SPE-210097-MS
Neutral-wettability Proppant Improves Post Treatment Cleanup and Enhances Productivity

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Outline

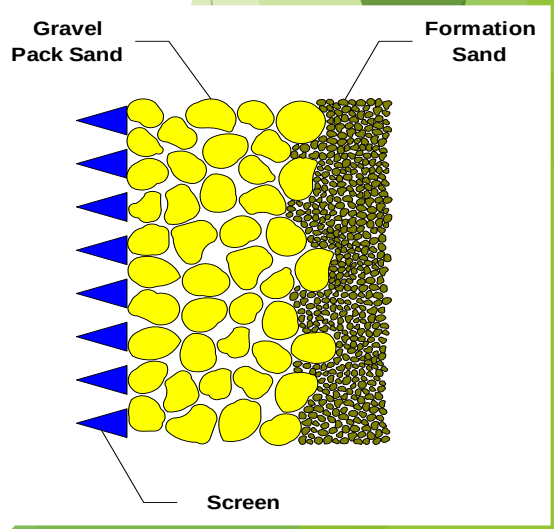
- Introduction.
- Challenge.
- Current available solutions.
- Neutral-Wettability proppant technology theory.
- Case History and Results.
- Conclusion.

Introduction

- Sand production is one of the oldest problems facing the petroleum industry.

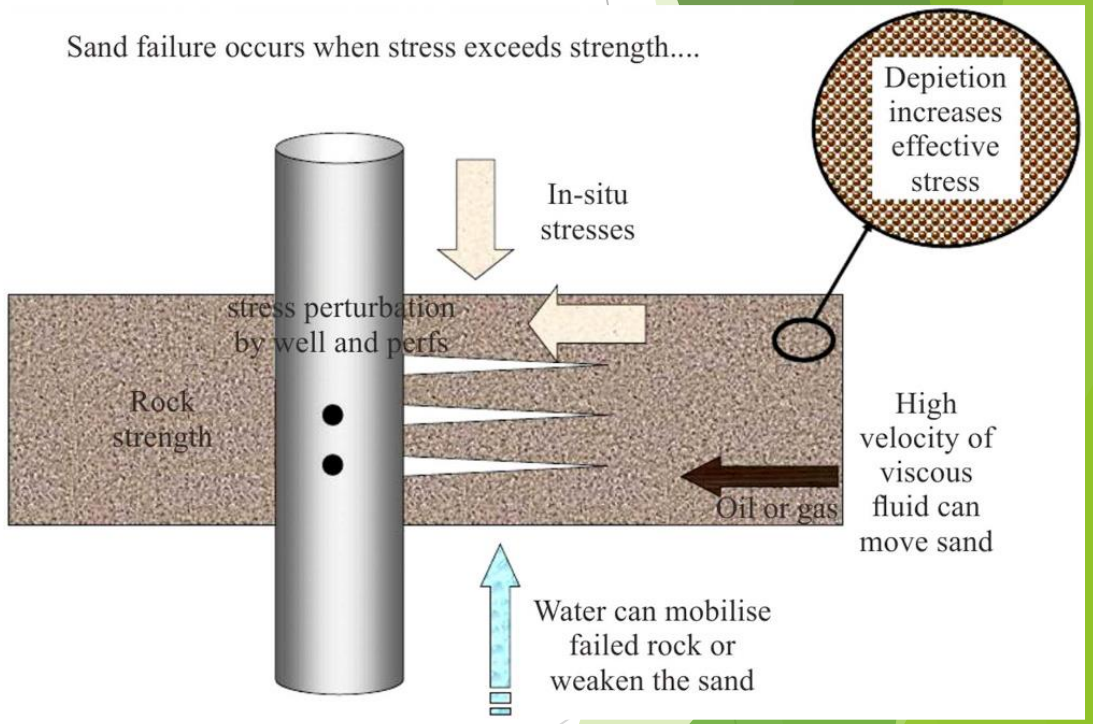
- **<u>Costs associated with sand production are:</u>**
  - Maintenance costs
  - Deferred production
  - Frequent workover.
  - Handling and disposal costs

- **Gravel Pack is the best sand control technique in terms of productivity and longevity**



Introduction

- As the reservoir pressure depletes overtime result from pore pressure reduction, which leads to reduce the reservoir fluid production.
- Reducing the reservoir pressure causes increase in the amount of stress that applies on the formation sand.
- If the effective stress exceeds the formation strength the formation particles are crushed from its matrix and cause damage.



