Review Well Testing for Western Kentucky Deep Well Project

February 7, 2008

Injectivity Test Objectives
(First Pass)

- Prove can inject/dispose CO2 in either of the St Peter, Knox or Mt. Simon
- Determine reservoir characteristics of the reservoirs selected for injection

Well Test Study

- Reviewed old test data
- Estimated K ranges for Mt Simon and Knox
- Made PTA* simulations for proposed well
- Designed injectivity test scenarios for test well

*Pressure Transient Analysis

Permeability Estimates

- Permeability estimates for the Mt. Simon and Knox horizons are based on test data from DuPont WAD #1 (~ 40 miles away)
- Mt Simon's average perm is in the range of .4 to 1.8 md. Knox's average perm is 0.4 to 3.2 md after test data normalized using porosity and adjusted to new expected depths.
- It is recognized that the bottom 20 ft section of Knox had fractures that contributed to ~ 70% of the injection, which would calculate ~ 95 md equivalent perm.
- Target well will be acid stimulated and expect to tie in to potential fractures network

PTA Simulation Work Summary

Mt. Simon 3530 Pi

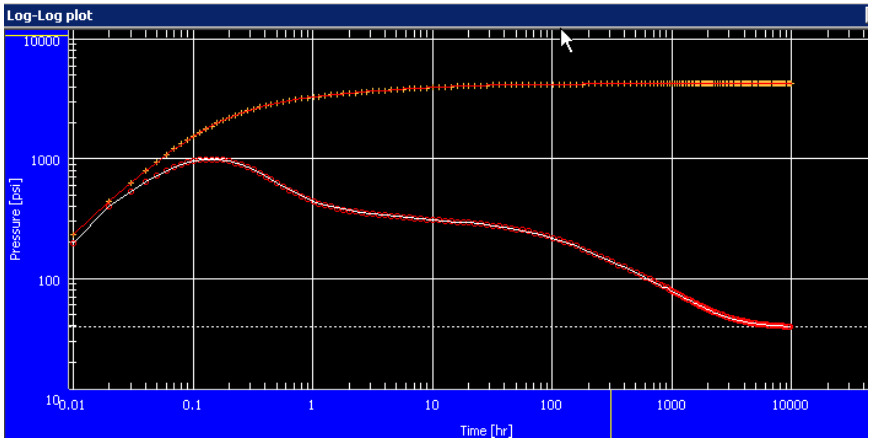
Case	K (md)	Perf (ft)	Skin	Max Inj Rate	KvKh	t to IARF		1st Stab	
	md	ft		bpd		Hrs	Days	Hrs	Days
1	0.4	700	0	1500	1	10	0.4		0.0
2	1.8	700	0	5500	1	4	0.2		0.0
3	0.4	300	0	600	0.1	800	33.3	24	1.0
4	1.8	300	0	2800	0.1	200	8.3	10	0.4

Knox 2330 Pi

Case	K (md)	Perf (ft)	Skin	Max Inj Rate	KvKh	t to IARF		1st Stab	
	md	ft		bpd		Hrs	Days	Hrs	Days
1	0.4	2500	0	5000	1	3	0.1		0.0
2	1.8	2500	0	6000	1	2	0.1		0.0
3	0.4	300	0	1000	0.1	20000	833.3	40	1.7
4	1.8	300	0	4000	0.1	5000	208.3	10	0.4

Knox Simulations Basis Used for Injectivity Test

Case	K (md)	Perf (ft)	Skin	Max Inj Rate	KvKh	t to IARF		1st Stab	
	md	ft		bpd		Hrs	Days	Hrs	Days
1	0.4	2500	0	5000	1	3	0.1		0.0
2	1.8	2500	0	6000	1	2	0.1		0.0
3	0.4	300	0	1000	0.1	20000	833.3	40	1.7
4	1.8	300	0	4000	0.1	5000	208.3	10	0.4



Option 1
Mt Simon and Knox Test

- Drill to TD and run 5-1/2” Long String as planned
- Perf and test Mt Simon
  - Perf a 700-ft section
  - Perf a 300-ft section
- P/A Mt Simon
- Perf and test Knox
  - Perf all 2500ft
  - Perf a 700-ft section
  - Perf a 300-ft and 100-ft section
- P/A Knox

Option 2
Mt Simon and St Peter/Knox Test

- Drill to TD and run 5-1/2” Long String as planned
- Perf and test Mt Simon
  - Perf a 700-ft section
  - Perf a 300-ft section
- P/A Mt Simon
- Perf and test St Peter and Knox
  - Perf St Peter 200-ft section and test
  - Perf a 700-ft section of Knox
  - Commingled Test of Knox and St Peter
- P/A St Peter and Knox

