

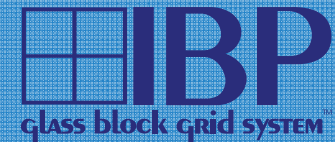
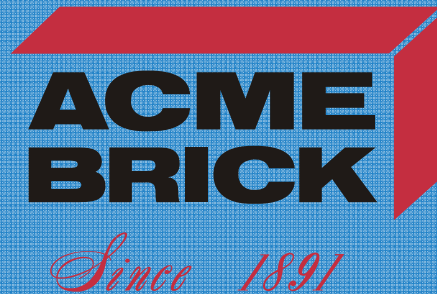
THE BENEFIT OF BOTTOM ASH IN THE MANUFACTURE OF CLAY FACE BRICK

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Acme Brick Company

Fort Worth, Texas

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SAN FELIPE PLANT

- Built in 1985
- Residential face brick
- Production > 100 MMBE/year
- Wet preparation
- Soft extrusion
- Stick drying
- Dry set
- Dehacker

A wide-angle photograph of a large, flat, reddish-brown stockpile of plastic chew clay. The stockpile is a uniform, dark reddish-brown color and extends across the entire width of the image. The foreground is a lighter, sandy or silty surface with some tire tracks. The sky is a clear, pale blue. The text "PLASTIC CHEW CLAY STOCKPILE" is overlaid in white, bold, sans-serif font in the center of the image.

PLASTIC CHEW CLAY STOCKPILE

A large, conical stockpile of reddish-brown sand or soil dominates the middle ground. The pile has a textured, uneven surface. In the foreground, a flat, light-colored gravel or sand area is visible, with a yellow caution tape stretched across it. The sky is a clear, pale blue. The overall scene is an outdoor industrial or construction site.