Challenge

- Gravel packing depleted reservoirs have the risk of excessive completion brine losses into the formation.

- Brine invasion can cause:

1. Formation damage .
2. Reduction in permeability to hydrocarbon.
3. Impairment in well productivity.
4. Requirement for CT lifting post treatment

Current Available Solutions

- Methods currently used treating highly depleted reservoirs for recovering brines as follow:

1) Methanol
   - Highly Flammable
   - Toxic
   - Costly

2) Surfactant
   - Non-efficient
   - Temporary

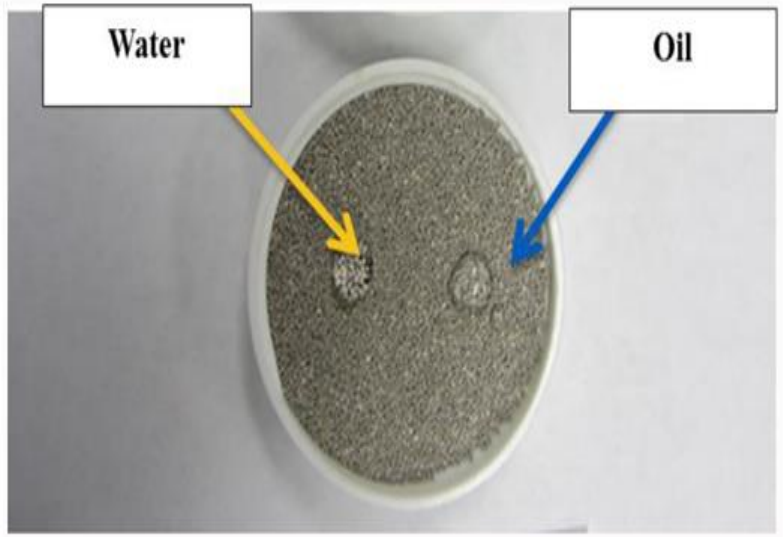
3) Foamed Fluids
   - Complex operation
   - Difficult to predict pressure
   - Costly

$$C_p = \frac{2\gamma cos\theta}{a}. \text{ A}$$

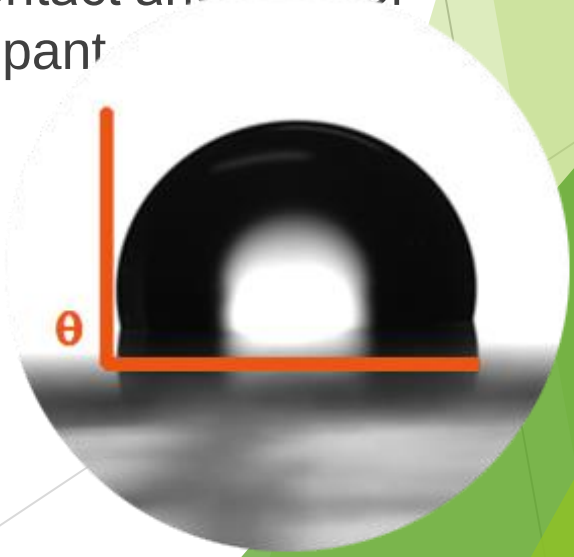
γ: interfacial tension (dynes/cm)
θ: contact angle (º)
a: pore radius (mm)
A: constant convert the capillary pressure to pound per square foot (psi) (A=145.10-3)

Neutral-Wettability proppant technology theory

- Engineering Interfaces with neutral wettability: neither oil nor water wet
- Surface modifier is covalently bonded through condensation reacti



- Neutral wettability
- Better cleanup and improved conductivity to hydrocarbon
- Permanently modify wettability on proppant surface
- Optimize contact angle (θ) of fluid to proppant

