Assessment of Formation Damage Potential of Corrosion Inhibitor Squeeze Applications

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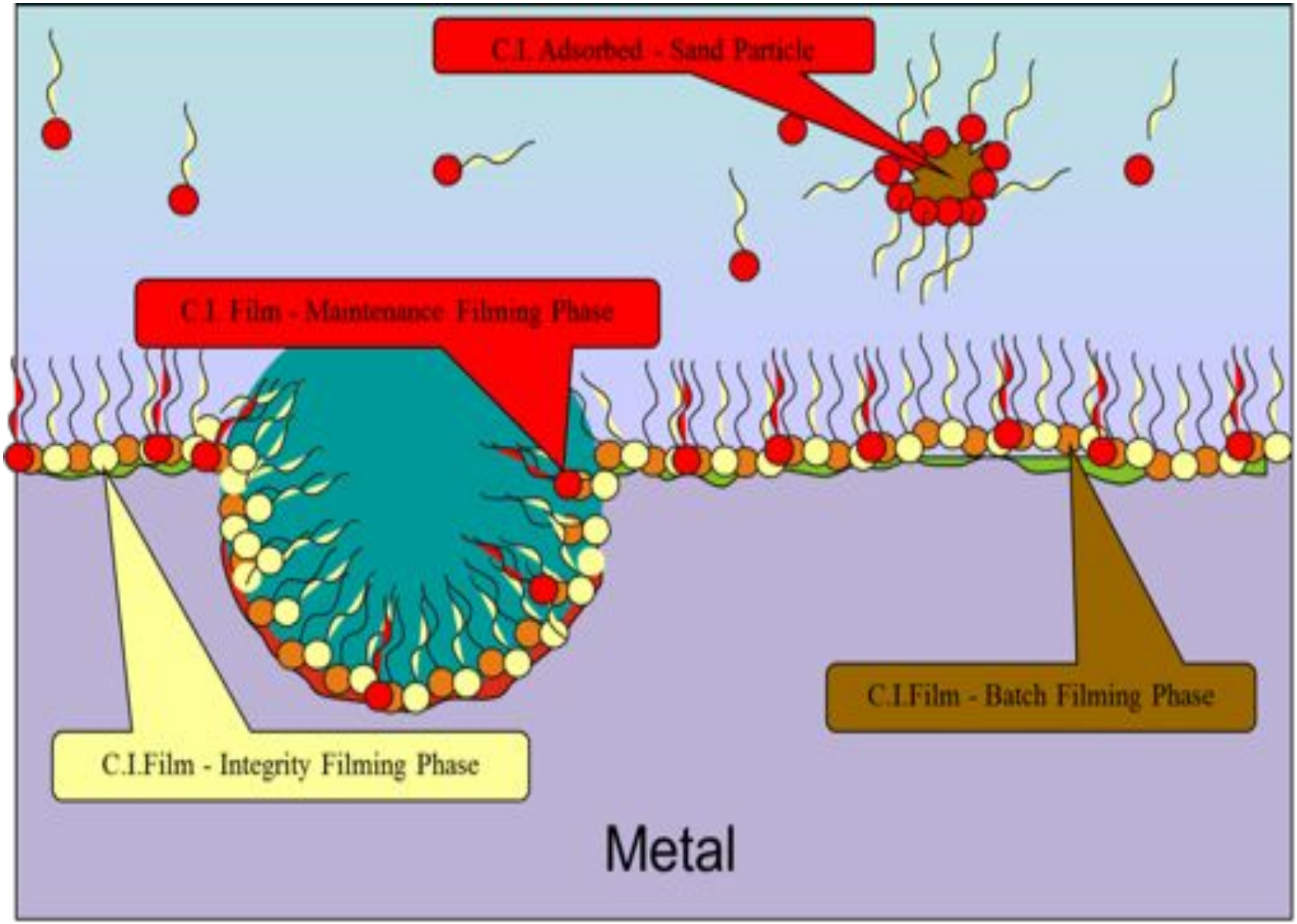
Nalco Champion an Ecolab Company

Presentation Content

- Introduction
- Details of the test methods used for “matrix” and “matrix/fracture” flow tests
- Coreflood results
- Study conclusions
- Future work
- Acknowledgments

