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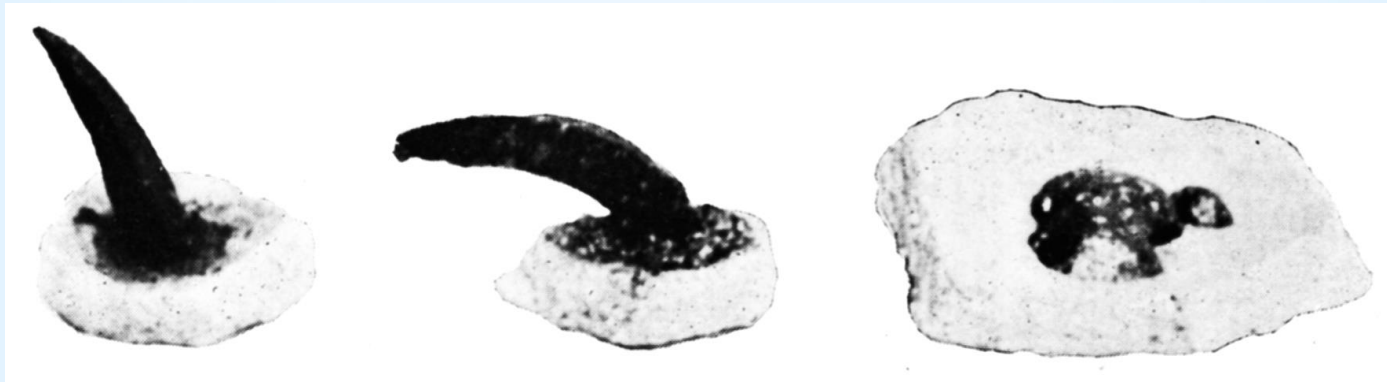
**Understanding Wall Slag**  
**SPLAT FACTOR**  
**Quantified**