Option 3
Mt Simon and Open-Hole Knox Test

- Drill to TD and run 5-1/2” Long String. Cement the 5-1/2” casing and leave string set for retrieval after first test.
- Perforate and test Mt Simon
  - Perf a 700-ft section
  - Perf a 300-ft section
- P/A Mt Simon
- Cut 5-1/2” casing above Mt Simon and expose all Knox
- Test Knox Open Hole
- P/A Knox

Option 4

Open-Hole Mt Simon Test and Knox Test

- Drill to TD. Run 5-1/2” LS from surface to top of Mt Simon. Cement 5-1/2” string and leave string set for either a cased hole or OH test of the Knox
- Perform OH test on Mt Simon
- P/A Mt Simon
- Test Knox
  - OH after cut/retrieving 5-1/2” section or
  - Perf a 700-ft section
  - Perf a 300-ft section
- P/A Knox
- Test St Peter
- P/A Knox

Injection Test Rates, Pressures and Volumes

Planned Tests					
Formation	Injection hrs	FallOff hrs	Max Rate bwpd	Volume Inj bbls	Max Inj Press psi
Mt Simon	6	24	6000	1500	5720
Knox	6	24	6000	1500	4000
St Peter					2800?
(totals)	12	48		3000	

Typical Injectivity Test					
Pumping Schedule				Fall off Time	Total Hrs
bpm	bpd	pumped min	hr	hrs	
1	1440	20	0.333333		
2	2880	20	0.333333		
4	5760	20	0.333333		
4.167	6000	300	5		
totals		360	6	24	30

Note: Knox data above assumes fractures are present.

Envisioned Injectivity Test

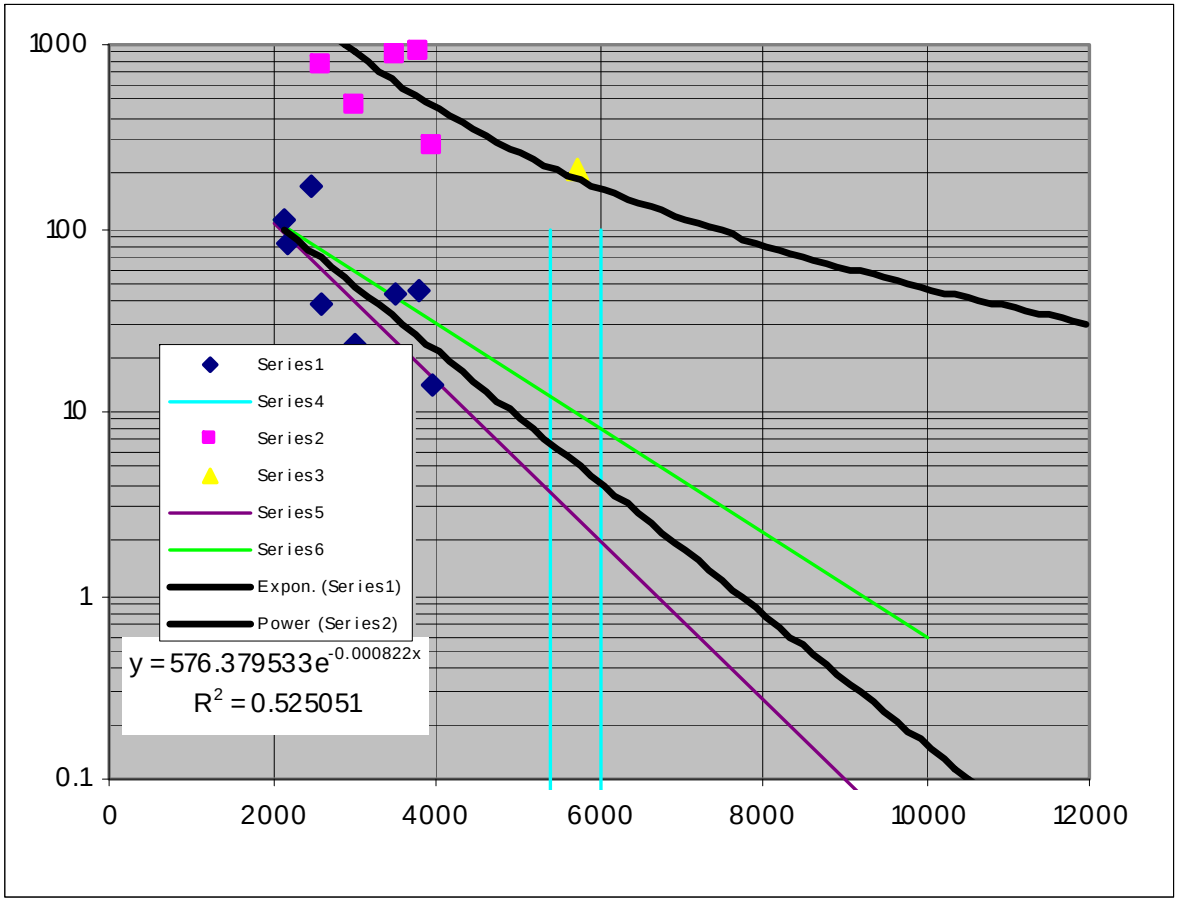
Perforate **Mt Simon** & set up tanks & other testing equipment
Run test packer w/ no go
Swab/test well (pits/frac tank) until cleaned up, take produced water samples)
Inject Saltwater as required for injectivity test
SI well for fall-off
Injectivity test for PLT run?
Inject Saltwater as step-rate test to fracture rate
Kill well and abandon zone with BP and bailed cmt
Pressure test BP
Perforate **Knox**
Acidize as required
Inject Saltwater as required for injectivity test
SI well for fall-off
Injectivity test for PLT run?
Inject CO_2 (3 - 6, 000 tons)
SI well for fall-off
Inject Saltwater as step-rate test to fracture rate
Flow back well until dead or kill
Kill well and abandon zone with BP and bailed cmt

