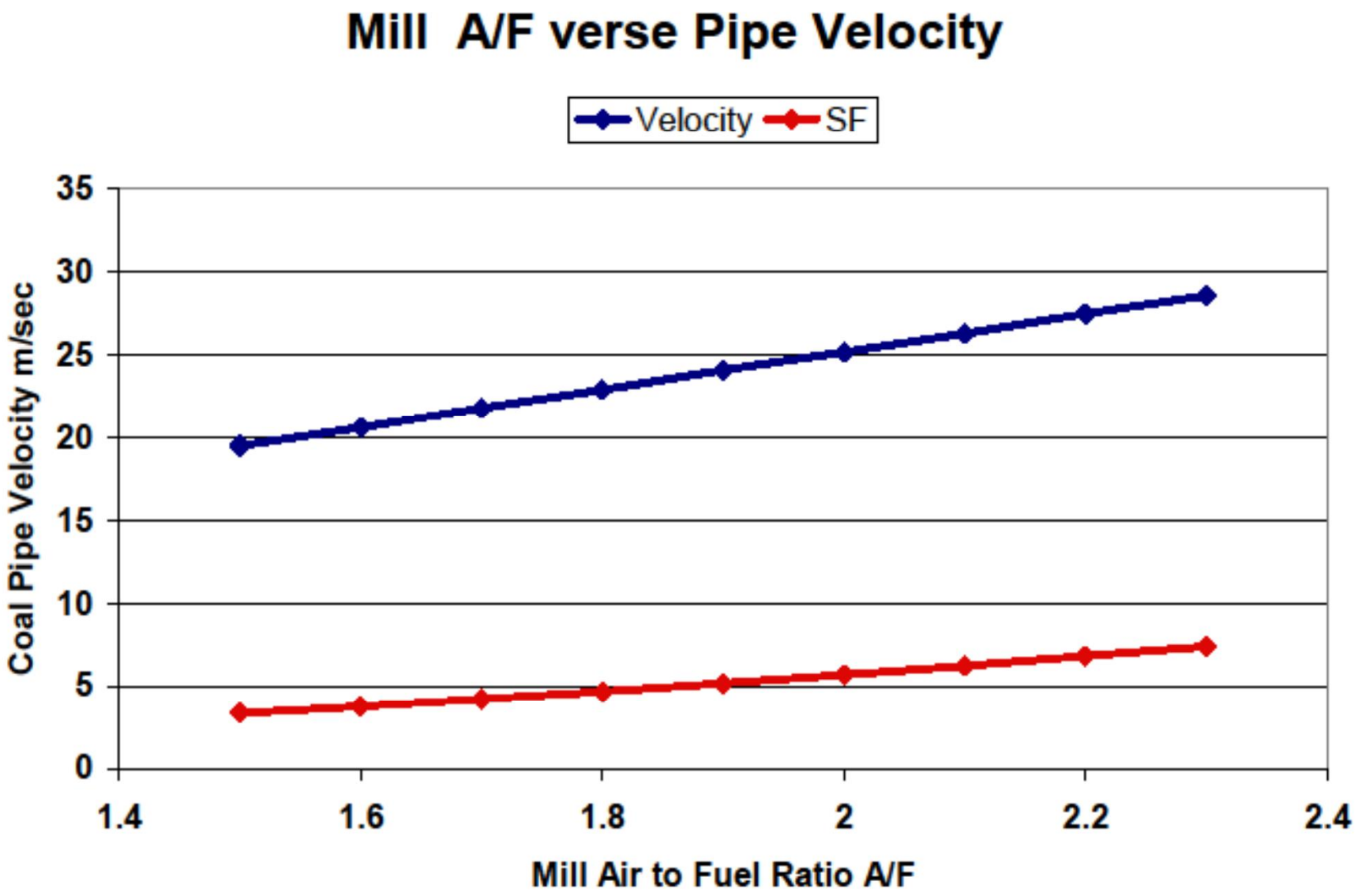
SPLAT FACTOR

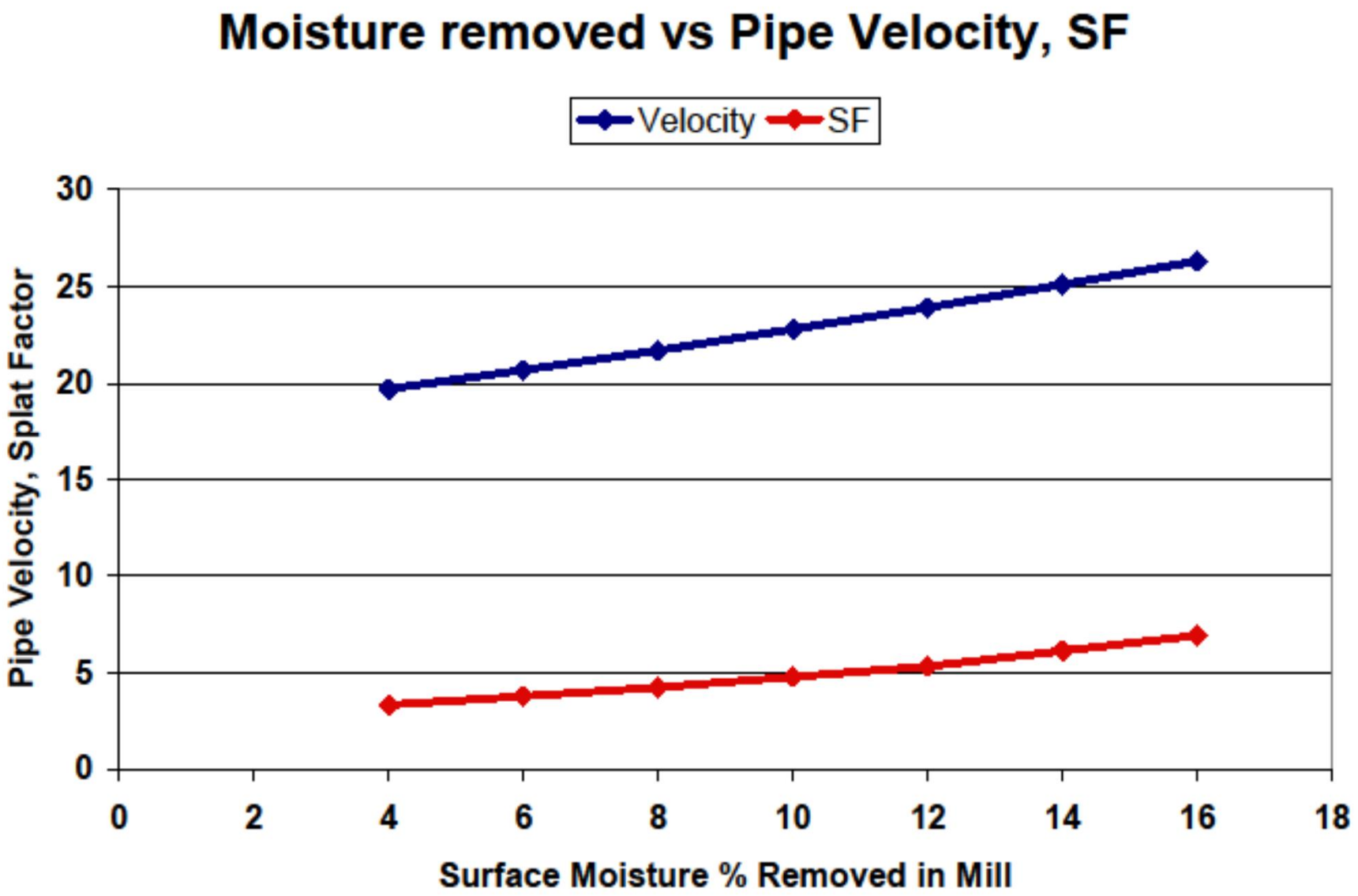
- Low with low levels of large particles
- Low with low levels of ash and sulfur
- Lowers with less PA flow A/F is important