**Rod Hatt**

**859-873-0188**

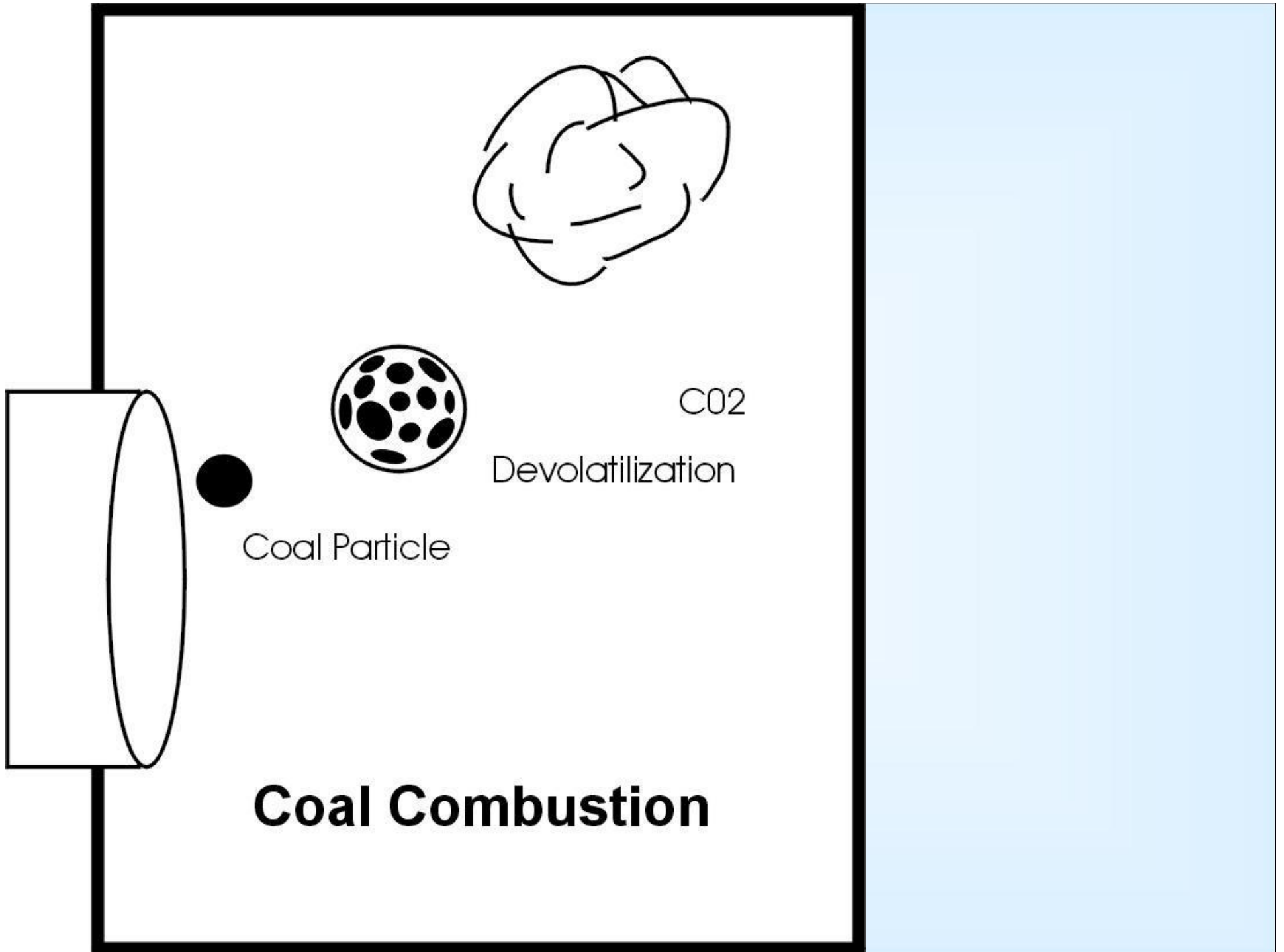
**rod\_hatt@coalcombustion.com**

# Why are we using fusion temperatures?



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



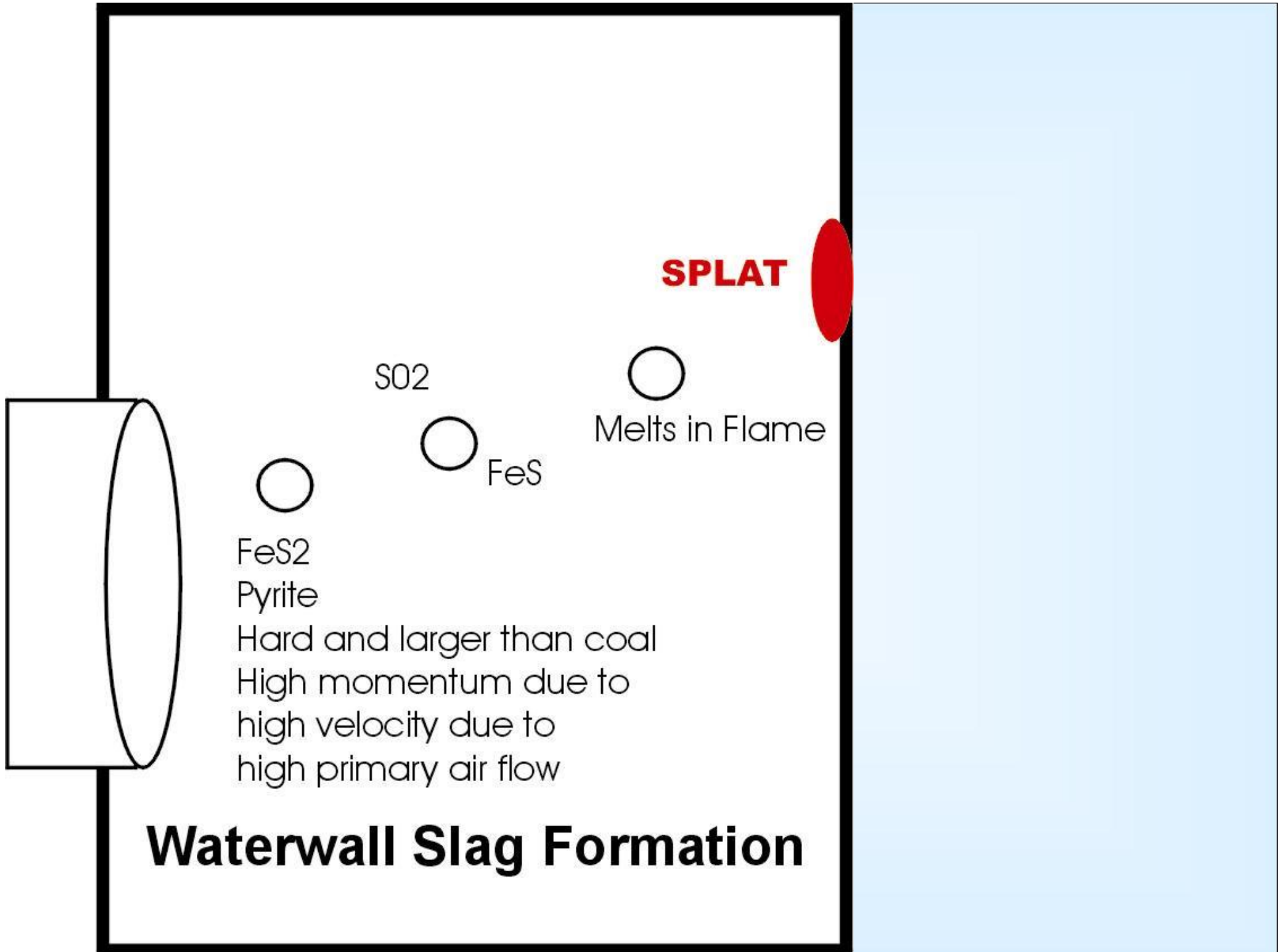


# Coal Combustion

Coal Particle

Devolatilization

CO<sub>2</sub>



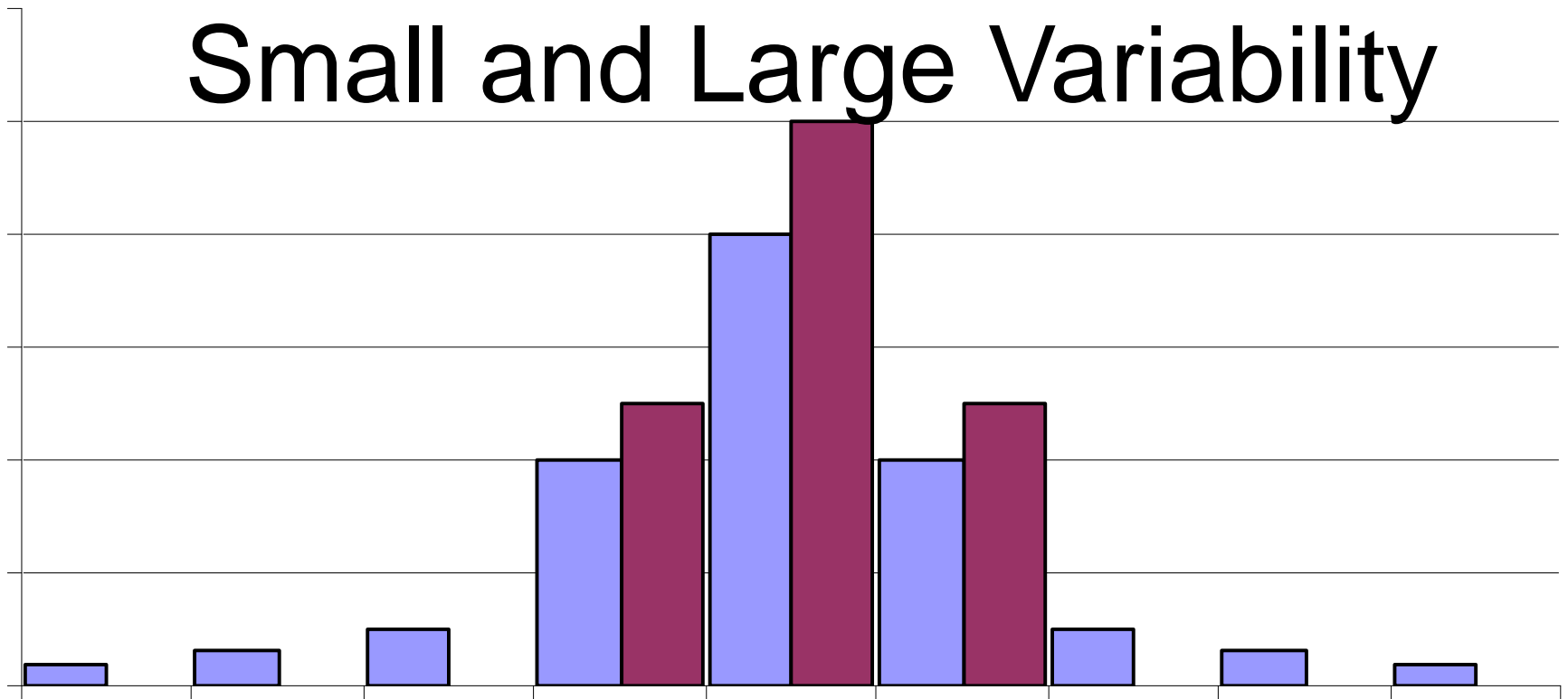
## Waterwall Slag Formation





**Lowest cost coal  
is always raw.**