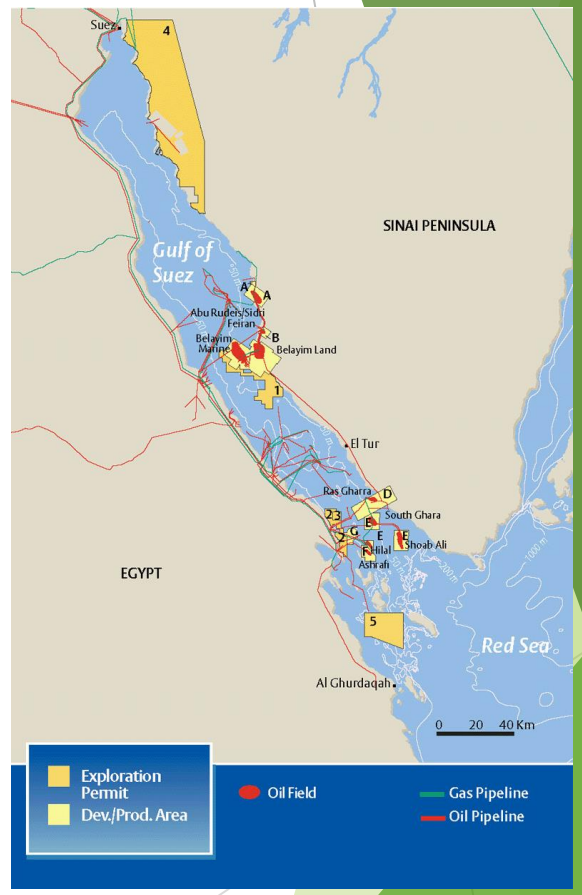


Θ ~90º for both water and oil

Case History and Results

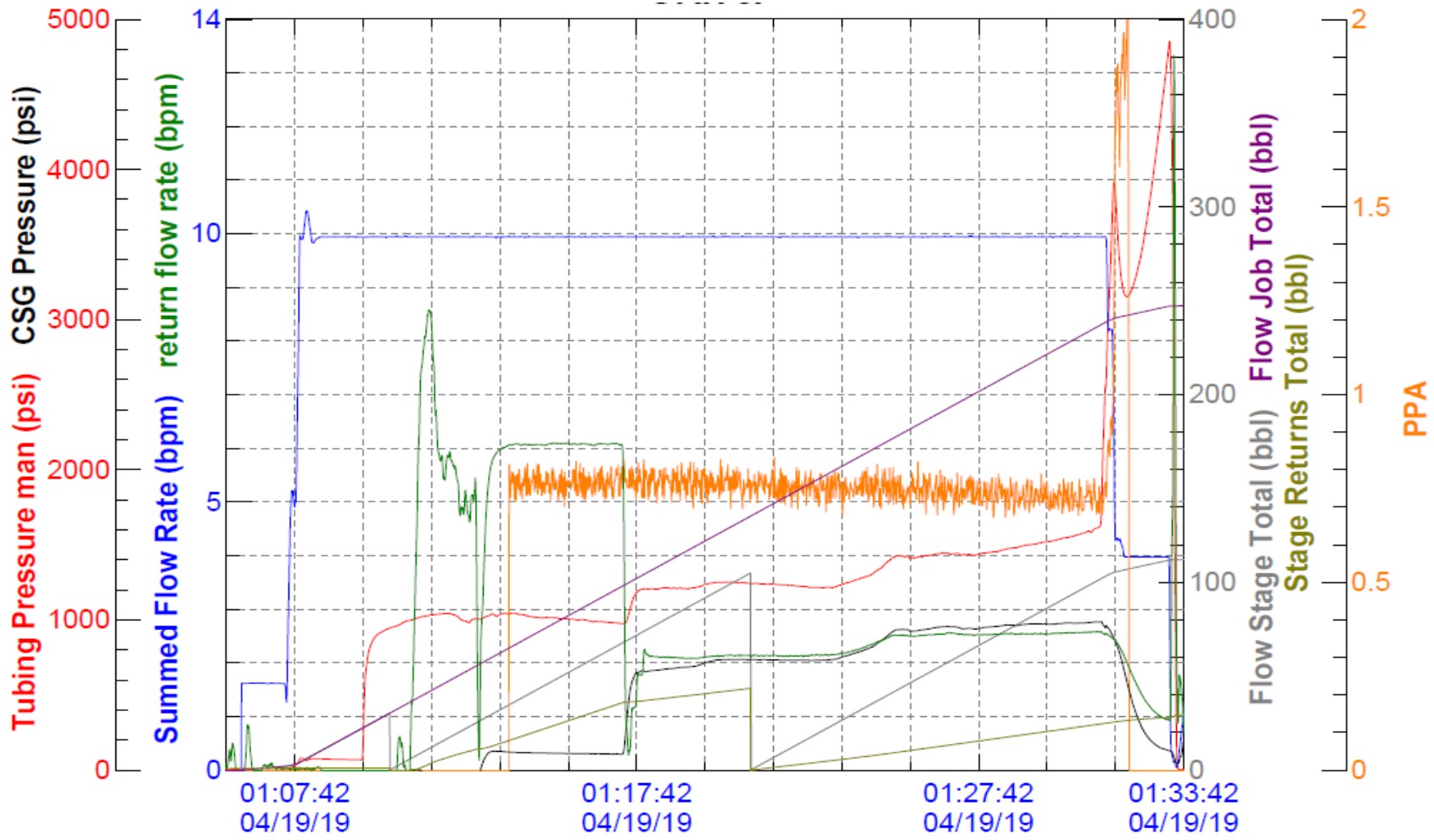
- Well 113-137 Zone II sandstone formation in Belayim land Field
- Current reservoir pressure gradient 0.1 psi/ft (i.e.79% depletion).
- Nearby water aquifer as indicated in CH logs.
- Very low ESP run life < 3 months due to sand production.
- Formation sieve analysis showed poor sorting and uniformity coefficient.
- Both production rate control and standalone screens failed to manage sand production in offset wells.