SPLAT FACTOR

Coal Pipe Velocity increases due to

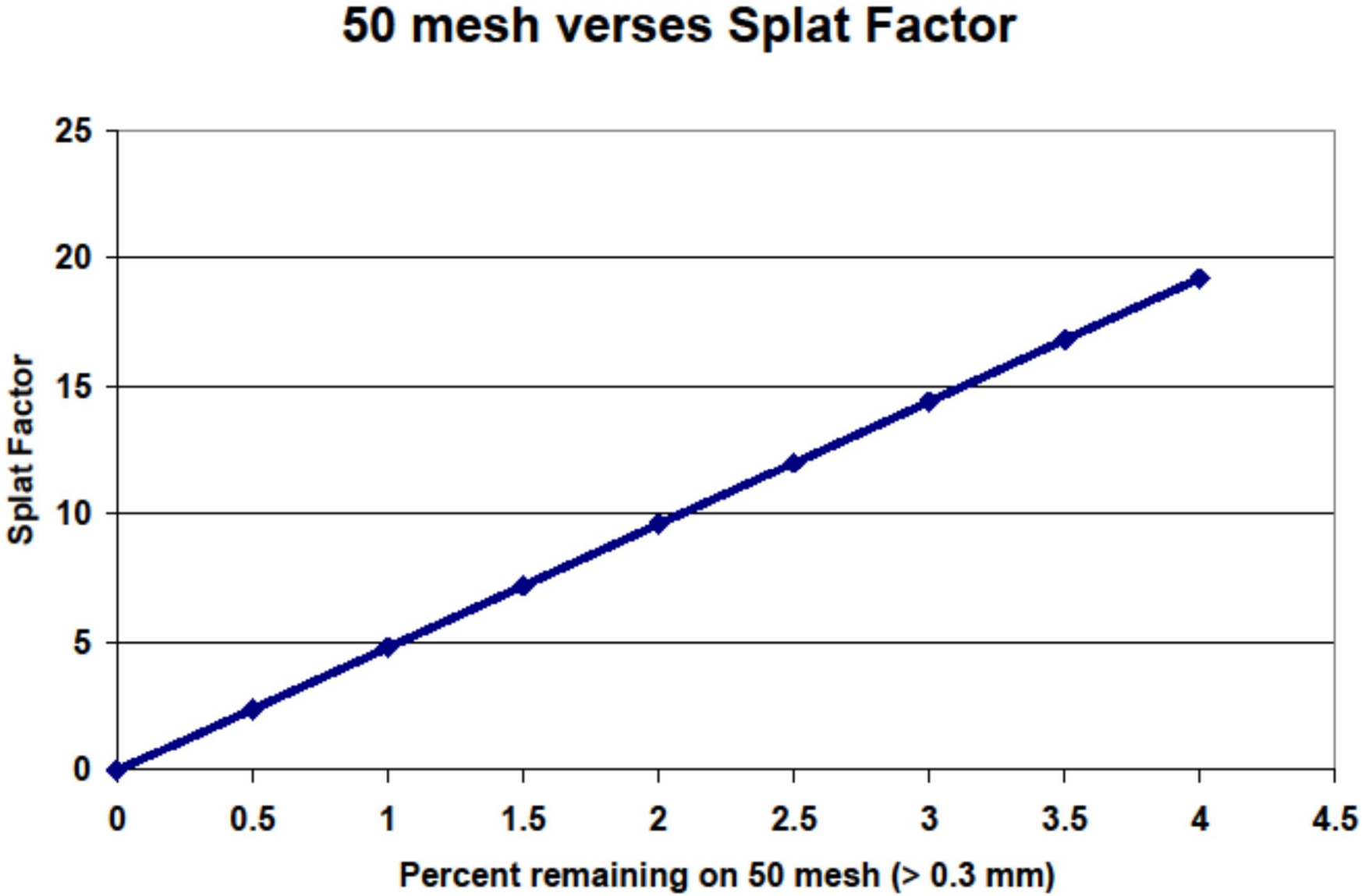
1. **High PA flow (mill A/F)**
2. **Low CV coal**
3. **High moisture**