# Small and Large Variability



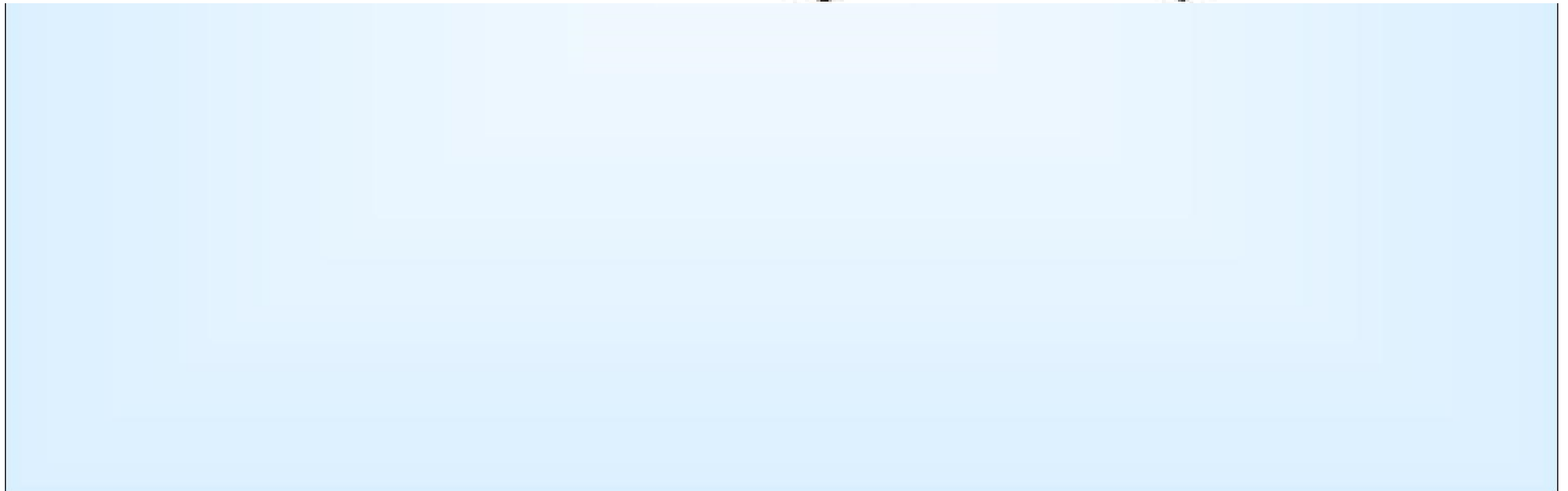
ASTM reports same ash level



# Plant Limit



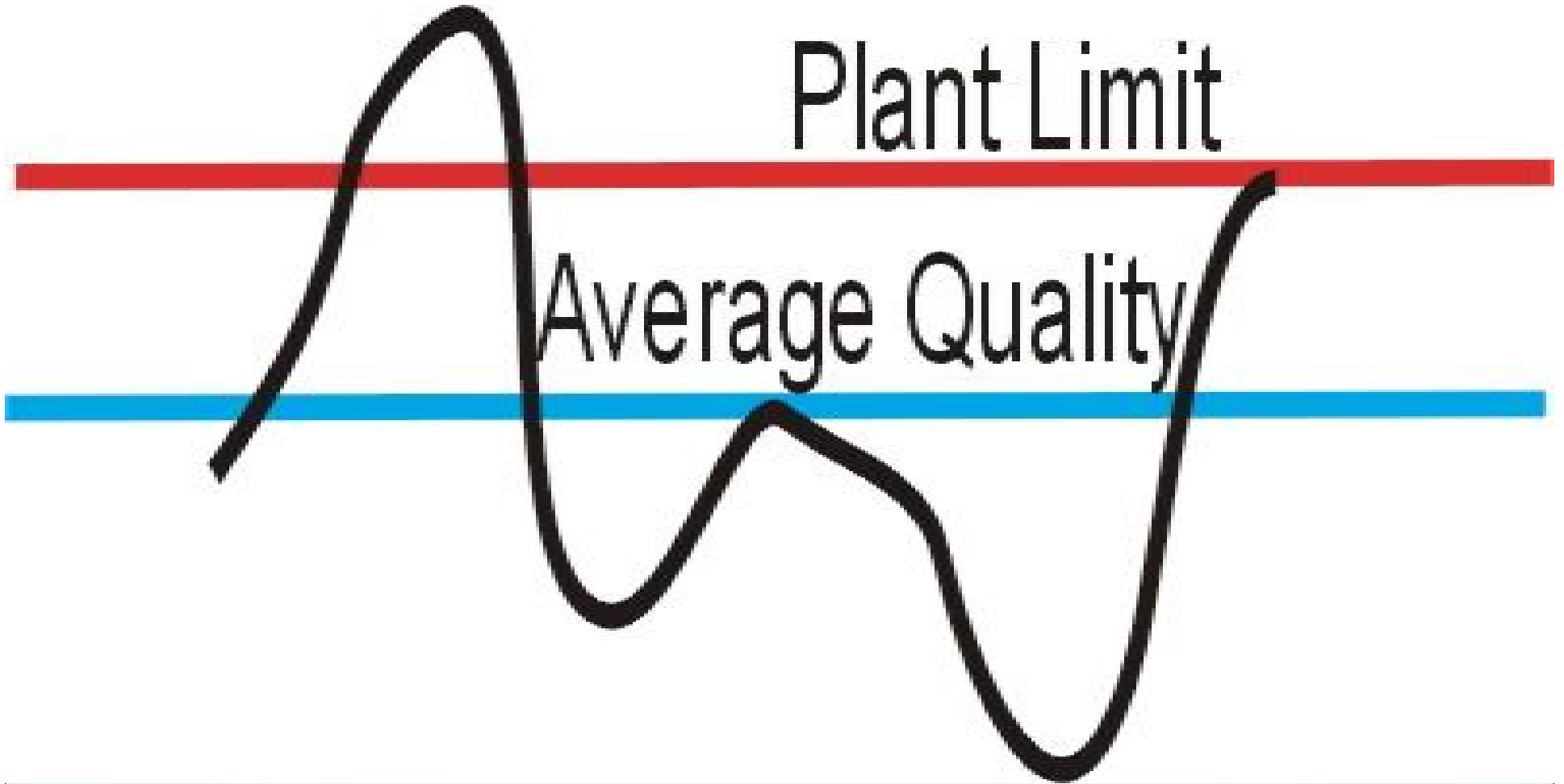
## Average Quality





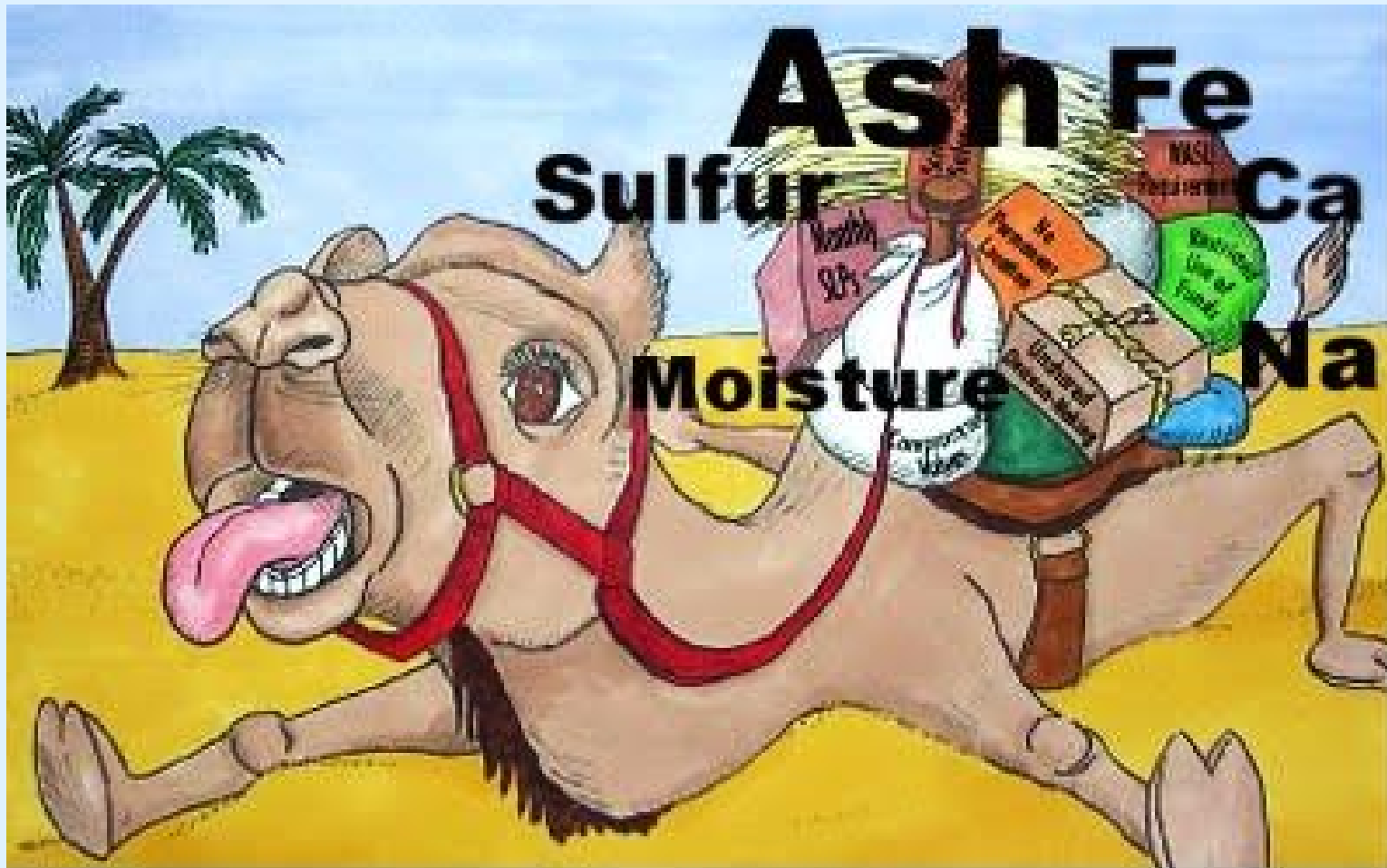
Plant Limit

Average Quality



**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?**

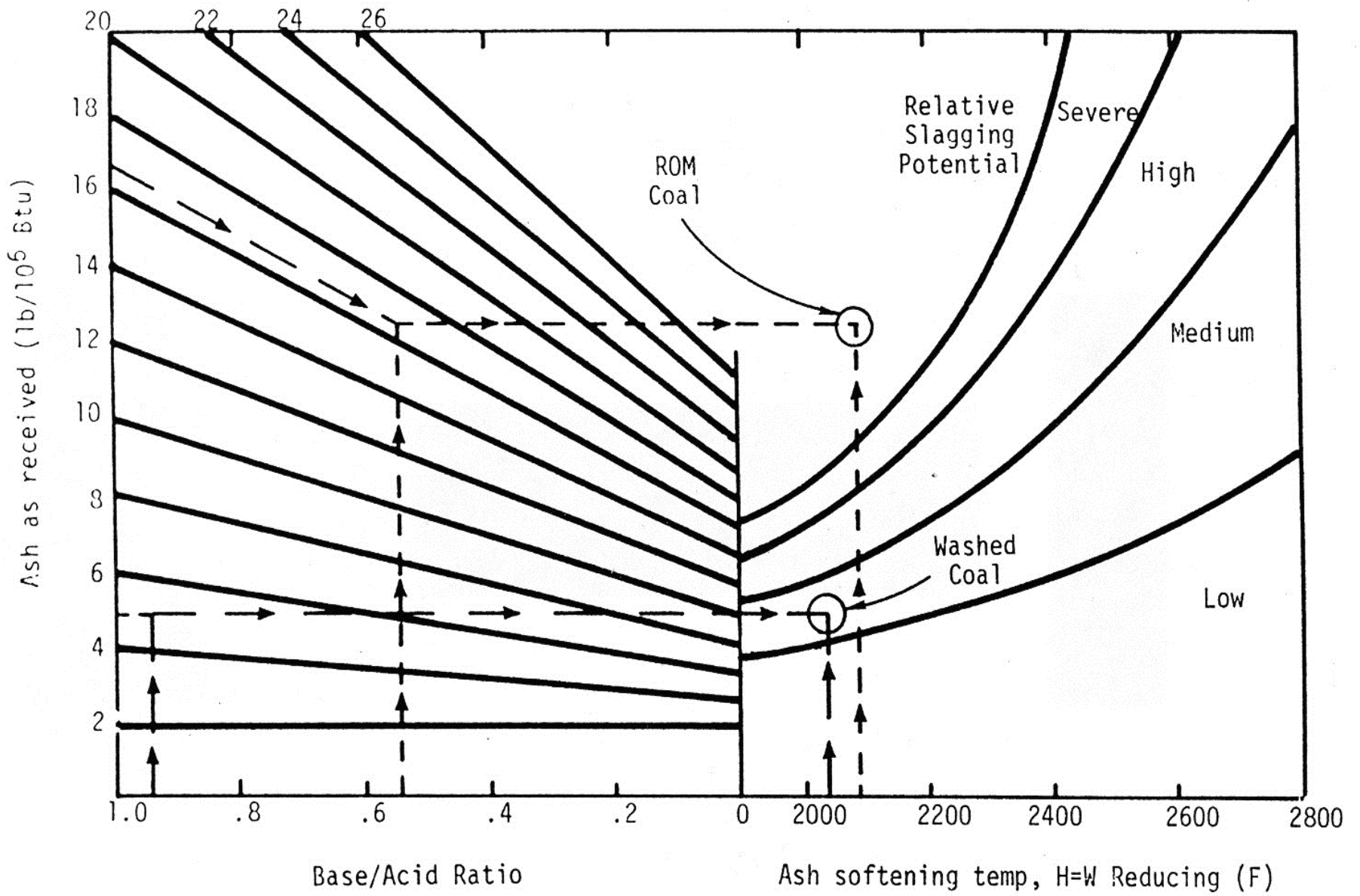


Figure 2-23. AEP slagging index (31).

