Coal Combustion Inc.
Understanding the business of coal

Coal Quality As the Boiler Sees It

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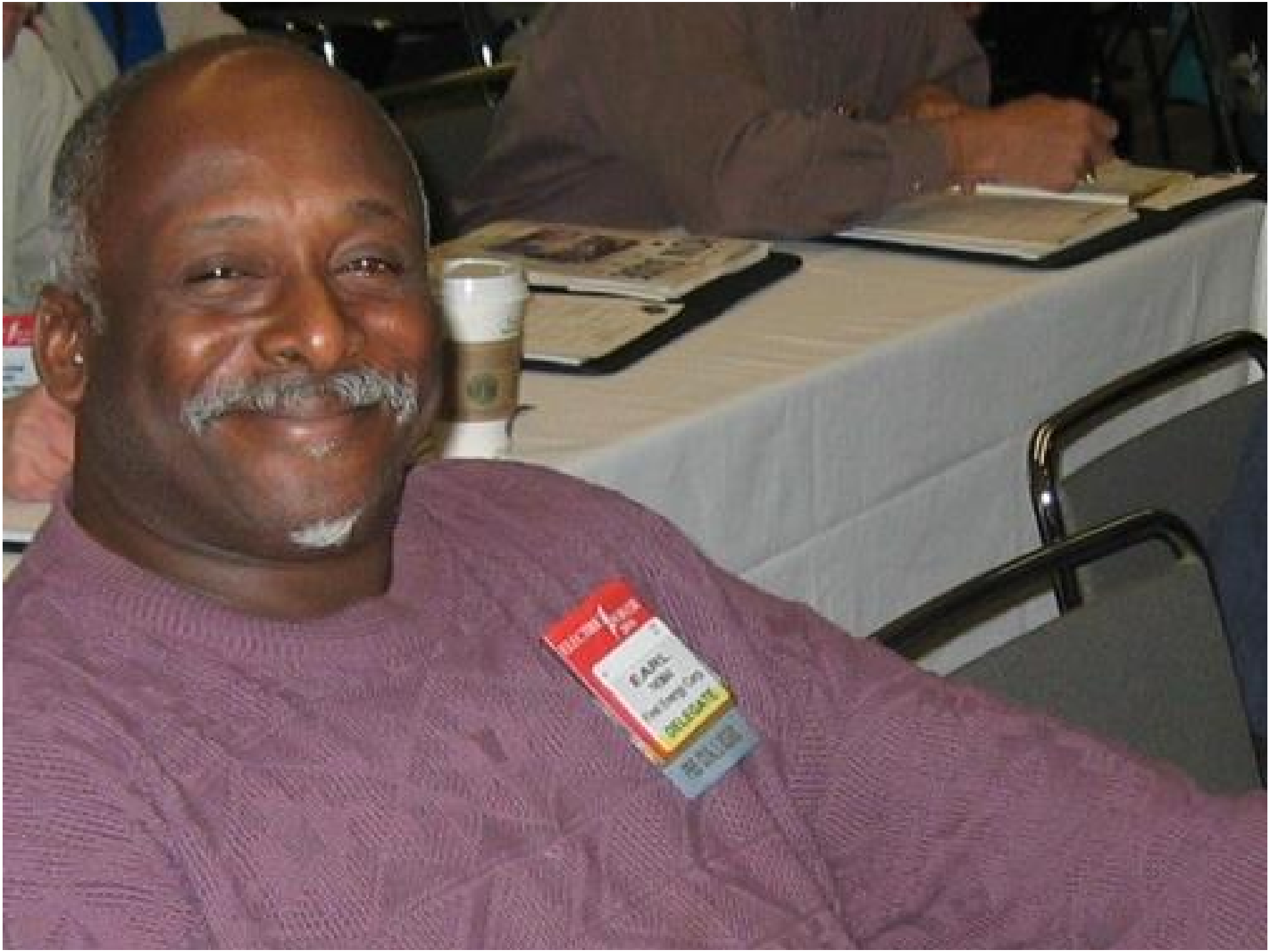
Finding Hot Spots


Hattie's


JSTLER


OASIS



Short Prox

Moisture – total moisture in sample

Ash – inorganic rock like material remaining after complete combustion

Sulfur – total sulfur in sample including organic, pyritic, and sulfate

Heating Value – higher heating value (HHV) of coal expressed as Btu/lb. British thermal unit (Btu) is the amount of energy needed to raise one pound of water one degree F.

Ultimate

Moisture, Ash, Sulfur – as described

Carbon – total elemental carbon

Hydrogen – total elemental hydrogen not included in moisture, (fuel hydrogen)

Nitrogen – total elemental nitrogen

Oxygen (by difference) – remaining major element calculated by summing moisture, ash and elements listed above and subtracting from 100

Ash Chemistry

Major & Minor Elements

% of Ash

SiO_2
Al_2O_3
TiO_2

SO_3

Fe_2O_3
CaO
MgO
K_2O
Na_2O

Boilers want Heat.