Mill A/F verse Pipe Velocity
Velocity
SF
35
30
25
20
15
10
5
0
Coal Pipe Velocity m/sec
1.4
1.6
1.8
2
2.2
2.4
Mill Air to Fuel Ratio A/F


Moisture removed vs Pipe Velocity, SF
Velocity
SF
Pipe Velocity, Splat Factor
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
Surface Moisture % Removed in Mill

SPLAT FACTOR

Low with low levels of large particles


50 mesh verses Splat Factor
Splat Factor
25
20
15
10
5
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Percent remaining on 50 mesh (> 0.3 mm)

Pulverizers

70 % passing a 200 mesh screen
Minimum
or Maximum?

Old School!

Need 75% for high pyrite low NOx

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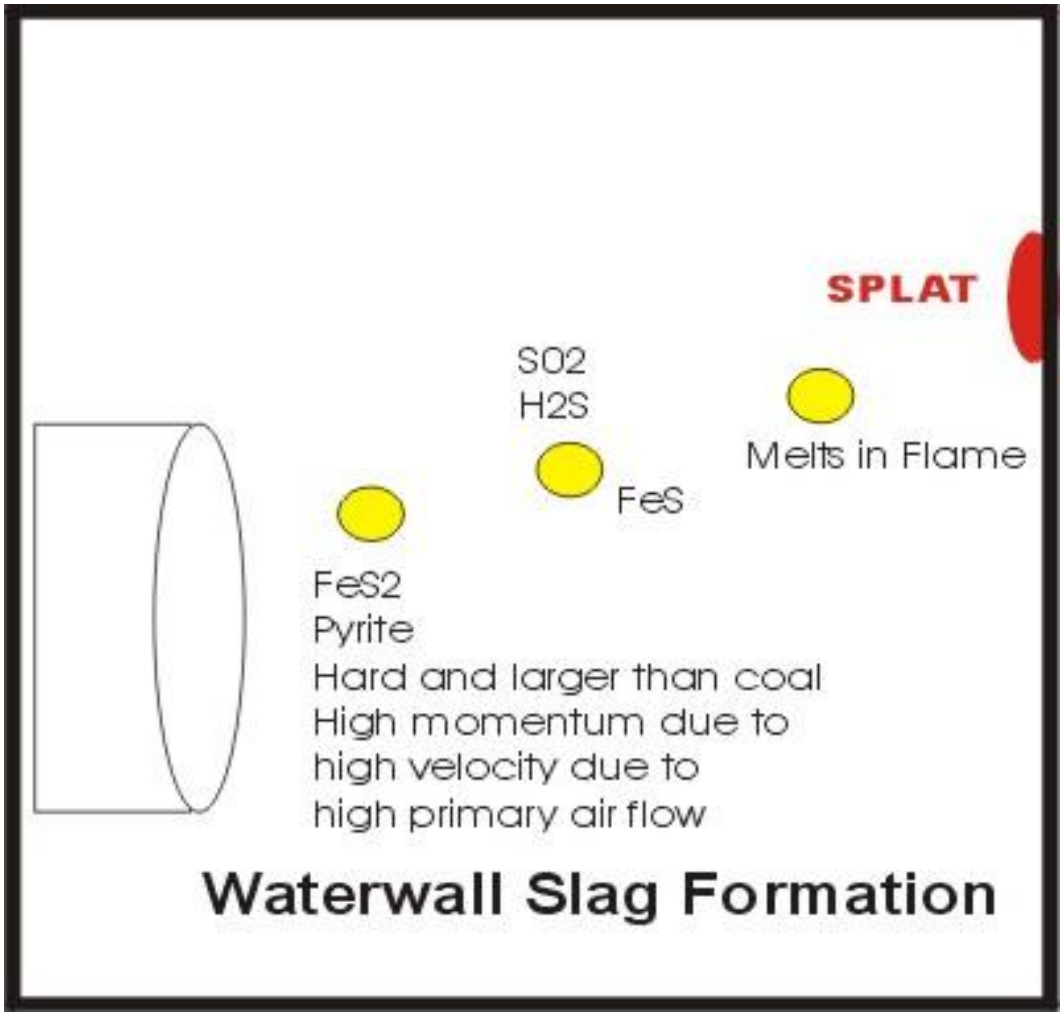