**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**

$$= \%ash / (Kcal/10,000) \\ \times (\%Element/100)$$

**Pyritic**



**sulfur is attached  
to iron in  
fool's gold**

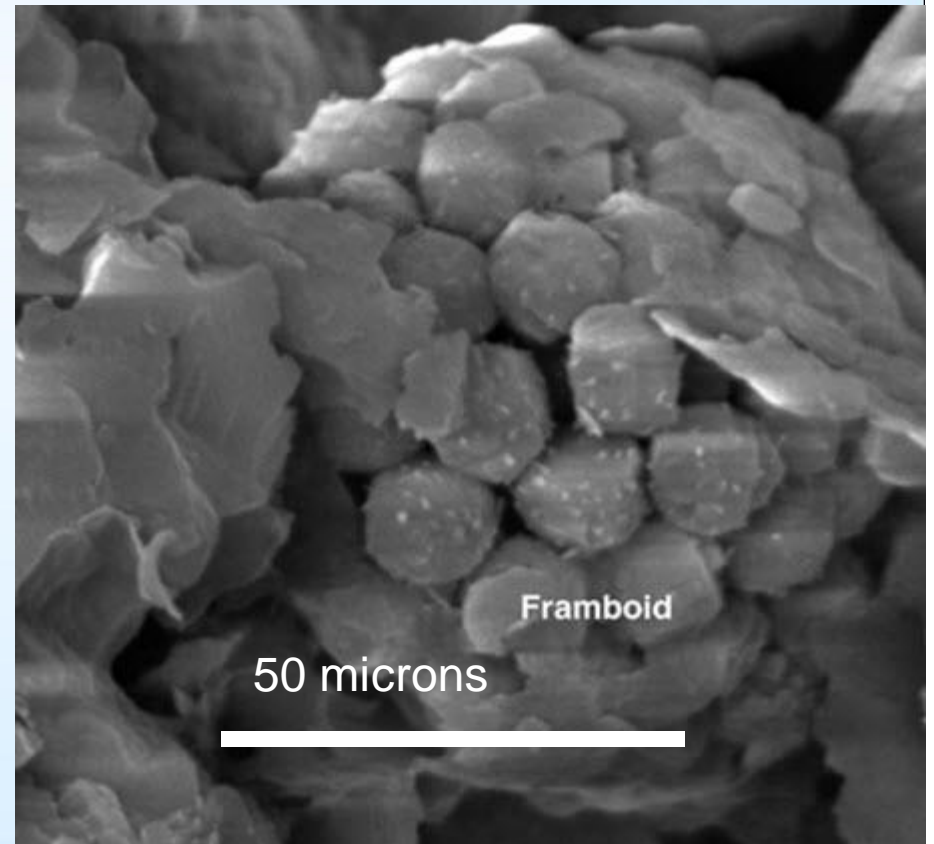
$\text{FeS}_2$





**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<sub>2</sub>O<sub>3</sub>/MKcal**

