

REGENERATIVE AIR HEATERS

MATERIALS AND COATINGS

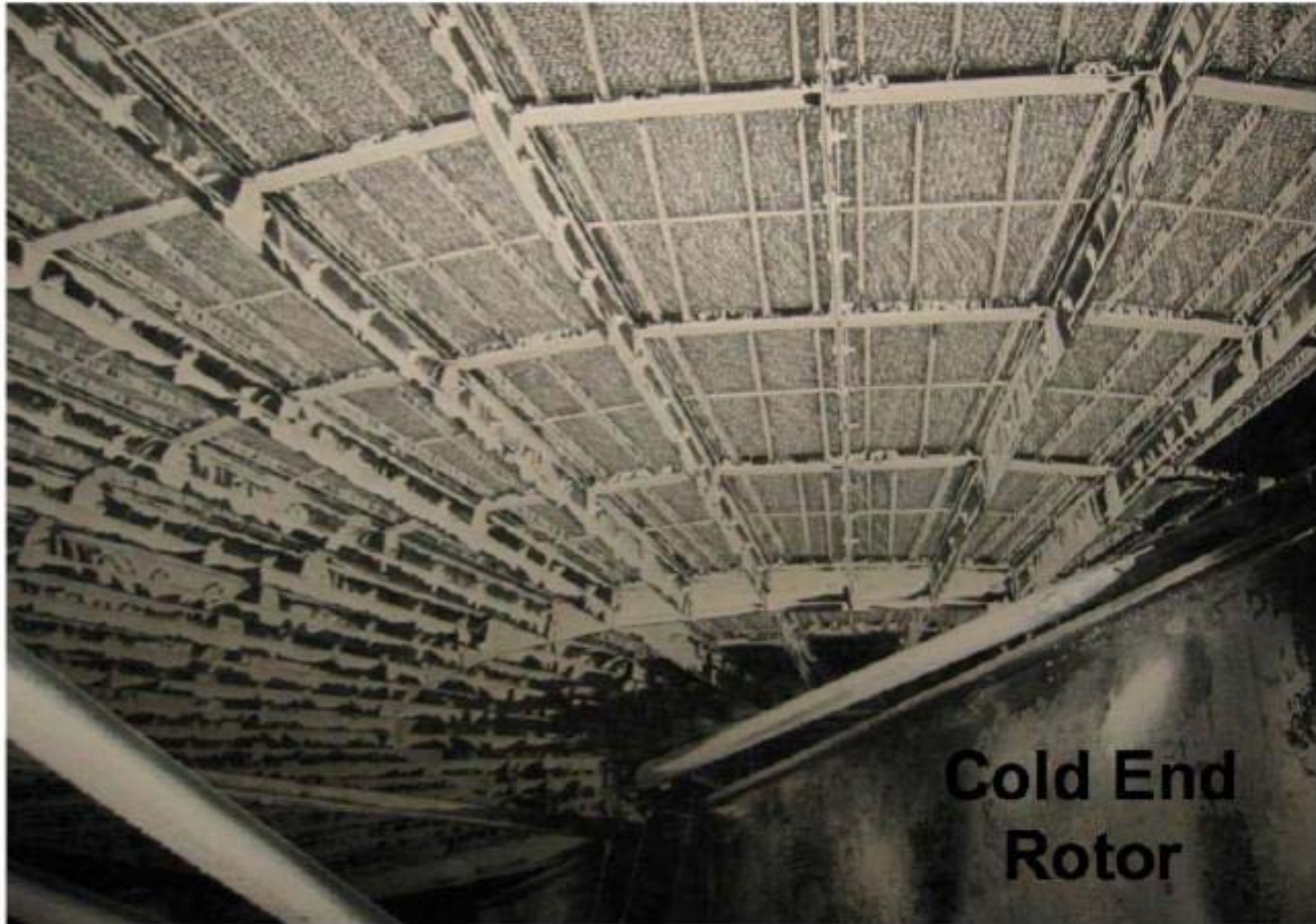
FOR

ACID & ABS CORROSION PROTECTION