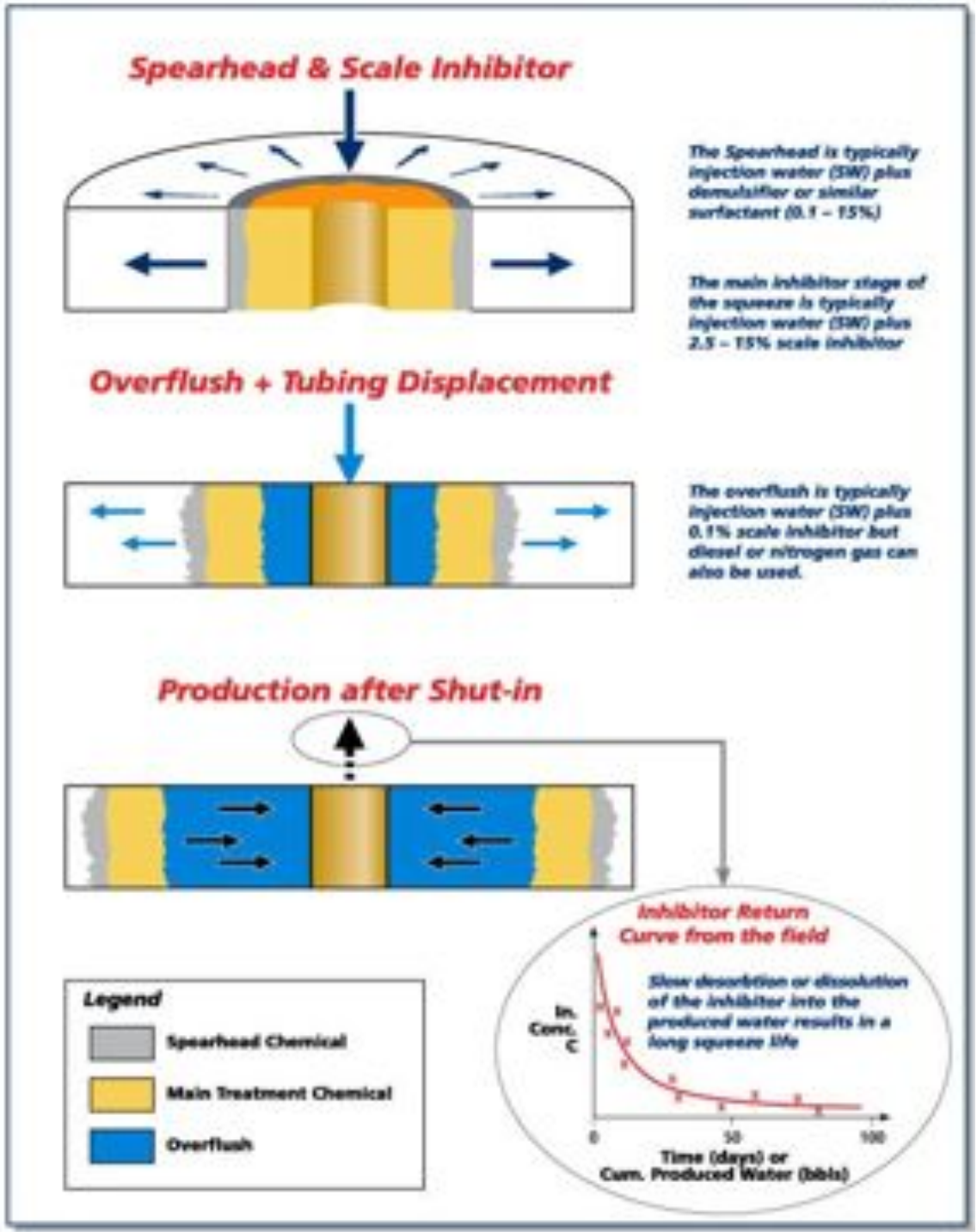
Introduction

- How are corrosion inhibitors applied (batch vs Continual) ?
- The downhole corrosion control challenge (CIV vs Batch)
- Initial CI “A” product selection and historic field application results for CI “A” squeeze treatments (SPE 137622)
- Corrosion inhibitor (CI) “A” is an Imidazoline/HAN blend


C.I. Adsorbed - Sand Particle
C.I. Film - Maintenance Filming Phase
C.I.Film - Batch Filming Phase
C.I.Film - Integrity Filming Phase
Metal

Scale Squeeze – Batch Treatment

- How does this process differ in a CI squeeze ?
- Shallow penetration depth
- Coating tubing is as important as the rock