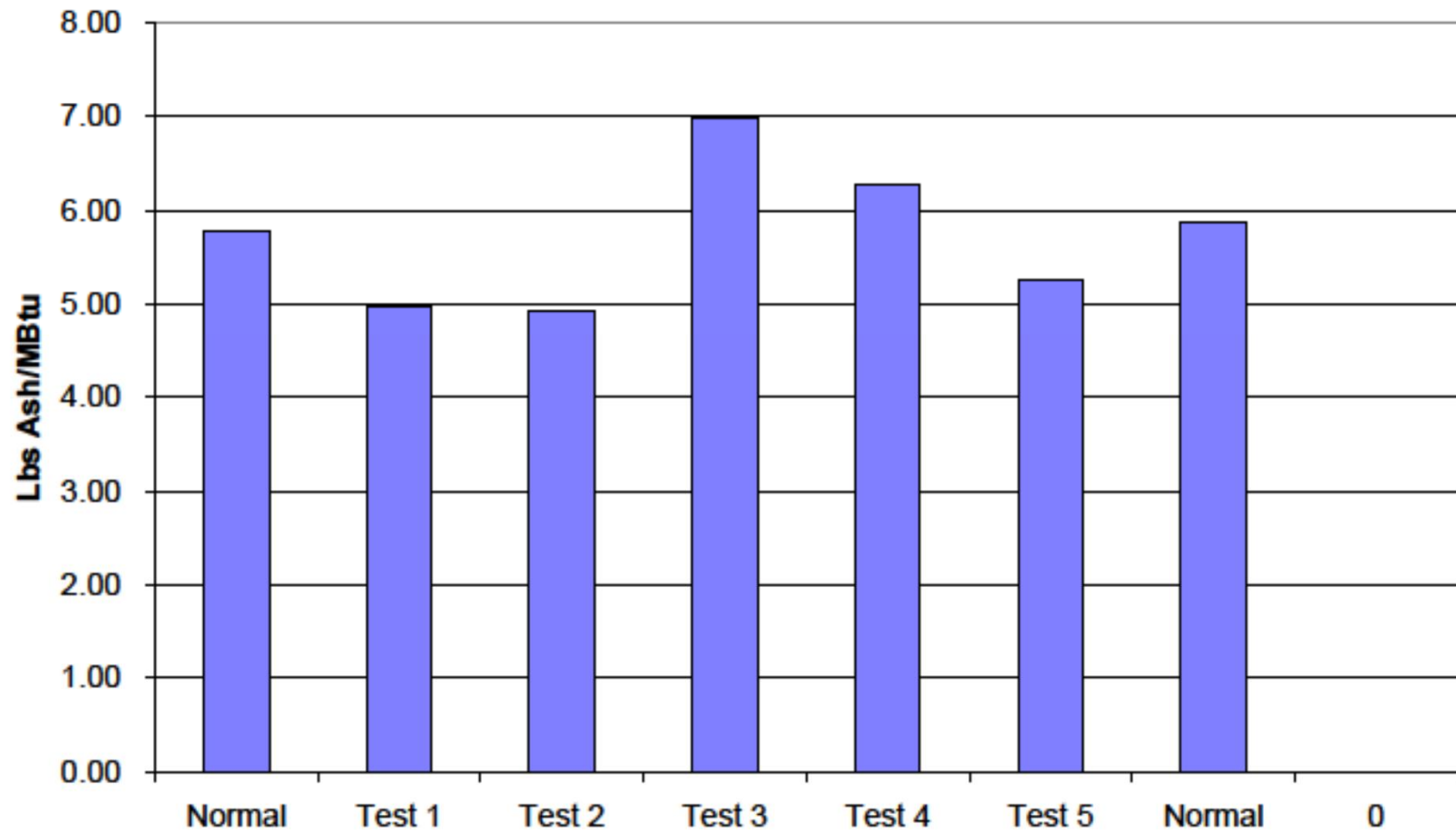
# Raask Quartz

**%Quartz ~  $\text{SiO}_2 - 1.5x \text{Al}_2\text{O}_3$**

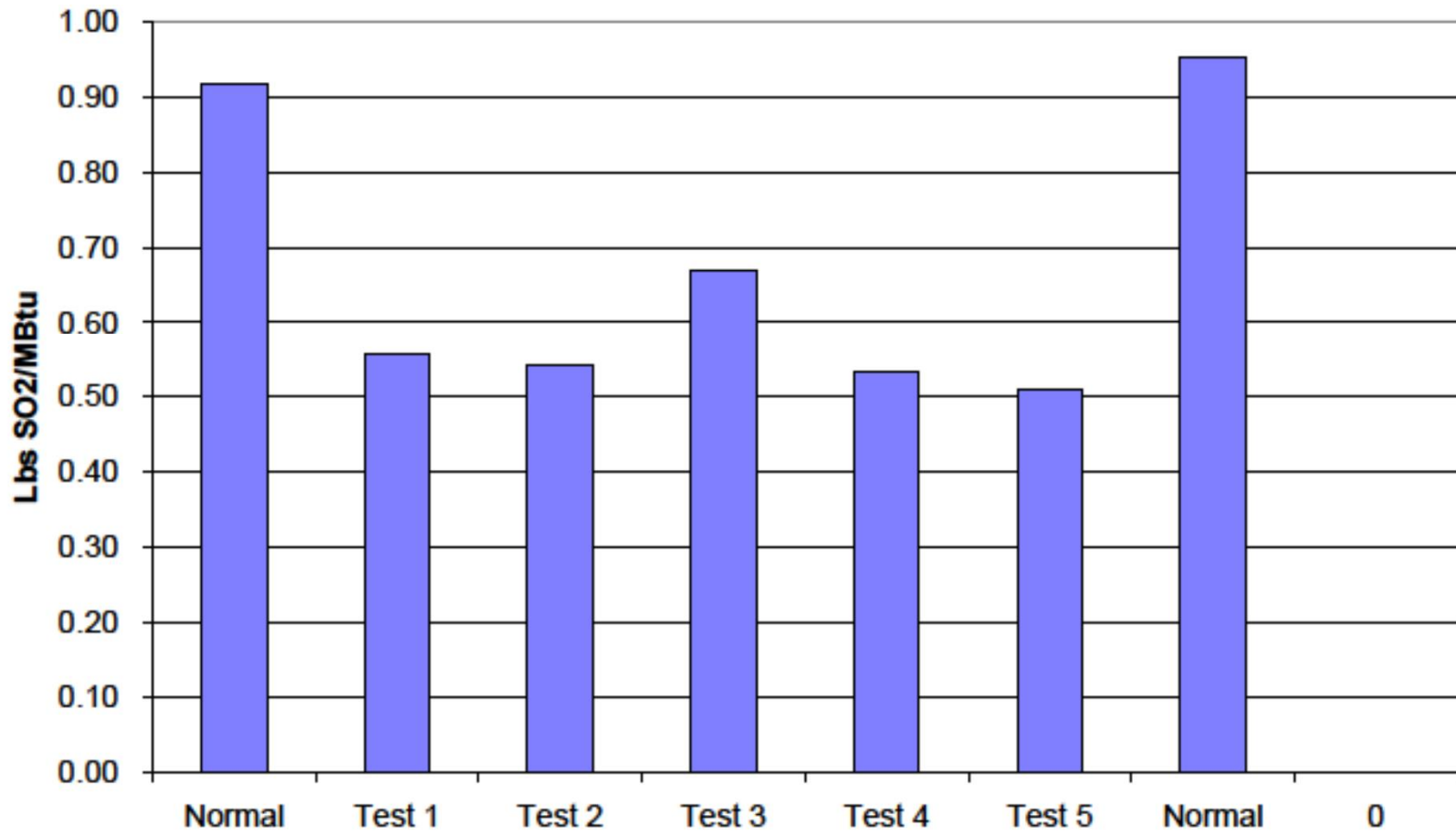
**% Quartz X Kg ash/MKcal =**

**Kg Quartz per Million Kcals**

## Lbs Ash/ MBtu

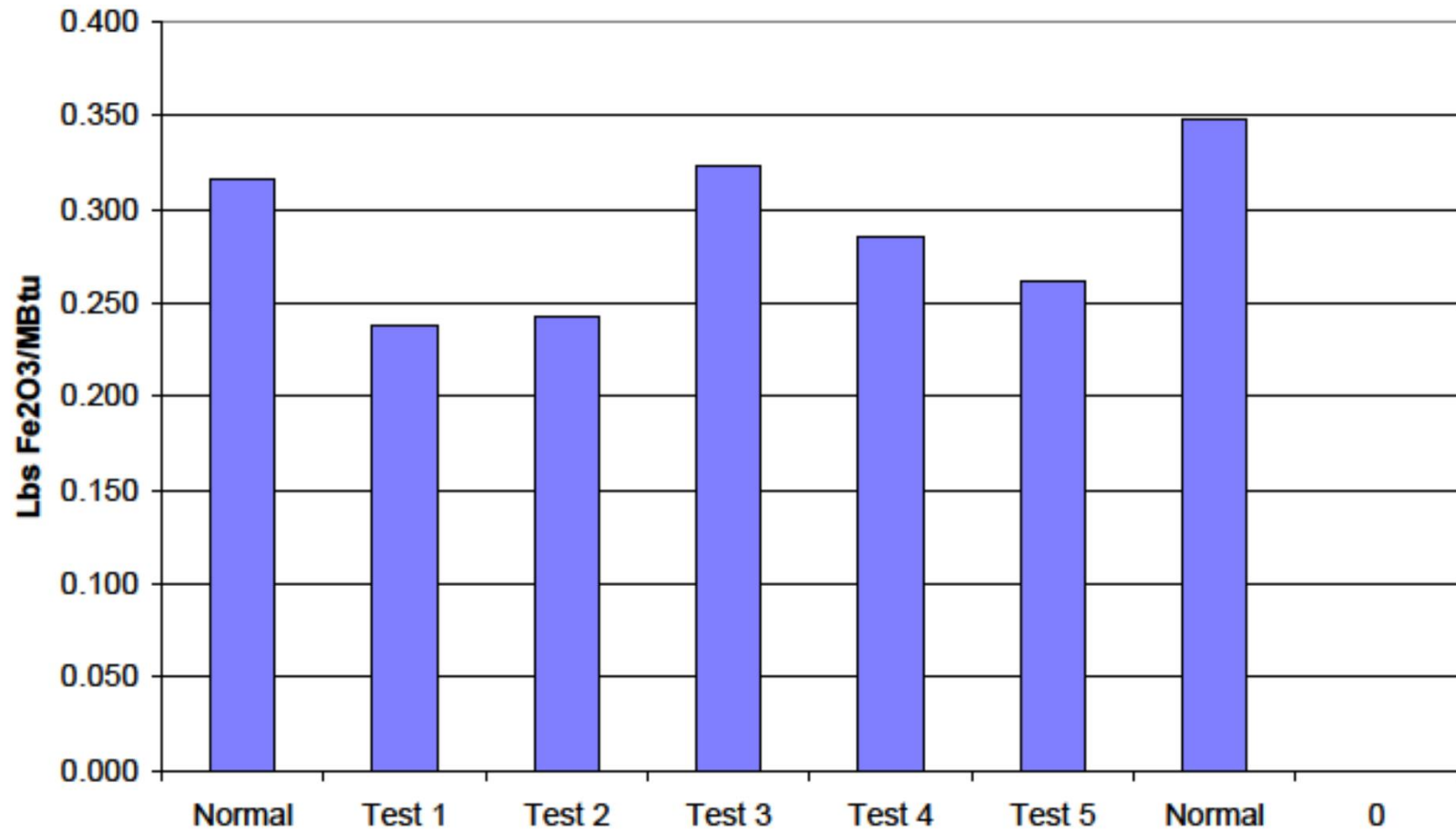