We know this because operators say things like:

We'll add some heat
We're pour'n the coal to her
Burn Baby Burn
Get her Hotter
Add Fuel to the Fire
We increase the fire
Let's get things heated up
We burn coal
Hunka, hunka Burning coal
Let's stoke her fire
Poke those embers
We heat it up
Stoke'm up baby
Were going to make it real hot

We understand the concept of buying Btus by pricing fuels In:

$/MBtu = ($/ton) / 2x(Btu/lb/10,000)

Example:

$40/ton coal 12,500 Btu/lb.

$/MBtu = (40)/2x(12,500/1,000)

$/MBtu = (40)/(2x12.5)

$/MBtu = 40/25 = $1.60 per MBtu

We understand the concept of buying Btus and,

Boilers want heat.

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

LOADING LEVELS

The industry has used SO_2 emission levels expressed in lbs SO_2/MBtu for over 20 years

ESP performance is based on the lbs Ash/MBtu, Ash Loading, not percent ash.

Lbs. of ash/MBtu

= %ash / (Btu/10,000)

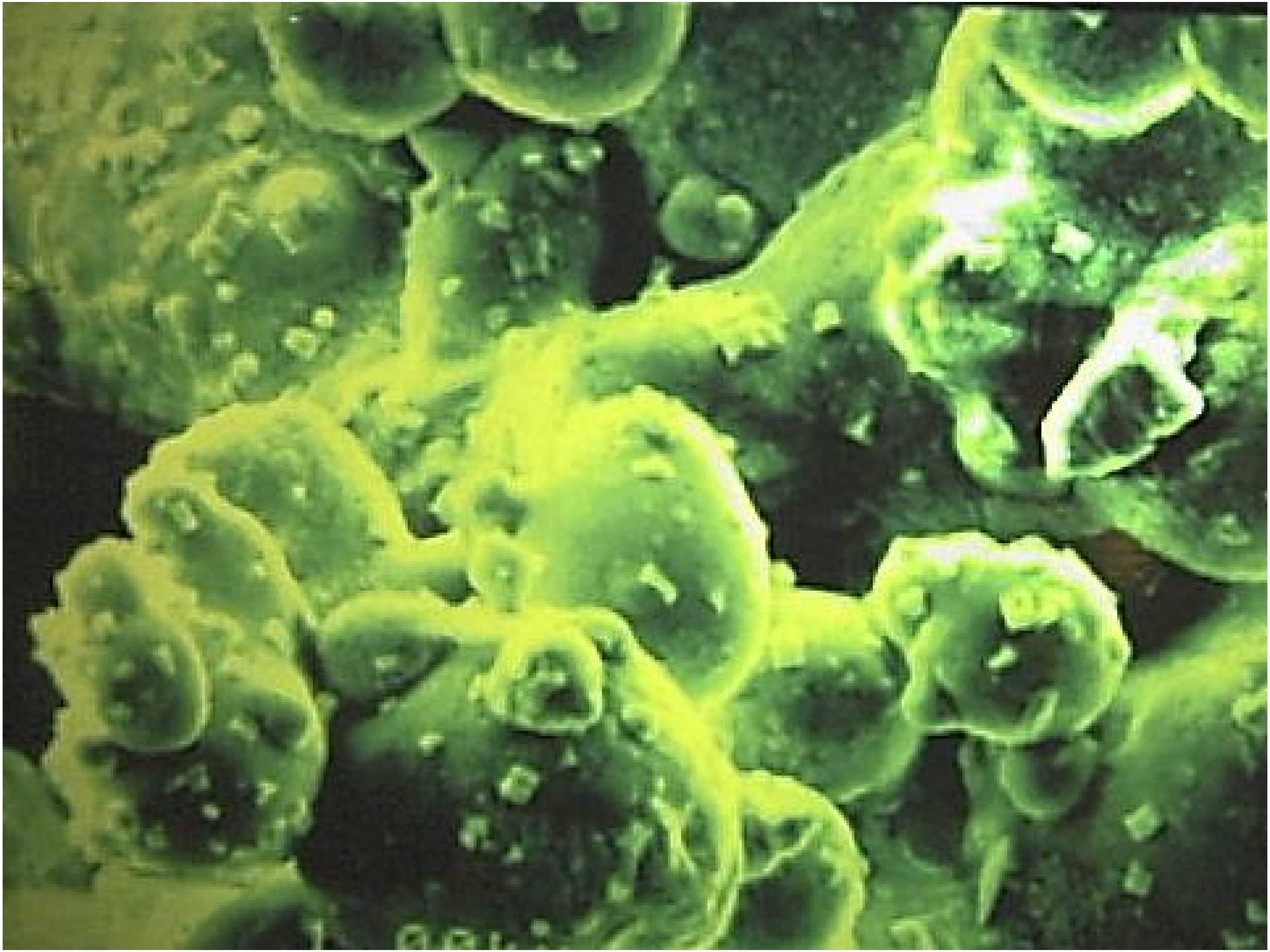
Many slagging concerns have been addressed using Ash Loading and Elemental loading levels; especially