SANDY ABEL STOCKPILE



WET PREPARATION-ROTARY SCREEN FEEDER



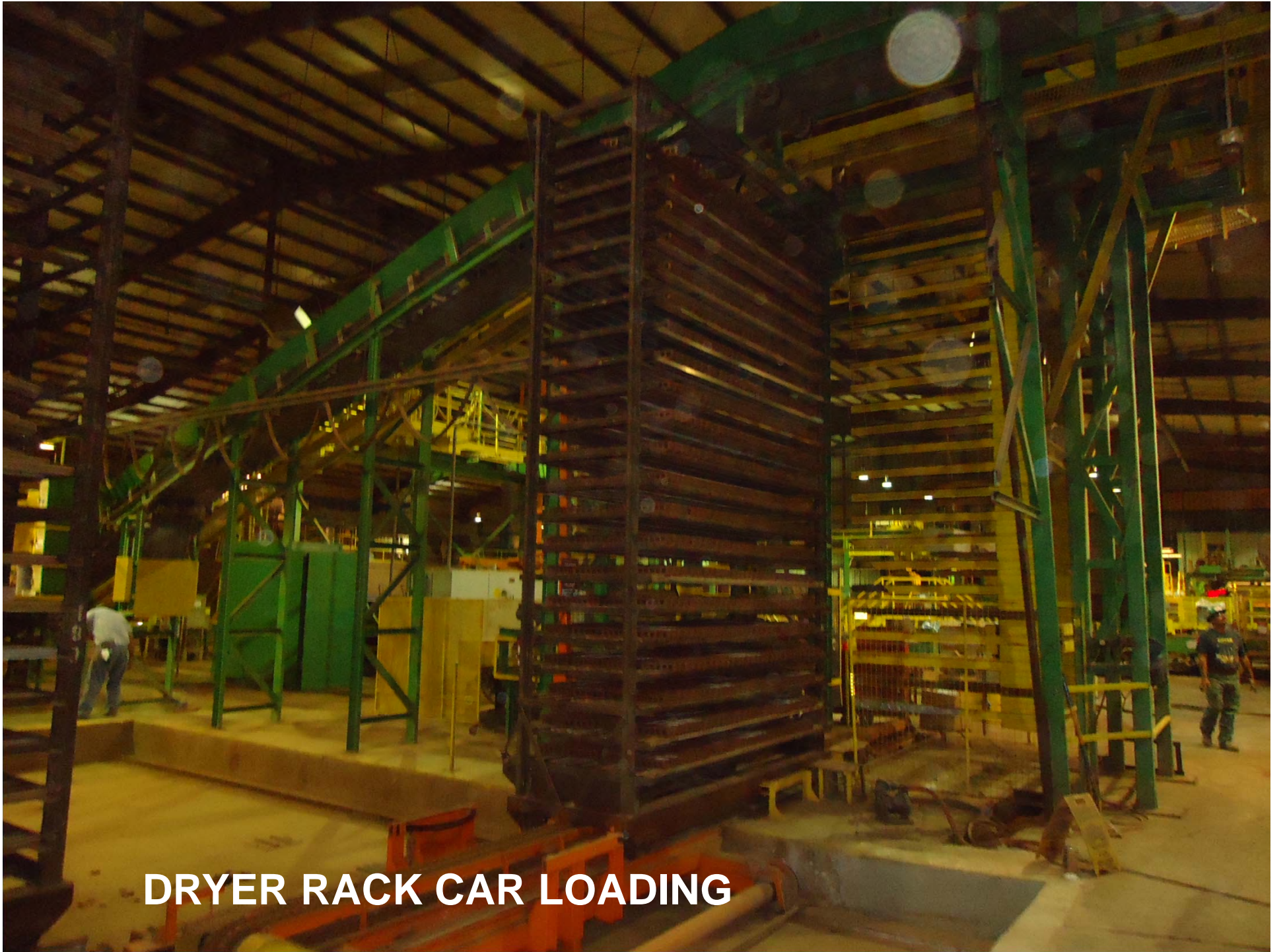
MULTI-BUCKET RECLAIMER



SOFT EXTRUSION



MULTI-WIRE HARP CUTTER



DRYER RACK CAR LOADING



**INDIVIDUAL “STICK” DRYING
SEMI-CONTINUOUS DRYER**



24 WIDE KING SIZE DRY SET CAR



22 HIGH DRY SET



TOP-FIRED TUNNEL KILN



DEHACKER



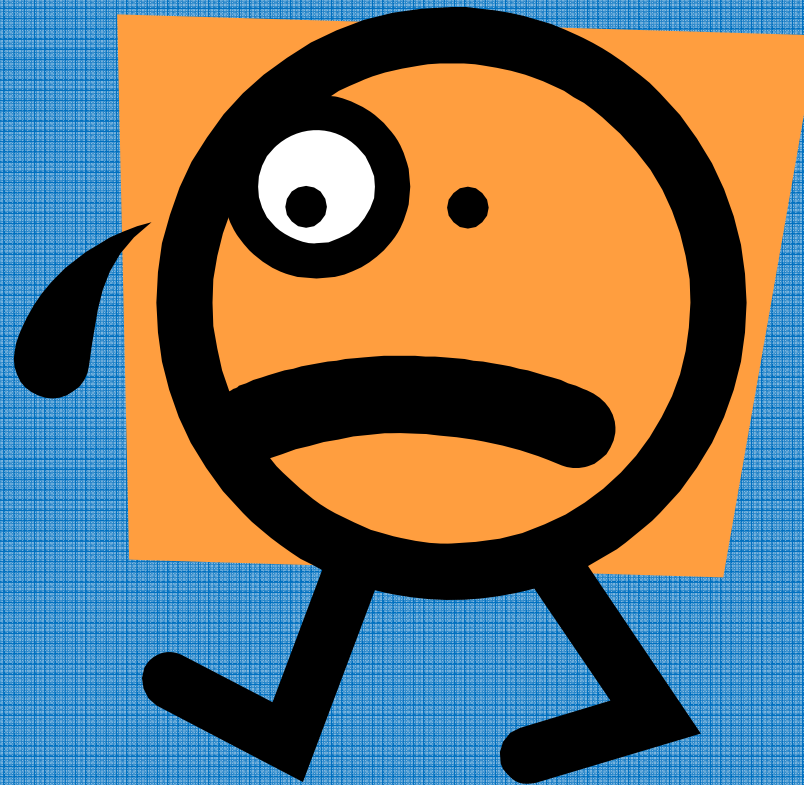
DEHACKER

PLANT STARTUP ISSUES IN 1985.....

- Extrusion laminations
- Excessive dryer cracking
- Pre-heat cracking
- Cooling cracking
- Poor fired strength
- High bat loss (>50%)
- Poor quality
- Disastrous cost impact



**AFTER MUCH RESEARCH, MANY TRIALS
AND ERRORS.....**



**IN 1987 A GROG PLANT WAS INSTALLED AND
BOTTOM ASH WAS INTRODUCED**



FAST FORWARD 25 YEARS

PURPOSE OF THE WORK

- To study the characteristics of the combined materials, with and without bottom ash.
- To determine the mechanisms at work which make the bottom ash effective.
- To understand the key process control parameters necessary for ongoing success.
- To provide scientific evidence of the benefits of bottom ash in the manufacture of clay face brick.

SFP test bodies

Non – bottom ash body (SFP-17)

Chew clay	50%
Abel sand	50%

Current SFP bottom ash body (SFP-18)

