

REINHOLD ENVIRONMENTAL Ltd.



2011 APC Round Table & Expo Presentation

July 11-12, 2011, in Cleveland, OH / Hosted by FirstEnergy

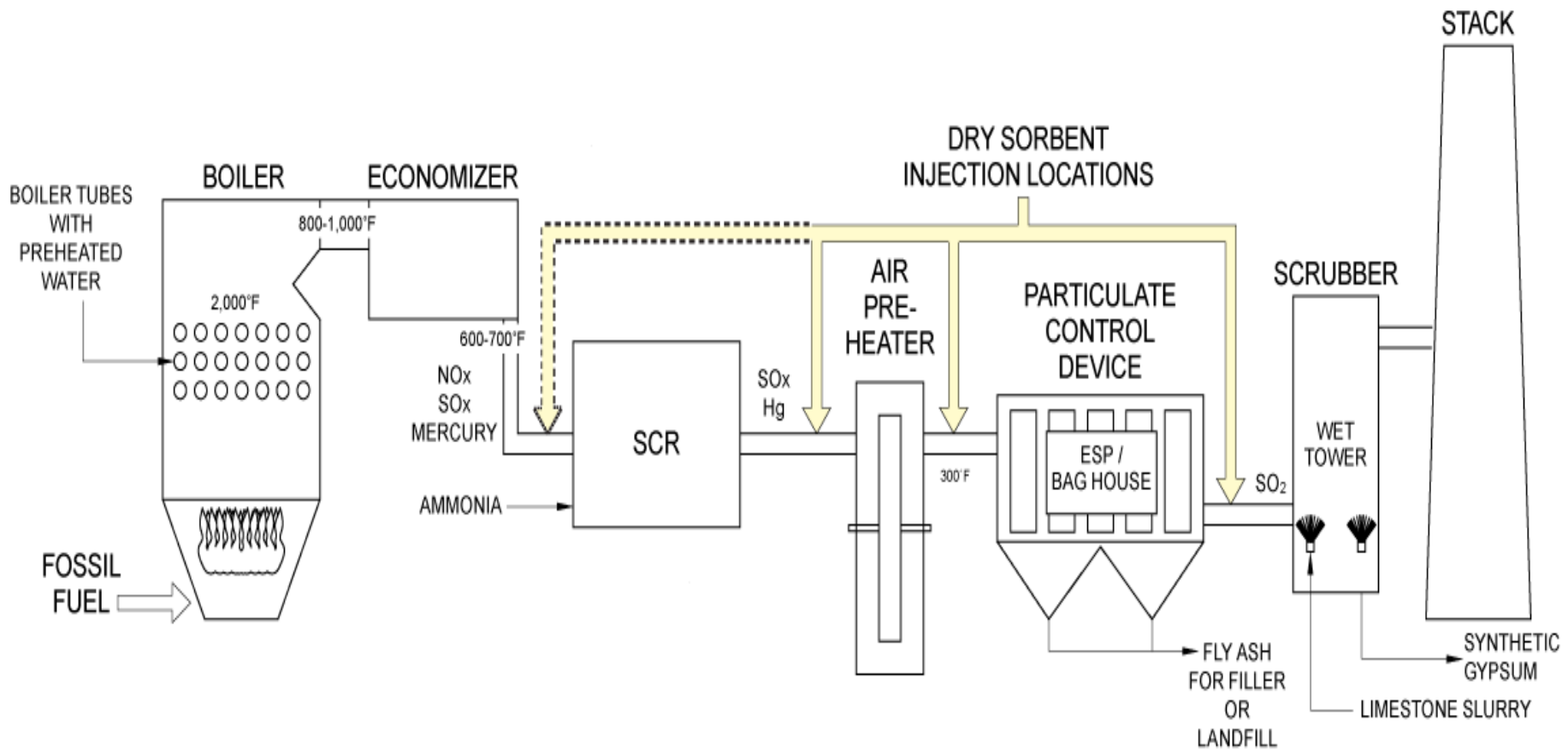
All presentations posted on this website are copyrighted by Reinhold Environmental, Ltd (RE). Any unauthorized downloading, attempts to modify or to incorporate into other presentations, link to other websites, or obtain copies for any other uses than the training of attendees to RE's Conferences is expressly prohibited, unless approved in writing by RE or the original presenter. RE does not assume any liability for the accuracy or contents of any materials contained in this library which were presented and/or created by persons who were not employees of RE.

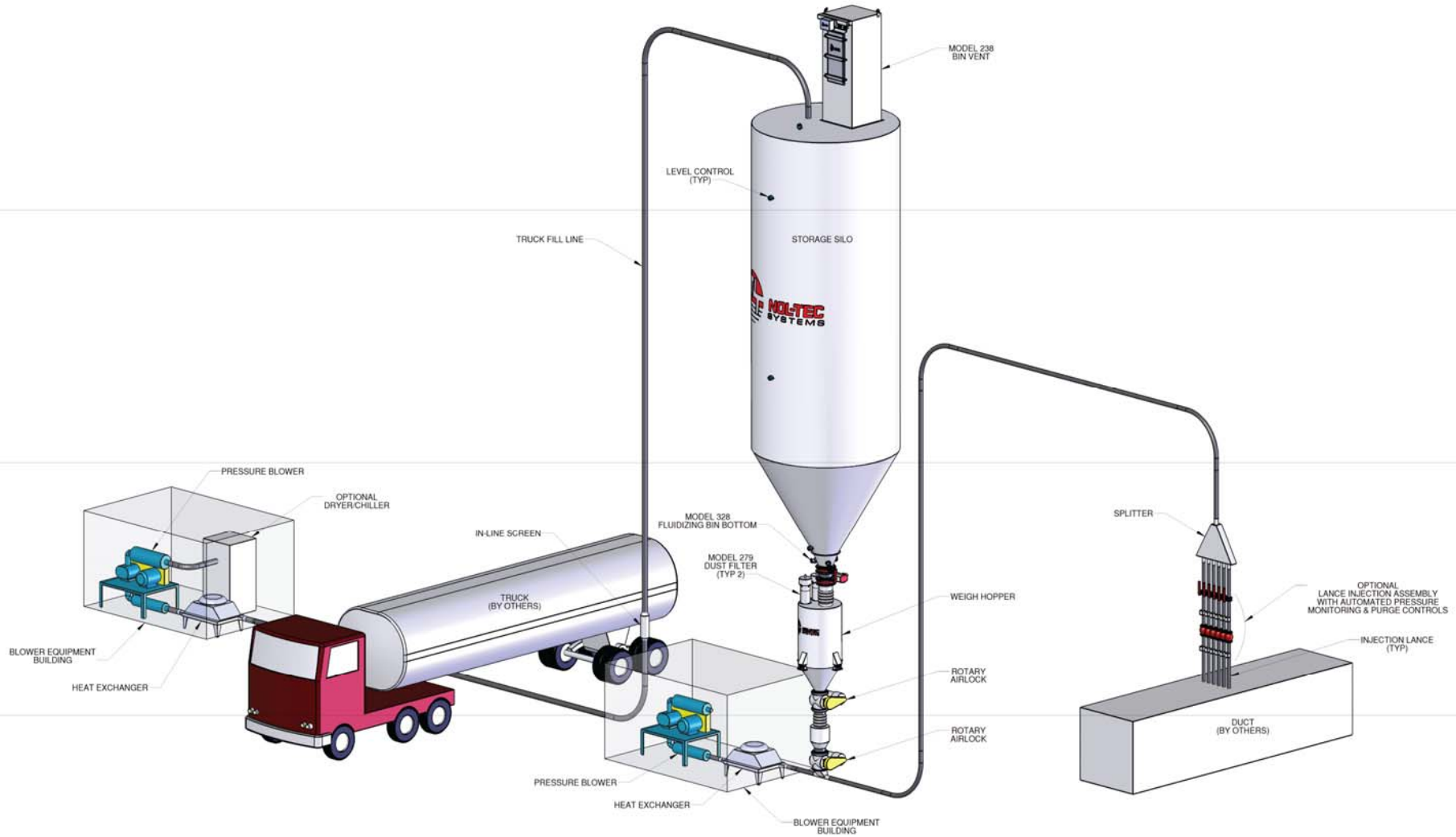
**FLY ASH RESISTIVITY WITH INJECTED REAGENTS
AND
PREDICTED IMPACTS ON ELECTROSTATIC PRECIPITATORS**

Robert Mastropietro
V.P. Technology
Lodge-Cottrell Inc.

Dry Sorbent Injection:

- Low capital solution for reduction of acid gases (SO_2 , SO_3 , HCl, F)
- Alkali sorbent injected as a powder upstream of ESP
- Various sorbents can be used
 - sodium bicarbonate
 - trona
 - hydrated lime
- Injection can affect ESP performance





COAL FIRED ELECTRIC GENERATION-SORBENT INJECTION
(TYPICAL ARRANGEMENT)

SORB-N-JECT™
Technology

TITLE	SORBENT CONVEYING & INJECTION SYSTEM	DATE	01APR10	 <p>NOL-TEC SYSTEMS www.nol-tec.com 651-750-8600 USA</p>
DRAWN BY	LTS	RS&M	--	
CUSTOMER	NOL-TEC SYSTEMS LINO LAKES, MN.	SCALE	1:40	<p>SHEET 1 OF 1 DRAWING NUMBER LAYOUT-1</p>
SAE	--	SCALE	1:40	

PROPRIETARY AND CONFIDENTIAL
The information contained in this drawing is the sole property of NOL-TEC SYSTEMS. Any reproduction in part or as a whole without the written permission of NOL-TEC SYSTEMS is prohibited.

Design Parameters for Electrostatic Precipitators

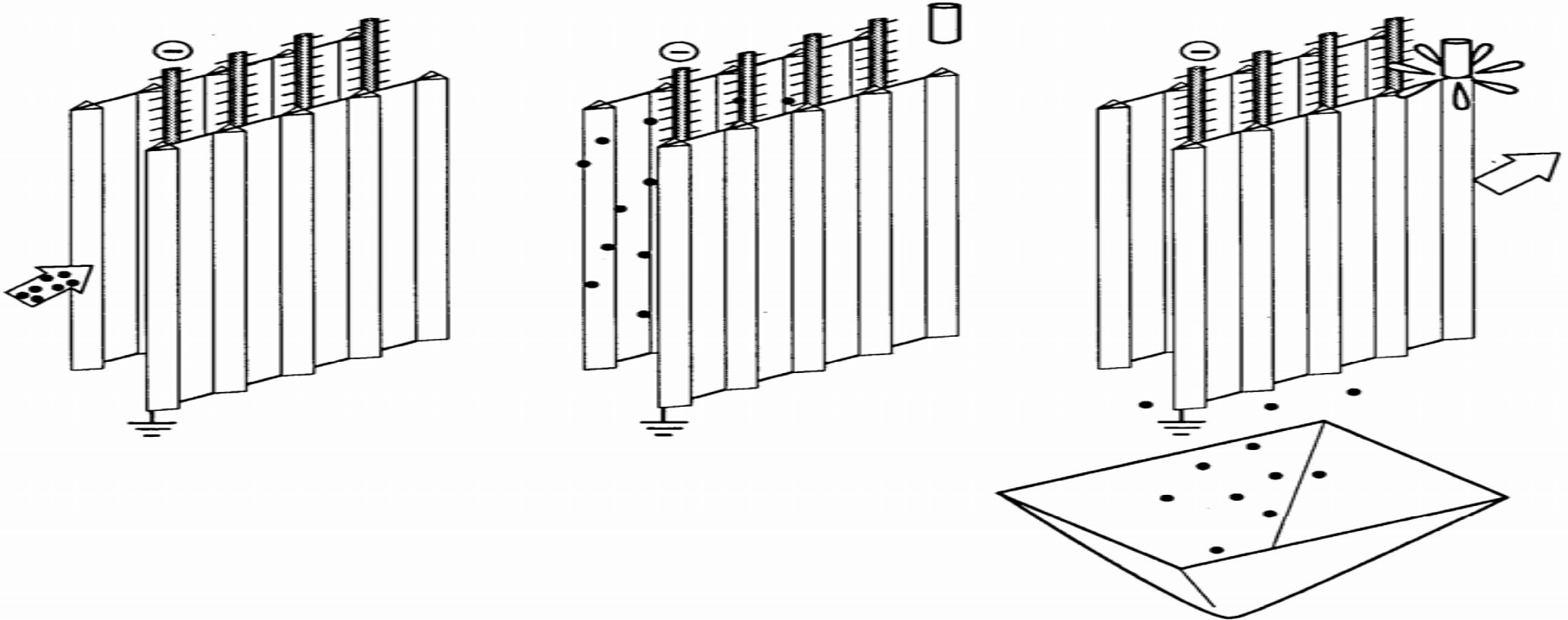
- Gas flow rate/ESP Size
- Inlet Particulate Resistivity
 - *Fly ash and coal chemistry*
 - *Flue gas temperature and moisture*
- Inlet Particle Size
- Inlet Particulate Loading
- Required Outlet Loading
 - Desired Removal Efficiency

FIGURE 1 ESP Operating Principle

Particles suspended in a gas enter the precipitator; passing through ionized zones around high voltage electrodes, through a corona effect, emit negatively charged ions into the gases.