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Condensation Deposits



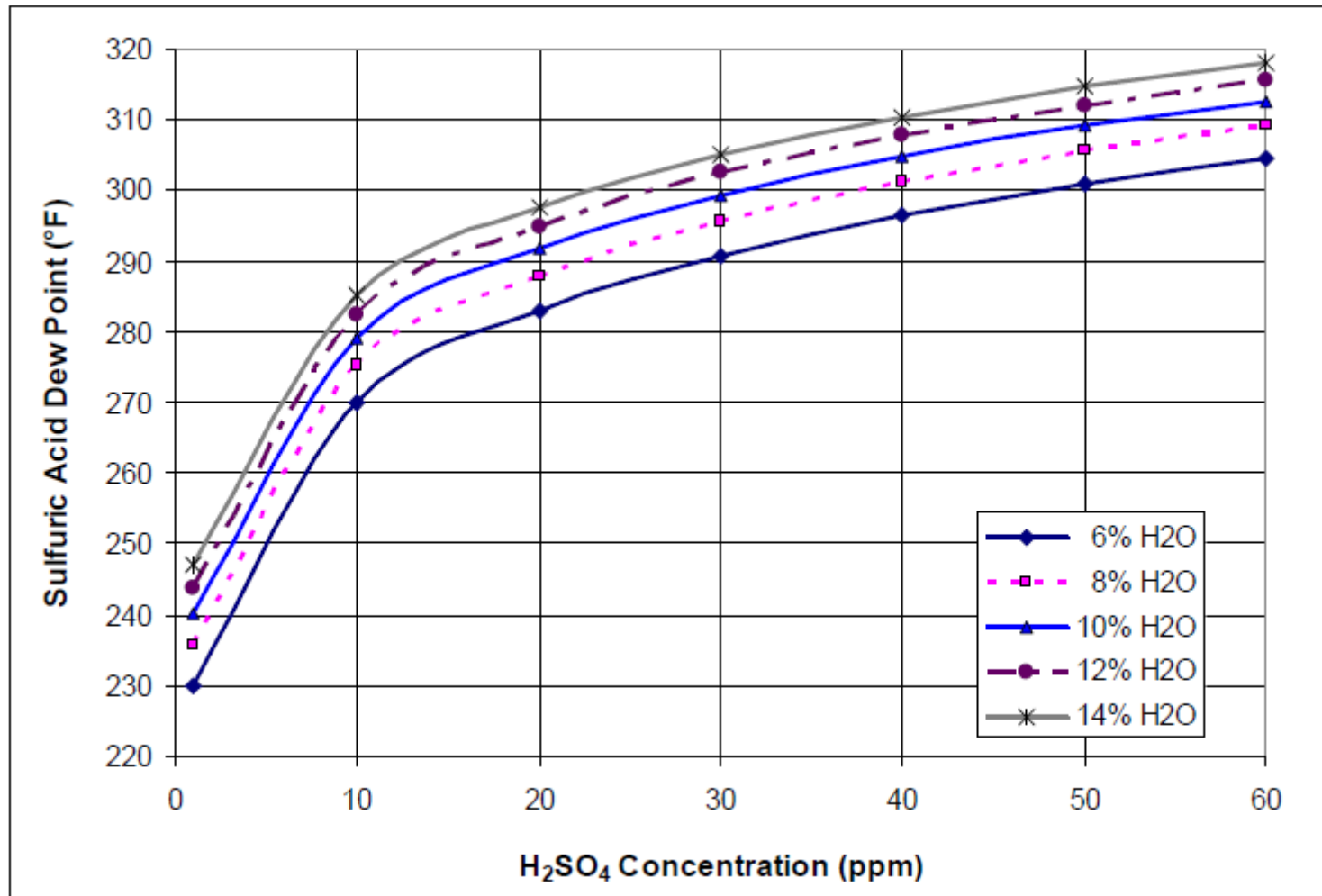
