An Innovative Method to Maximize Sand-free Gas Rate

**October 2022**

Agenda

- Safety Moment

- Chemical Sand Control Case Study

  - The Well

  - The Problem

  - The solution

  - Post the solution

  - Conclusions

- **What can lead to sand production?**

  – Reservoir depletion

  – Water cut

  – Incorrect gravel pack design/execution

  – Exceeding the operating guidelines in terms of:

    - *Rate limit*

    - *Bean up criteria*

    - *Downhole velocity limits*

    - *Drawdown*

  – Multiple well interruptions

- **What are the consequences of sand production?**

  – Restricted production rates

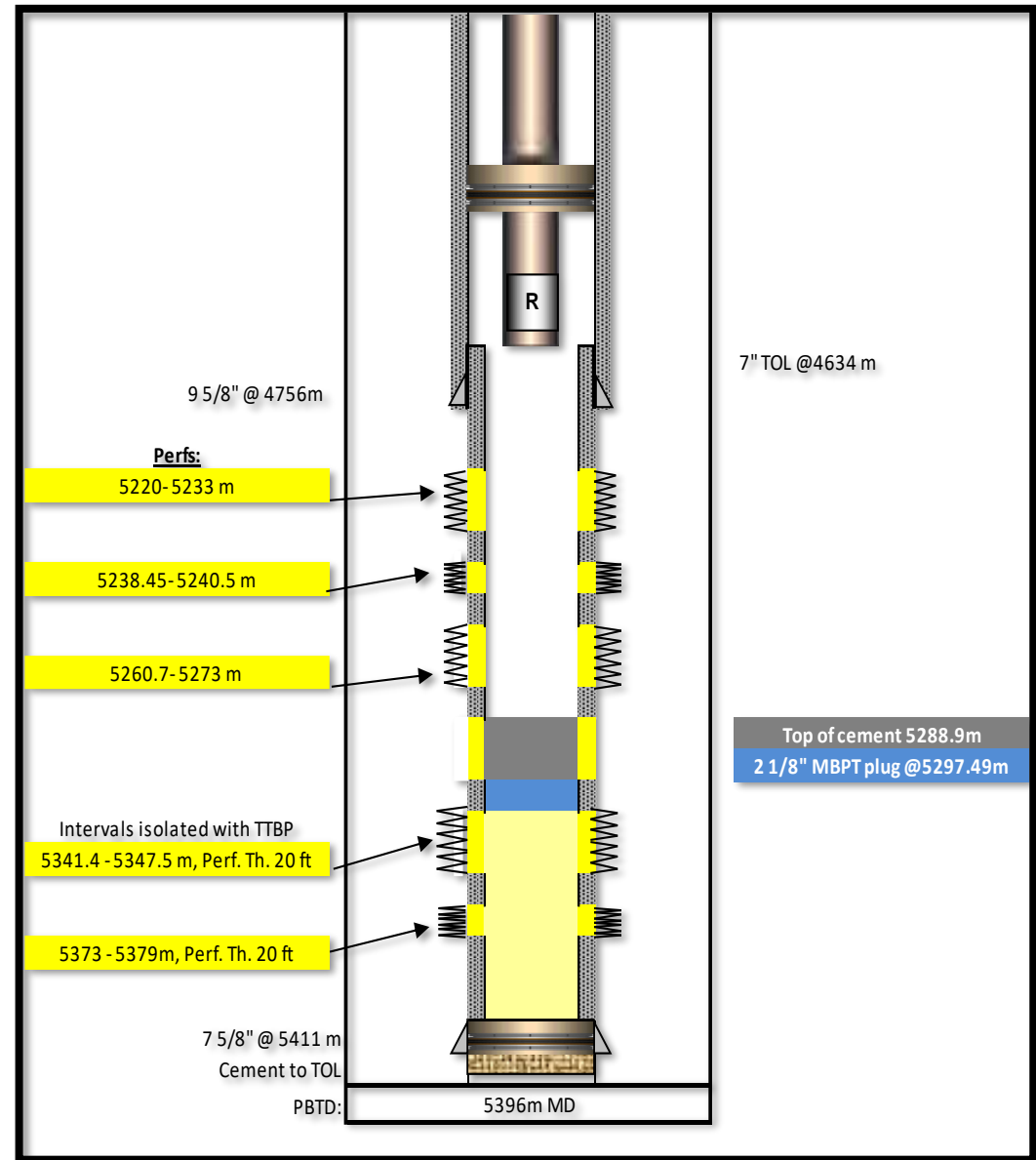 – Erosion in downhole equipment and surface facilities