The negatively charged gas field around each electrode charges passing particulates, causing the particulates to migrate to the electrode of opposite polarity, the collector plates.

The charged particulates gather on the grounded collector plates. Rappers shake loose the agglomerate which falls into the collection hoppers for removal.



Electrostatic Precipitator Sparking

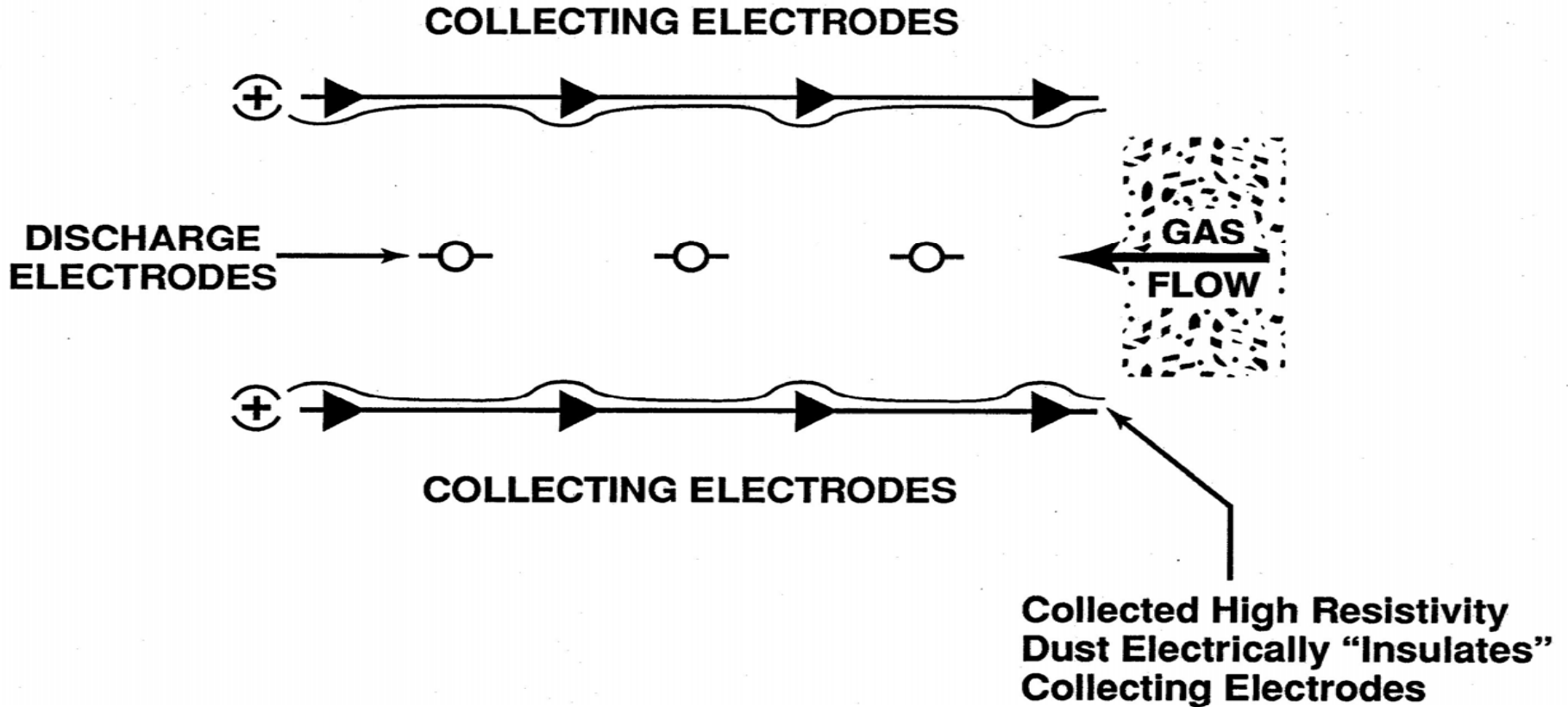


Figure 1

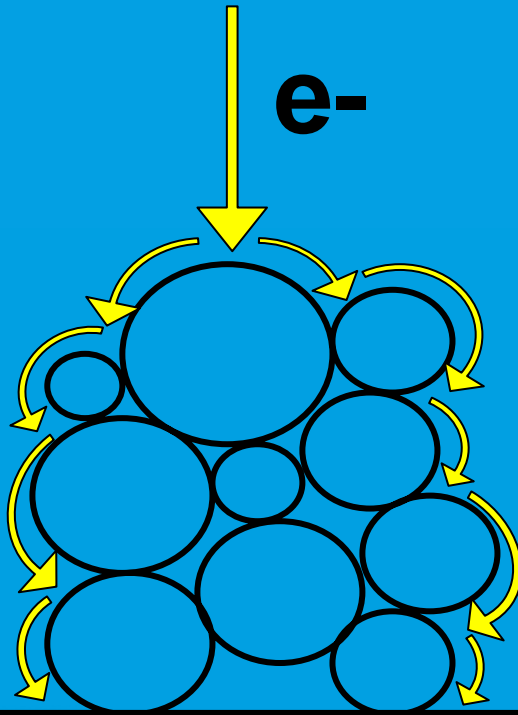








Surface Conduction



Bulk Conduction

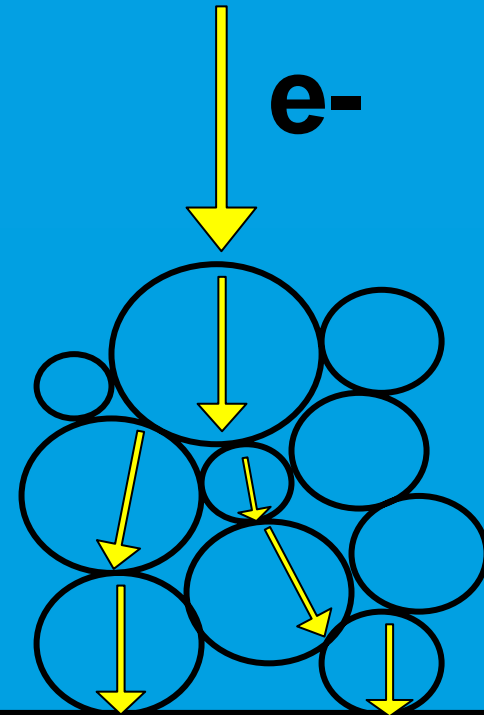
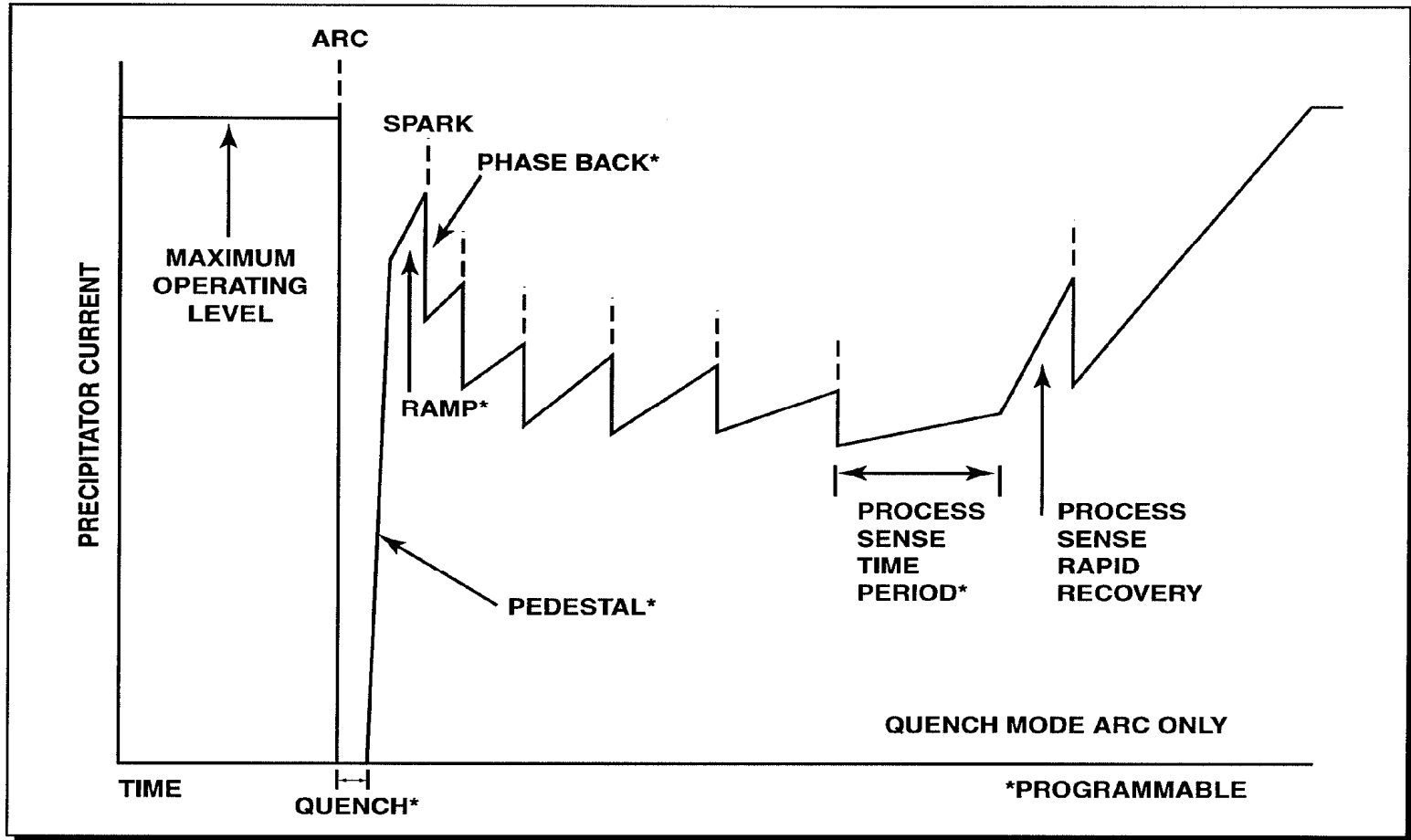