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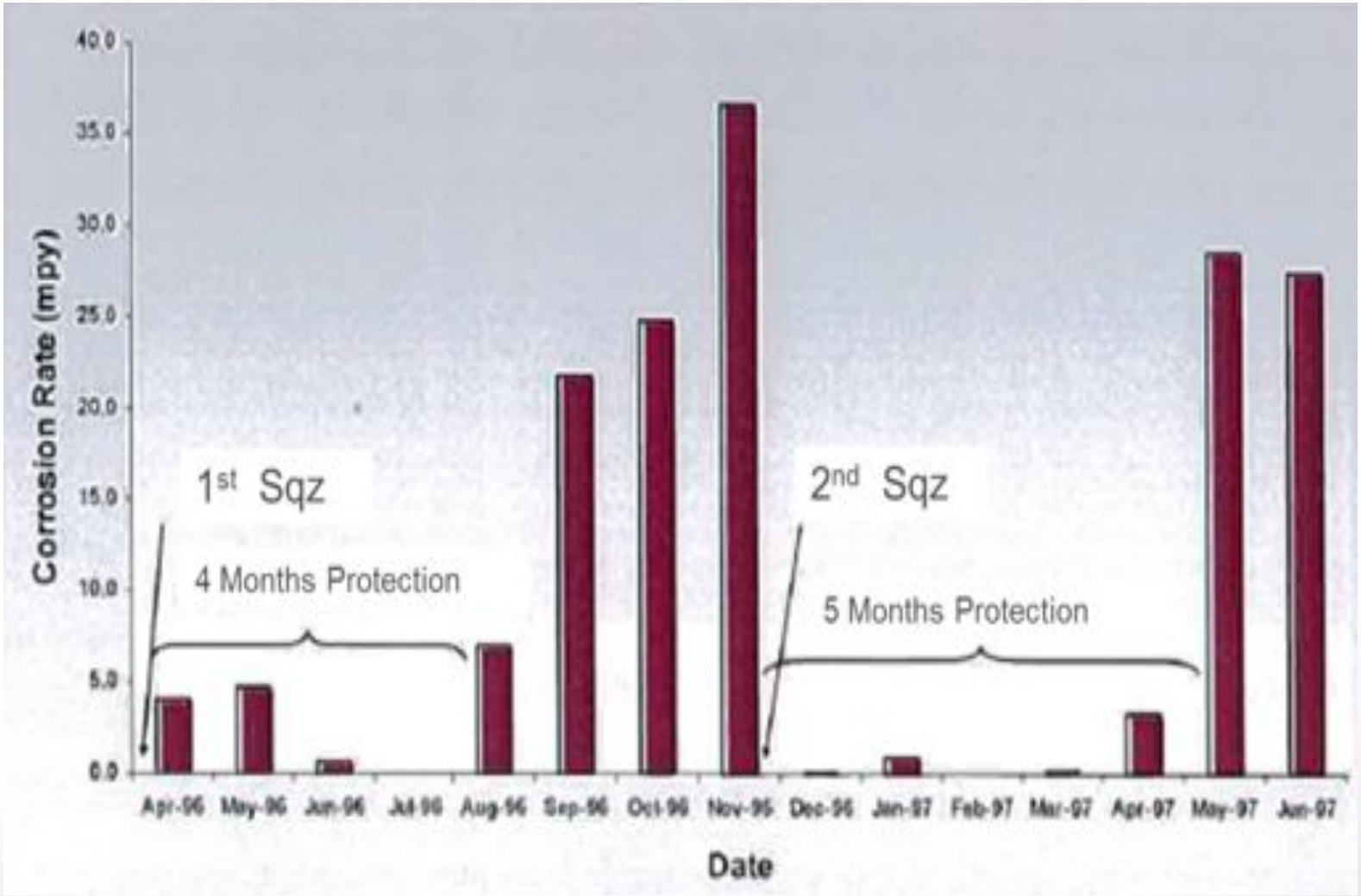
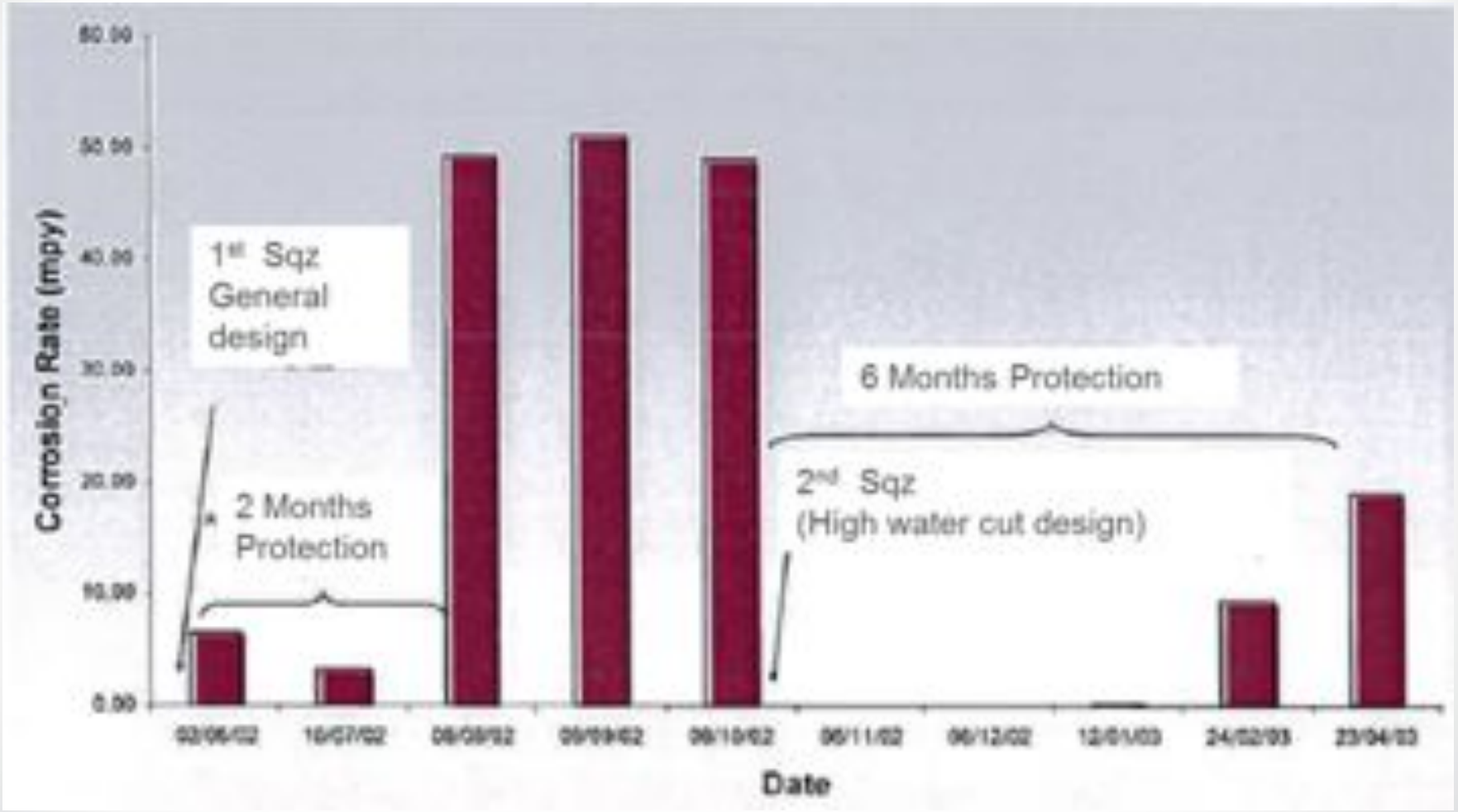
Field Performance Data – Low Water Cut