  – LOPC
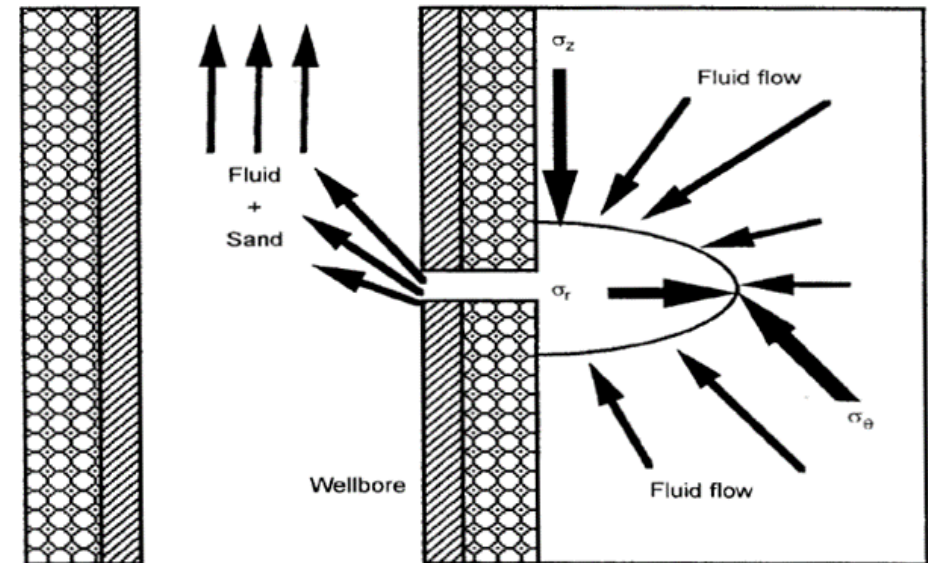
Chemical Sand Control Case Study

The Well

WAK-4

- West Akhen 4 is a 48° deviated well drilled in early 2005

- The well was cased and perforated in March 2005 by wire line perforating through tubing.

- Reservoir temperature is 280°F (138°C)

- The well has a 7-5/8" 52.8 lb/ft liner, completed with 5-1/2" 23 lb/ft, C-95 tubing