FIGURE 1

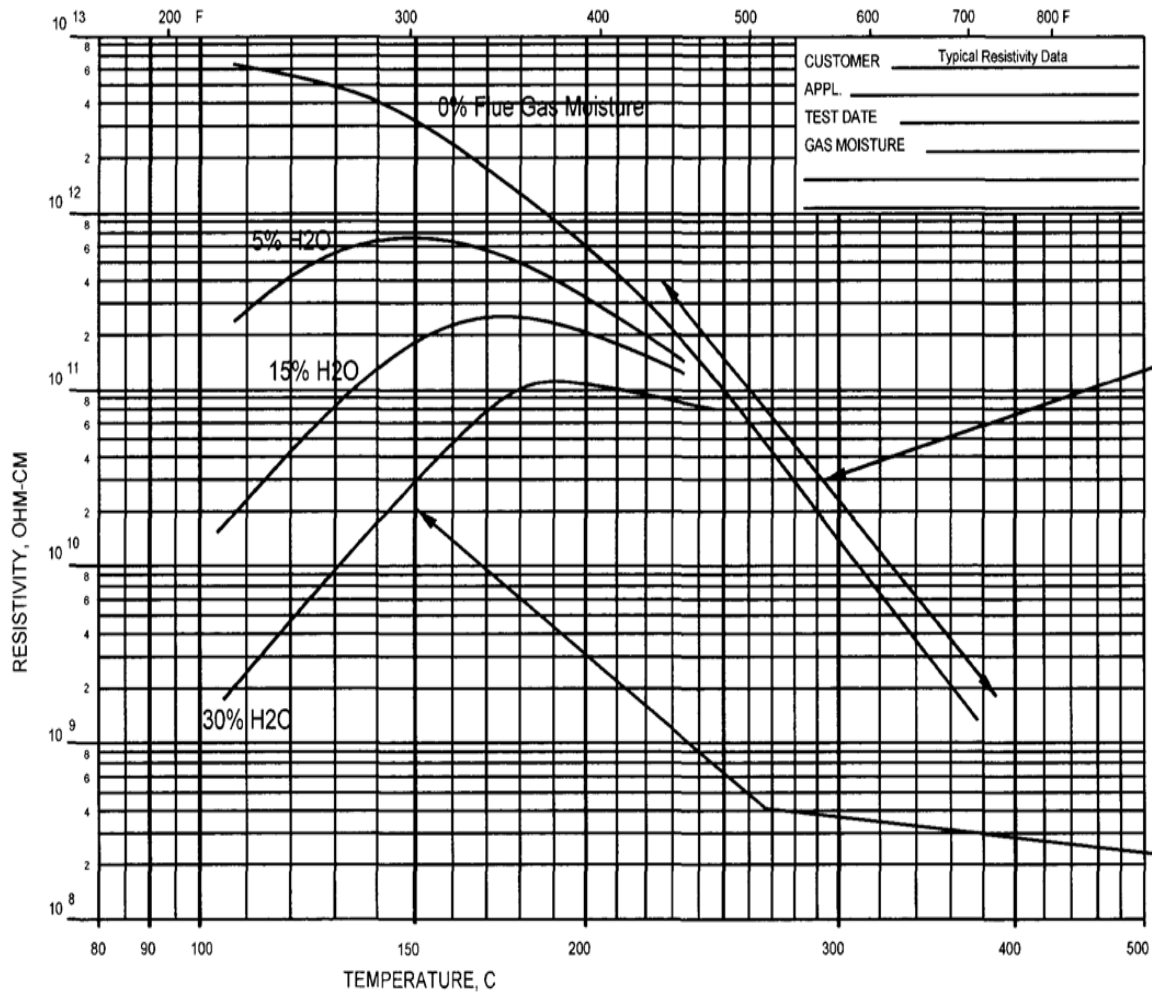
Typical MTC Operations During Unstable Process Conditions



➤ LABORATORY RESISTIVITY APPARATUS



Resistivity Cell & Electrode



Conductivity at high temperature is impacted by vibration of molecules. The higher the temperature the greater the vibration. This causes better conduction (i.e. lower resistivity) as the temperature increases.