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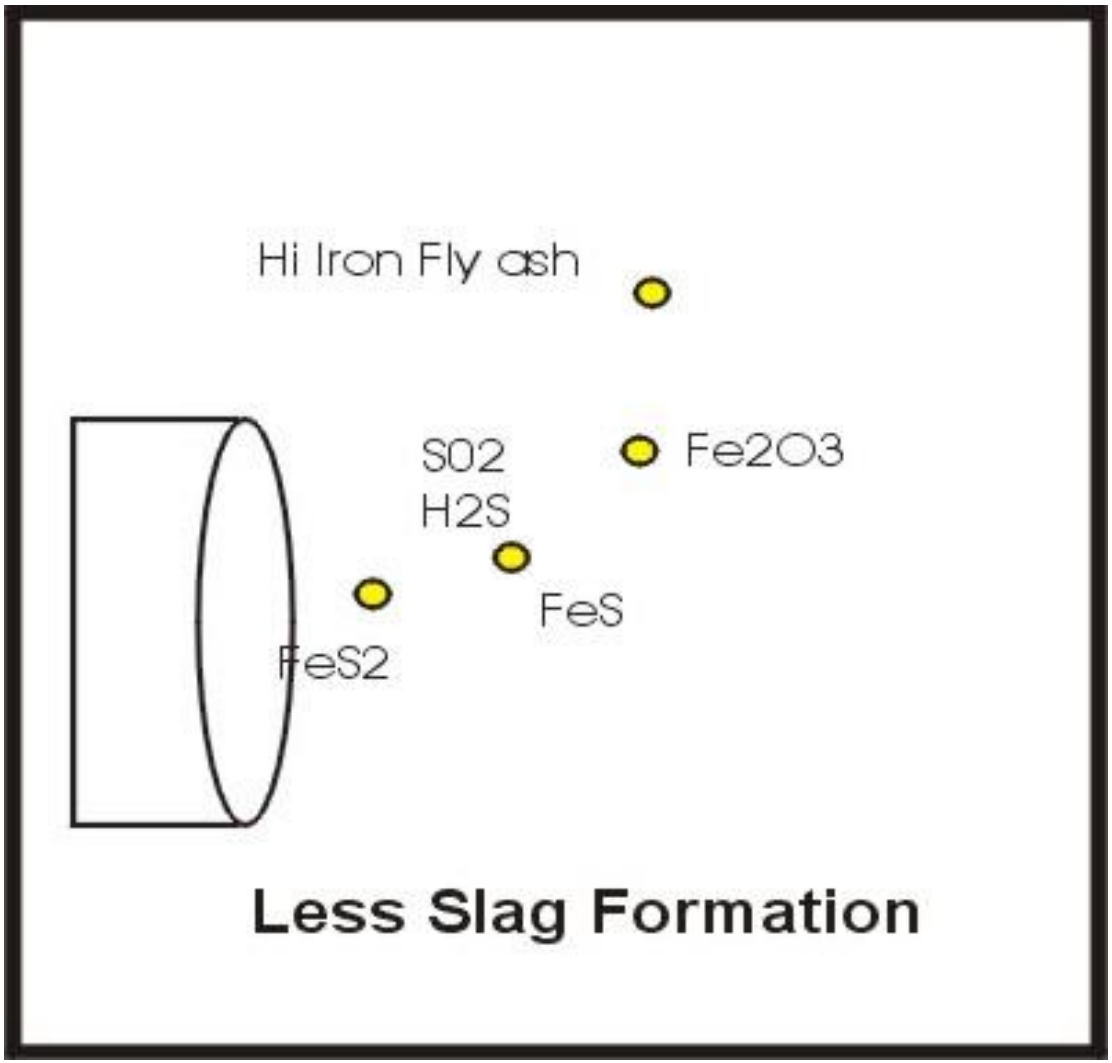

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Thank you!