## Lbs SO<sub>2</sub>/MBtu

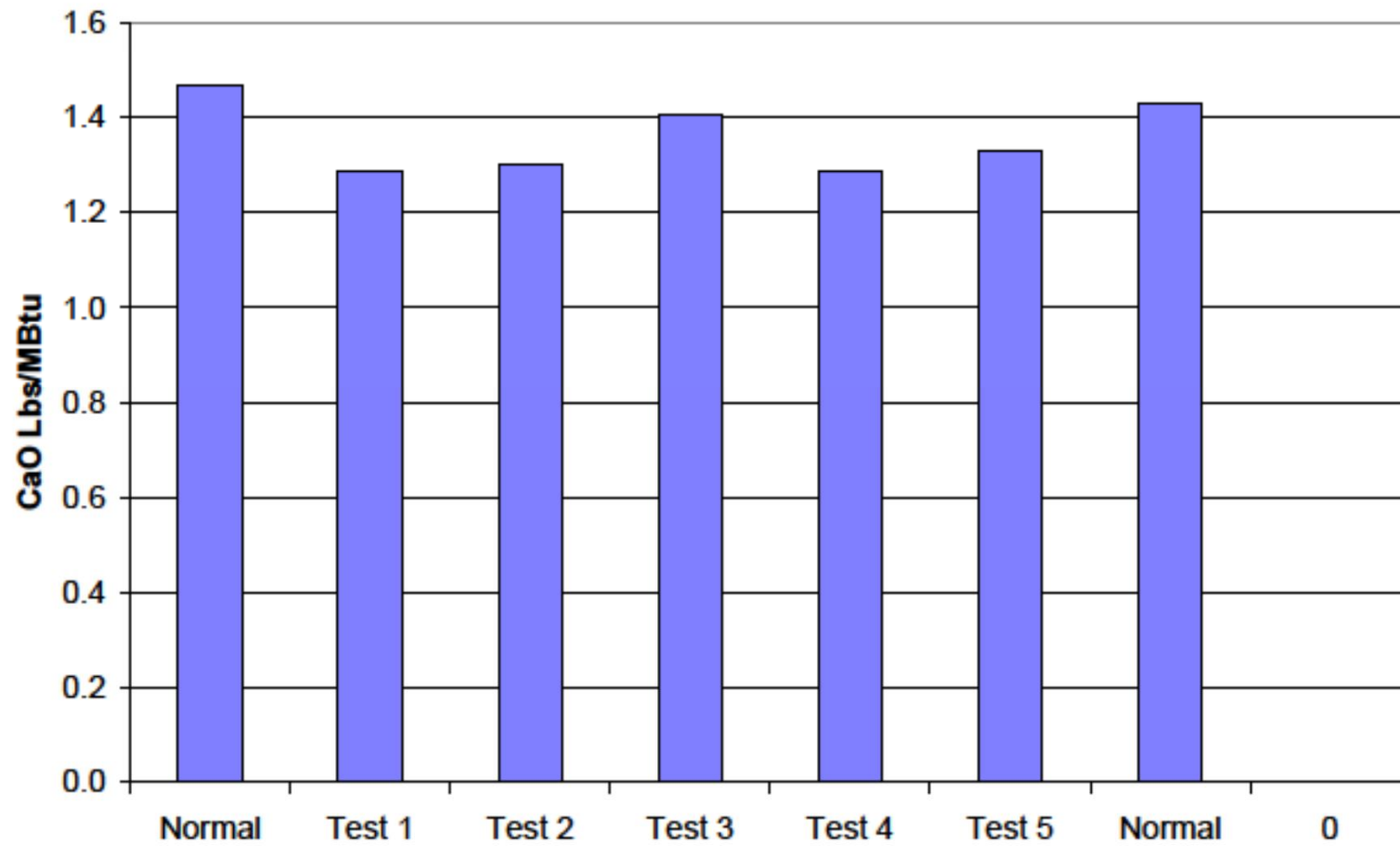




## Fe203 Lbs/MBtu



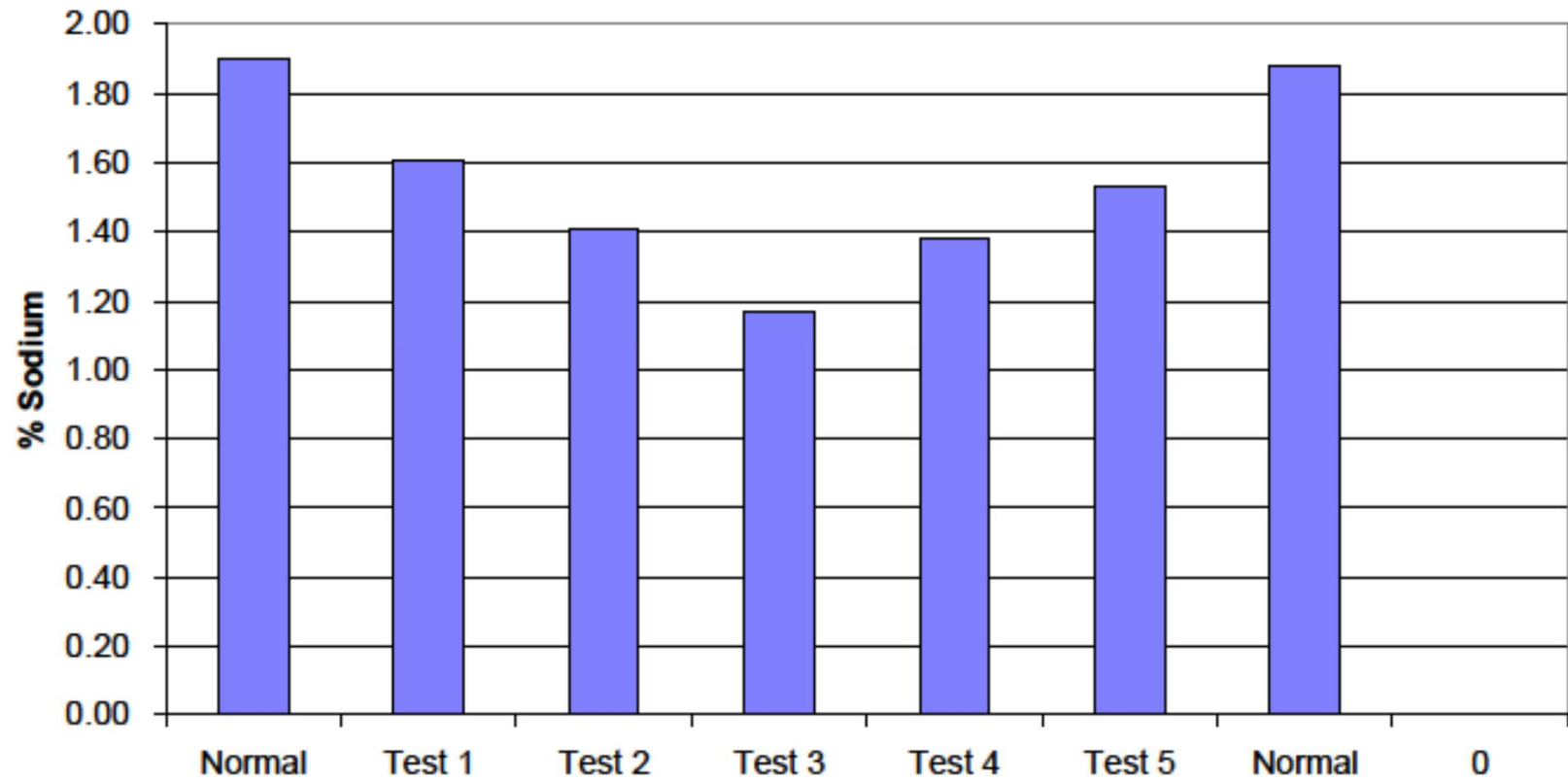
## CaO Lbs/MBtu



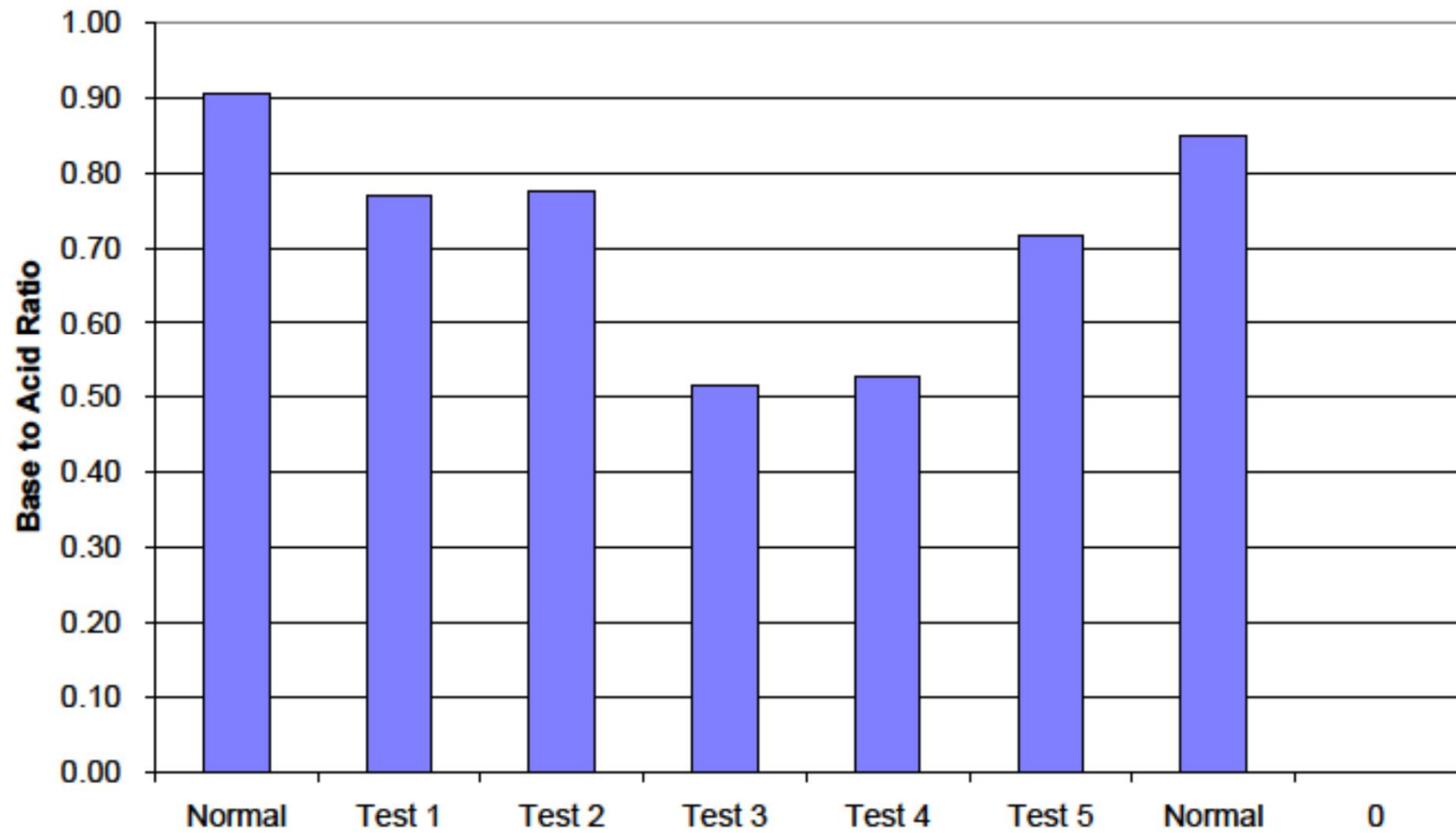


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## Percent Sodium in Ash as Na<sub>2</sub>O