Conductivity at low temperature is dependent on the amount of surface condensation on the dust. The condensation is controlled by the amount of water in the flue gas, and how cool the flue gas gets.

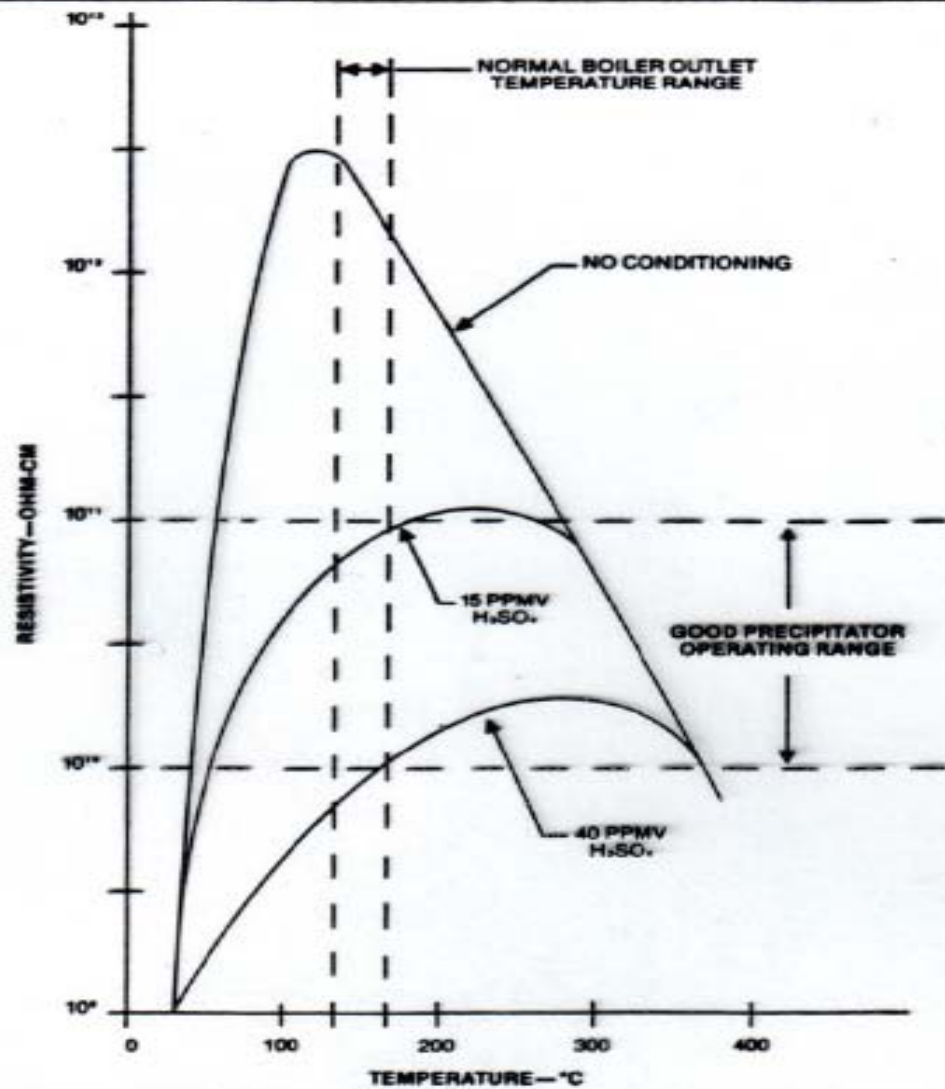
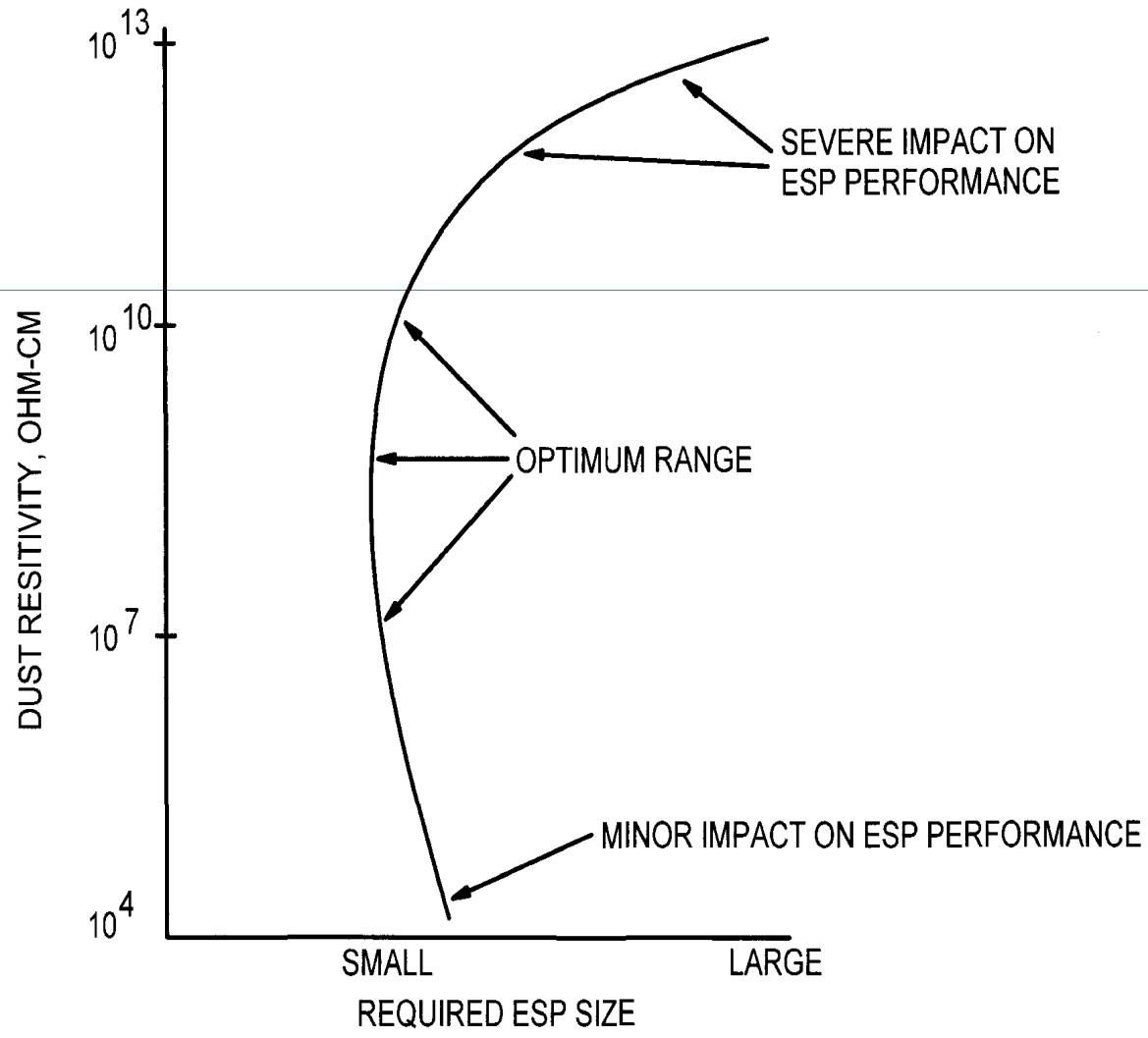
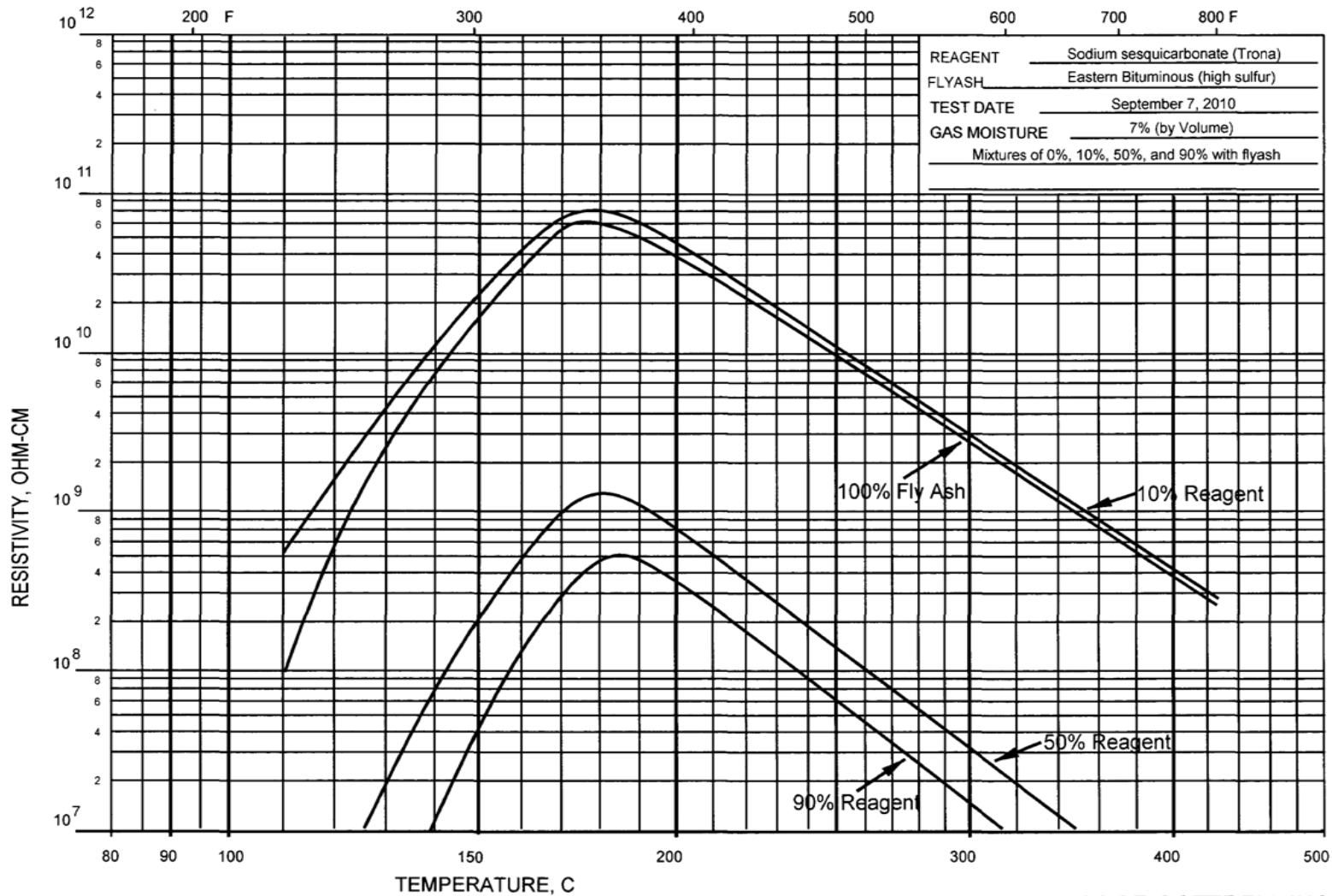
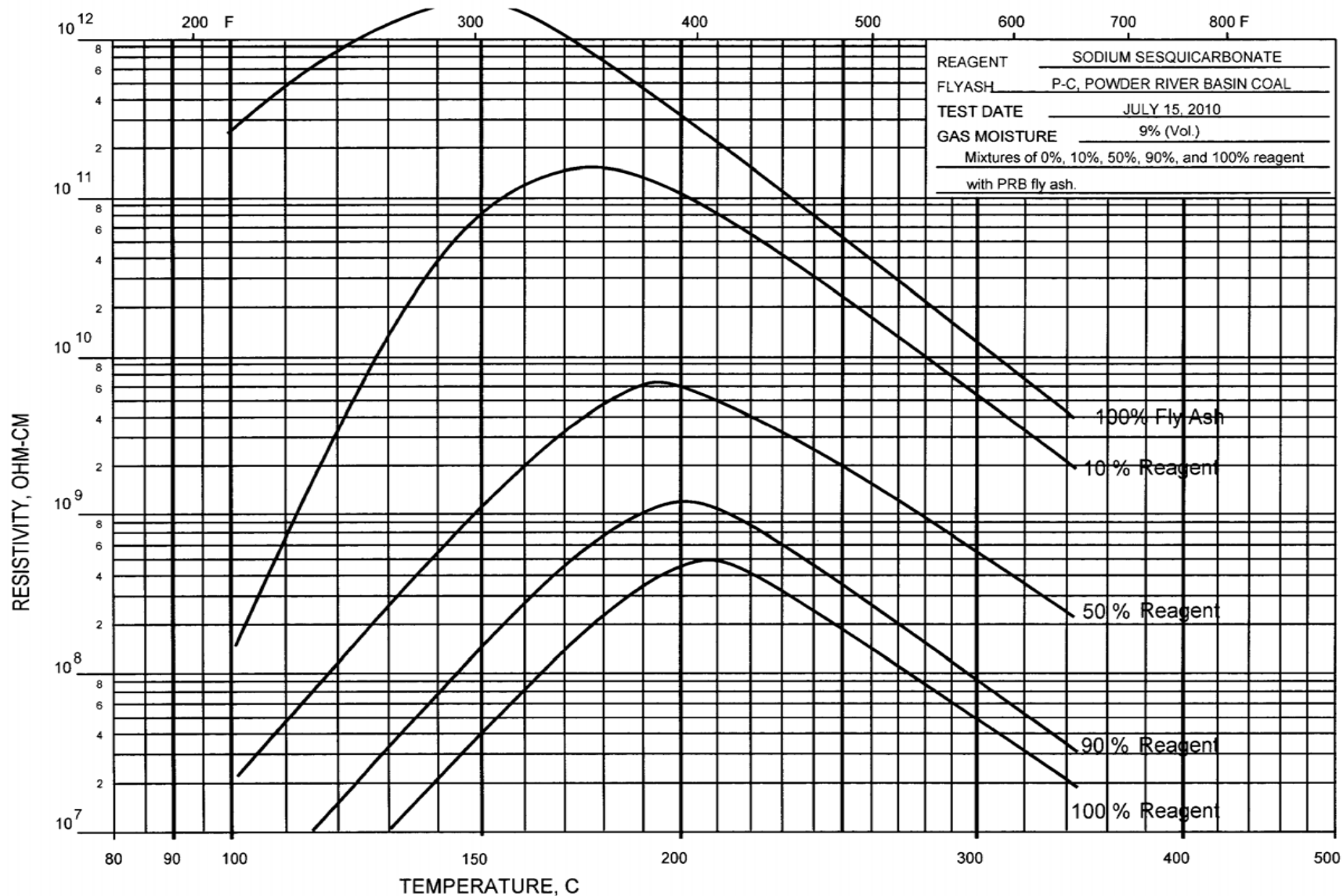
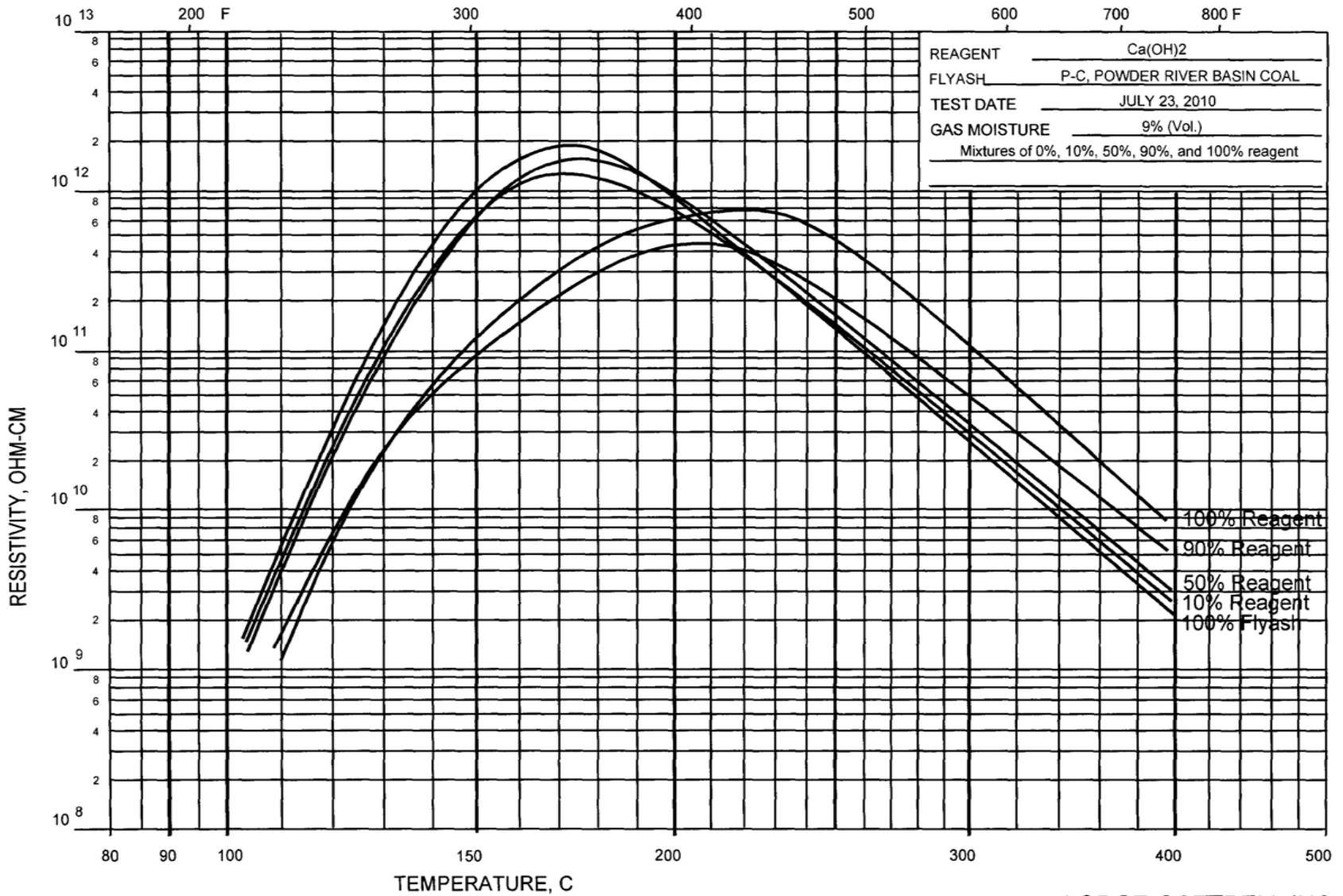