COLD END CORROSION



AH DETERIORATION

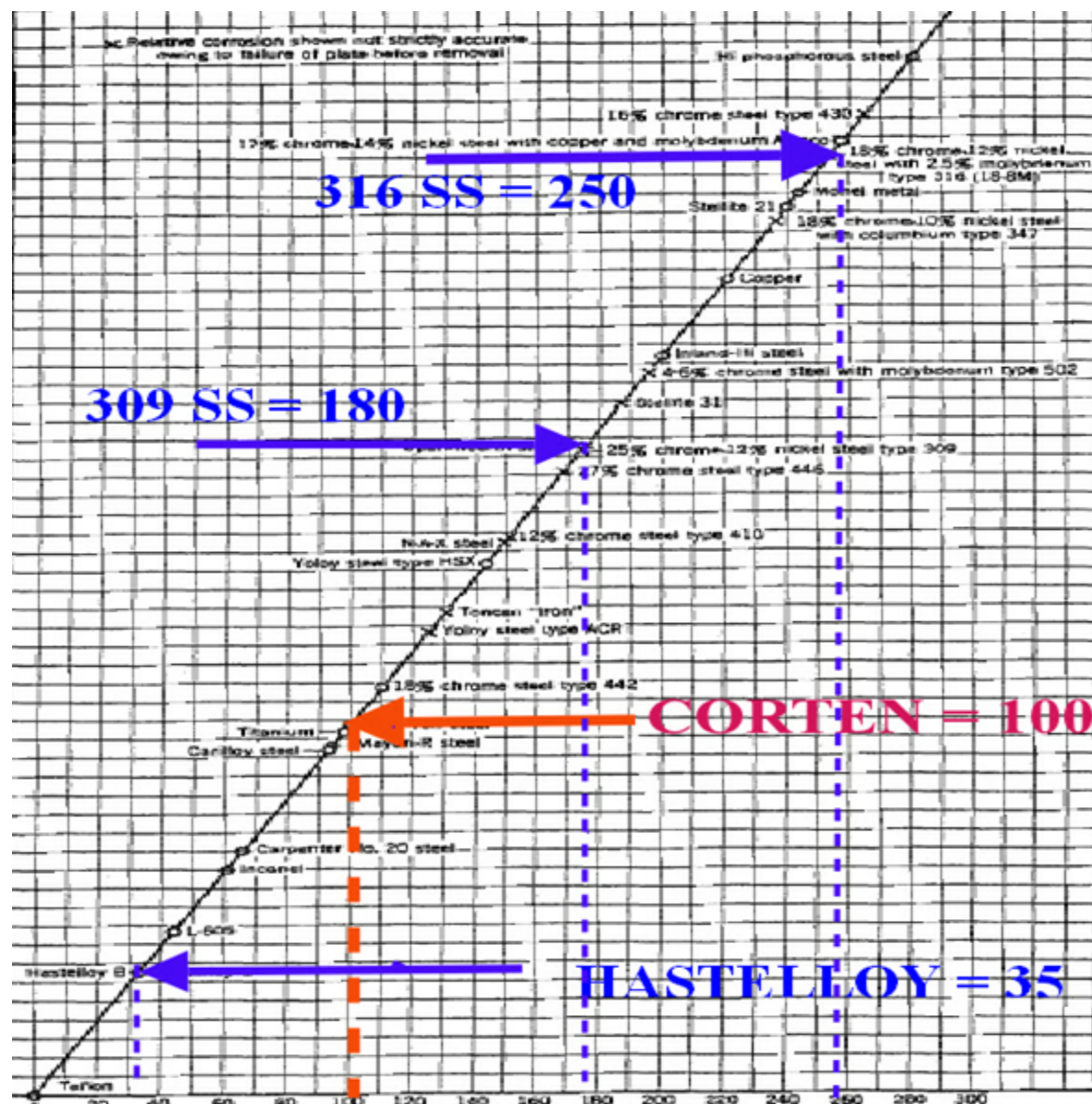


SO₃ Vs. Sulfuric Acid Dew Point Temp.