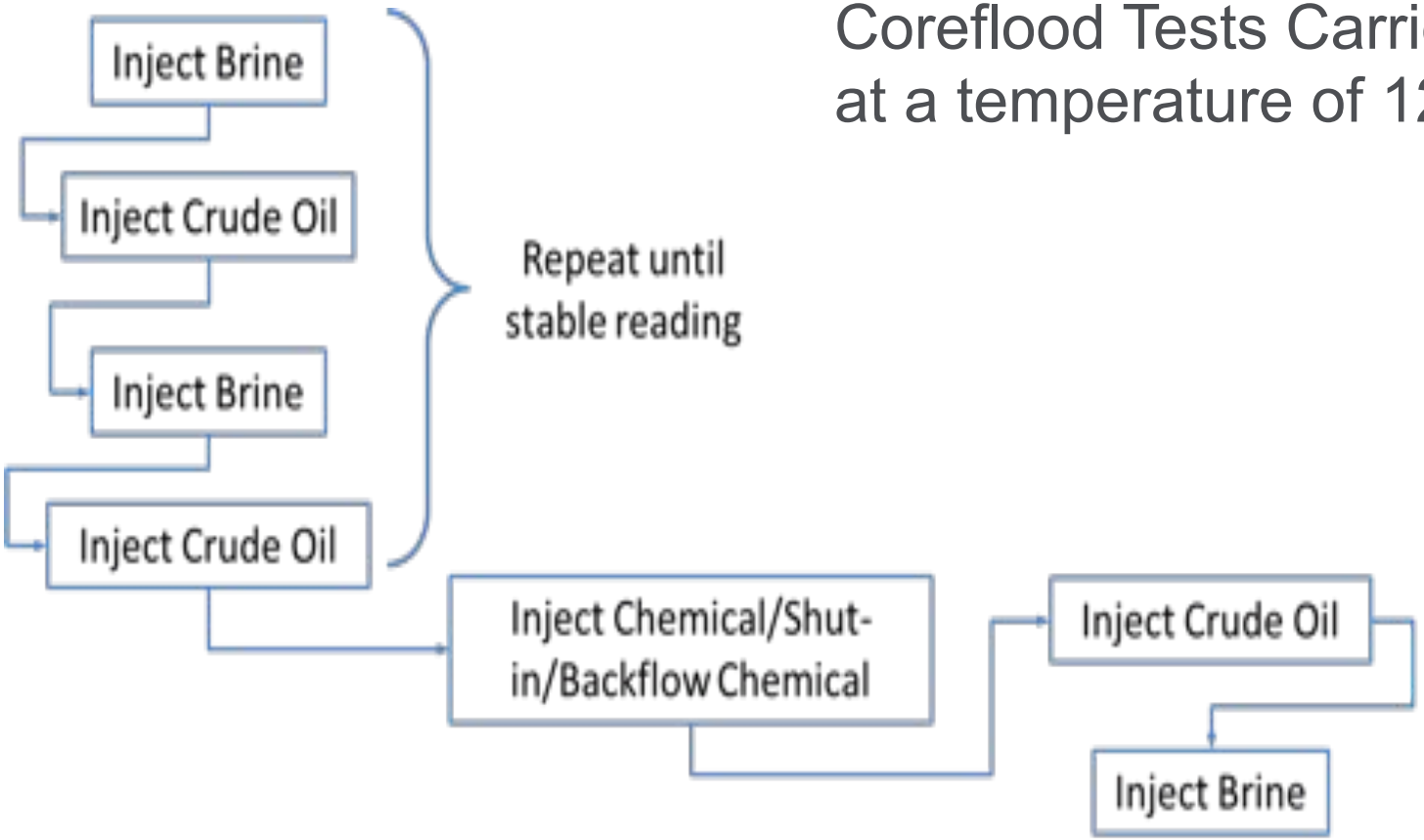
SPE 137622

Field Performance Data – High Water Cut



SPE 137622

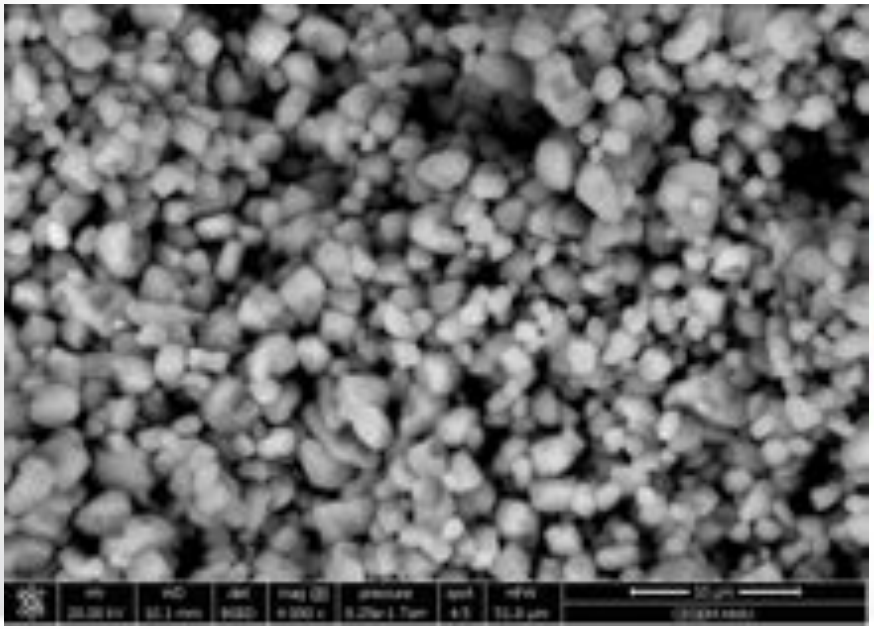