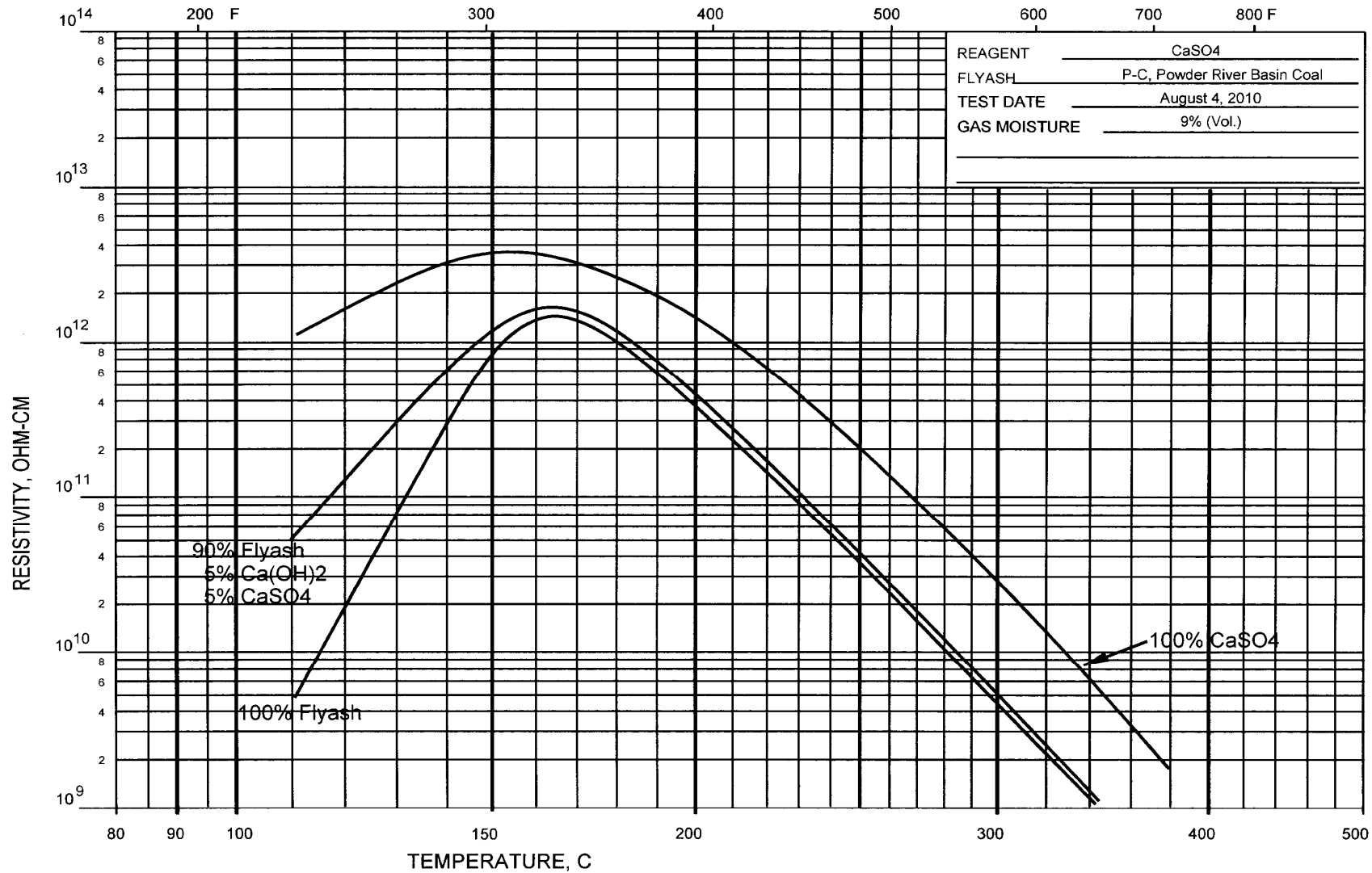
Figure 1. Typical Flyash Resistivity

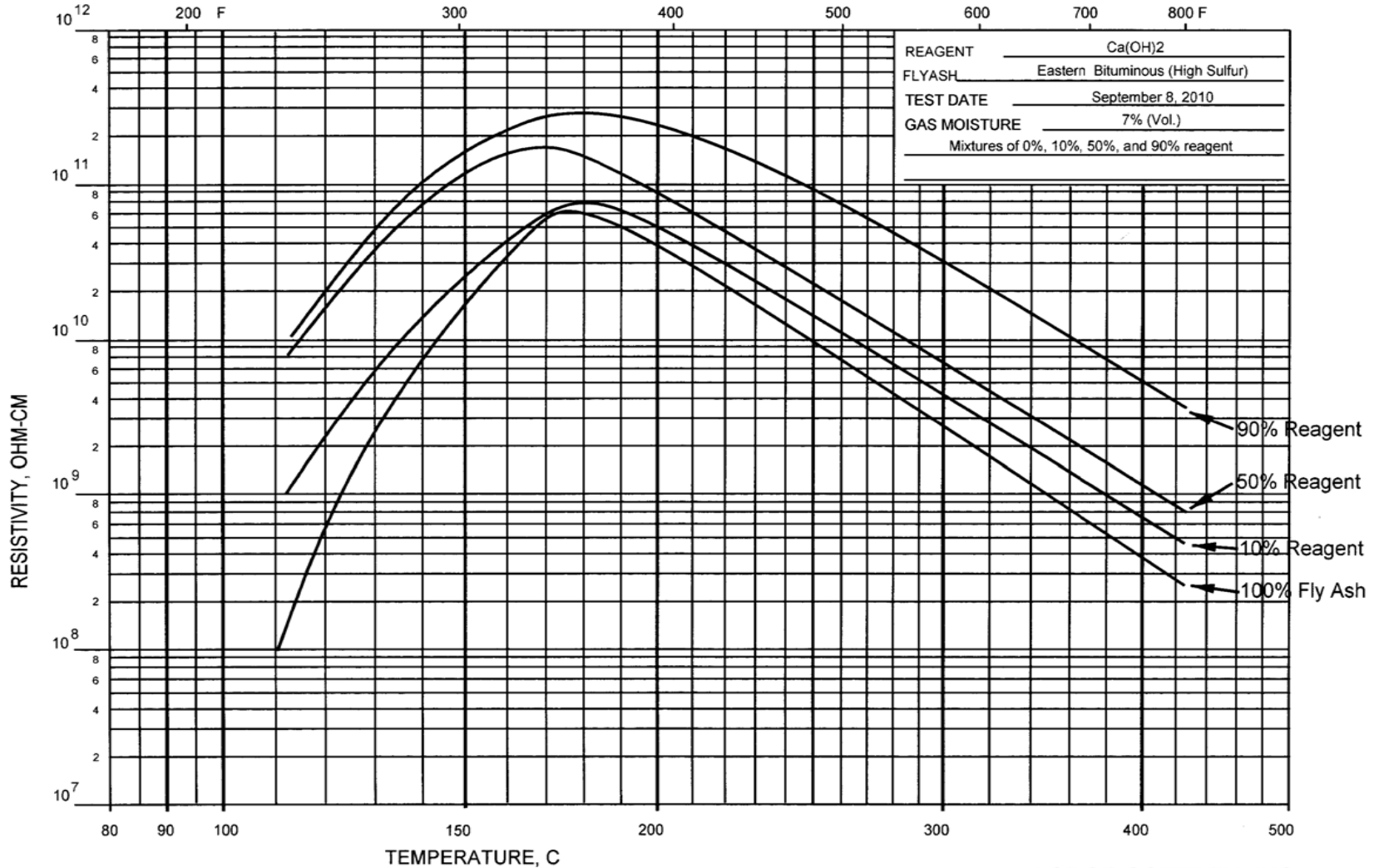


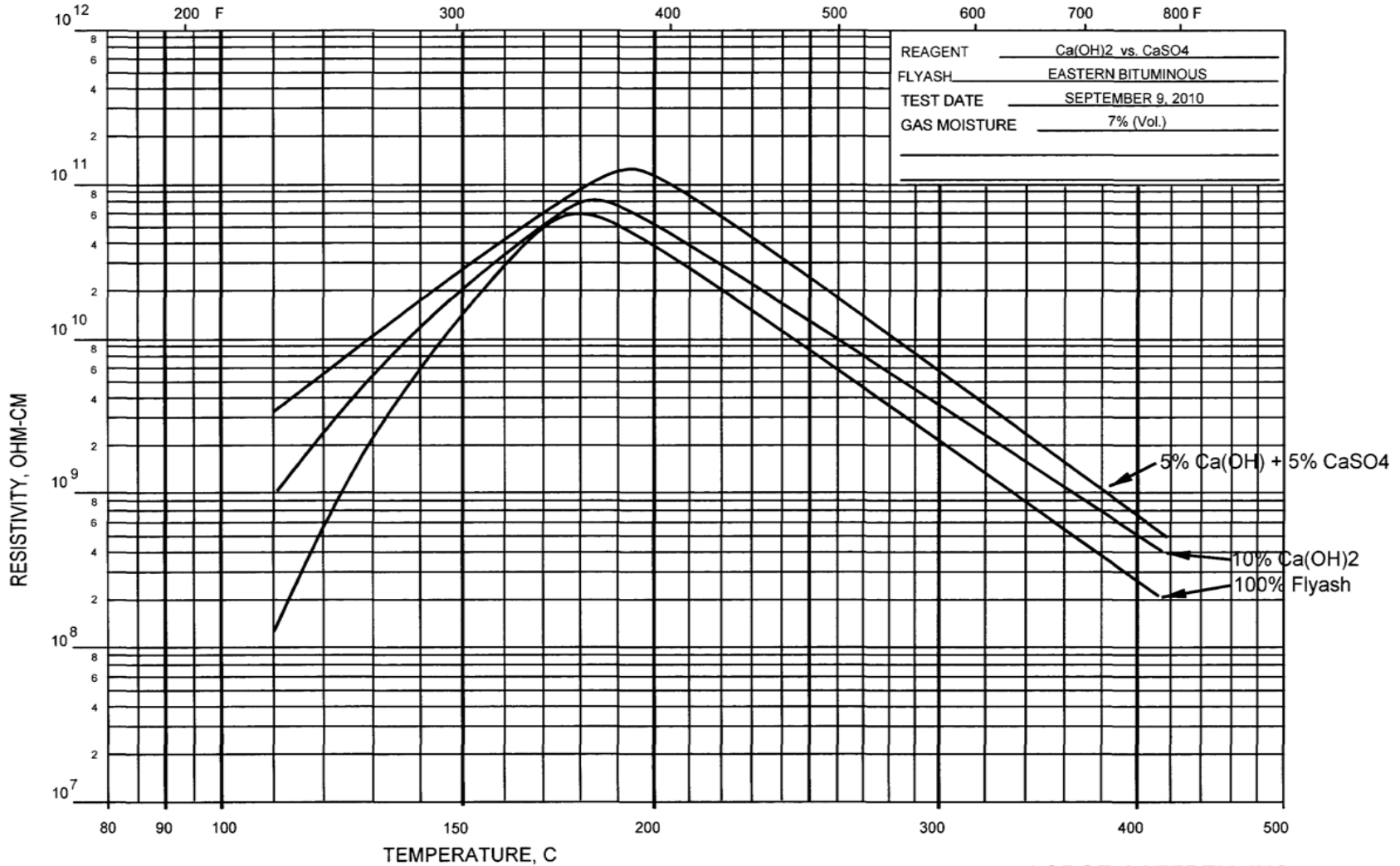




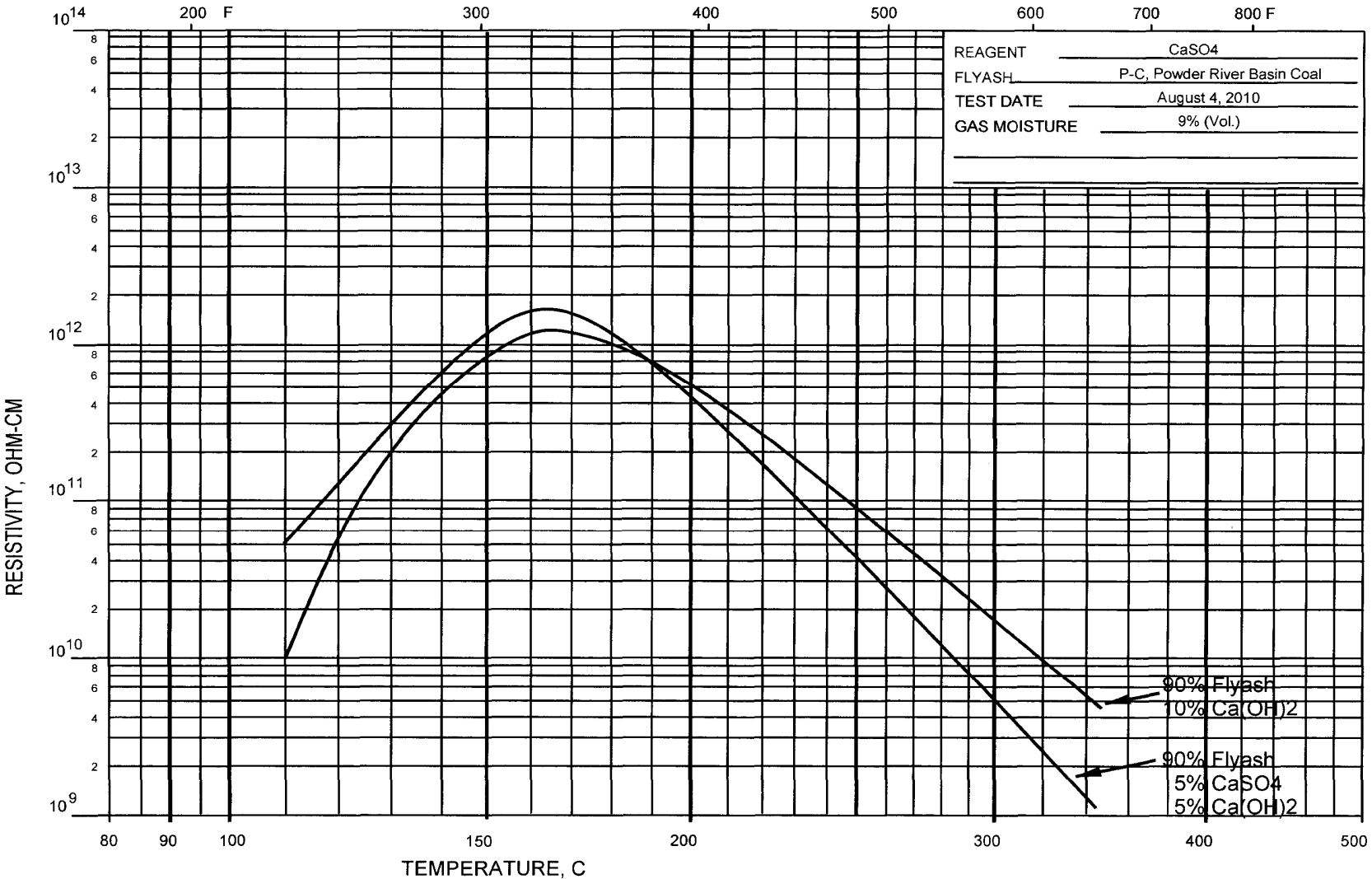