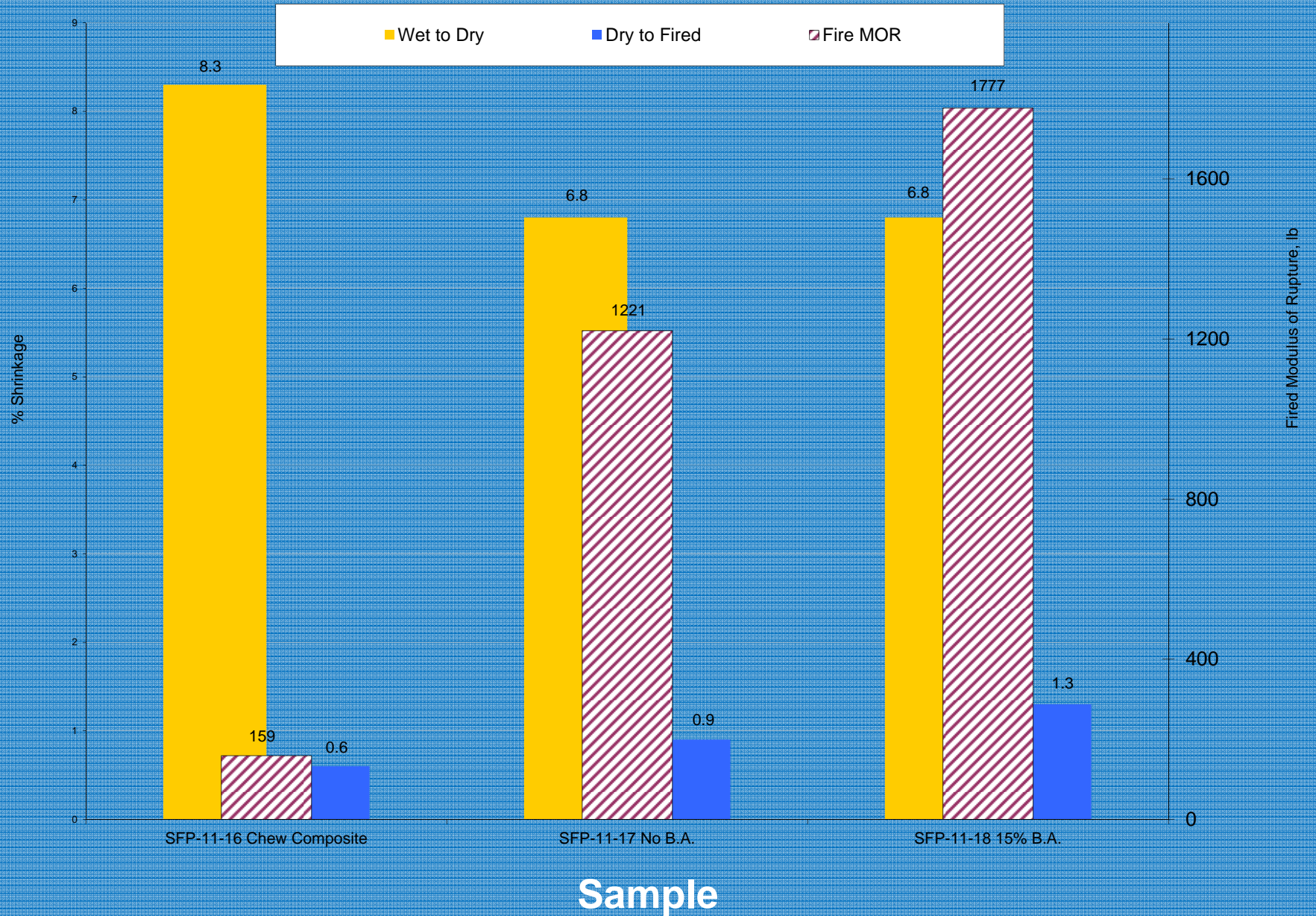
Chew clay	53%
Abel sand	32%
Bottom ash	15%

Analyses performed

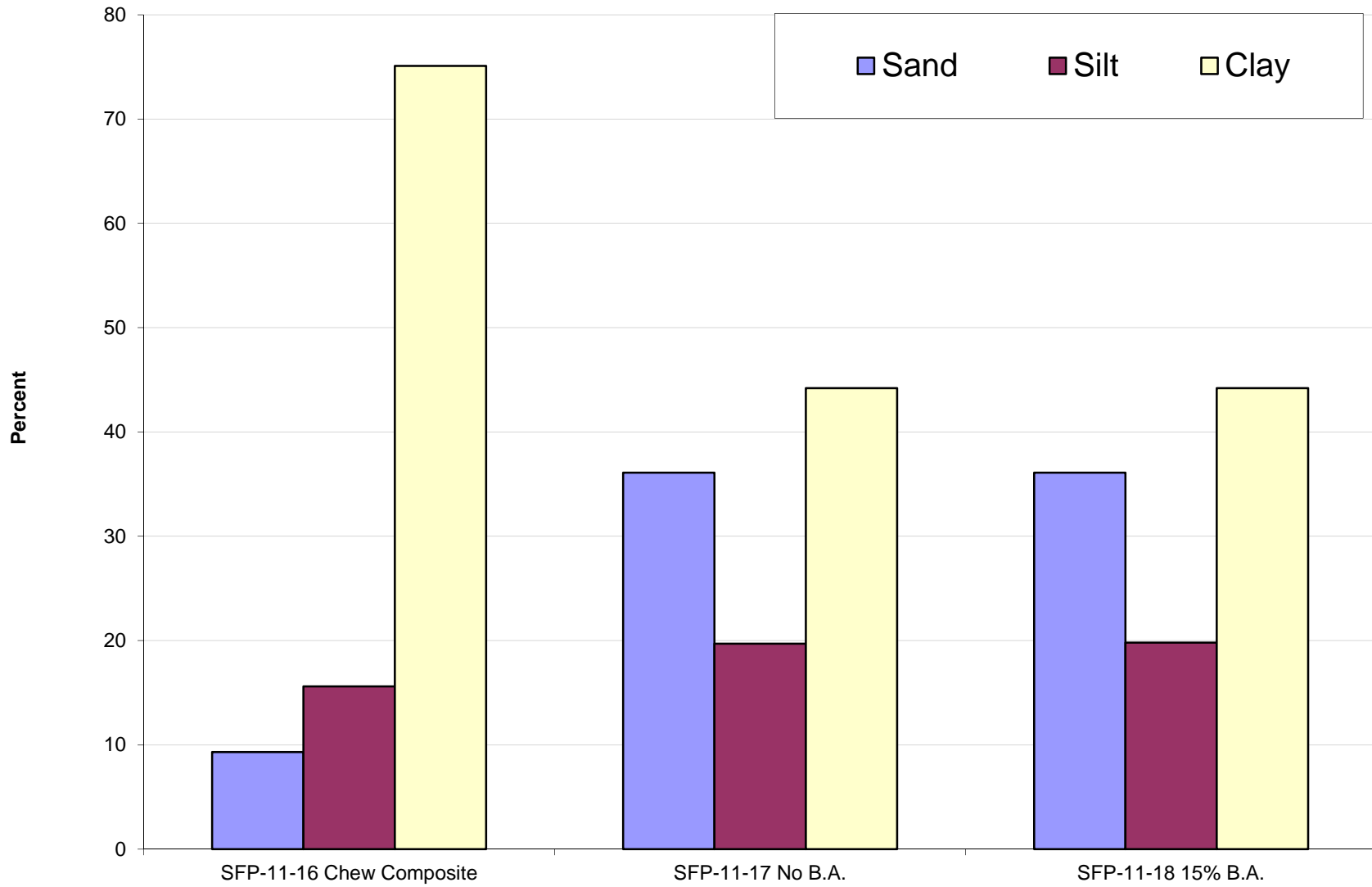
- Dry and fired physical properties
- Particle Size Equivalent
- Pore size distribution
- Simultaneous Thermal Analysis
- Chemical analysis
- Mineralogy XRD
- Microscopy