- It is a cased and perforated completion, without traditional sand control

9 5/8" @ 4756m

7" TOL @4634 m

R

Perfs:
5220- 5233 m

5238.45- 5240.5 m

5260.7- 5273 m

Top of cement 5288.9m
2 1/8" MBPT plug @5297.49m

Intervals isolated with TTBP
5341.4 - 5347.5 m, Perf. Th. 20 ft

5373 - 5379m, Perf. Th. 20 ft

7 5/8" @ 5411 m
Cement to TOL

PBTD: 5396m MD

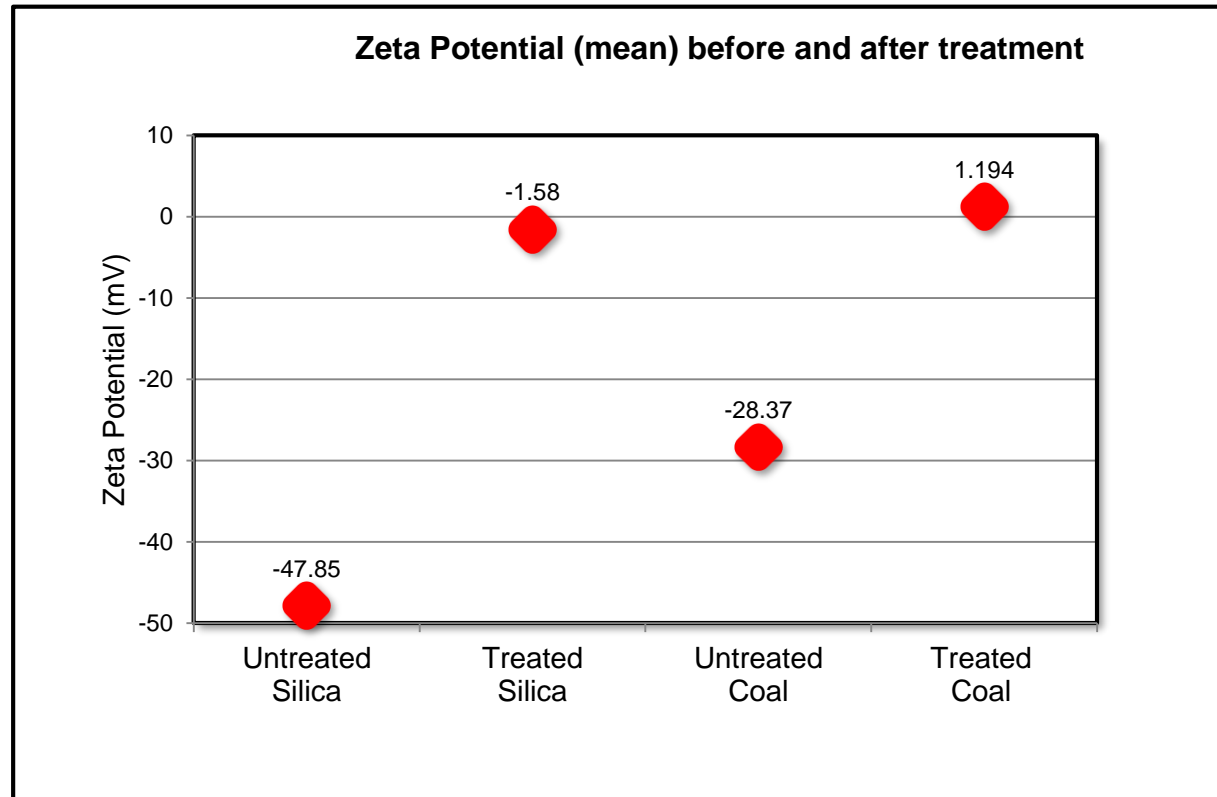# The Problem

Problem statement

- The well was producing at ~ 70 MMscf/d before it was choked back in the summer of 2008 due to sand production concern based on indications from acoustic sand monitors

- The concern was validated with signs of choke erosion in November 2008 and has been progressively choked back since then

- The well started producing water in the summer of 2009 after a long SI period of 40 days

- Subsequently the flow rate was controlled to 30 MMscf/d to manage sand production and was gradually reduced to 10 MMscf/d to maintain sand free production