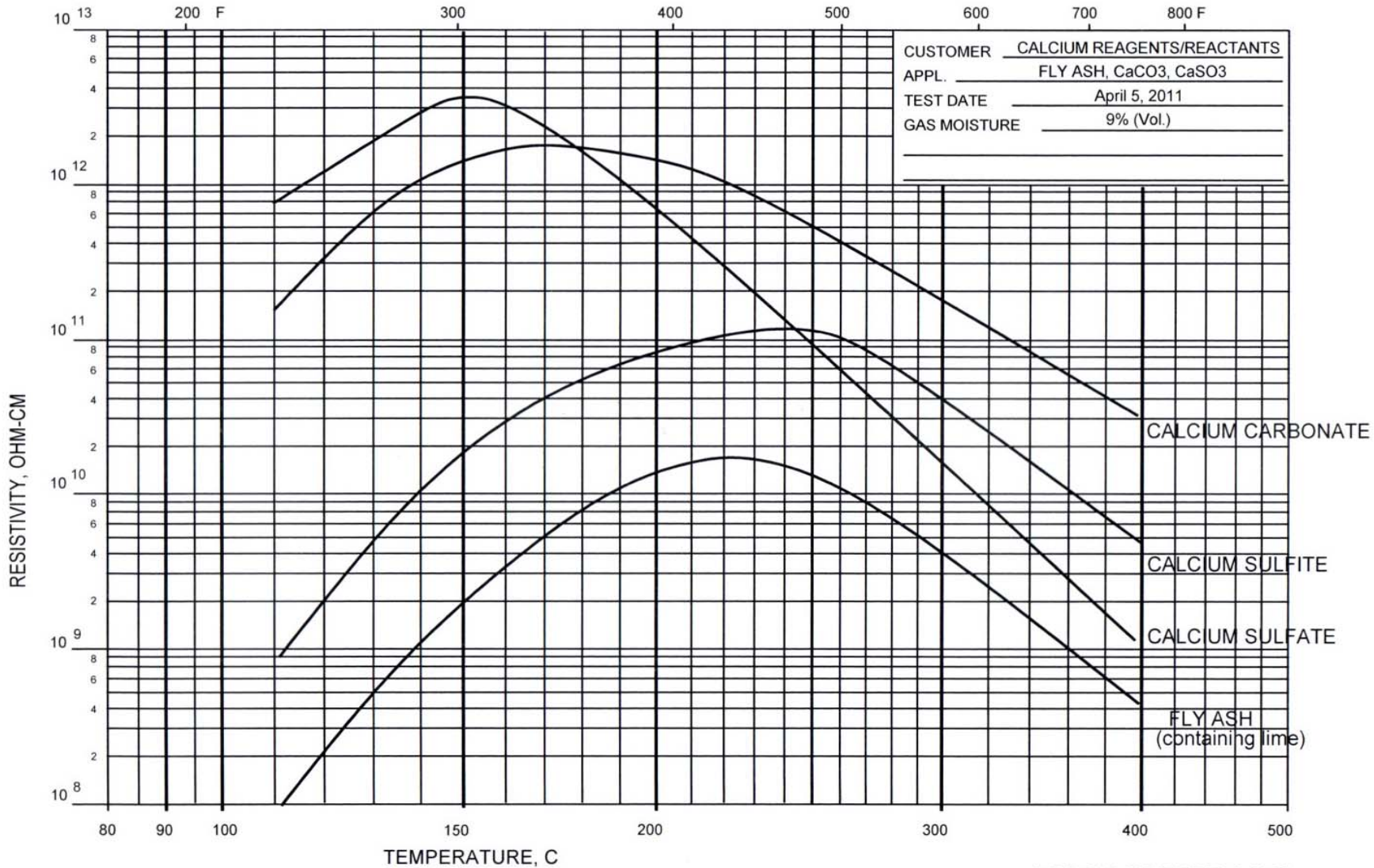




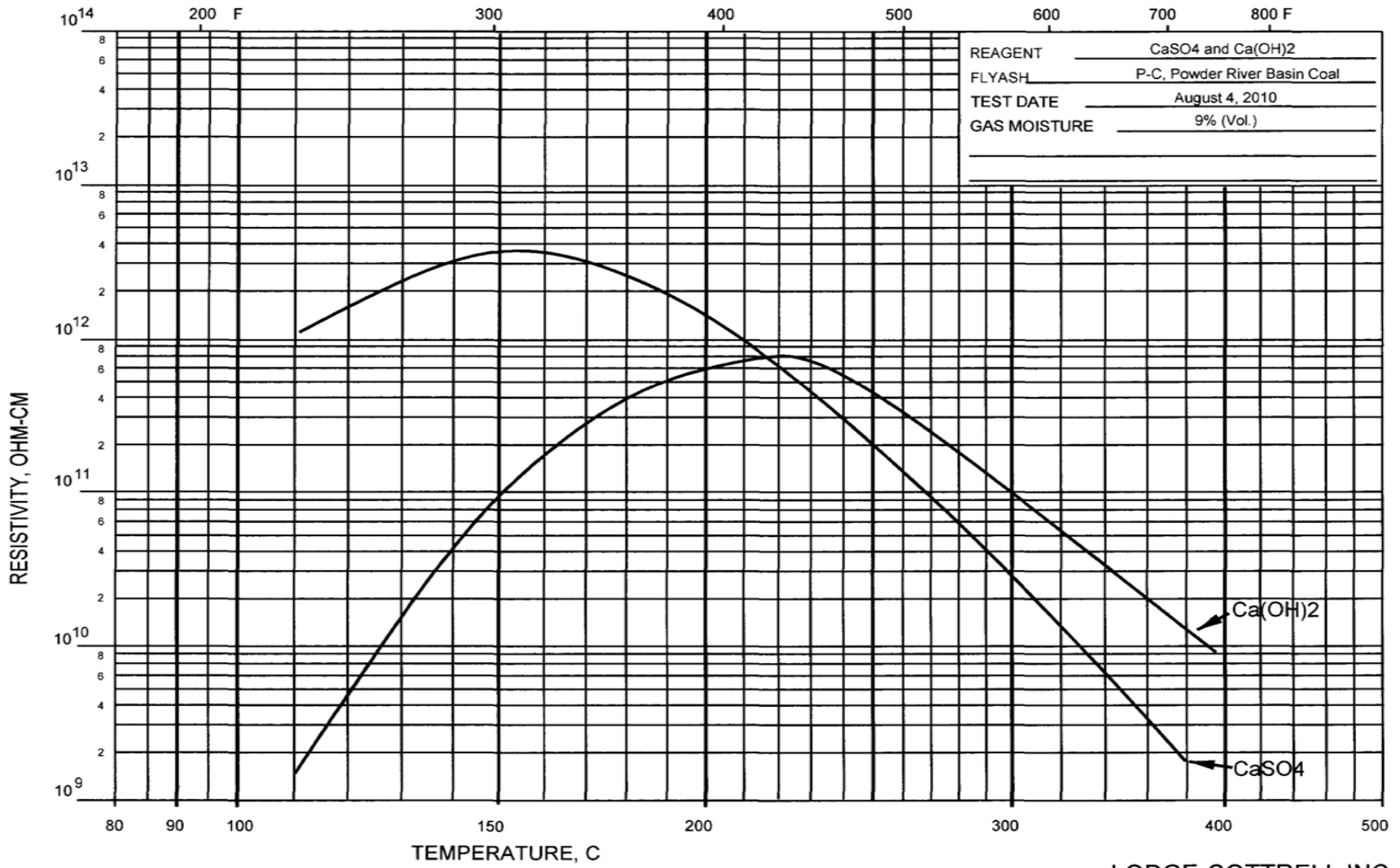


REAGENT	Ca(OH) ₂ vs. CaSO ₄
FLYASH	EASTERN BITUMINOUS
TEST DATE	SEPTEMBER 9, 2010
GAS MOISTURE	7% (Vol.)