FINDINGS

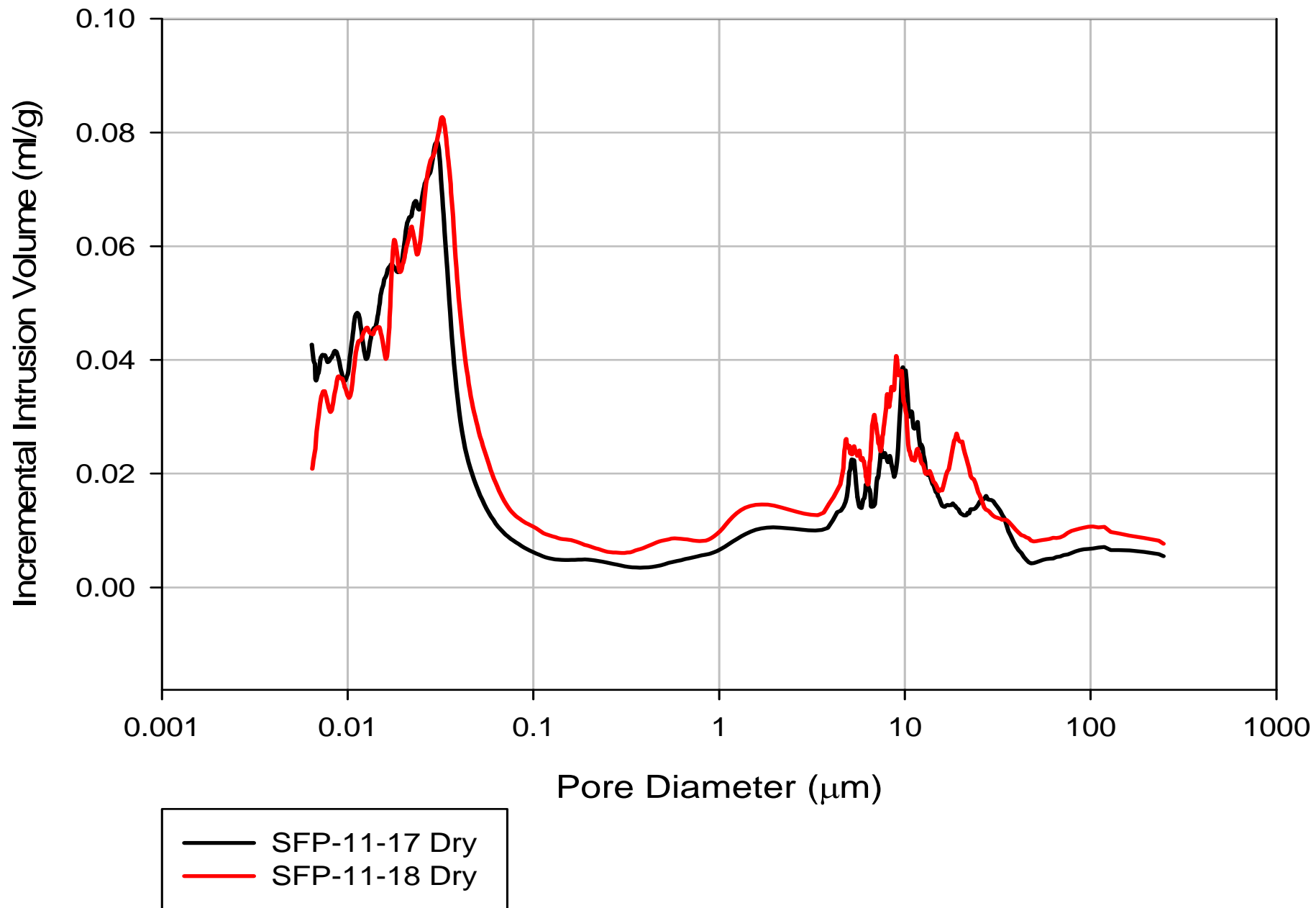
Linear Shrinkage and Strength Comparison