Basic Coreflood Program Concept



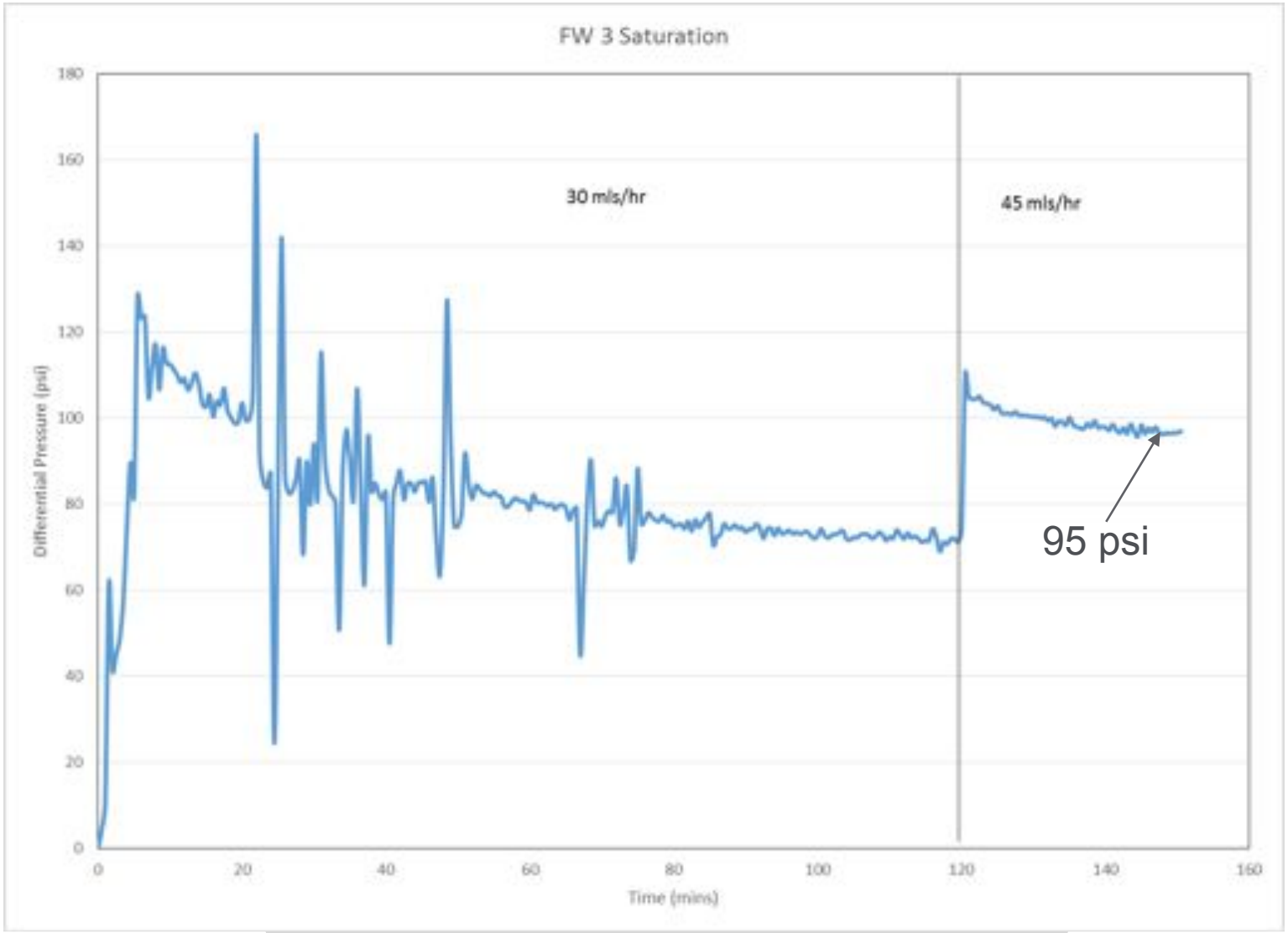
Coreflood Tests Carried out at a temperature of 125C

