

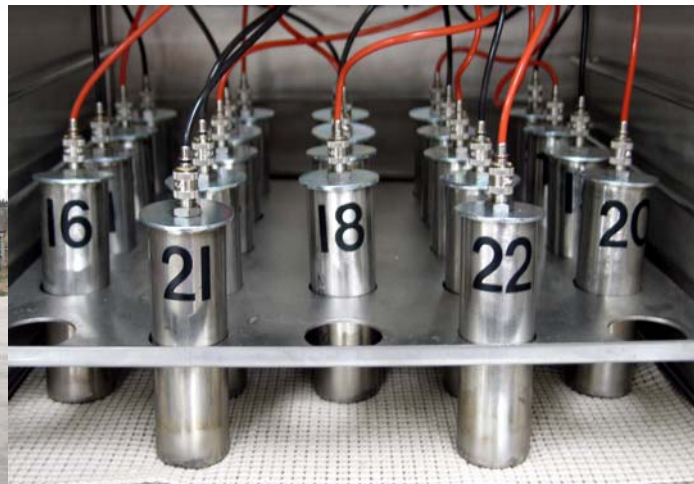
SCAL, Inc.

SPECIAL CORE ANALYSIS LABORATORIES, INC.

Quick-Desorption™ Shale Evaluation/Tight Rock Analysis Sorption Isotherms Performed on Rotary Sidewall Samples

SCAL, Inc. has designed a new technique and fully automated equipment capable of measuring unconventional gas desorption of shale and coal samples independent of sample size. The equipment can measure cuttings, sidewall or full diameter samples by changing the desorption canisters and clicking a few buttons in our software. It works very well with rotary sidewall samples.

The equipment is installed in an SUV and consists of an accurate mechanical convection laboratory oven (0.3 °C uniformity), stainless steel canisters of various sizes and a very accurate gas measuring system operating isothermal at reservoir temperature. The measuring system includes an industrial computer interfaced with a laptop computer. The equipment is powered by digital inverter-generators and in-line digital UPS systems.



After sealing the samples in canisters at the well site we collect desorption data as we drive back to our laboratory facility where the testing is continued.

Once the gas production ends we take the points from the linear portion of the gas production versus square root of time plot and calculate the lost gas using the USBM method. By adding the measured, the lost and the residual gas we determine the total gas content of the sample in scf/ton.

The residual gas is measured by grinding a portion of each sample into a fine powder using a special sealed temperature controlled mill. A desorption test is performed on the powdered sample and the residual gas is measured.

Before grinding the samples porosity, Klinkenberg permeability, bulk and grain density are measured at ambient and reservoir confining stress.

The analysis, interpretations or opinions expressed in our reports represent the best judgement of Special Core Analysis Laboratories Inc.. Special Core Analysis Laboratories Inc. assumes no responsibility and makes no warranties of any kind as to the productivity, proper operation or profitability of any oil, gas or any other mineral in connection which such a report is used or relied upon.

P. O. Box 9730 * Midland, TX 79708-2730 * 1-888-561-5407 * (432)-561-5406 * FAX (432)-561-5339 * mv@scalinc.com

Quick-Desorption™ Test

Company : SCAL, Inc. Sample : 1
 Well Name : Test #1 Depth : 9,500.0 ft
 File No. : 8000

Standard pressure: 14.7 psia Fluid : drilling mud
 Standard temperature: 60 °F

Date 1/22/2008
 Start tripping out: 3:08 Trip time : 2:02 hr:min
 At surface : 5:10 At the surface : 0:37 hr:min
 In the canister : 5:47 USBM time : 1:38 hr:min