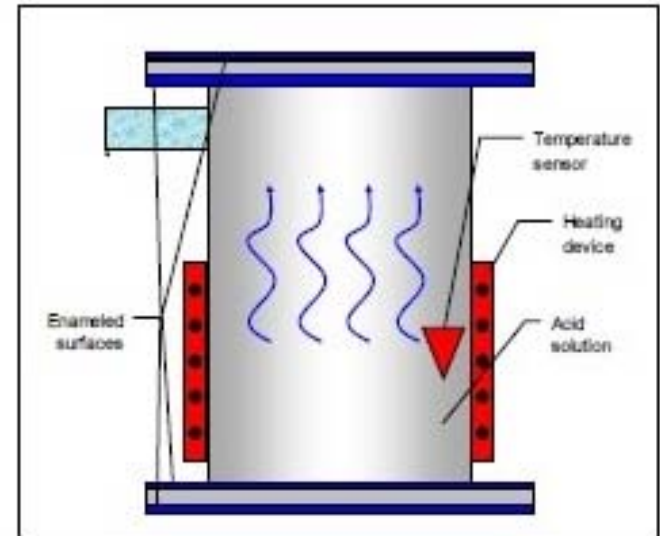


Ref. A&WMA, 2008 Mega Symposium,
 “The Effect of SO₃ Sorbents on Electrostatic Precipitator Performance”, Paper