Check the permeability oil/water change after chemical application and flowback

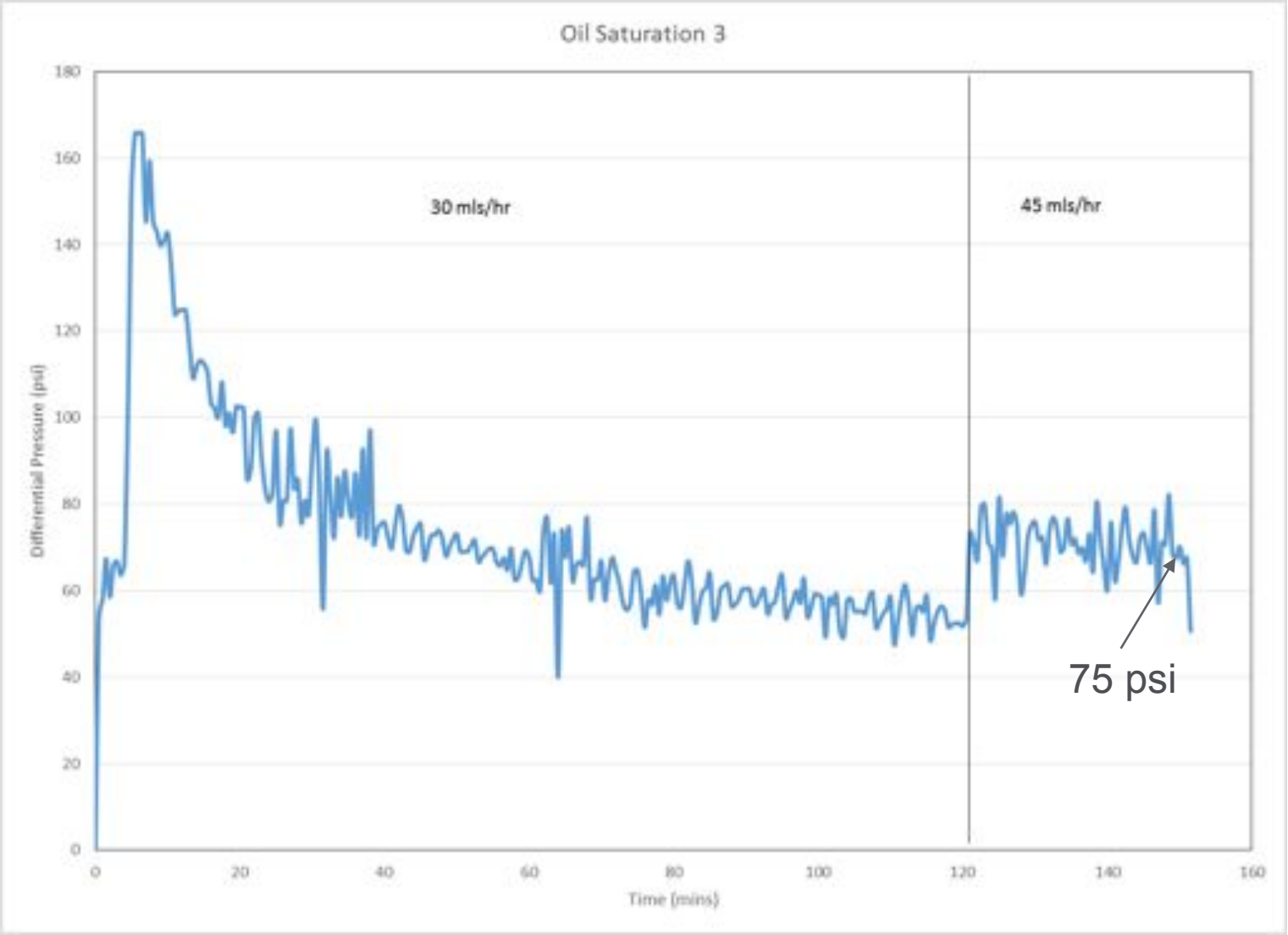
“Matrix” Flow Test



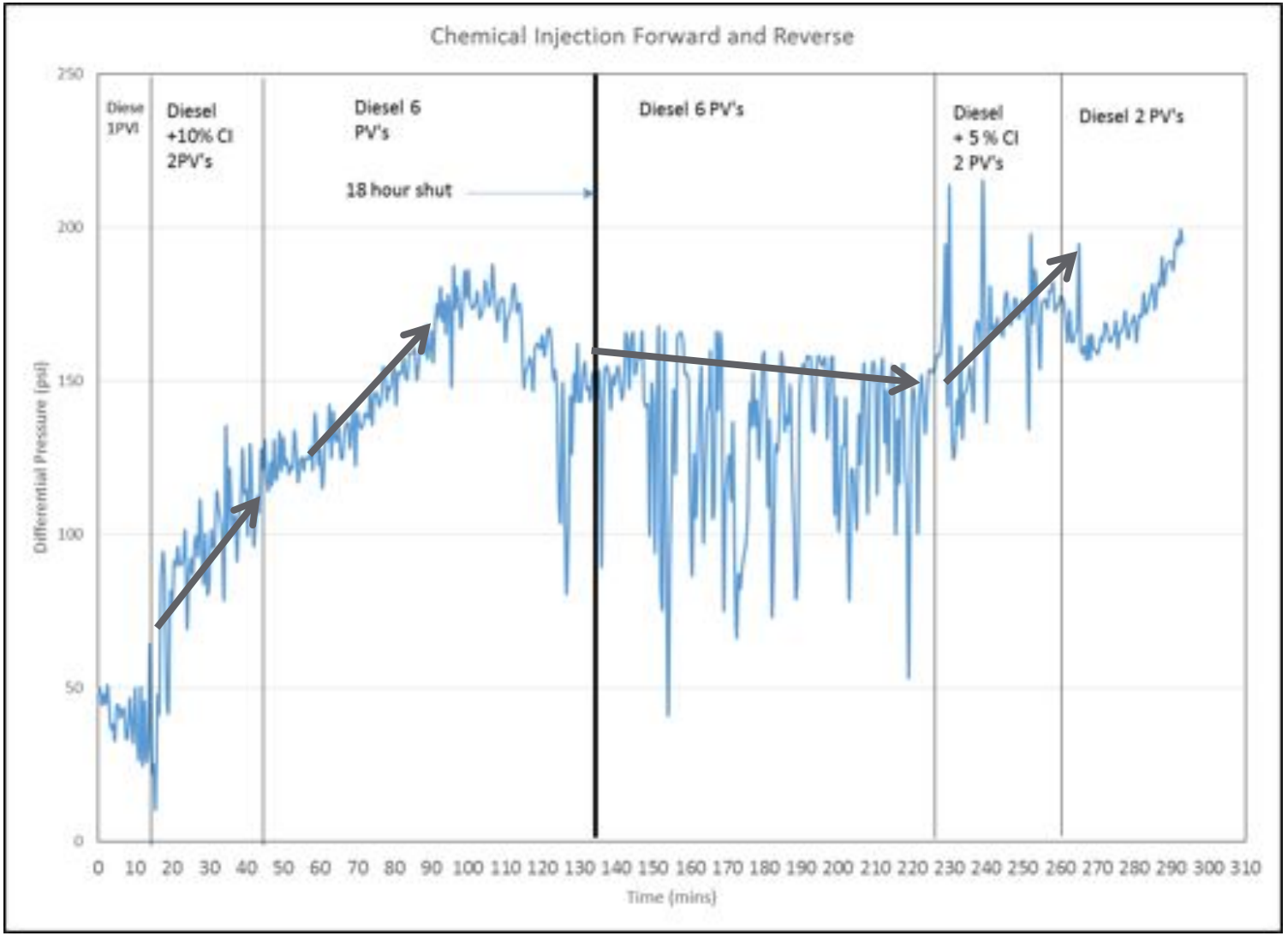
FW Saturation Cycle Pre Chemical



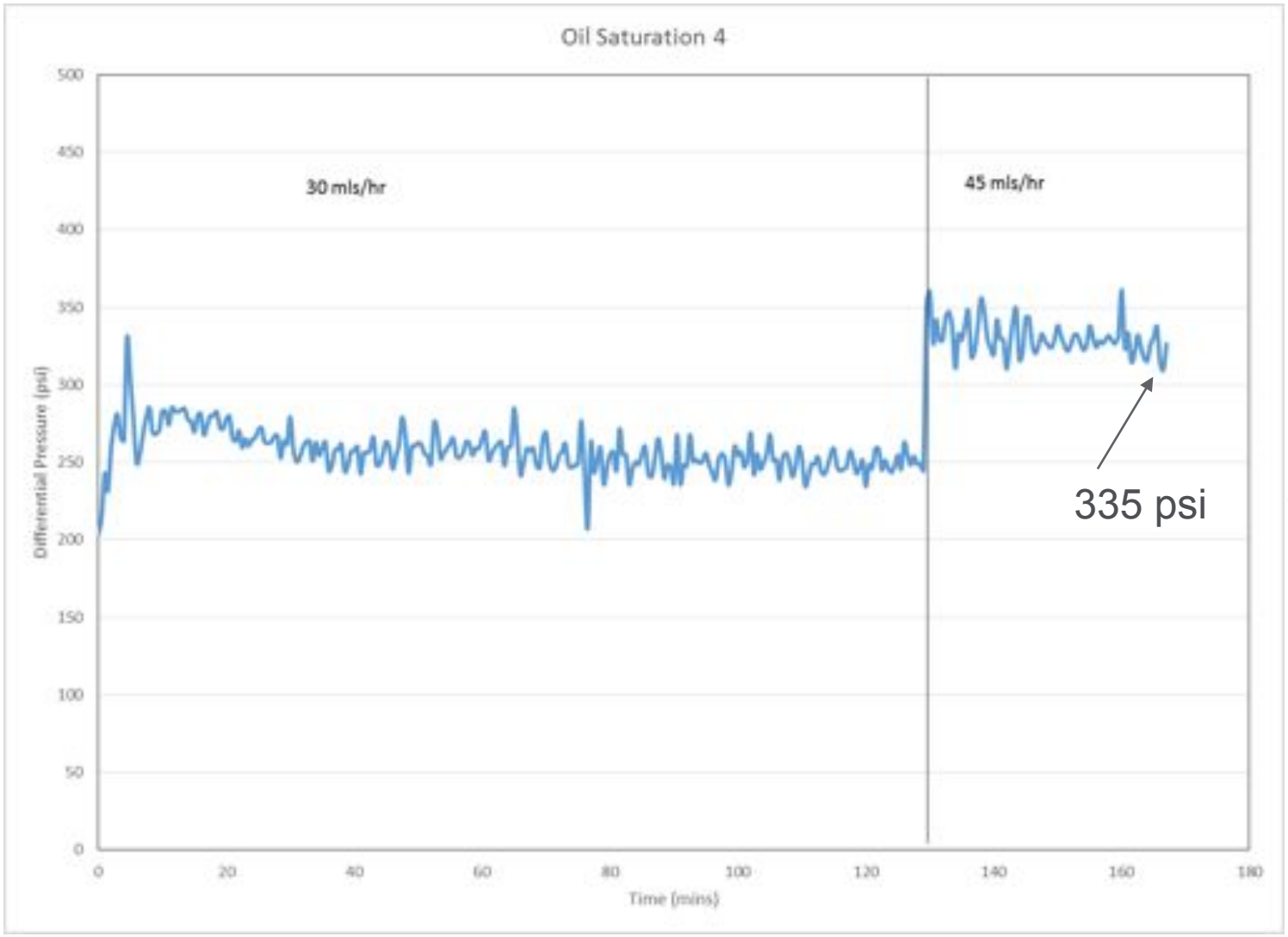
Oil Saturation Cycle Pre Chemical