- **<u>Recommended sand control technique is cased hole gravel pack</u>**



Belayim land field, Egypt

Case History and Results

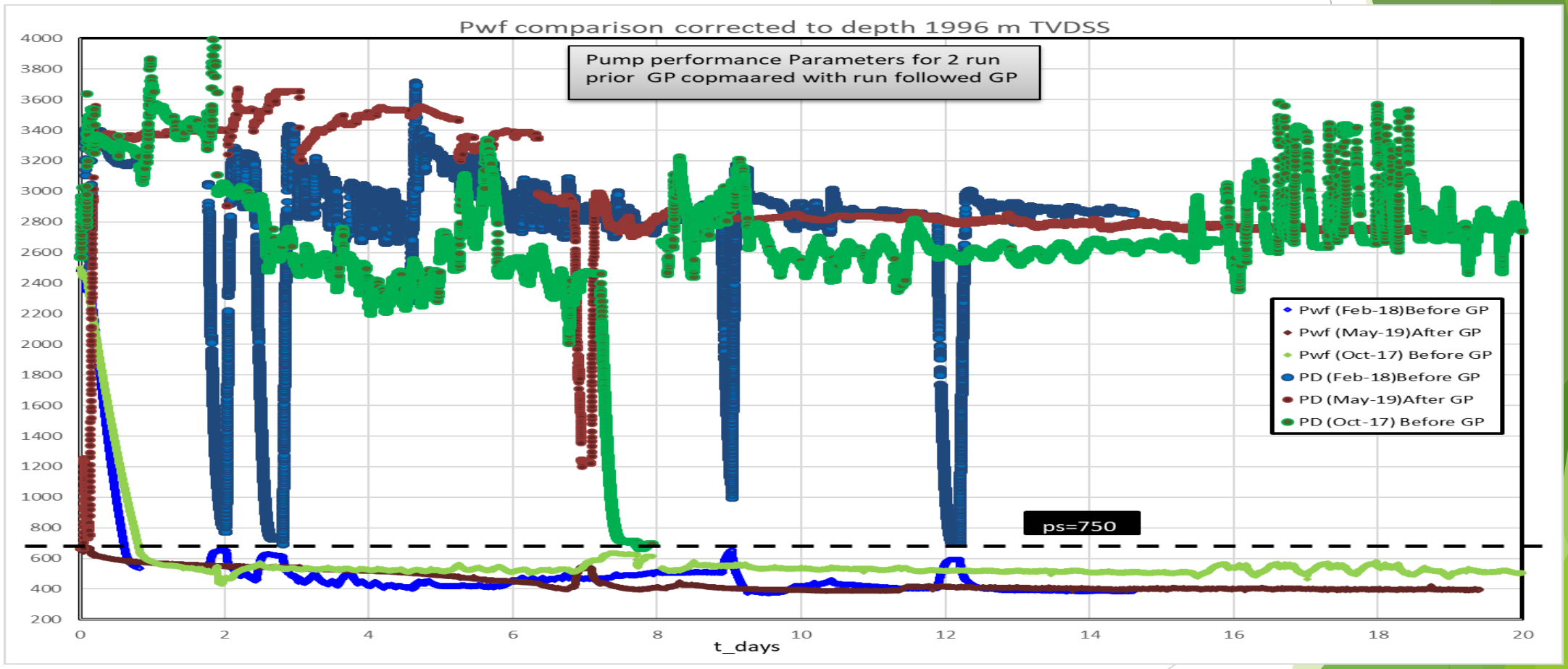


- 4” Excluder2000 Screen technology inside 7” CSG.
- Carrier fluid 8.7 ppg KCL

Job Results:

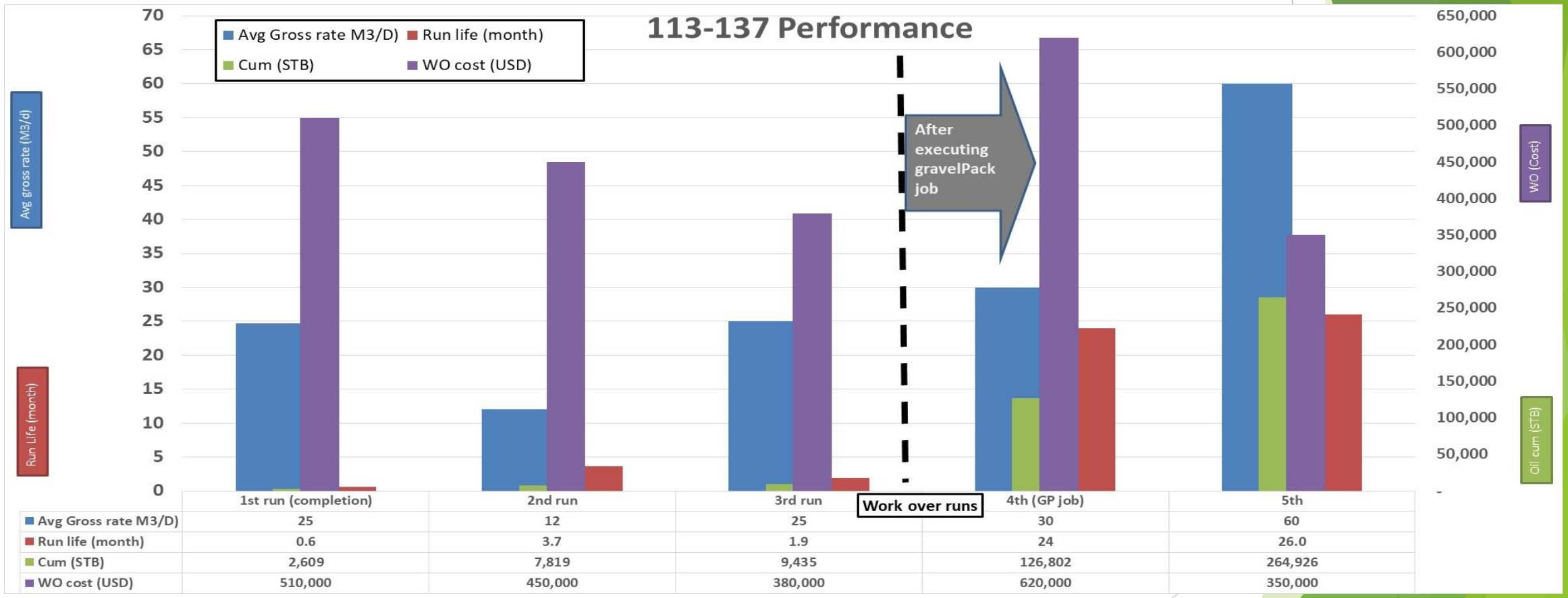
- 100% Annular packing.
- Perforation packing factor is ~ 50 lb/ft.
- 100% fluid recovery using ESP without CT
- PI >15% compared to offset wells

Case History and Results



Comparison of DH pressure Sensor including pump intake pressure and discharge pressure of different ESP runs before and after GP job

Case History and Results



	1st run (completion)	2nd run	3rd run	4th (GP job)	5th
Avg Gross rate M3/D)	25	12	25	30	60
Run life (month)	0.6	3.7	1.9	24	26.0
Cum (STB)	2,609	7,819	9,435	126,802	264,926
WO cost (USD)	510,000	450,000	380,000	620,000	350,000

Summary of Production performance for each run life / workover before and after Gravel pack jobs

Conclusions

Gravel Packing depleted well with NeutraProp has successfully achieved the following:

- 100% recovery for all pumped brine.
- Saved $50 K by eliminating the required CT cleanout run post the GP job.
- Faster clean-out compared to traditional proppant
- Increased PI by around 15% compared to offset wells.
- No Sand Production causing longer life of the ESP pump (2 years Vs. 3 months).
- Eliminating the use of alcohol/foam and its associated HSE risks

Thank You / Questions

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