CORROSION RELATIVE TO CORTEN %

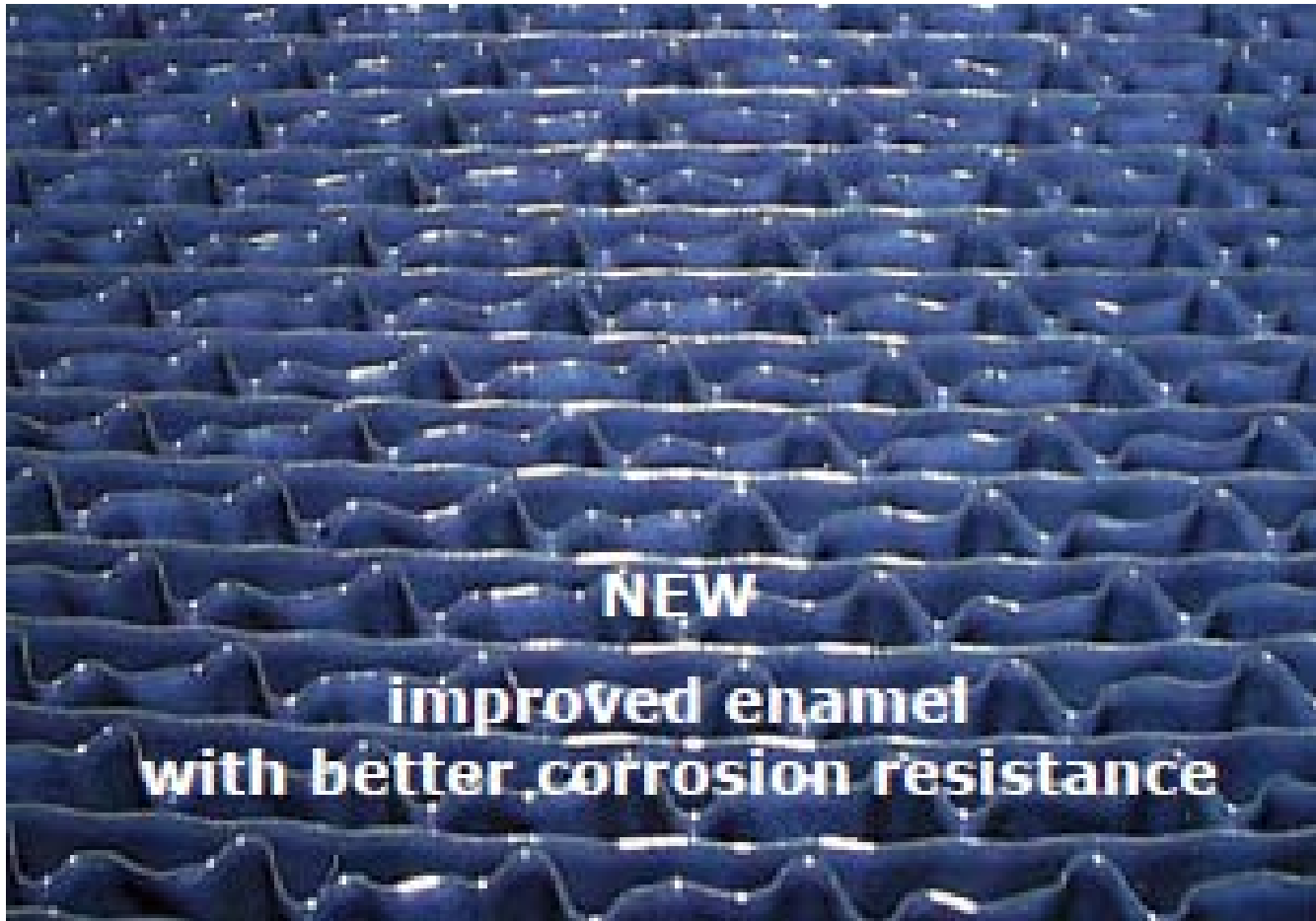


Corrosion Resistance



Specimen weight and surface roughness is measured before and after the corrosion process.

ACID RESISTANT COATINGS



PICK YOUR CORROSIVE

What is Enamel?

Compounds are melted to form a homogenous glass surface

Composition of a chemical resistant enamel

Compounds	%
SiO ₂	57
B ₂ O ₃	9
Na ₂ O	11
K ₂ O	2
CaO	3
BaO	3
TiO ₂	6
Li ₂ O	3
CoO	2.8
NiO	1.2
F	2

Failed Enameled Element



Steel Substrate Improvements:

(Decarburization to .004% C and pickling)

ENAMEL DEFECTS PER SQUARE METER:

1960's	500	(0.1% Carbon)
1980's	150	
1990's	75	
2004	50	(European Standard for Air Heaters)
2012	5	

**Decarburized and Pickled Enameling
Steel has Corrosion Resistance Similar
to CorTen Steel**

Corrosion Resistance

Corrosion attack after boiling for one hour in:

	Enamel steel	Corten steel	Ground enamel	Heat exchanger enamel
10% NH_4HSO_4	400 g/m ²	400 g/m ²		< 0,10 g/m ²
10% NH_4HSO_4	20 g/m ²	30 g/m ²	3 g/m ²	< 0,02 g/m ²
30% H_2SO_4	6.000 g/m ²	4.500 g/m ²	2.000 g/m ²	< 0,20 g/m ²
Water	0,6 g/m ²	0,4 g/m ²		< 0,02 g/m ²
Water vapour	0,2 g/m ²	0,3 g/m ²		< 0,10 g/m ²
30% HCL				< 0,10 g/m ²
30% HNO_3				< 0,05 g/m ²