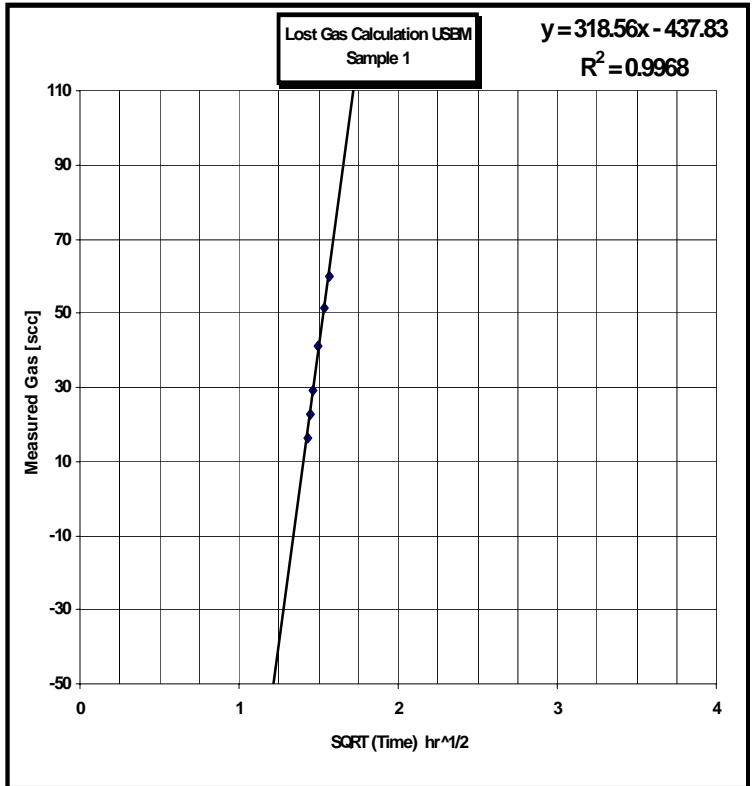
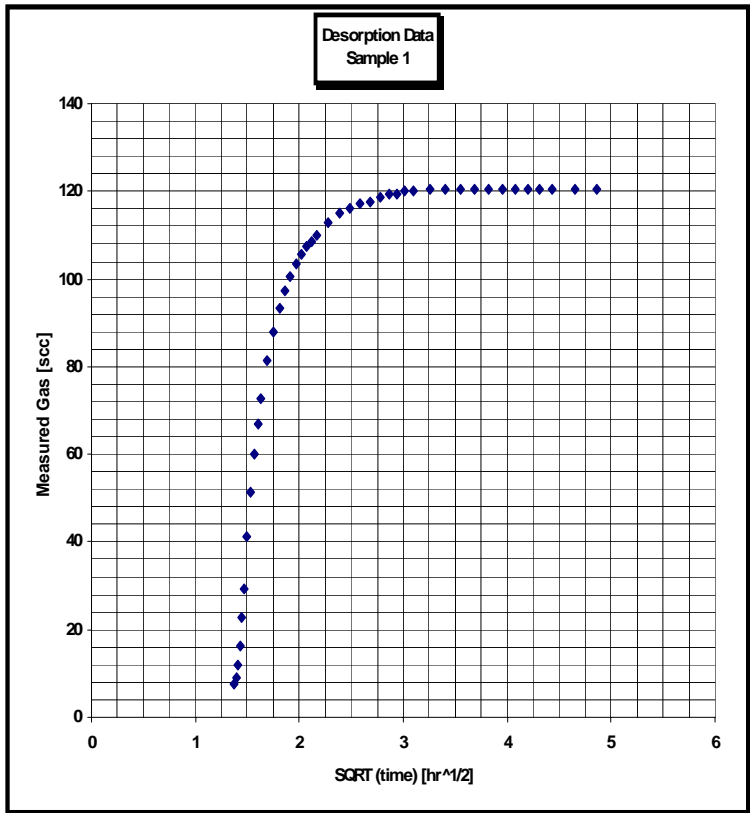
Measured Gas (M) 2.40 scc/g 76.7 scf/ton*
 Lost Gas (L) 8.70 scc/g 278.7 scf/ton*
 Residual Gas (R) 0.89 scc/g 28.6 scf/ton*

Total Gas Content (M+L+R) 11.99 scc/g 384.1 scf/ton*

Measured Gas 120.53 scc Weight : 50.322 g
 Lost Gas Intercept 437.83 scc Desorption temperature: 180 °F

Nb. SQR(TotalTime) Gas Regression Data for Lost Gas Calculation USBM
 hr^{1/2} scc

Nb.	SQR(TotalTime) hr ^{1/2}	Gas scc		
1	1.37	7.64		
2	1.39	9.16		
3	1.41	12.01		
4	1.43	16.38	1.43	16.38
5	1.45	22.94	1.45	22.94
6	1.46	29.26	1.46	29.26
7	1.50	41.15	1.50	41.15
8	1.53	51.46	1.53	51.46
9	1.57	59.98	1.57	59.98
10	1.60	66.98		
11	1.63	72.71		
12	1.69	81.24		
13	1.75	87.94		
14	1.81	93.27		
15	1.86	97.33		
16	1.92	100.64		
17	1.97	103.40		
18	2.02	105.63		
19	2.07	107.40		
20	2.12	108.69		
21	2.16	110.02		
22	2.28	112.88		
23	2.38	114.96		
24	2.49	116.00		
25	2.59	117.09		
26	2.68	117.72		
27	2.77	118.70		
28	2.86	119.26		
29	2.93	119.56		
30	3.02	119.93		
31	3.10	120.10		
32	3.26	120.38		
33	3.41	120.48		
34	3.55	120.53		
35	3.69	120.53		
36	3.82	120.53		
37	3.95	120.53		
38	4.08	120.53		
39	4.20	120.53		
40	4.32	120.53		
41	4.43	120.53		
42	4.65	120.53		



Quick-Desorption™ and Shale Evaluation

Company: SCAL, Inc.