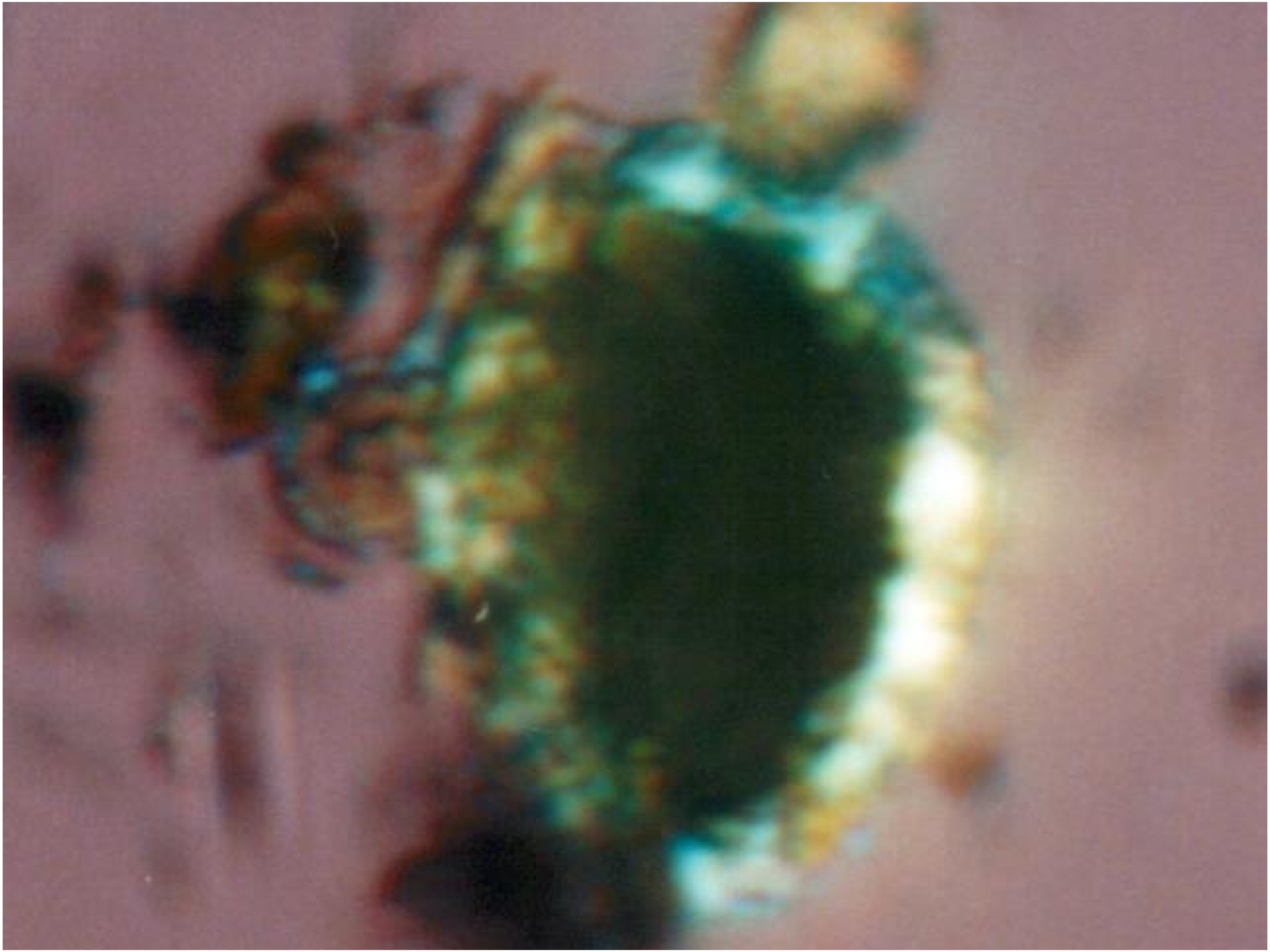
Fe_2O_3, CaO, Na_2O

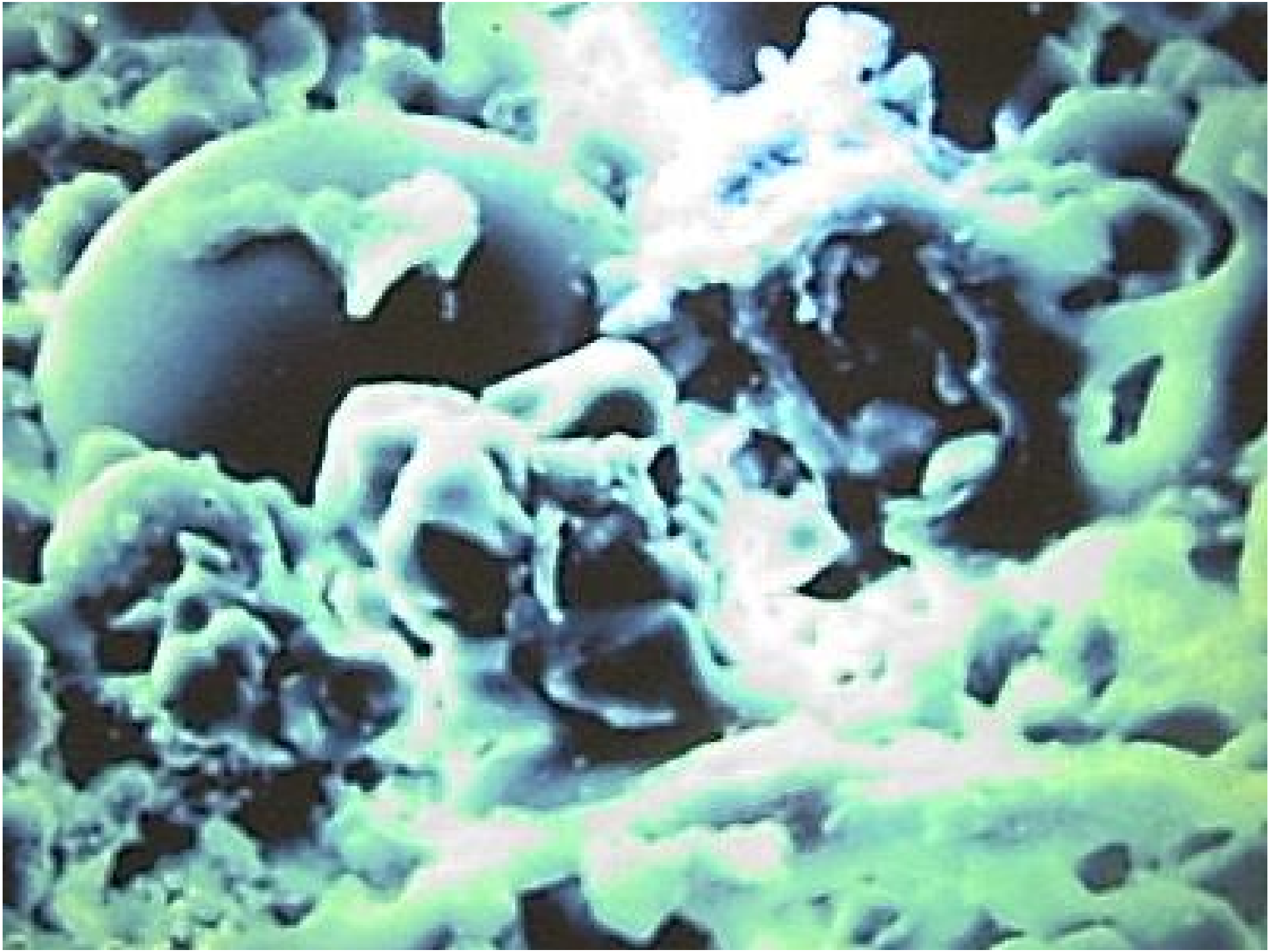
Ash Deposits

Slagging - Molten