Special Test Considerations

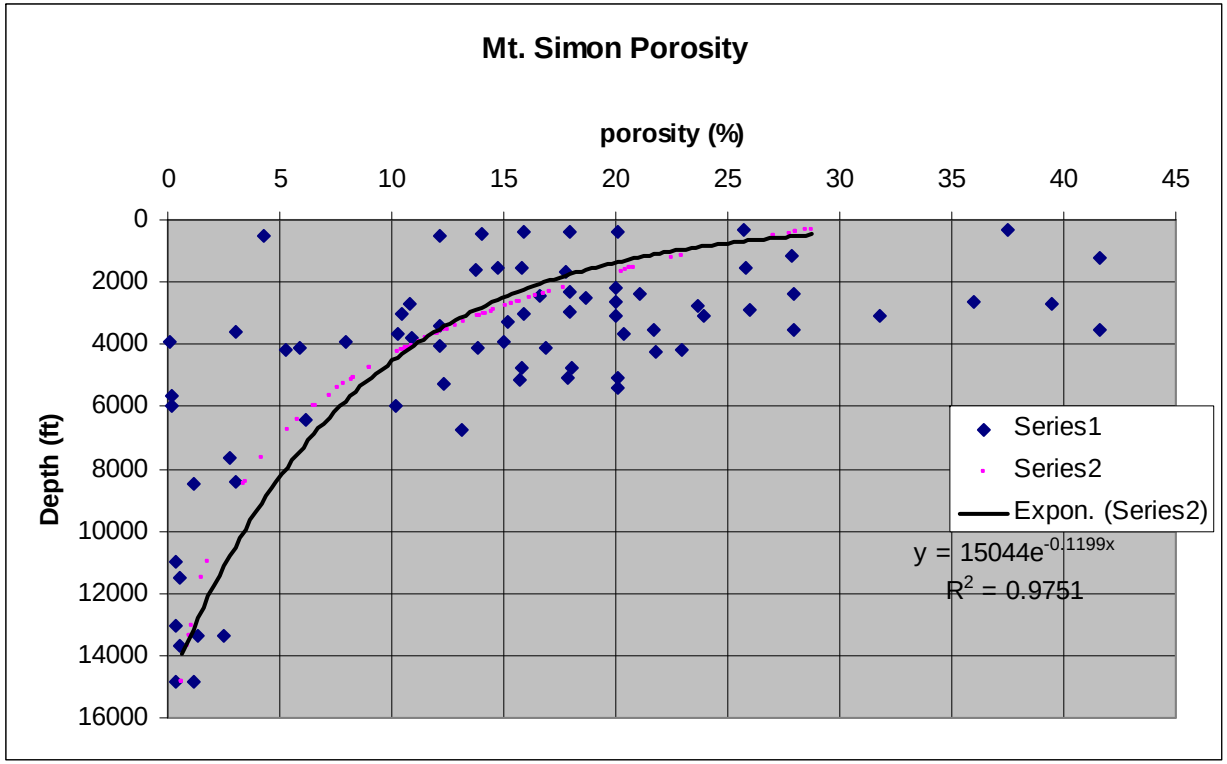
- Sampling
- Production Log Tests
- Acidizing
- Test sequence
- Interference testing?

Supporting Data

Mt Simon/St Peter Porosity-Permeability Data



Mt Simon/St Peter Porosity Data



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