County: Midland

Desorption Temperature:

150 °F

Well: Test #1

State: Texas

Confining Pressure:

2,000 psi

Sample		Quick-Desorption				Plug (microfracture) Data				Crushed Sample Data					Diffusion Parameter		
		As received										Extracted and Dried					As received
No.	Depth ft	Measured Gas scf/ton*	Lost Gas scf/ton*	Residual Gas scf/ton*	TOTAL Gas scf/ton*	Matrix Perm nD	Plug Perm mD	Plug Porosity %	Bulk Density g/cc	Gas Filled Porosity %	Total Porosity %	Saturations Water %	Oil %	Grain Density g/cc	Plug D/r ² 1/sec	Crushed D/r ² 1/sec	Ratio
1	6,100.0	23.3	50.1	37.6	111.0	595.4	0.0069	3.12	2.609	8.17	11.95	28.31	2.5	2.785	1.22E-04	2.44E-04	0.50
2	6,200.0	41.3	70.2	58.4	169.9	806.0	tbfa	2.83	2.749	6.54	22.38	30.1	1.9	2.870	5.88E-05	1.30E-04	0.45
3	6,300.0	22.1	24.4	12.1	58.5	283.2	0.0186	2.01	2.611	4.18	11.33	39.8	2.0	2.732	4.71E-05	2.68E-04	0.18
4	6,400.0	66.1	78.3	59.6	204.0	885.2	tbfa	3.95	2.725	8.61	18.87	33.2	2.1	2.755	4.73E-05	7.17E-05	0.66
5	6,500.0	12.9	21.6	8.9	43.4	286.2	0.0066	2.23	2.777	4.01	7.38	38.2	1.7	2.860	5.66E-05	2.51E-04	0.23
6	6,600.0	32.6	51.7	21.4	105.7	314.3	0.0056	3.48	2.696	7.60	10.31	20.5	2.6	2.832	8.09E-05	1.50E-04	0.54
7	6,700.0	53.3	79.1	24.5	156.9	736.5	0.0025	8.11	2.493	11.42	17.09	28.4	2.9	2.608	7.13E-05	2.31E-04	0.31
8	6,800.0	62.5	83.8	34.6	180.8	333.1	0.0034	2.24	2.438	5.12	7.74	20.8	2.9	2.520	6.03E-05	2.37E-04	0.25
9	6,900.0	29.3	37.2	13.7	80.2	320.4	0.0072	4.47	2.634	6.66	7.78	29.6	2.7	2.641	6.06E-05	2.61E-04	0.23
10	7,000.0	33.5	46.5	11.5	91.5	333.9	0.0002	3.56	2.560	6.30	8.51	33.5	3.0	2.650	6.17E-05	2.15E-04	0.29
11	7,100.0	34.4	56.6	16.3	107.4	455.5	0.0044	2.81	2.597	5.61	9.76	34.7	2.6	2.723	8.50E-05	1.71E-04	0.50
12	7,200.0	36.1	60.9	16.9	113.9	570.3	0.0029	3.26	2.528	7.22	11.08	26.7	3.2	2.628	8.08E-05	2.38E-04	0.34
13	7,300.0	31.4	64.5	15.5	111.4	509.2	0.0019	1.80	2.467	5.97	10.11	30.2	3.1	2.572	1.05E-04	2.66E-04	0.39
14	7,400.0	25.4	44.9	13.2	83.5	397.3	0.3253	3.32	2.513	7.09	12.19	32.0	3.1	2.608	7.94E-05	2.64E-04	0.30
Average		37.0	55.4	23.6	115.9	479.3	0.0344	3.39	2.599	6.64	11.89	30.6	2.6	2.692	7.26E-05	2.14E-04	0.37