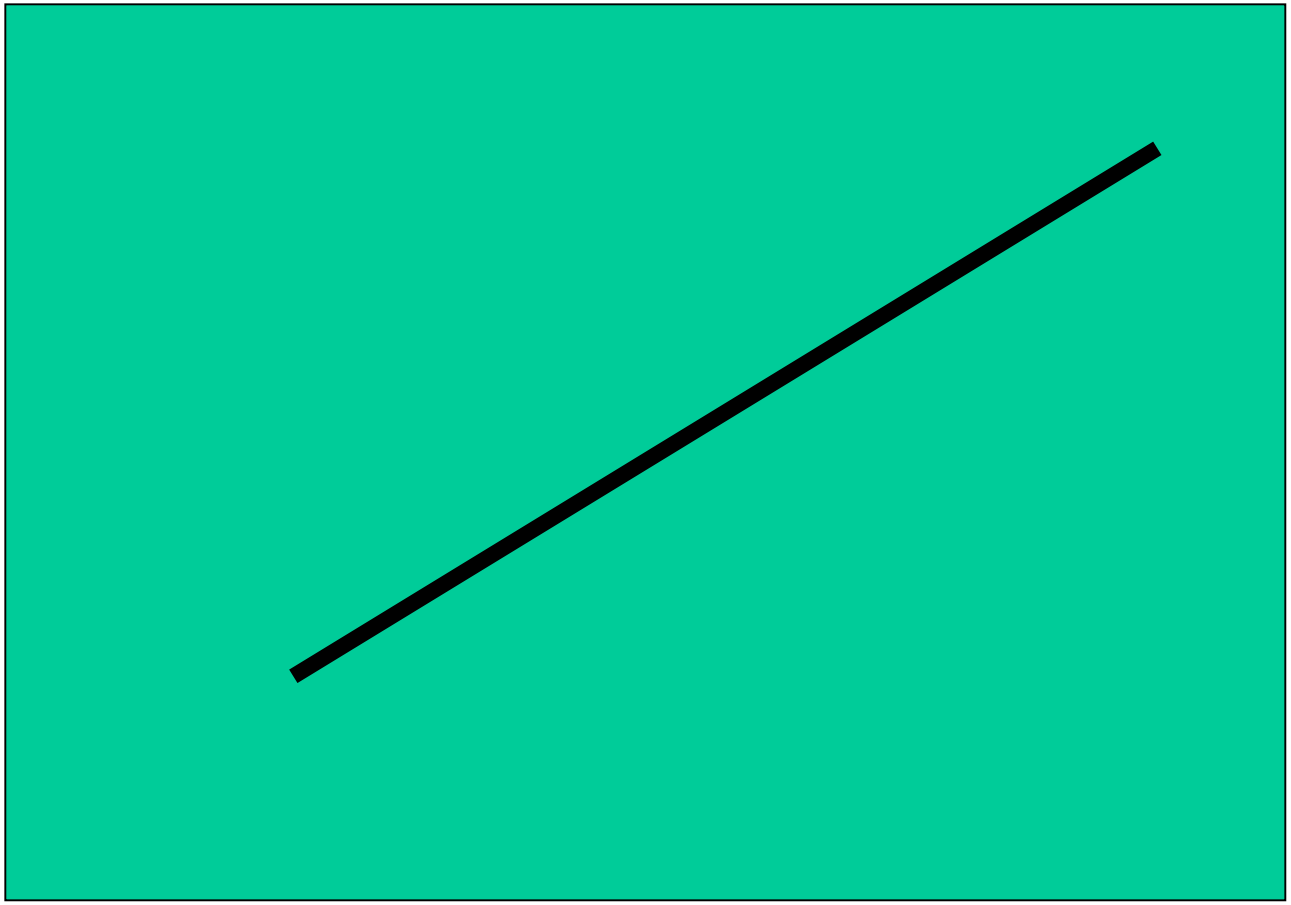
Fouling - Sulfate Salts







What does the SO3 represent?



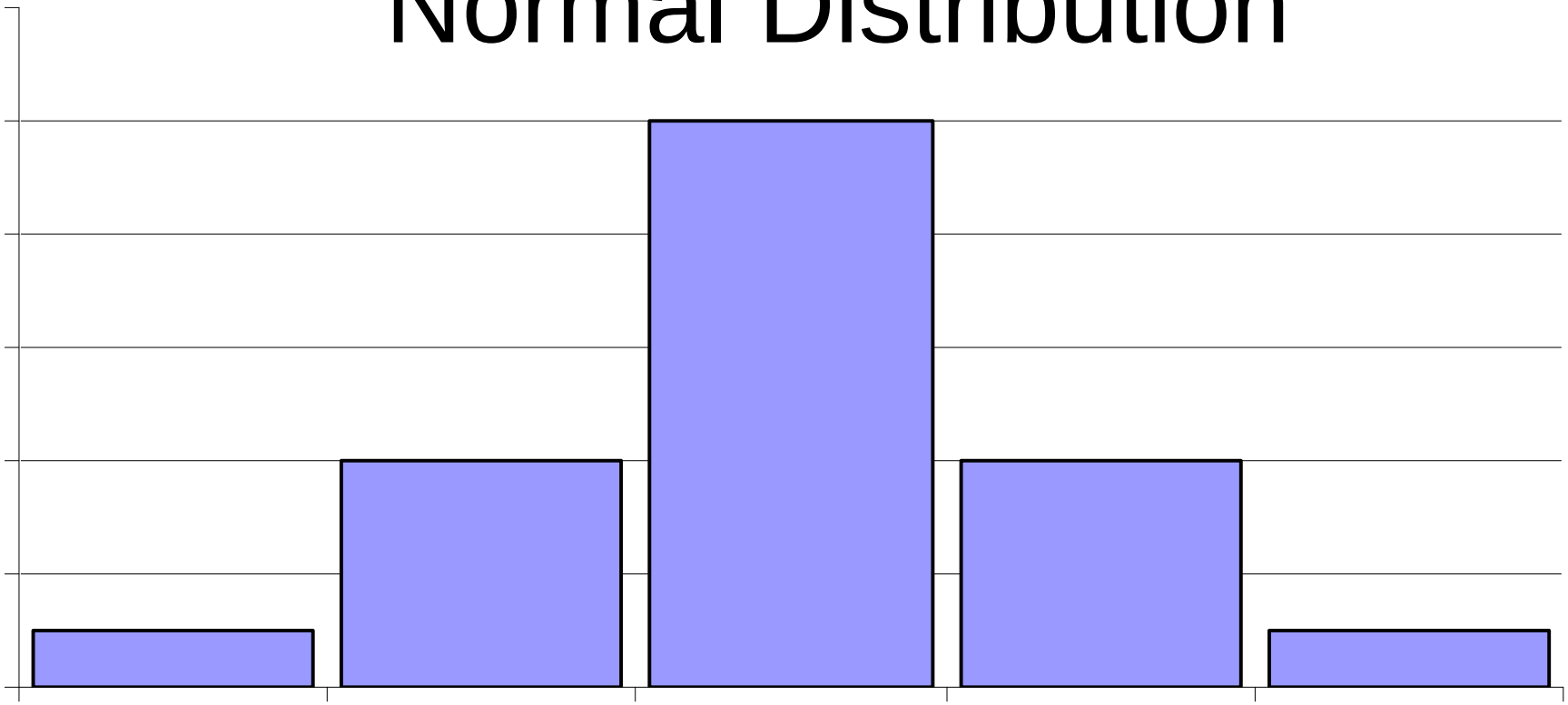
Experience suggests that rating PRB coals using calcium and sodium loading levels correlates better than percent sodium and calcium and fusion temperatures