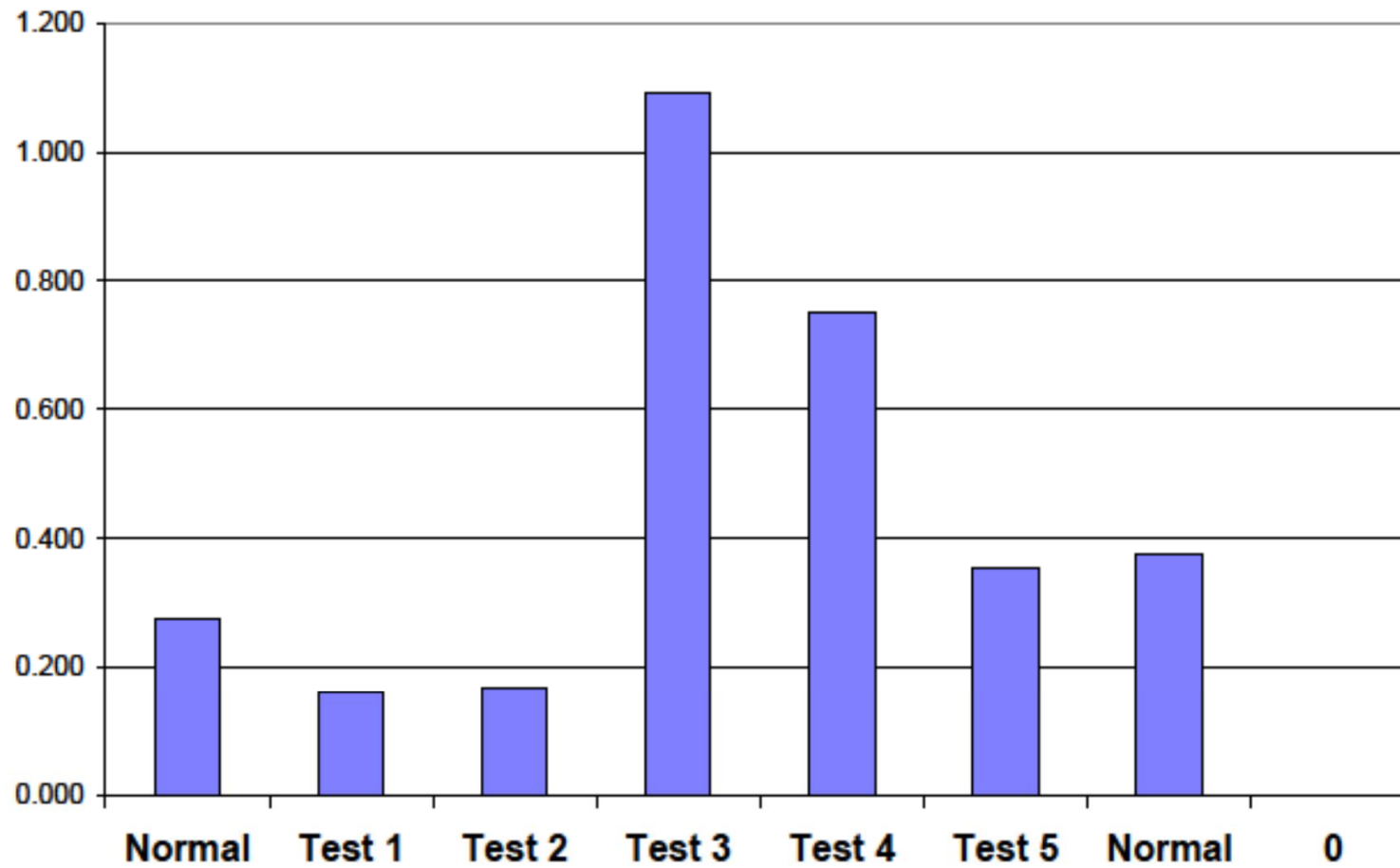
## Base/Acid





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## Lbs Quartz/MBtu



# SPLAT FACTOR

**Kinetic Energy**

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

**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**

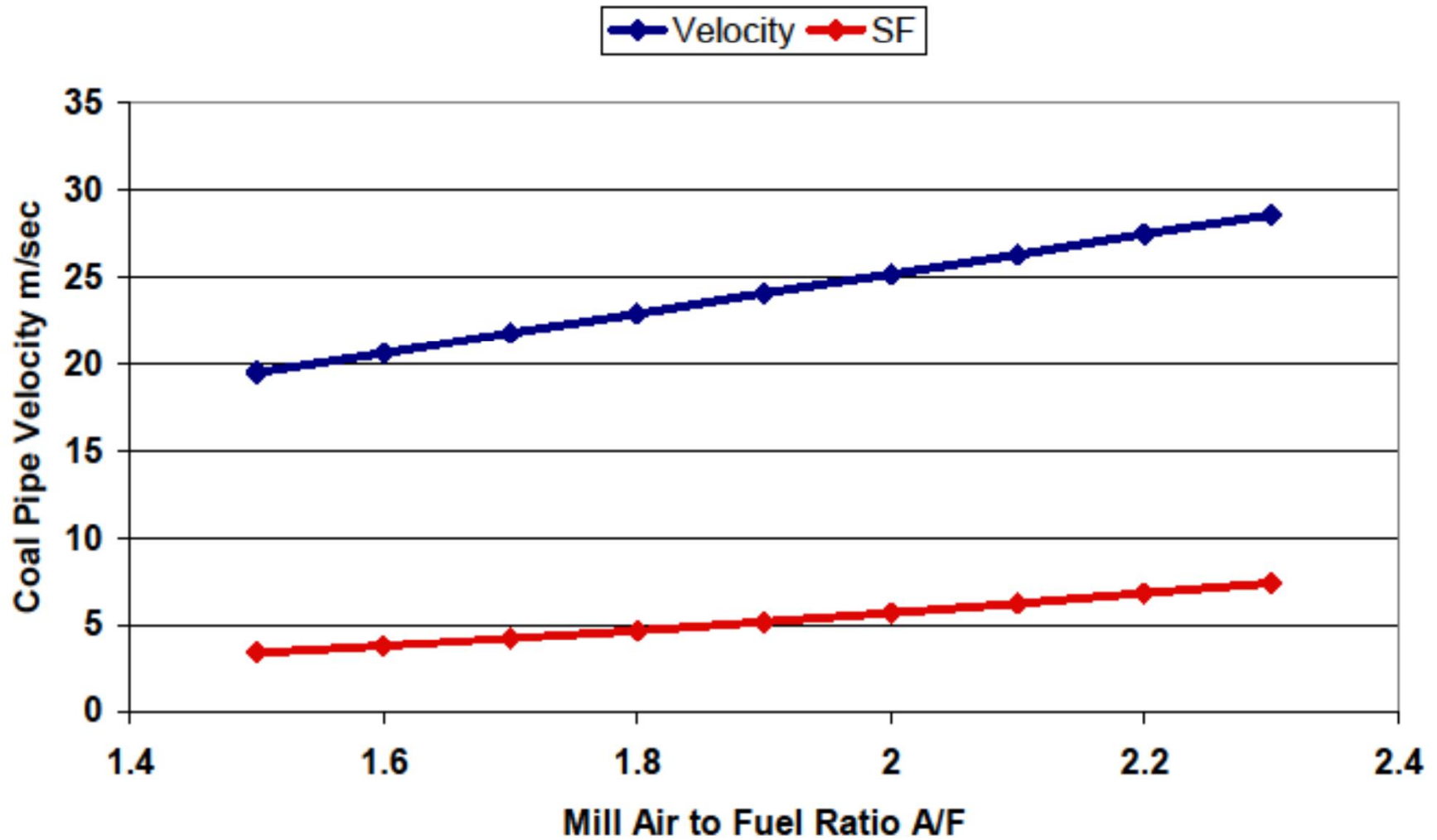
**Lowers with less PA flow A/F is important**

# **SPLAT FACTOR**

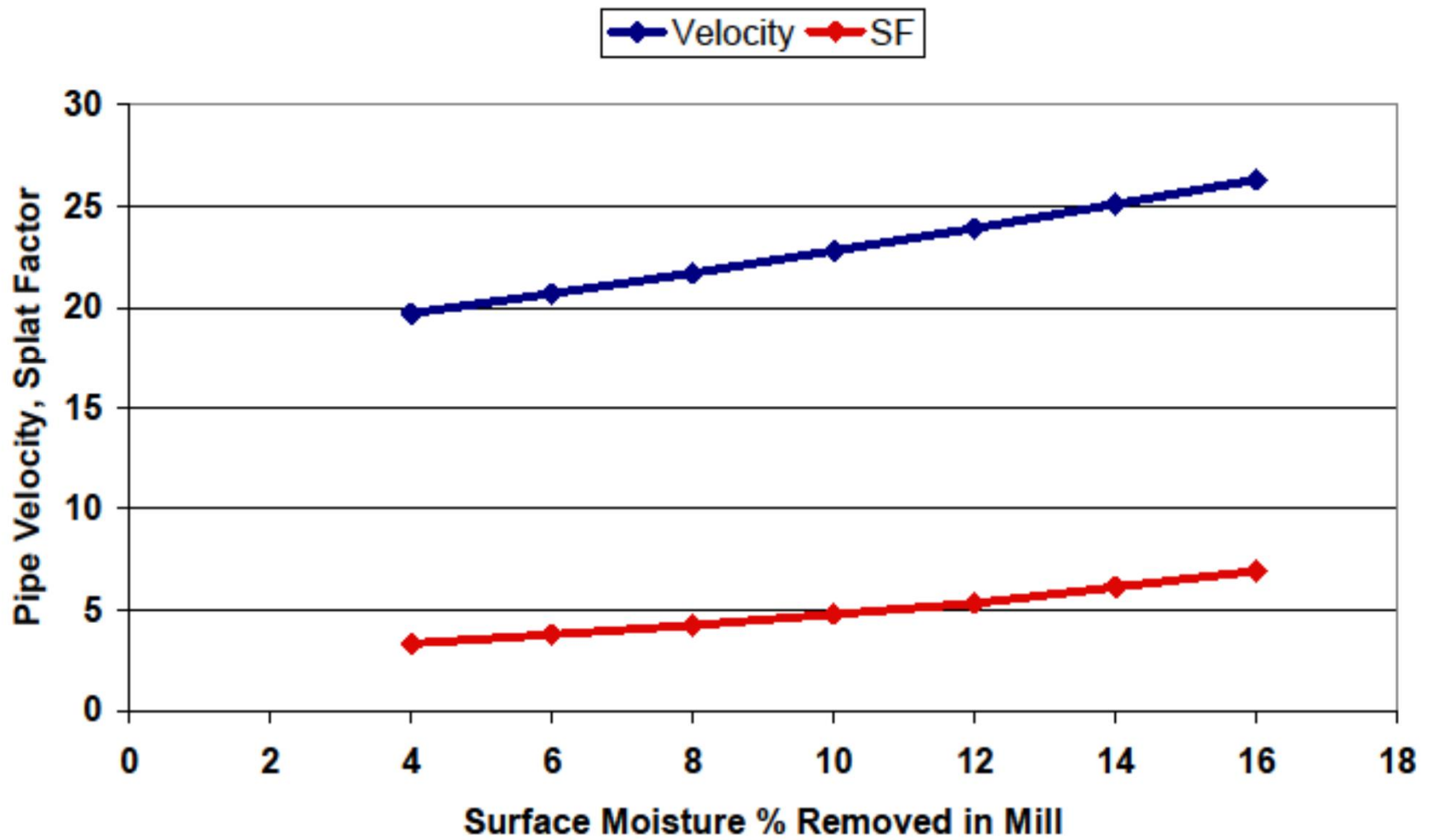
**Coal Pipe Velocity increases  
due to**