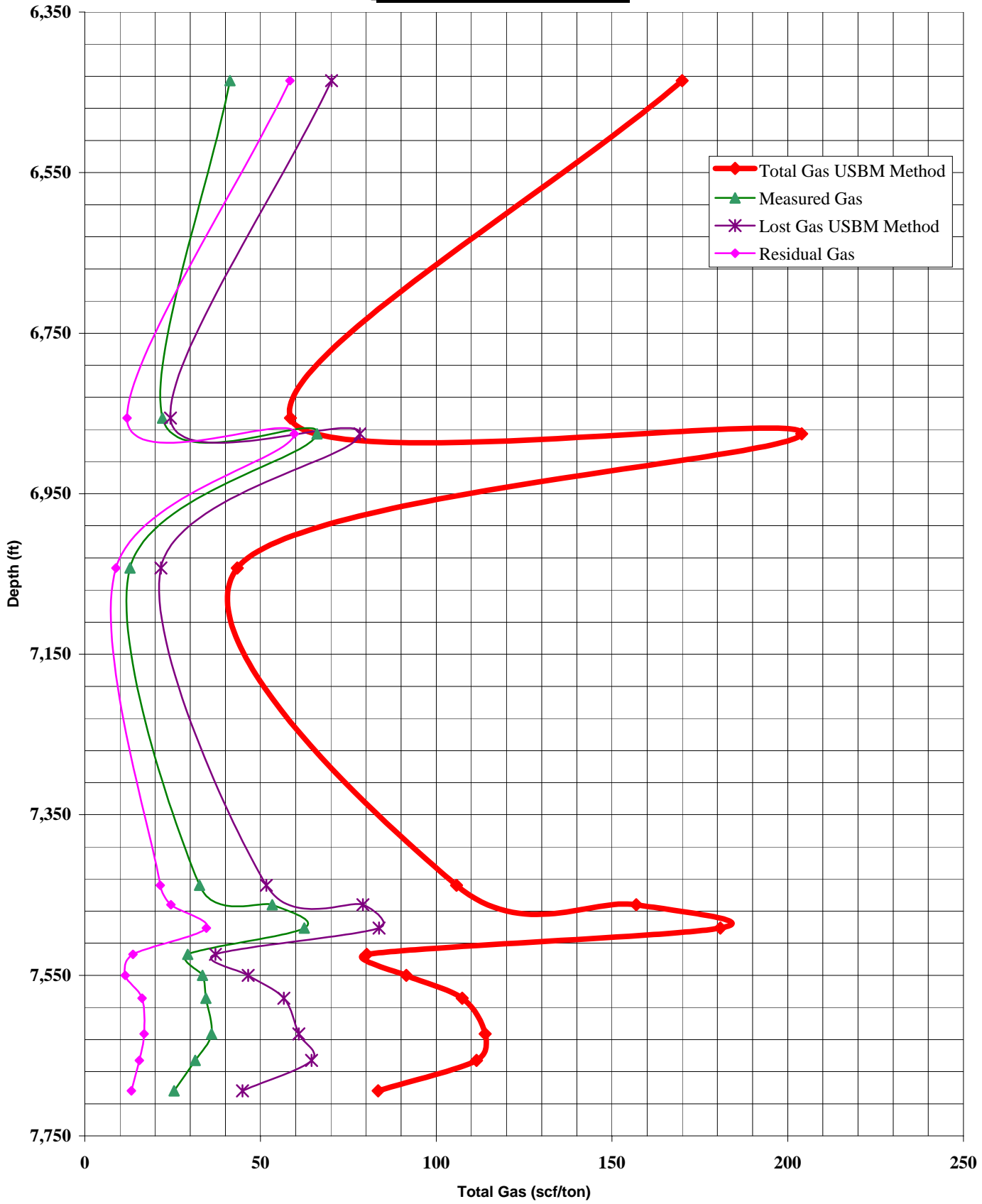
Notations:

- D Diffusion coefficient [cm²/sec]
- r Sphere Radius [cm]
- D/r² Diffusion parameter [1/sec]
- ton* US Short ton equal to 2,000 lbs

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**Gas Composite Test Well #1
USBM Method**



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The equipment was successfully used on many Barnett and Woodford shale wells. Rotary sidewall samples seem to provide the best option:

1. The side wall samples can be lifted from reservoir pressure and temperature quickly therefore minimizing the lost gas time.
2. This equipment can be used in very deep wells where the full diameter coring can not be used due to the long time it takes to recover these cores.
3. Due to sample size (1" diameter and 1 ¾" length) the desorption time is reduced from weeks to days. It is now possible to accurately measure the total gas (scf/ton) in the vertical pilot hole before drilling the horizontal legs.
4. Sidewall samples can be selected over the whole open hole area after consulting the logs and are not limited to a previous "core point selection" and the length of a conventional core barrel (normally 30 to 60 ft).
5. The gas head correction is automated and reduced (around 2-3 scc) by the new procedure.
6. The measurements are performed isothermally at reservoir temperature eliminating the conventional large temperature corrections. New high technology fast and accurate transducers combined with fast multiple computers make these measurement possible.
7. The procedure is non destructive and the samples are available for other measurements; tight rock analysis, residual gas measurements, adsorption, XRD, CST, geochemical measurements, etc.

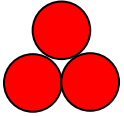
On full diameter cores we can cut (at the well site) a vertical plug in the center of the core and perform the desorption on this plug decreasing the desorption time from months to days.



If you have any questions please give us a call.

Sincerely,

Mihai Vasilache
Petroleum Engineer, President



SCAL, Inc.

SPECIAL CORE ANALYSIS LABORATORIES, INC.

Quick-Desorption™ and Shale Evaluation

A new and unique evaluation procedure was developed to perform most of the shale analysis testes on rotary sidewall samples or vertical plugs cut on location from the center of a full diameter core. The retrieval time is a lot shorter in the sidewall case and is not dependent on the drilling crew experience (long trip out time). Due to the sample dimension the desorption is much faster than full diameter (days versus months).

1 Measured gas

A fully automated laboratory is present on location when the rotary sidewall samples are taken. The cores are cut from top to bottom and retrieved from the coring tool ASAP to minimize the lost gas. The wire line trip out time is recorded and used in the USBM lost gas calculation. Vertical plug samples can be cut, in the center of a conventional core, at the well site and used for Quick-Desorption and Shale Evaluation. The portable laboratory returns to our laboratory facility while collecting desorption data at constant reservoir temperature. The desorption is conducted until the gas production ends.

2 Lost gas and matrix permeability

The linear portion of the desorption curve is used to determine lost gas and the diffusion parameter for the plug samples.

3 Bulk density, micro fracture porosity and permeability at confining stress

Bulk density and micro fracture permeability and porosity measurements are performed at reservoir confining stress on the wet shale sample (if a straight cylinder can be shaped from the recovered core material). If the sample quality is poor, only the bulk density is measured.

4 Residual gas

The shale is grinded to about 45 mesh using special mills. Another desorption is performed at reservoir temperature on the granular sample to measure the residual gas and the diffusion parameter.

5 Total gas

Total gas is calculated by adding measured, lost and residual gas.

6 Geochemistry

A small portion of the sample is collected to perform TOC and Rock-Evaluation. The plug end trims are also available for further geochemistry and/or petrography analysis (TS, XRD, SEM).

7 Gas filled porosity

The gas filled porosity is measured on the crushed sidewall sample by gas expansion into the “as received” shale.

8 Water and oil saturations, total porosity, and grain density

The samples are extracted to measure the water and oil saturations. The total porosity and the grain density are also measured.

Sorption Isotherm

Methane 153 °F

Company : SCAL, Inc.

Well Name : Best #1
County : Midland, County
State : Texas

Sample : 1a Porosity : 2.24 %
 Depth : 6,492.0 Ft Grain Density : 2.62 g/cc
 Confining Pressure : 2,500 psi

Temperature : 153 °F Sample Weight : 13.422 g
 Atmospheric Pressure : 13.1 Psia

Test Results:

Step No.	Pressure psia	Adsorption scc/g	Adsorption scf/ton	Langmuir Gas Storage* scf/ton
1	491.3	1.84	66.9	73.0
2	983.0	3.12	110.3	110.5
3	1480.7	3.94	139.2	133.6
4	1977.3	4.40	155.2	149.0
5	2472.4	4.74	167.5	160.0
6	2962.1	4.76	168.2	168.3
7	3464.1	4.82	170.3	174.8

*** Langmuir Regression and Coefficients :**

PL : 1,038.8 Psia $G_s = VL \times P / (P + PL)$
 VL : 227.27 scf/ton

Where:

- Gs Gas storage capacity (scf/ton)
- VL The Langmuir volume (scf/ton) is the maximum amount of gas that can be adsorbed at infinite pressure.
- P Absolute pressure (psia)
- PL The Langmuir pressure (psia) affects the curvature of the isotherm and corresponds to the pressure at which half of the LV is adsorbed.