Test	Hi Na_2O	Low Na_2O
Btu/lb	9,300	9,000
% Ash	4.0	6.5
% Na_2O	8.0	5.0

Test	Hi Na_2O?	Low Na_2O?
lb Ash/MBtu	4.3	7.2
% Na_2O	8.0	5.0
lb Na_2O/MBtu	0.34	0.36

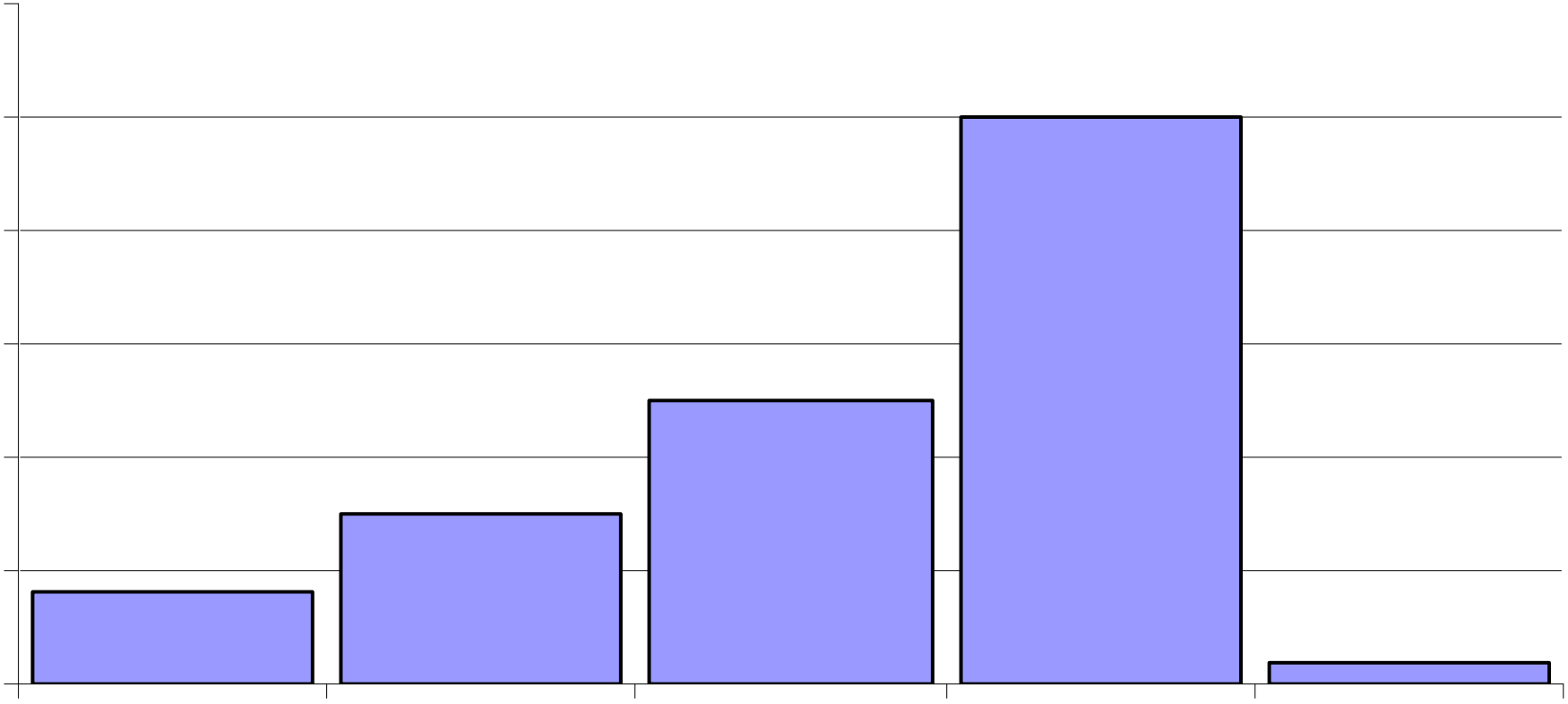
Coal Variability

Normal Distribution



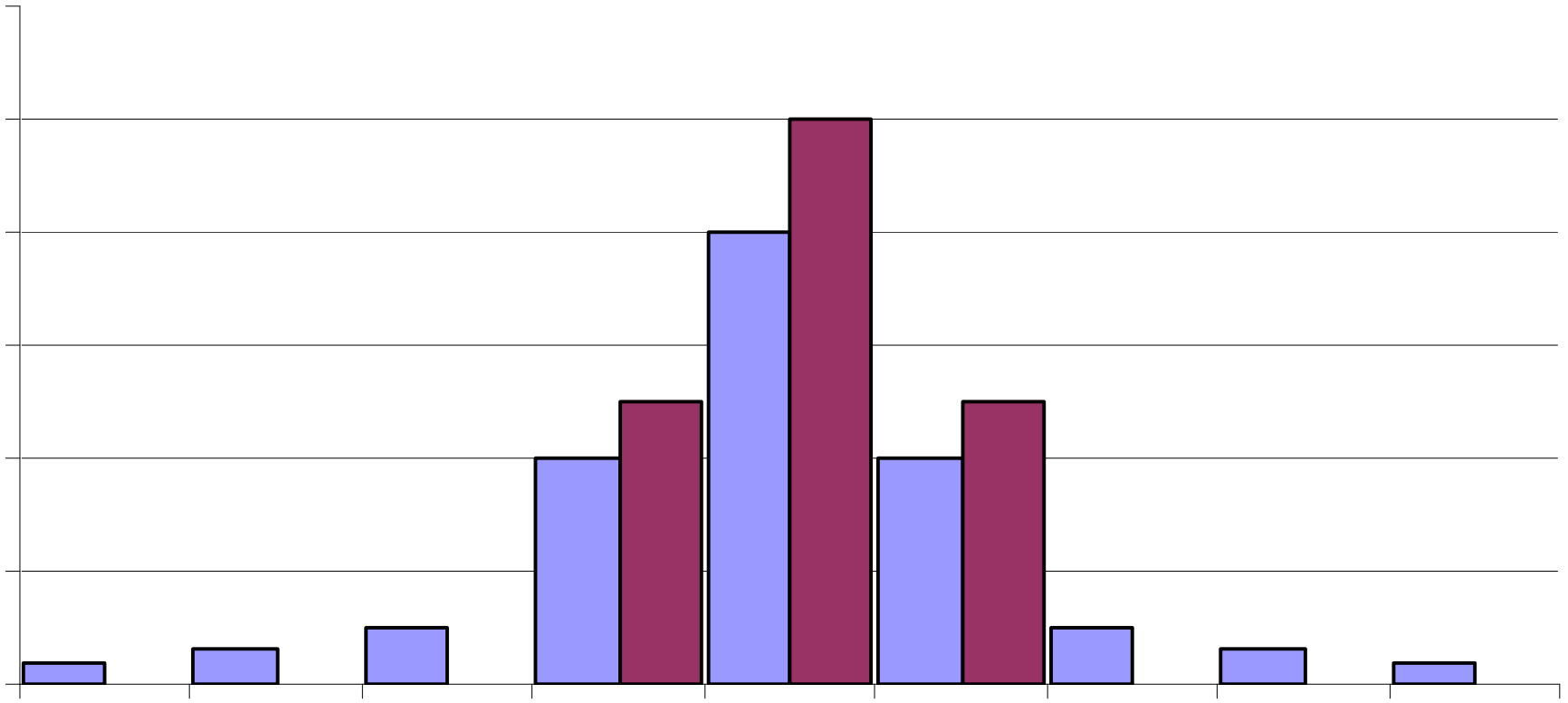
Quality Parameter