FLEXIBILITY



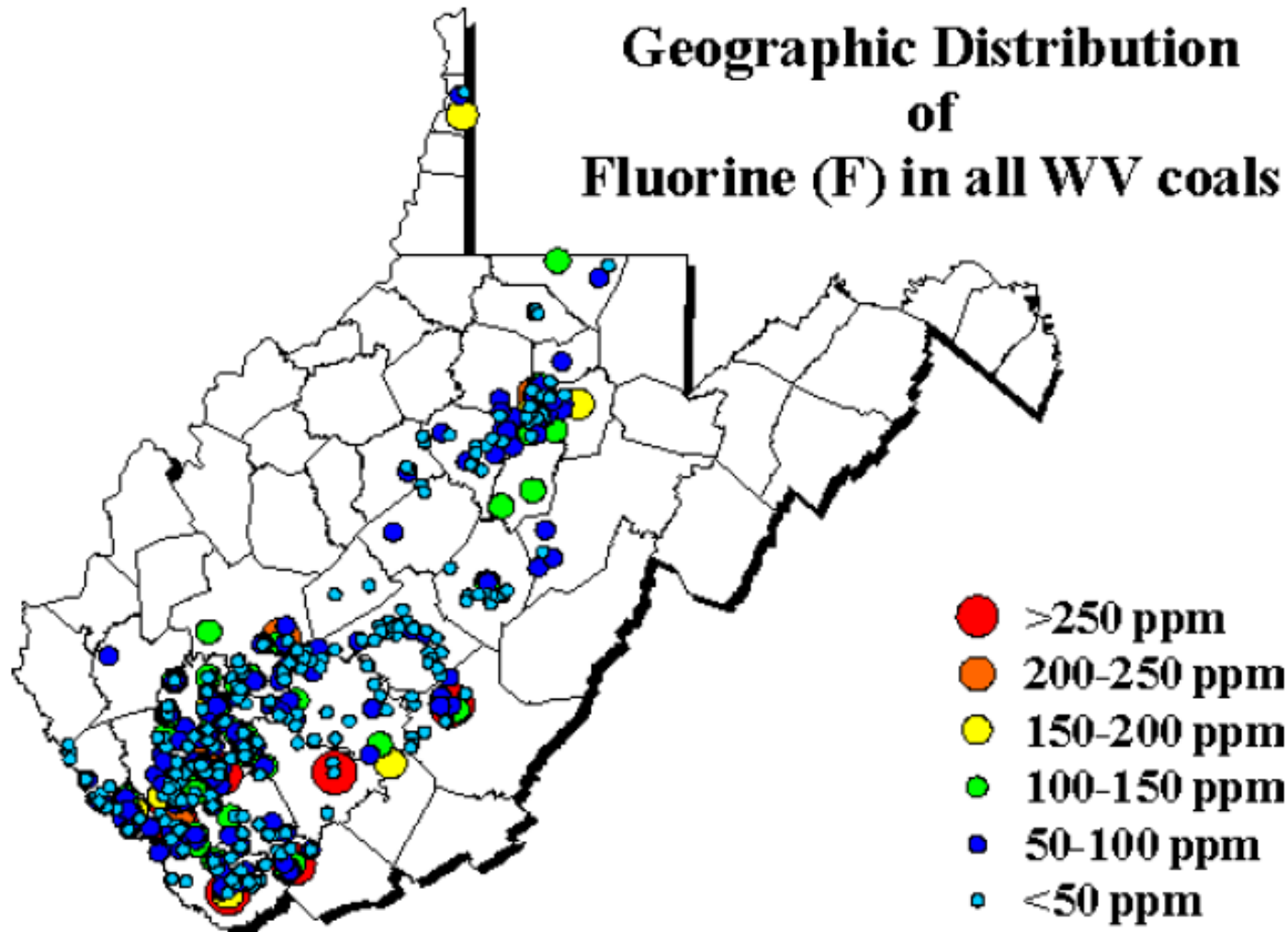
**Hydroflouric Acid (HF) will Dissolve
Silicone Dioxide –
The Main Component Of Enamel**
HF less than 10 PPM

FLUORINE EMISSIONS #/yr



Allegheny Energy Inc. Armstrong Power Station	Kittanning (Armstrong)	150150	Hydrogen Fluoride
Allegheny Energy Inc. Hatfield Power Station	Masontown (Fayette)	680680	Hydrogen Fluoride
Brunner Island Steam Electric Station	York Haven (York)	530800	Hydrogen Fluoride
Cheswick Power Station	Springdale (Allegheny)	193200	Hydrogen Fluoride