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

## Mill A/F verse Pipe Velocity



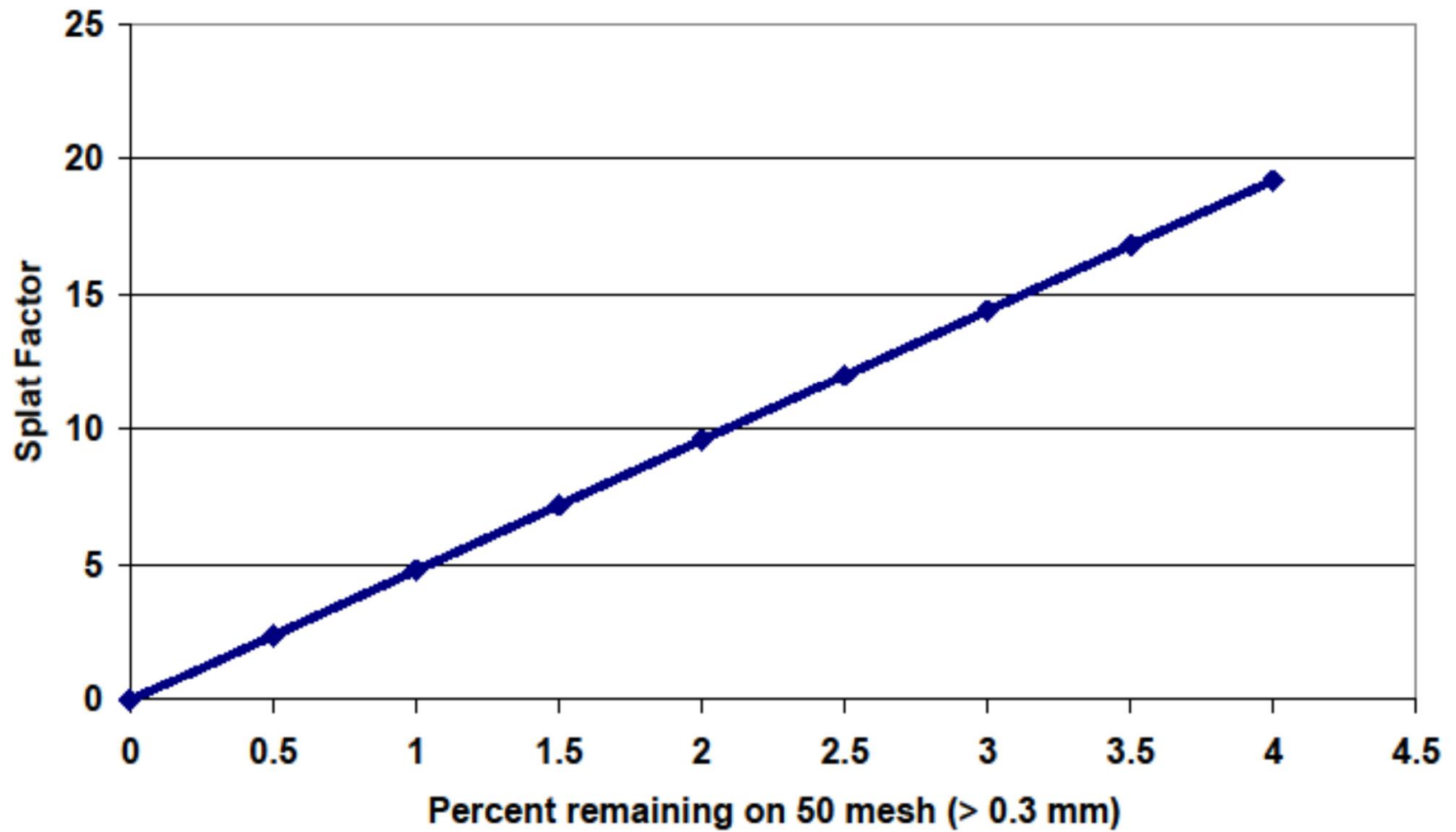
## Moisture removed vs Pipe Velocity, SF



# **SPLAT FACTOR**

**Low with low levels of large particles**

## 50 mesh verses Splat Factor



# Pulverizers

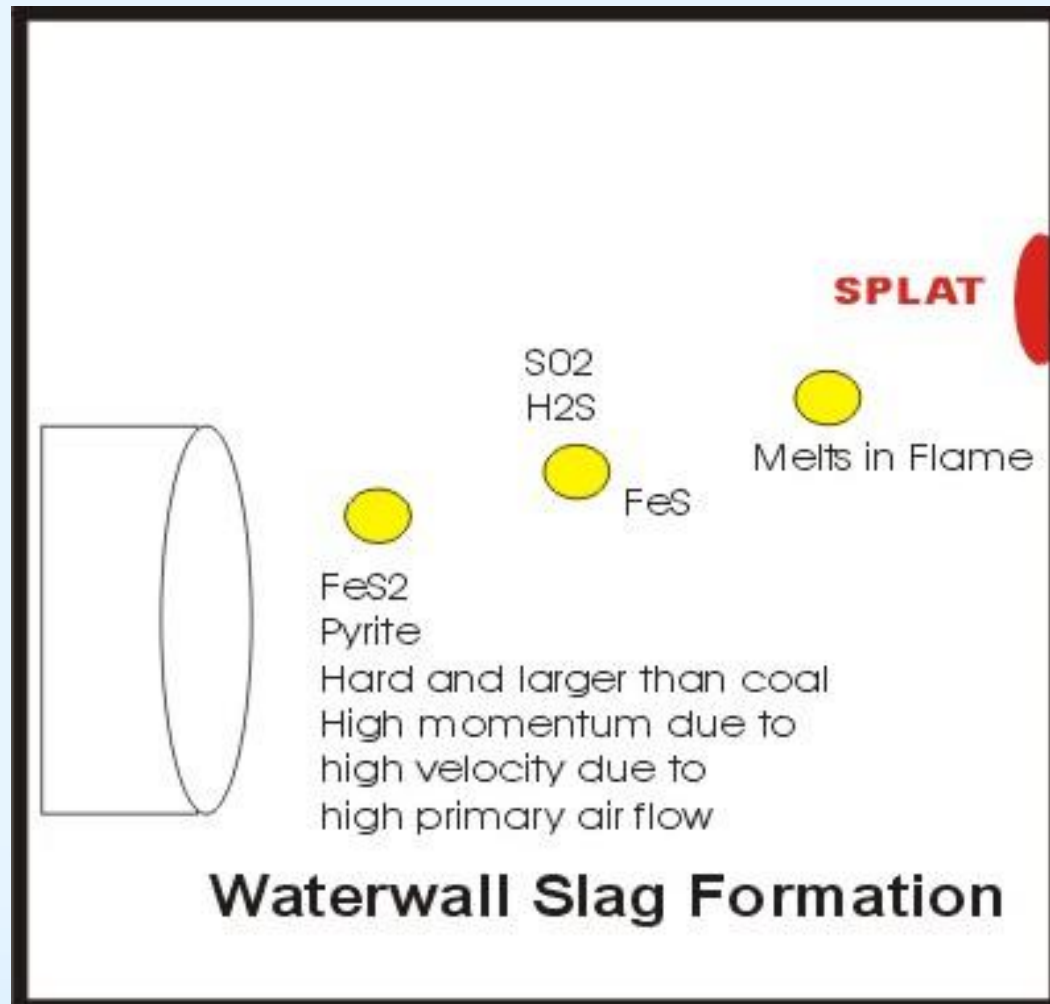
**70 % passing a 200 mesh screen  
Minimum  
or Maximum?**

**Old School!**

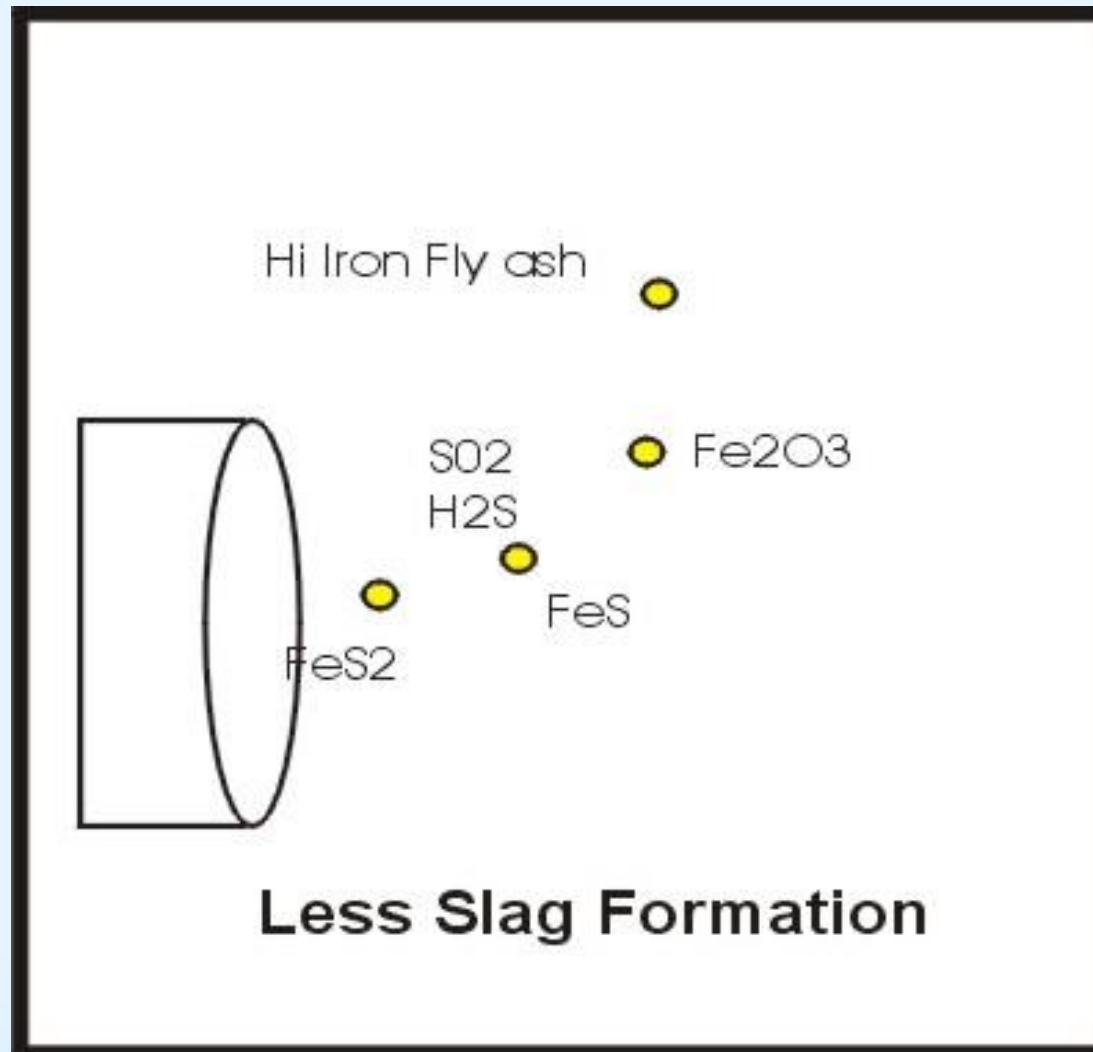
**Need 75% for high pyrite low NOx  
or  
At least try for 70%**



# Coal Combustion



# Coal Combustion





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**Thank you!**



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