WAK-4 Well Performance
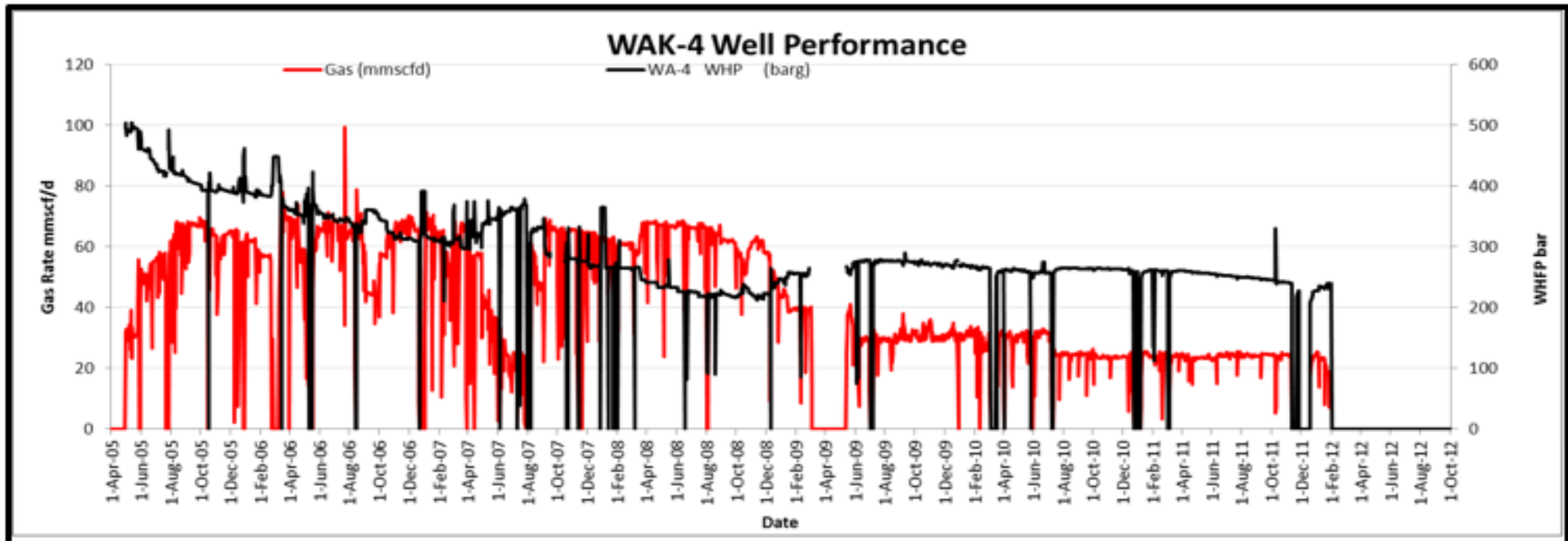
The Solution: Sand Conglomeration Chemical
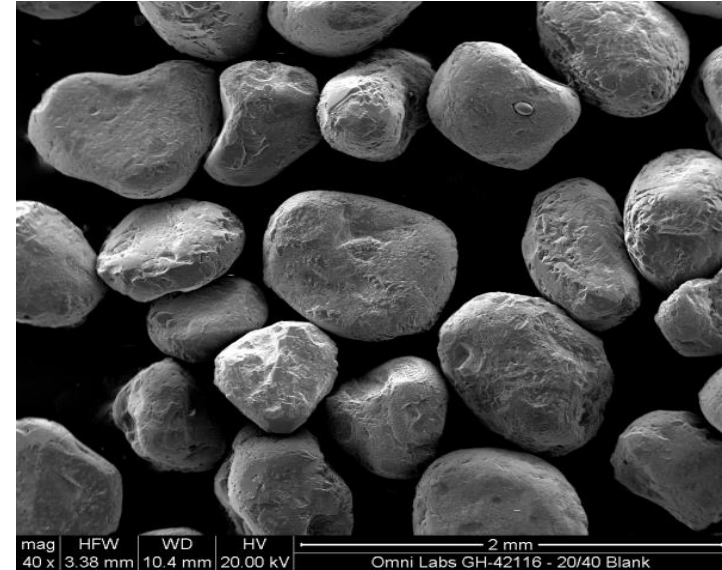
Sand Conglomeration

- The system used rapidly coats sand particle surfaces

- It alters the zeta potential of solid surfaces and creates a strengthened attraction between the particles

- This effect can be seen in the following graph of silica and coal treated with the system