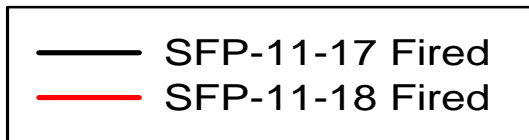
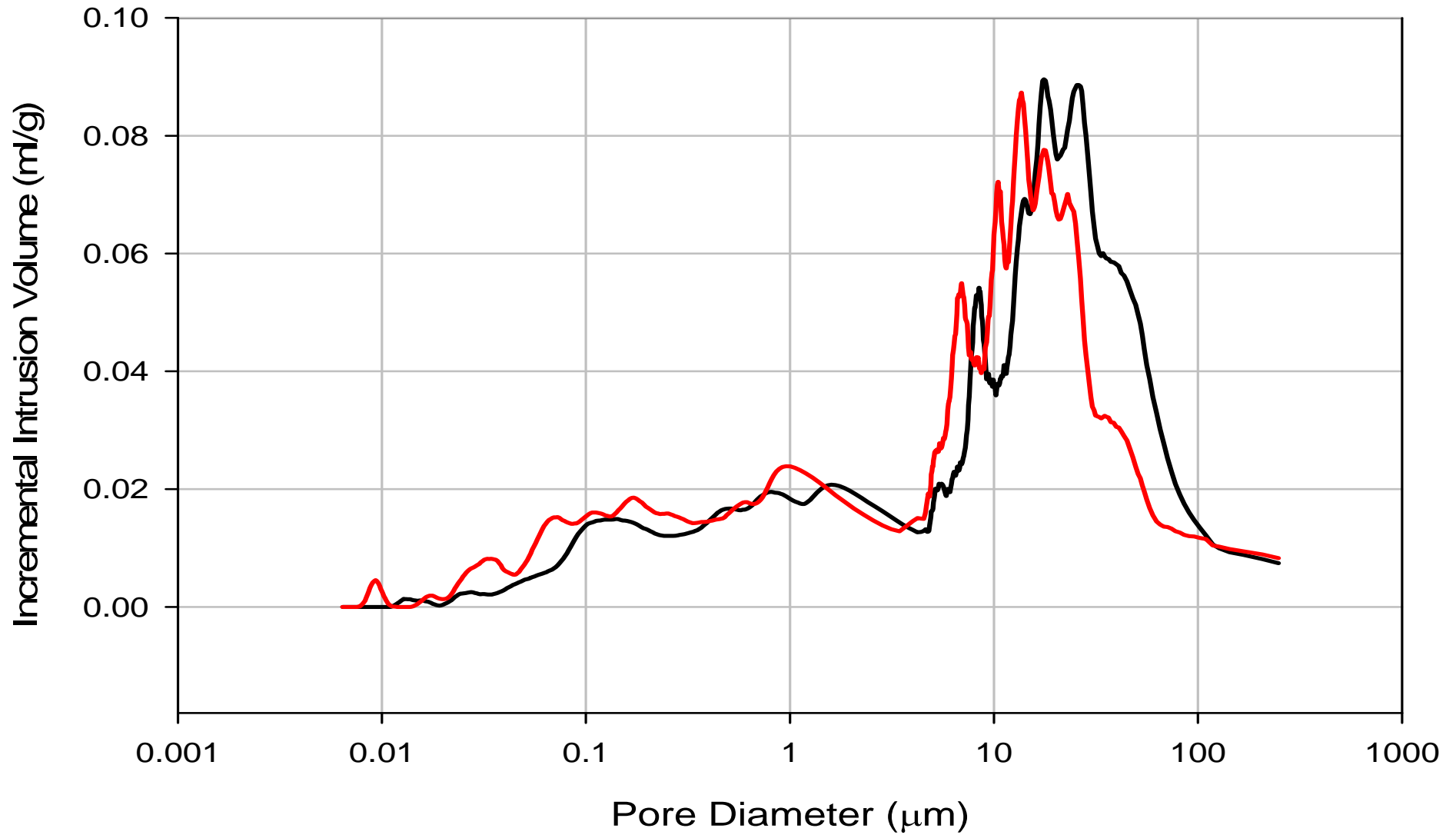
Particle Size Equivalency Comparison