Skewed Distribution



Quality Parameter

Small and Large Variability



Quality Parameter

Coal Reactivity

Volatile

Fuel Ratio, FC/Vol

MAF Oxygen

C/H

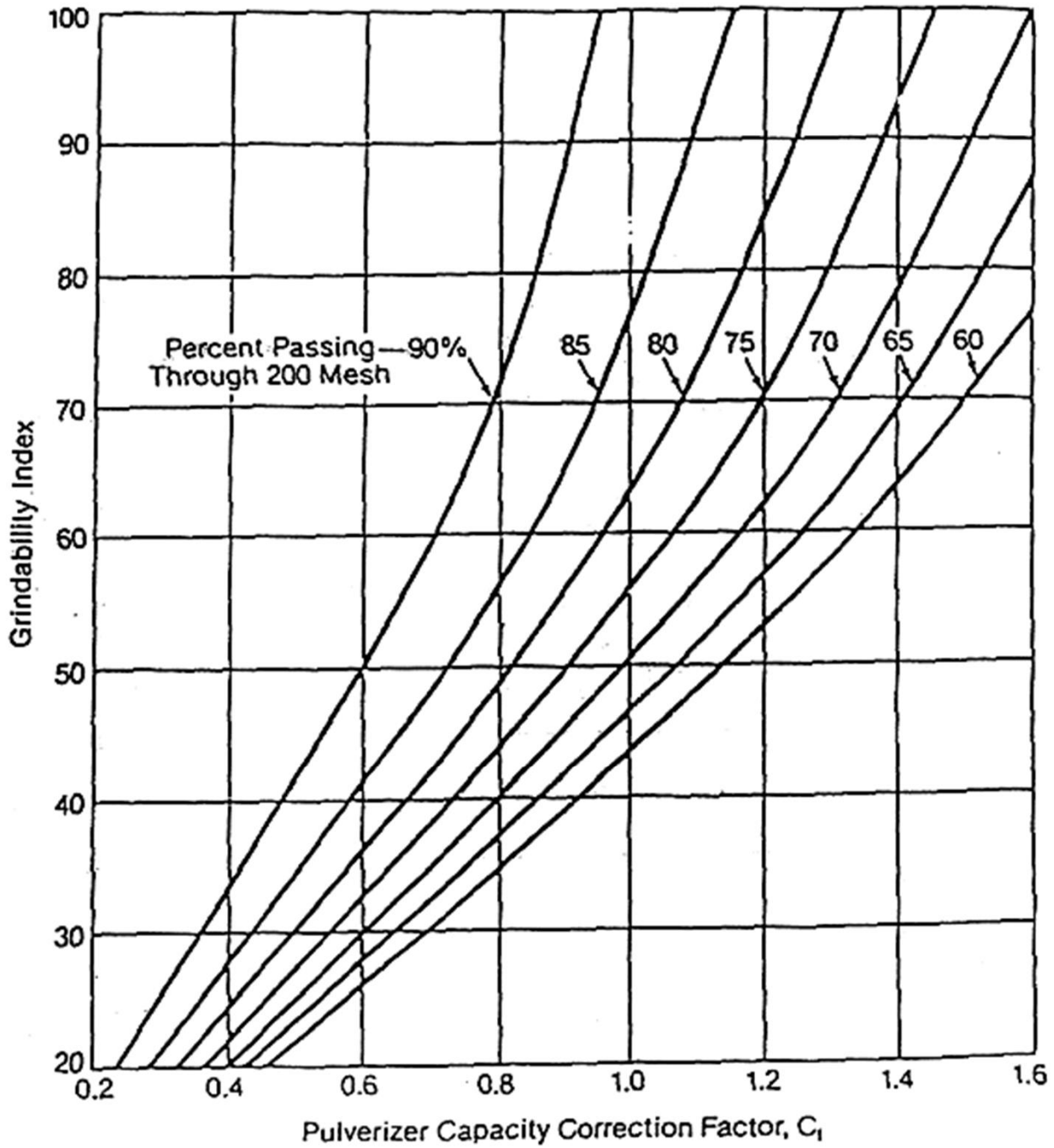
HGI and others

Coal Reactivity Consider: Volatile Oxygen per million Btus

Property	Eastern Bit.	PRB
Moisture	7	30
Ash	12	5
Volatile	35	32
Fixed Carbon	47	33
Oxygen	4	12
Btu/lb	12,000	8,800

Property	Eastern Bit.	PRB
Volatile	35	32
Fuel Ratio	1.34	1.03
MAF Oxygen	4.9	18.5
Vol/MBtu	29	38
Oxy/MBtu	3.3	13.6

Mill Capacity And HGI



Pulverizer Capacity

Test	East Bit	PRB
HGI	50	60
Btu/lb	12,000	8700
Cap	1.0	0.86

Boilers want Heat.