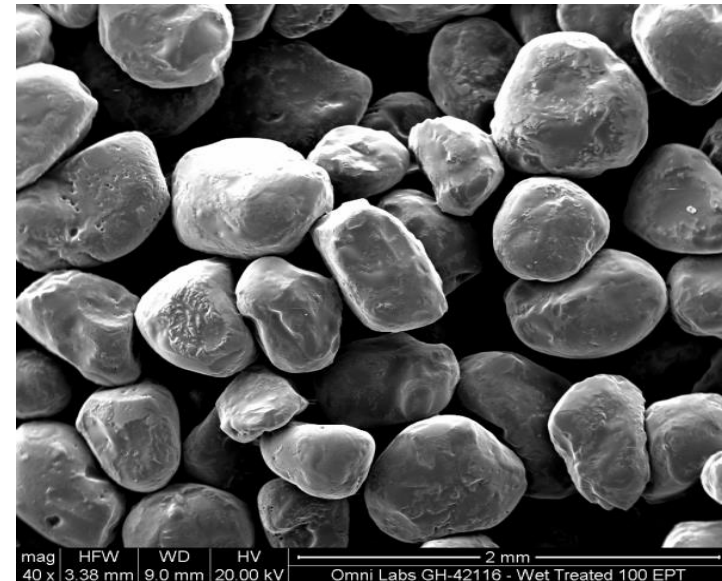- In terms of guidance, a positive to low negative value indicates good agglomeration:

Zeta Potential (mean) before and after treatment

Zeta Potential (mV)

-1.58 (Treated Silica)	1.194 (Treated Coal)	
-28.37 (Untreated Coal)		
-47.85 (Untreated Silica)		

Y-axis values: 10, 0, -10, -20, -30, -40, -50

X-axis: Untreated Silica, Treated Silica, Untreated Coal, Treated Coal

Zeta Potential [mV]	Stability behavior of the colloid
+3 to -5	Maximum agglomeration
-5 to -10	Strong agglomeration
-10 to -15	Medium to weak agglomeration
-16 to -30	Threshold
-31 to -100	Low to excellent dispersion

- This chemical does not fill the pore throats, but coats the surface and fills the scratches on the sand grains

- The coating on the surface of the sand is extremely thin (estimated at 20 – 40 Angstrom)

- The system does not significantly increase the UCS, but rather creates an ionic attraction between the particles with no significant loss of permeability

- If the ionic bond is broken, it will re-heal upon contact which enables job re-implementation

- This isn't a replacement to mechanical sand control, rather, it is anticipated that this can be used for many types of remedial sand control, including failed mechanical sand control systems, failed cased and perforated wells and may possibly enhance the quality of new sand control installations