PORE SIZE DISTRIBUTION Dry Brick

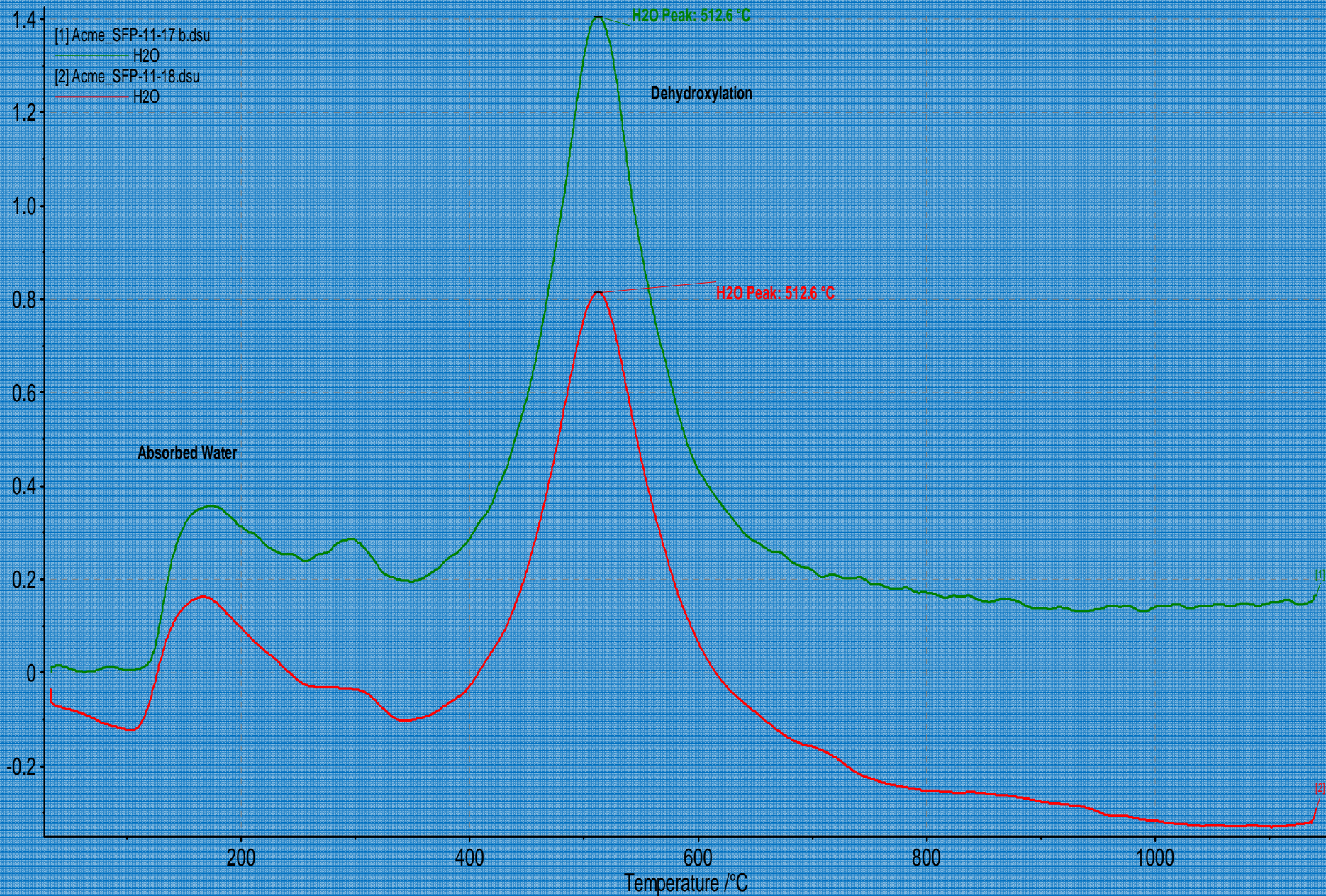


PORE SIZE DISTRIBUTION Fired Brick



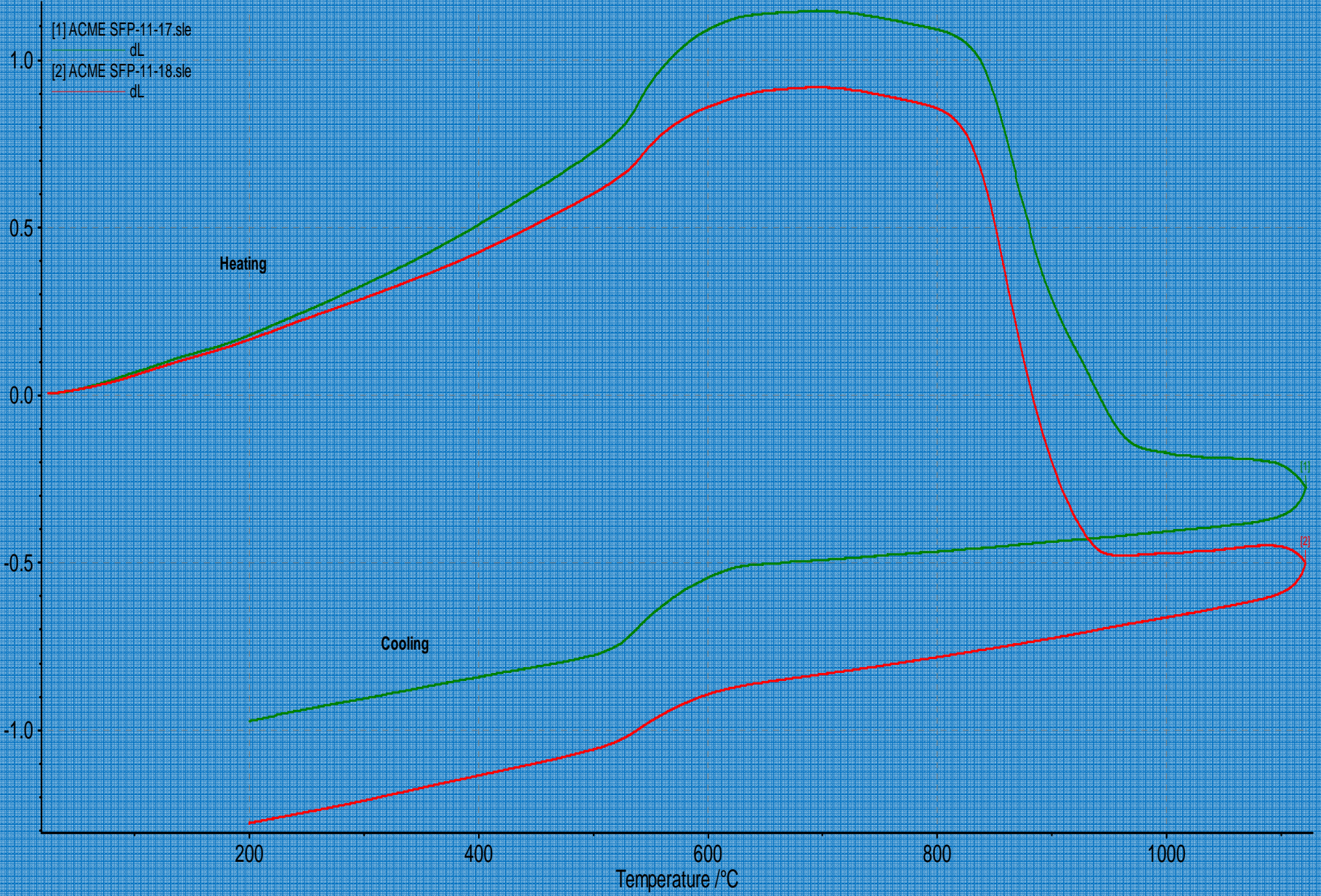
H2O

DTA ANALYSIS



dL/Lo/%

DILITOMETER ANALYSIS



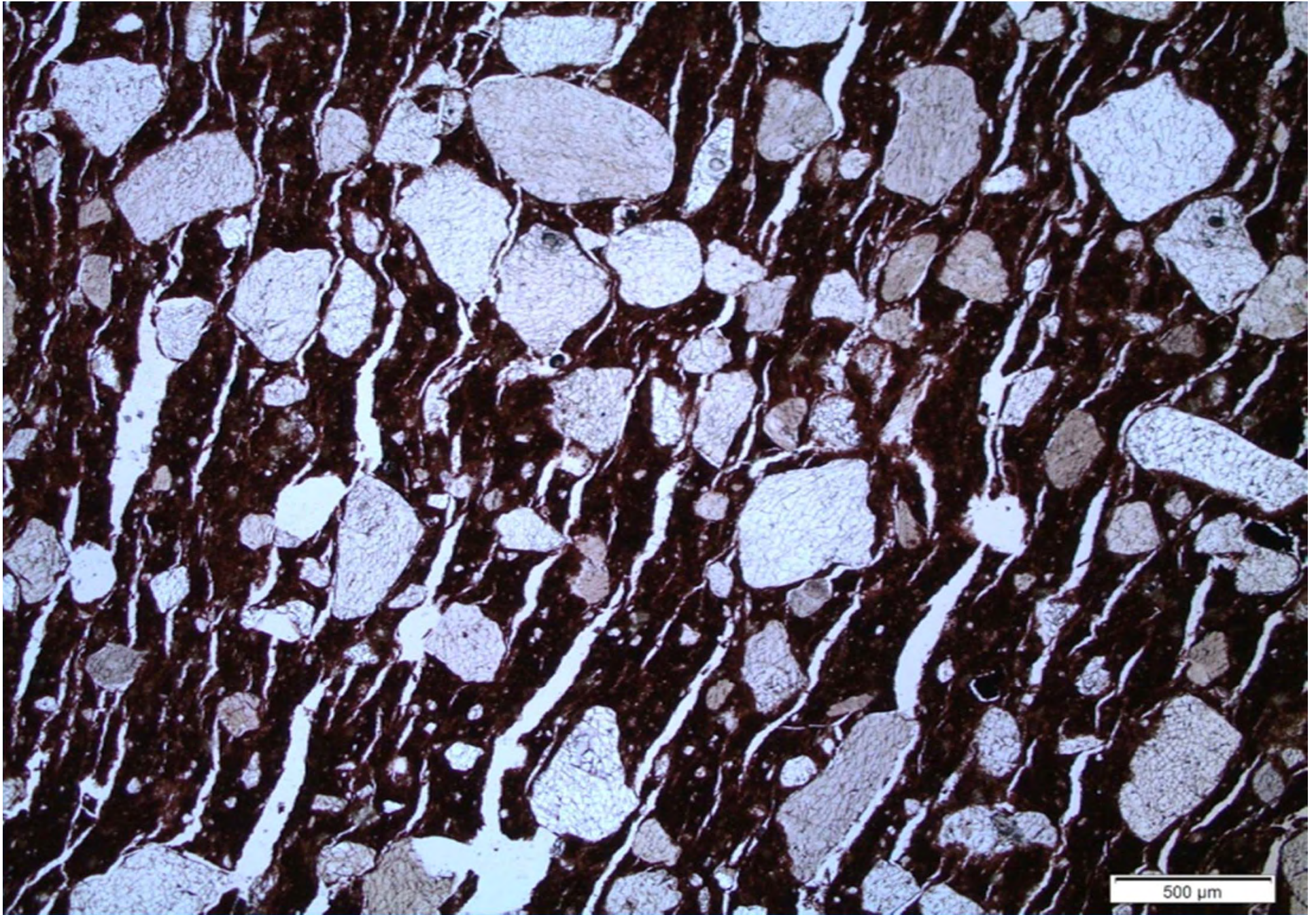
Approximate chemistry and mineralogy of the SFP body components.

Chemistry	Chew clay %	Abel sand %	Bottom ash %
SiO ₂	46.1	83.7	42.8
Al ₂ O ₃	15.6	13.0	16.8
Fe ₂ O ₃	5.70	3.31	7.52
Na ₂ O	0.29	0.05	1.09
K ₂ O	2,24	0.26	0.38
CaO	10.9	0.05	22.0
MgO	3.08	0.25	4.27
TiO ₂	0.66	0.32	1.29
S	<0.05	<0.05	0.34
Mineralogy			
Quartz	16	65	5
K-feldspar	5	-	<5
Plagioclase-fsp	-	-	10
Mica/illite	12	-	-
Smectite	42	-	-
Kaolinite	-	32	-
Calcite	17	-	-
Clinopyroxene	-	-	15
Gehlenite	-	-	20
“Amorphous”	-	-	<40