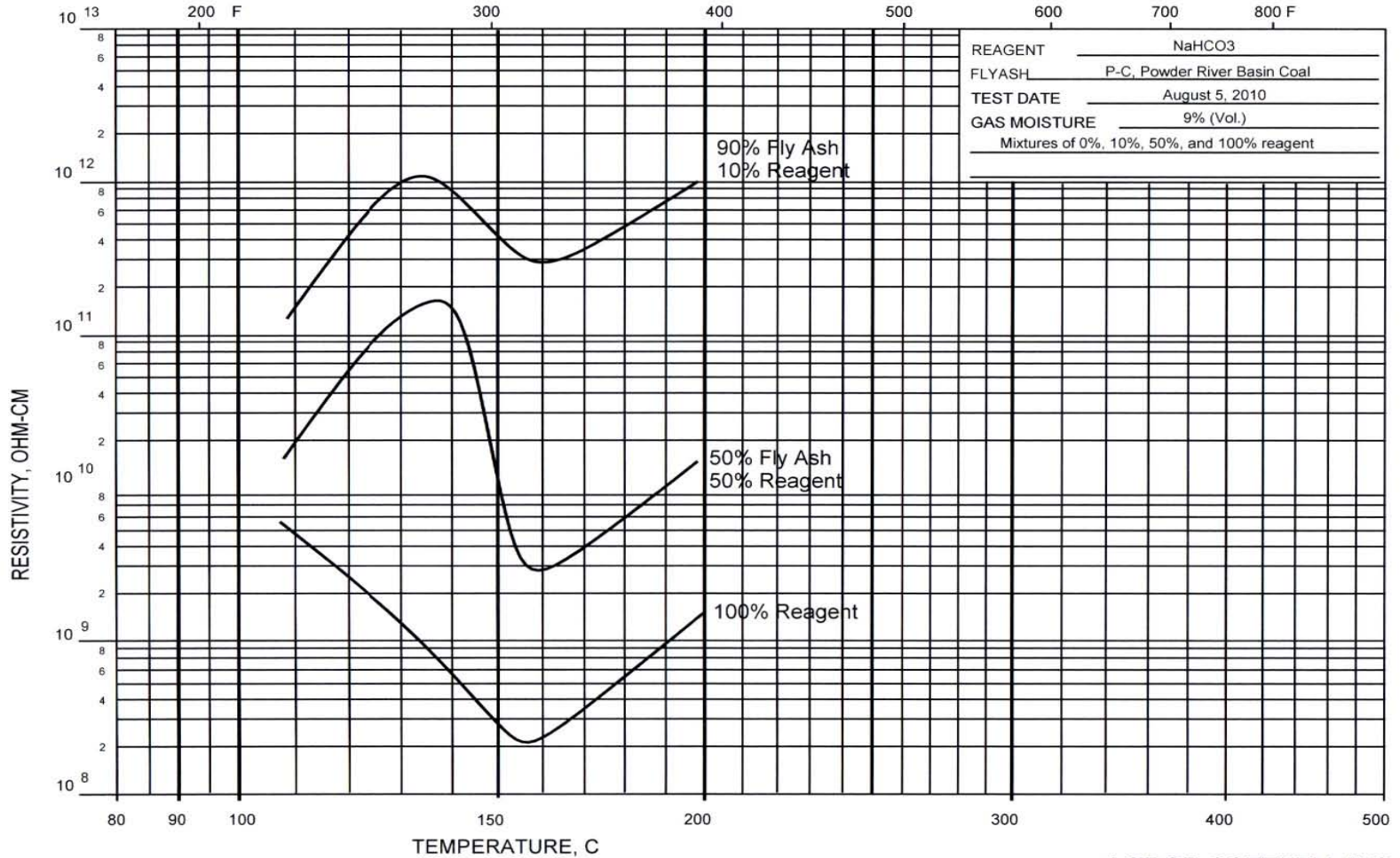


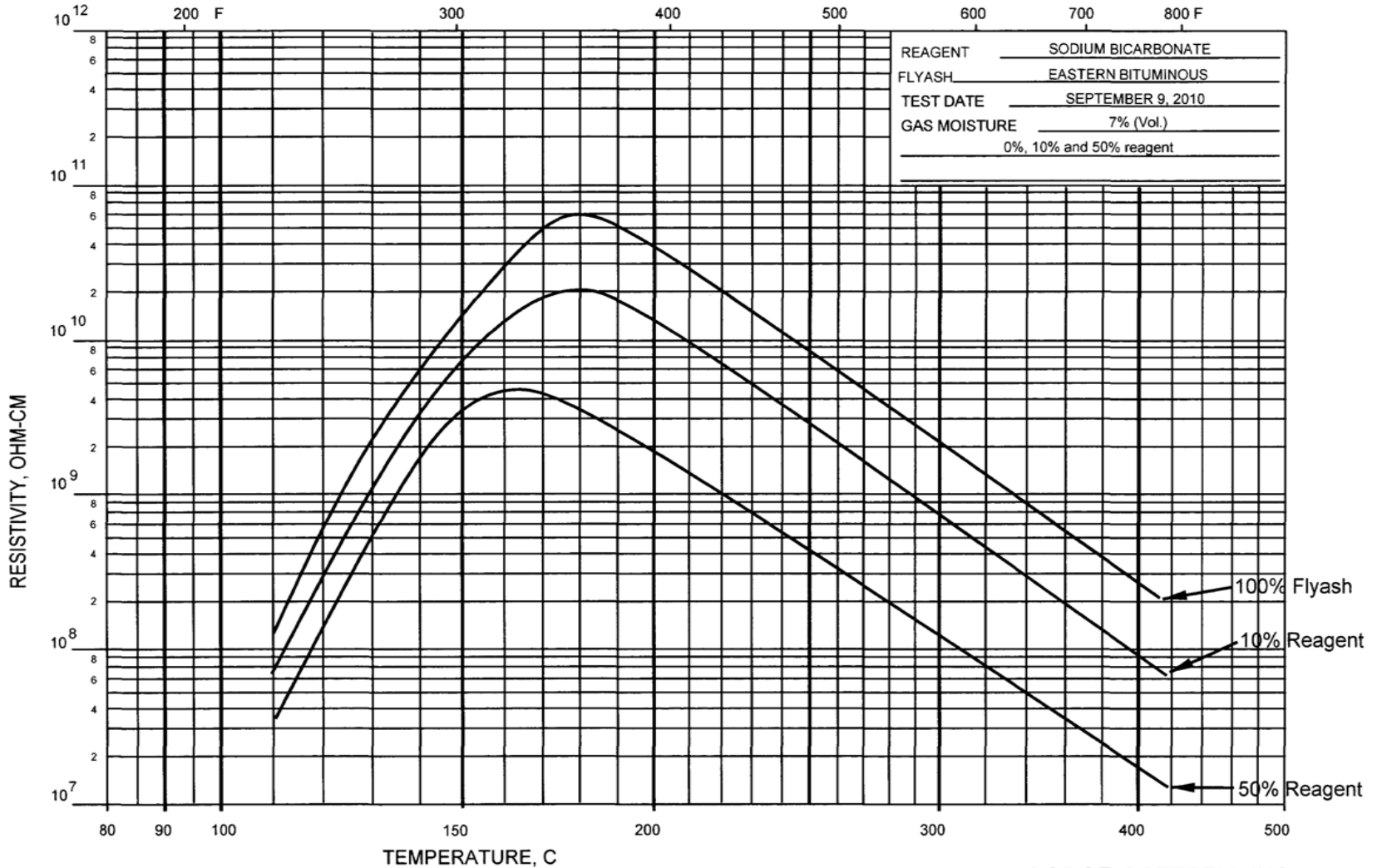


CUSTOMER CALCIUM REAGENTS/REACTANTS
 APPL. FLY ASH, CaCO3, CaSO3
 TEST DATE April 5, 2011
 GAS MOISTURE 9% (Vol.)

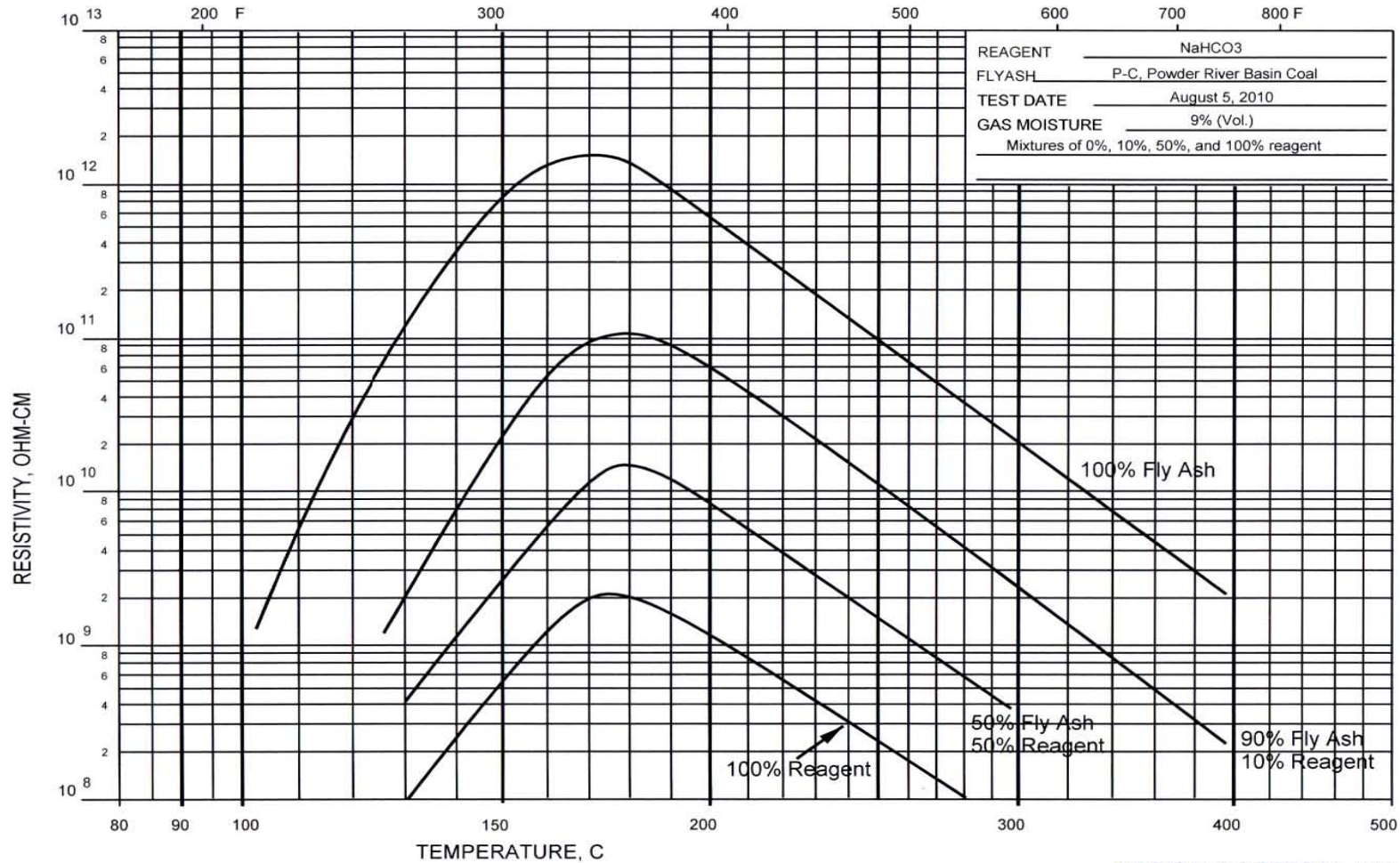


Problems with measuring resistivity of this material in ascending order. Reagent must be disassociating with increasing temperature.