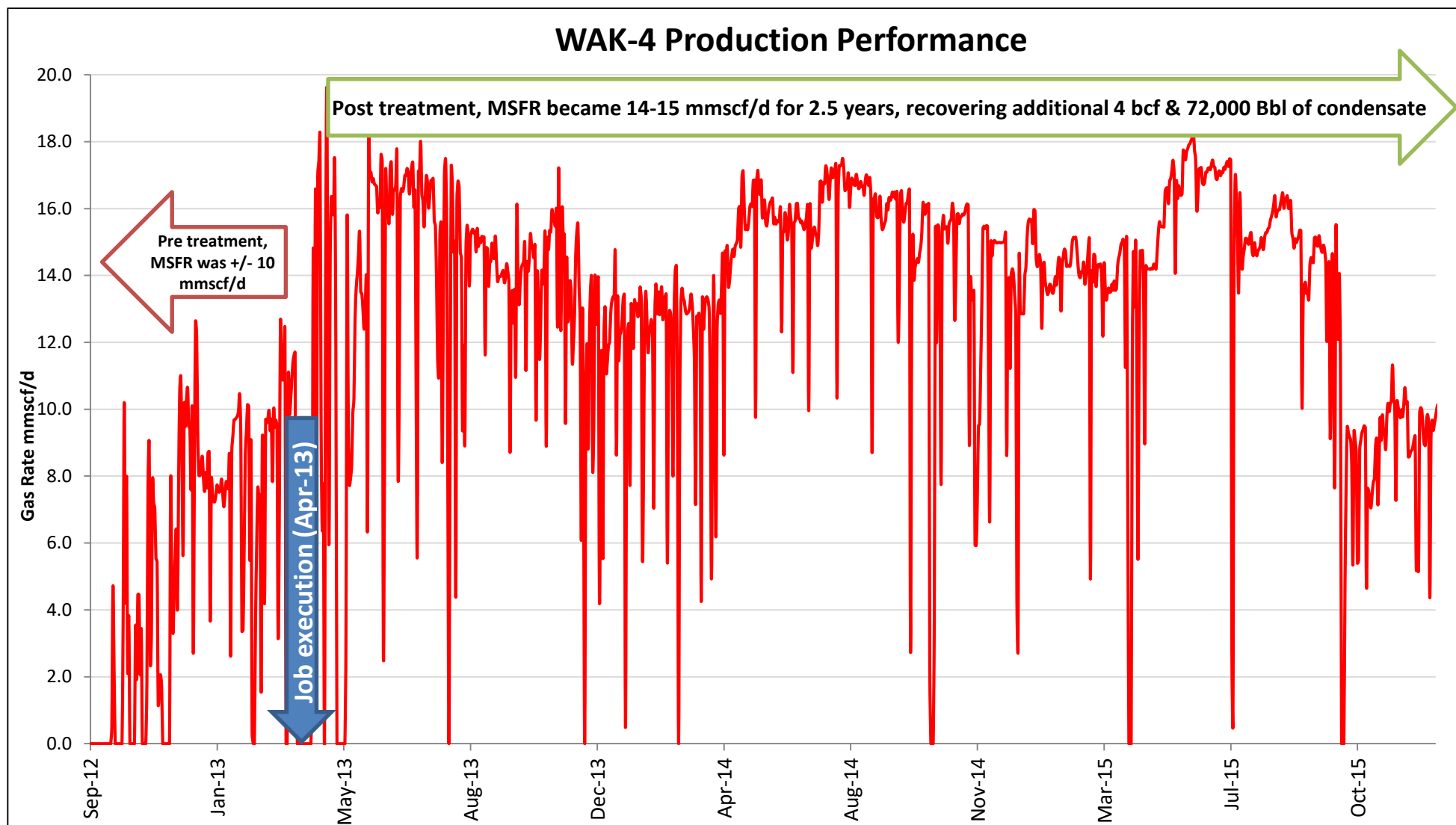| mag | HFW | WD | HV | 2 mm |
| 40 x | 3.38 mm | 10.4 mm | 20.00 kV | Omni Labs GH-42116 - 20/40 Blank |

Blank 40X

| mag | HFW | WD | HV | 2 mm |
| 40 x | 3.38 mm | 9.0 mm | 20.00 kV | Omni Labs GH-42116 - Wet Treated 100 EPT |

Treated 40X

Post the Solution

PhPC

WAK-4 Production Performance

Post treatment, MSFR became 14-15 mmscf/d for 2.5 years, recovering additional 4 bcf & 72,000 Bbl of condensate

Pre treatment, MSFR was +/- 10 mmscf/d

Job execution (Apr-13)

The team presented WAK-4 case in at the SPE ATCE, Oct. 27-29, 2014
SPE-170594-MS "Advanced Sand Control Chemistry to Increase Maximum Sand Free Rate with Improved Placement Technique - A Case Study"

Conclusions

PhPC

- Chemical sand consolidation can be effective in reducing sand production and increasing production. In the WAK-4 well it has increased production by around 50% for 2.5 years, recovering additional 4 bcf & 72,000 bbl of condensate

- The chemical can be used for many types of remedial sand control, including:
  - failed mechanical sand control systems,
  - failed cased and perforated wells
  - and may possibly enhance the quality of new sand control installations.

- It creates an ionic attraction between the particles with no significant reduction in permeability

- If the ionic bond is broken, it will re-heal upon contact which encourages job re-implementation (if reserves allow)