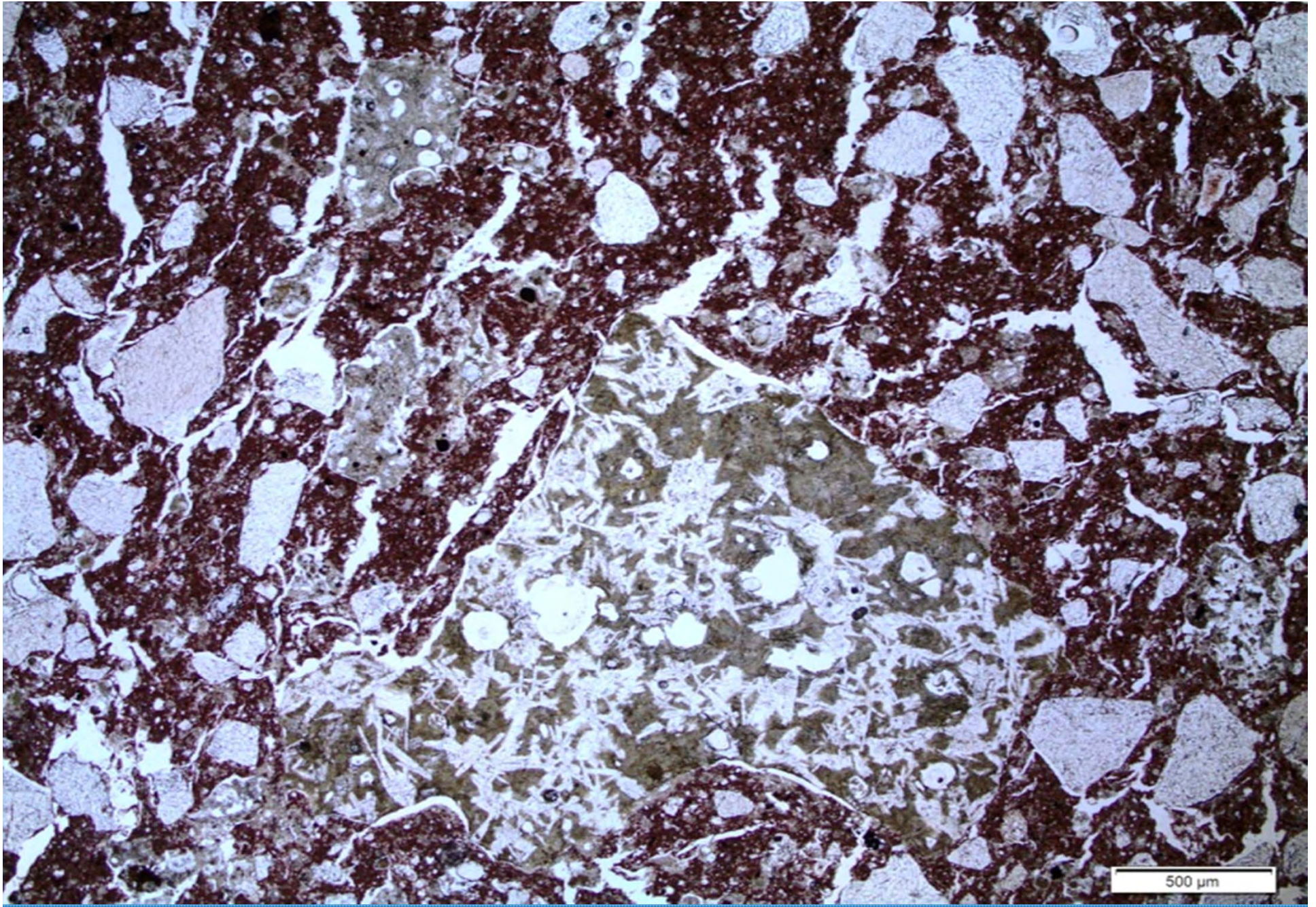
Comparison of chemical and mineralogical compositions : SFP17 and SFP18

Major chemistry	Approx unit	SFP 17 no BA <u>unfired</u>	SFP 17 no BA <u>fired</u>	SFP 18 BA <u>unfired</u>	SFP 18 BA <u>fired</u>
SiO ₂	%	65.35	73.8	57.48	66.9
Al ₂ O ₃	%	13.33	11.9	14.10	13.0
Fe ₂ O ₃	%	4.64	4.77	5.42	5.82
Na ₂ O	%	0.26	0.29	0.33	0.43
K ₂ O	%	1.52	1.42	1.65	1.49
CaO	%	6.86	6.34	10.13	9.86
MgO	%	2.03	1.71	2.49	2.23
TiO ₂	%	0.56	0.54	0.69	0.68
Mineralogy					
Quartz	%	40.5	34	30	20
Plagioclase	%	-	30	5	35
Clinopyroxene	%	-	-	-	12
Mica/illite	%	<5	-	<5	-
Hematite	%	-	<5	-	<5
Smectite	%	21	-	22	-
Calcite	%	11	-	12	-
Kaolinite	%	16	-	10	-
"Amorphous"	%	30	35	40	30

MIRCOSCOPIC ANALYSIS



NON BOTTOM ASH BODY



BOTTOM ASH BODY

SAN FELIPE PLANT TODAY

- > 100 MMBE per year
- Exciting range of Heritage KS Face Brick
- Excellent quality
- Effective QC controls
- < 2% Bat loss
- Highly profitable
- LEED credits
- EPA threat

ECONOMICS OF BOTTOM ASH

- Soluble salt content requires BaCO_3 usage
- Finer grinding needed to reduce “pyrite popping”
- Low cost body component
- Some energy benefit from autogenous combustion of carbon
- Energy reduction potential
- Process losses reduced
- LEED point advantage

CONCLUSIONS: Using Bottom Ash

- Reduces laminations
- Reduces drying shrinkage
- Reduces drying sensitivity
- Reduces dehydroxilation moisture
- Plagioclase feldspar phase increased
- Acts as an effective, stable flux
- Increases fired strength
- Reduces quartz inversion stresses
- Reduces process losses
- Non-hazardous body component

FINISHED PRODUCT QC





ADOBE WELLS WHITE #6 KING SIZE