FLUORINE IN COAL



Ammonium Bisulfate



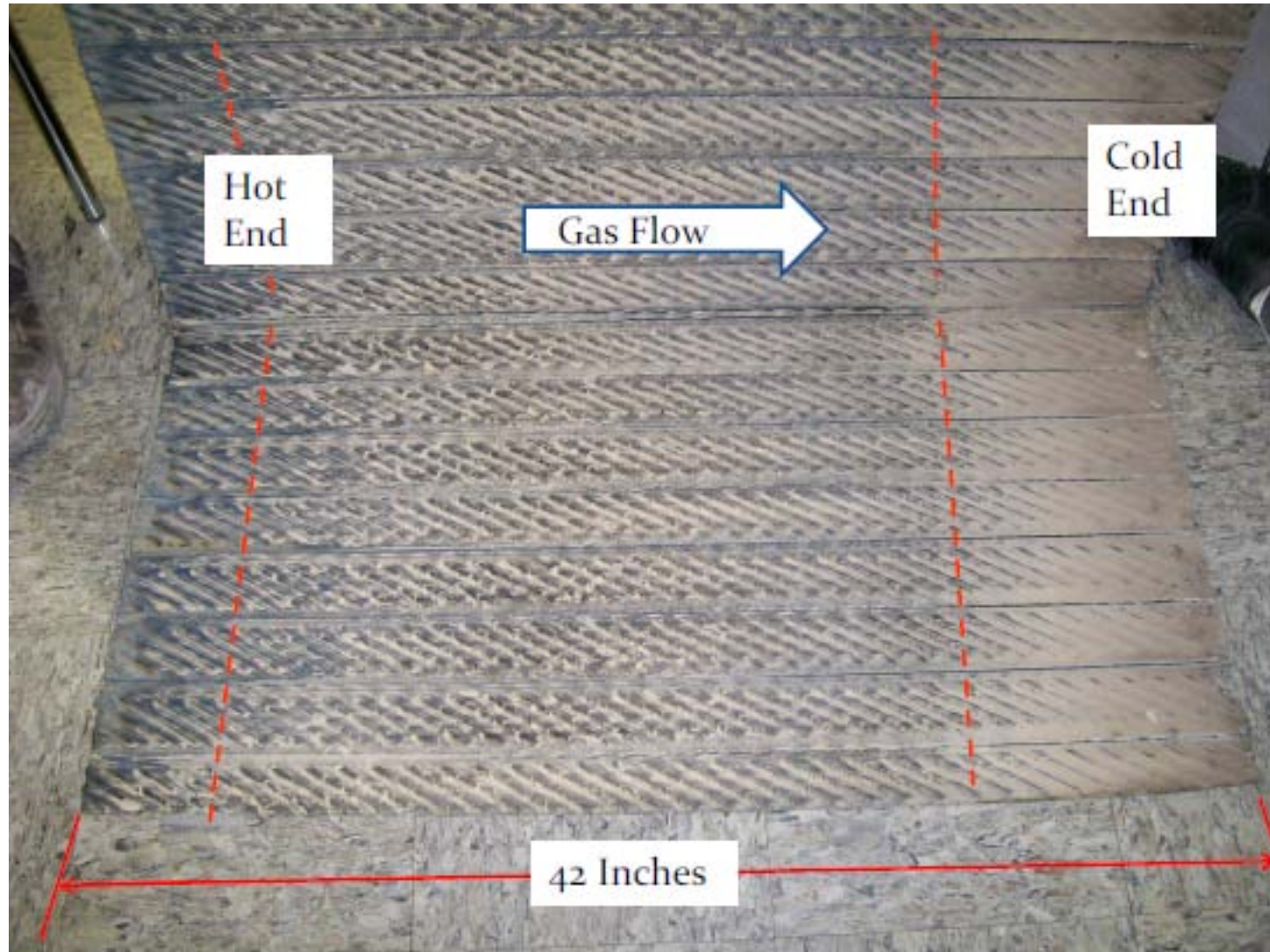
ABS Liquid Accumulates on Element
Temperature
Turbulent Impact
Smooth Surfaces Reduce Deposition