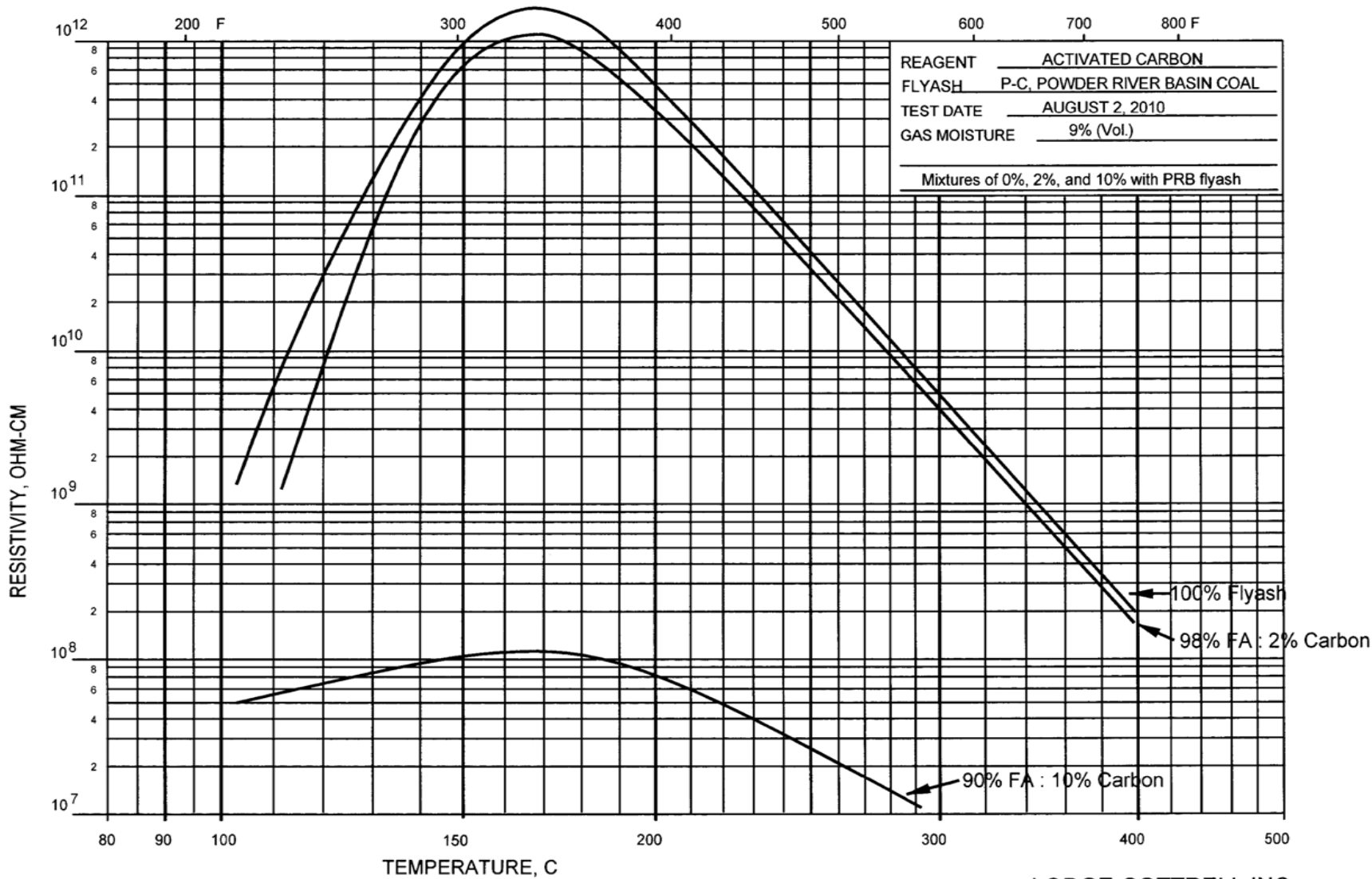


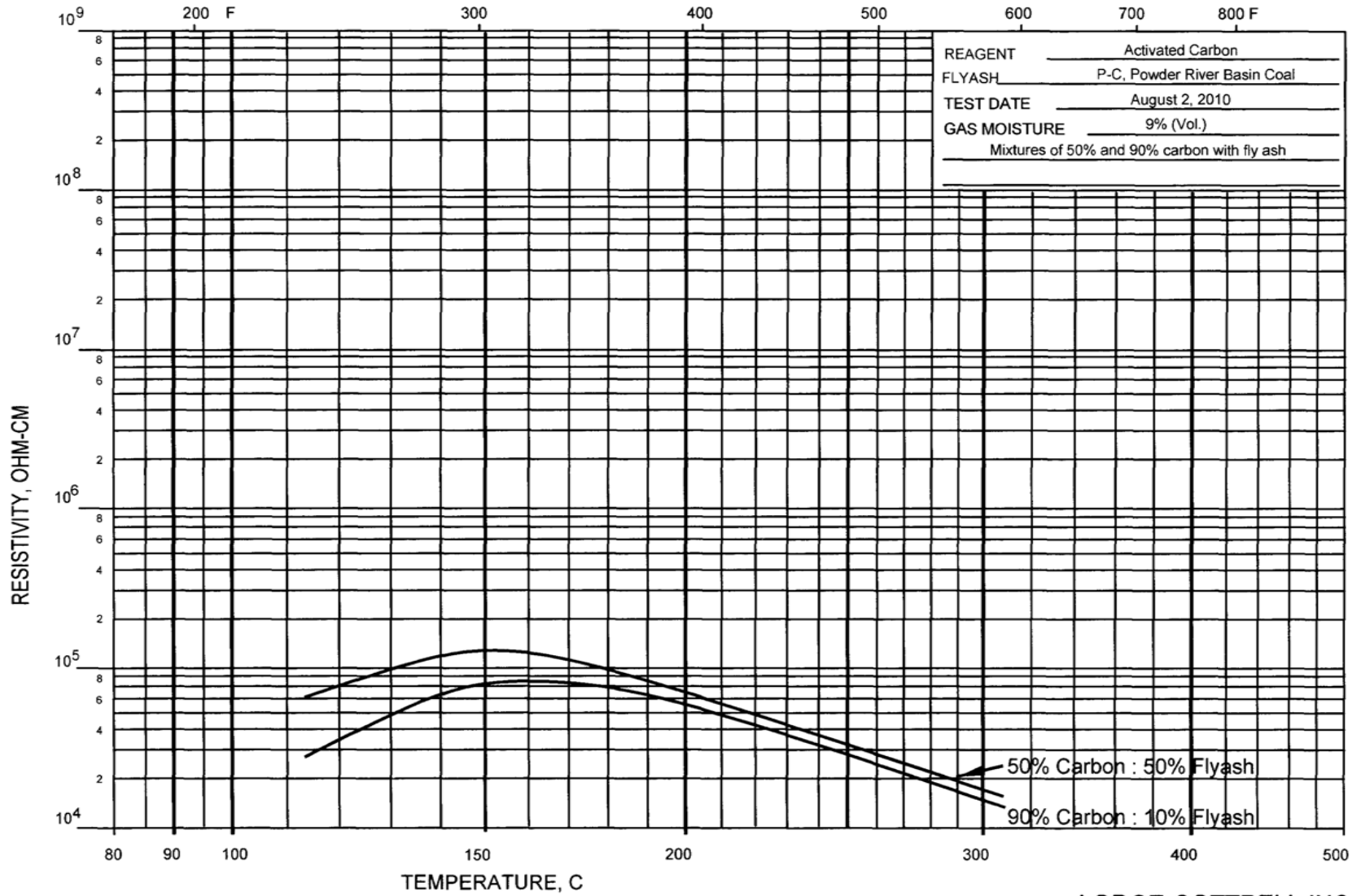


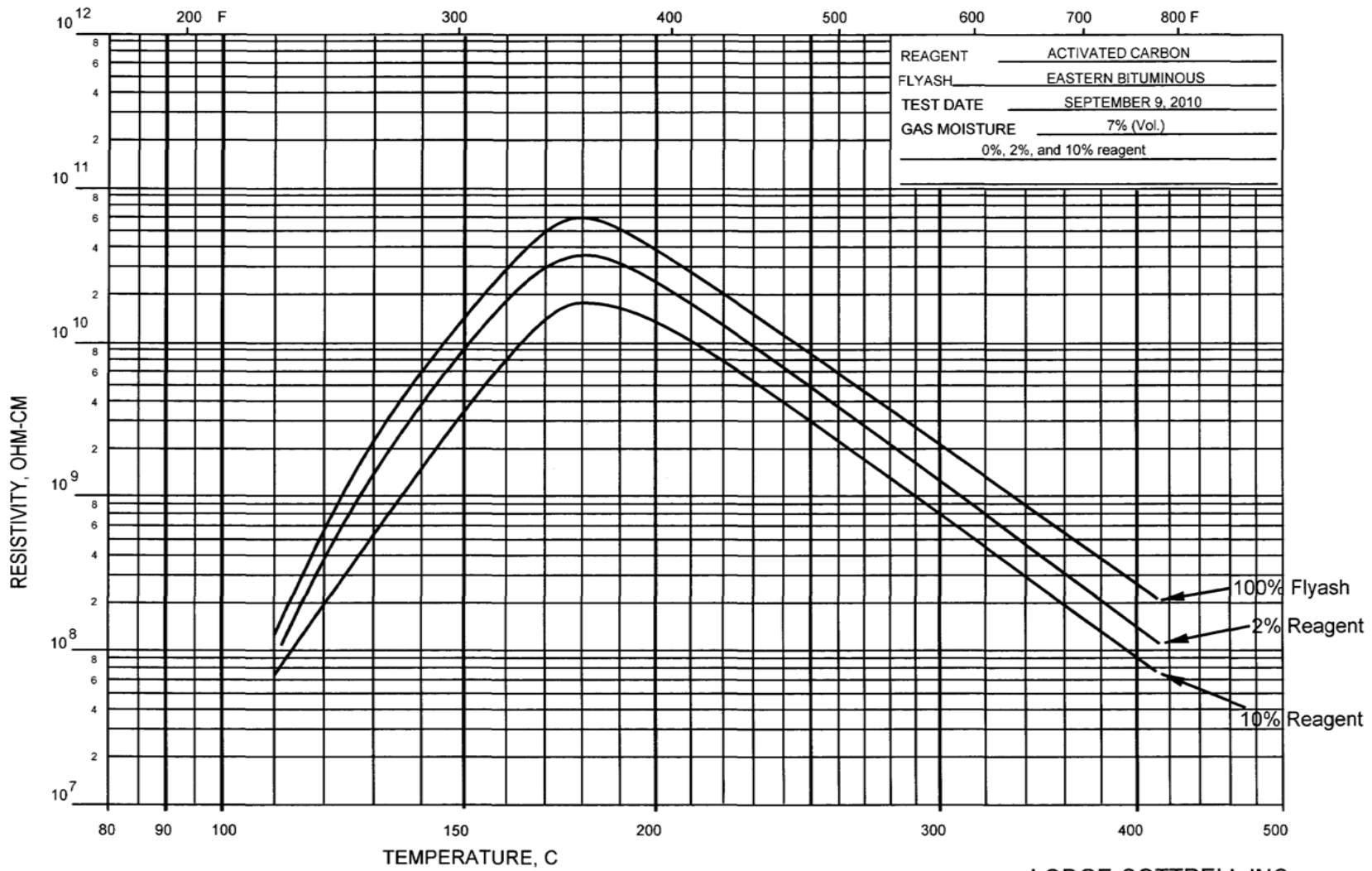
REAGENT	SODIUM BICARBONATE
FLYASH	EASTERN BITUMINOUS
TEST DATE	SEPTEMBER 9, 2010
GAS MOISTURE	7% (Vol.)
0%, 10% and 50% reagent	



REAGENT	NaHCO ₃
FLYASH	P-C, Powder River Basin Coal
TEST DATE	August 5, 2010
GAS MOISTURE	9% (Vol.)
Mixtures of 0%, 10%, 50%, and 100% reagent	







REAGENT	ACTIVATED CARBON
FLYASH	EASTERN BITUMINOUS
TEST DATE	SEPTEMBER 9, 2010
GAS MOISTURE	7% (Vol.)
0%, 2%, and 10% reagent	

Instrument: MALVERN MASTERSIZER 2000

Particle Size Analysis Report

Machine Tested: # 3, Milled Trona, 11-13-09, 08:20, 9000 lbs/hr., 52.5 F

Measured: Friday, November 20, 2009 3:13:44 PM

Customer / Nol-Tec Dominion

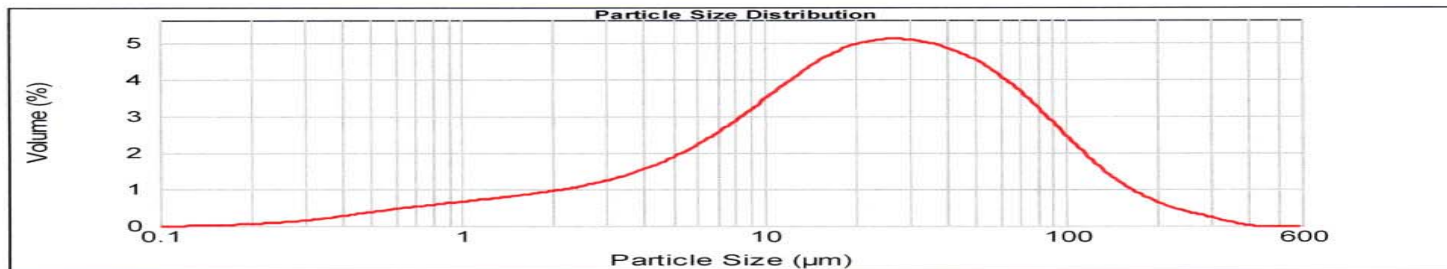
Particle Name: Trona
Measured by: B Chapman

Record No: 2
Sample bulk lot ref: 1
Result Source: Measurement

Particle RI: 0.000	Accessory Name: Scirocco 2000 (A)	Obscuration: 5.22 %
Absorption: 0	Analysis model: General purpose (fine)	Residual: 0.187
Dispersant Name: Dry dispersion	Size range: 0.020 to 2000.000 um	Weighted Residual: 0.186 %
Dispersant RI: 1.000	Result Emulation: Off	Result units: Volume

Concentration: 0.0012 %Vol	Vol. Weighted Mean D[4,3]: 36.996 um	Specific Surface Area: 0.978 m ² /g
Span: 3.787	Uniformity: 1.22	Surface Weighted Mean D[3,2]: 6.137 um

d(0.1): 3.000 um d(0.5): 22.379 um d(0.9): 87.741 um



3, Milled Trona, 11-13-09, 08:20, 9000 lbs/hr., 52.5 F, Friday, November 20, 2009 3:13:44 PM

Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.182	0.03	3.311	10.83	60.256	81.28	1096.478	100.00
0.011	0.00	0.209	0.07	3.802	12.09	69.183	84.82	1258.925	100.00
0.013	0.00	0.240	0.13	4.365	13.50	79.433	87.99	1445.440	100.00
0.015	0.00	0.275	0.22	5.012	15.10	91.201	90.72	1659.587	100.00
0.017	0.00	0.316	0.35	5.754	16.90	104.713	93.01	1905.461	100.00
0.020	0.00	0.363	0.51	6.607	18.96	120.226	94.86	2187.762	100.00
0.023	0.00	0.417	0.74	7.586	21.28	138.038	96.31	2511.886	100.00
0.026	0.00	0.479	1.03	8.710	23.91	158.489	97.41	2884.032	100.00
0.030	0.00	0.550	1.38	10.000	26.86	181.970	98.25	3311.311	100.00
0.035	0.00	0.631	1.78	11.482	30.14	208.930	98.86	3801.894	100.00
0.040	0.00	0.724	2.24	13.183	33.76	239.883	99.32	4365.158	100.00
0.046	0.00	0.832	2.75	15.136	37.68	275.423	99.64	5011.872	100.00
0.052	0.00	0.955	3.31	17.378	41.86	316.228	99.87	5754.399	100.00
0.060	0.00	1.096	3.91	19.953	46.25	363.078	99.98	6606.934	100.00
0.069	0.00	1.259	4.56	22.909	50.77	416.869	100.00	7585.776	100.00
0.079	0.00	1.445	5.27	26.303	55.36	478.630	100.00	8709.636	100.00
0.091	0.00	1.660	6.02	30.200	59.96	549.541	100.00	10000.000	100.00
0.105	0.00	1.905	6.83	34.674	64.52	630.957	100.00		
0.120	0.00	2.188	7.70	39.811	68.98	724.436	100.00		
0.138	0.00	2.512	8.65	45.709	73.30	831.764	100.00		
0.158	0.01	2.884	9.69	52.481	77.42	954.993	100.00		

If you have a large ESP...

- Injection of trona or sodium bicarbonate may improve the emissions
 - Resistivity reduction has a greater impact on ESP performance, than increase in inlet dust loading
- Injection of hydrated lime may be tolerable
 - ESP designed for high resistivity ash
- Ash removal system needs to be evaluated
 - Sorbent tends to collect in front fields
- Ash disposal options needs to be evaluated
 - Sodium salts are leachable

Factors to Consider in the Evaluation

- Original design conditions
 - Fuel, flow, temperature, ash, etc.
 - Original ESP configuration
- Current operating conditions
- Future operating conditions
- Current status of the ESP
 - Has it been well maintained or upgraded?
- Options for improving performance

If you have a small ESP...

- Injection of sorbent may increase your emissions
 - True for both sodium and calcium compounds
- ESP remedial options should be evaluated
- Ash removal system needs to be evaluated
- Ash disposal options need to be evaluated

ESP Remedial Options

- Optimizing Gas Flow through the ESP
- Upgrading T/R sets to high frequency
- Upgrading control systems
- Upgrading rapping configuration
- ESP enlargement
- Converting to a fabric filter

Tools to Assess the Impact of DSI on an ESP

- Process evaluation
- Portable Injection Units
- Resistivity Testing Lab

Conclusions

- Dry Sorbent Injection upstream of existing ESP can affect performance
- Predominant concern is impact on resistivity
- Other concerns are grain loading, particle size
- Sodium sorbents decrease resistivity
- Calcium sorbents sometimes increase resistivity
- Overall Effect on ESP Performance is case specific

Thank you!
Questions?

Bob Mastropietro
908-304-2616
ram@lodgecottrell.com