ABS Deposits Are Corrosive

ABS combined with Flyash is adherent

**Oxidized Surfaces increase ABS
adhesion**

ABS and H₂SO₄ Deposition



Mark Thomas and Associates, LLC

ABS



Mark Thomas and Associates, LLC

Non-Stick

**Standard
enamel**

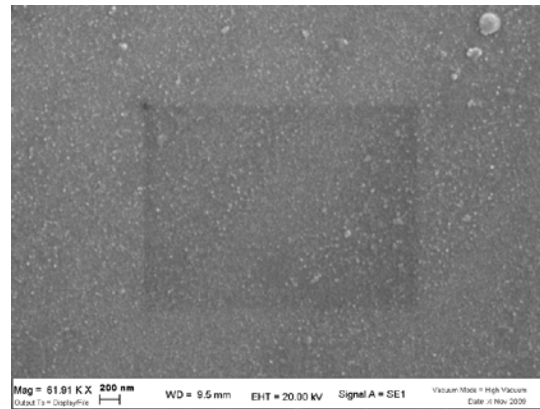
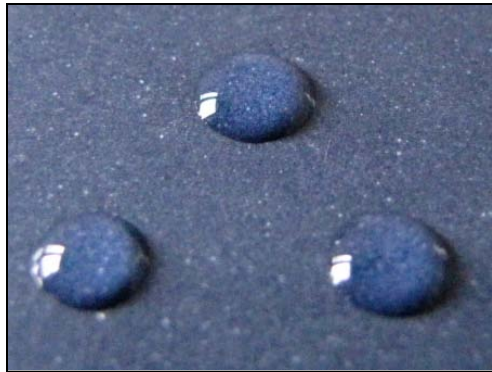


**A "Non- Stick"
enamel**

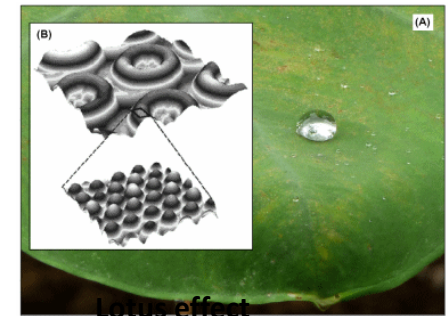
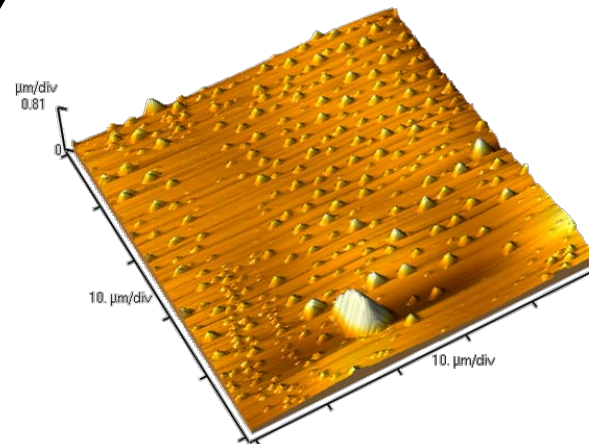
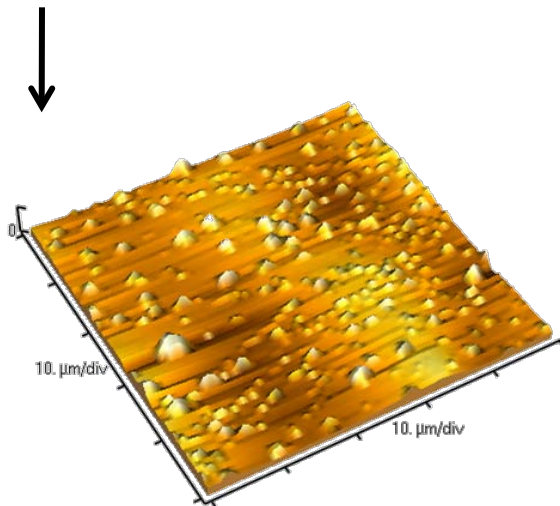


"Non-Stick" enamel

"Non Stick" enamel surface quality



Scanning Electron
Microscope (SEM)
analysis



Lotus effect

Lotus Effect



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