Chemical Injection, “Matrix” Flow

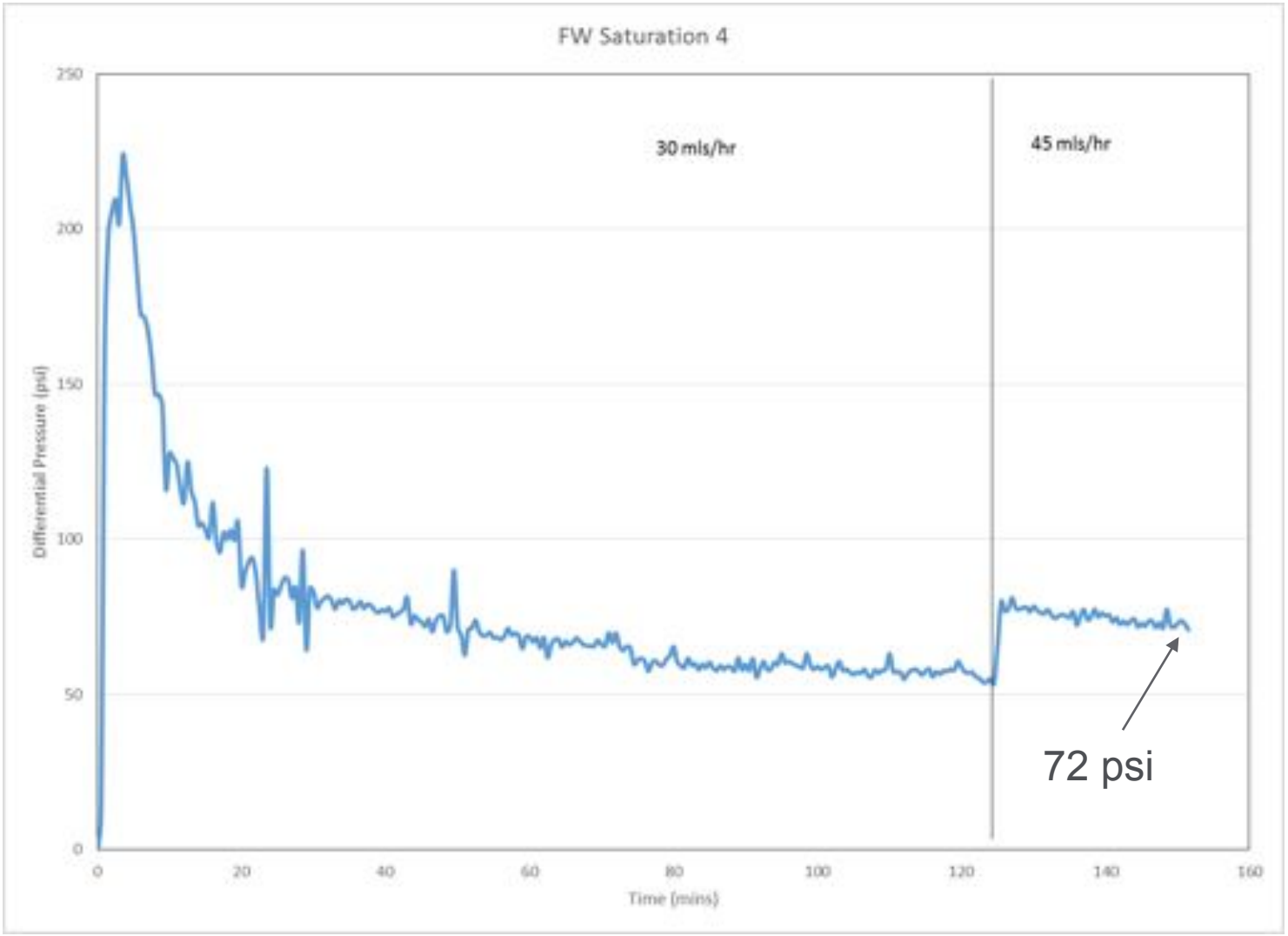


Oil Saturation Cycle Post Chemical



Pre Chemical
75 psi

FW Saturation Cycle Post Chemical



Pre Chemical
95 psi

“Matrix” Flow Test Permeability Data

Test Stage	Pereability (mD)	% Change Due to Chemical Application
FW No.3	1.4	
Oil No.3	4.3	
Chemical Injection		
Oil No.4	0.9	-78.8
FW No.4	2.1	47.9

Core shows reduced oil permeability and increased permeability to water – a negative relative permeability effect

“Matrix” Coreflood Results - Comments

- Low and higher permeability Matrix flow tests core show the following issues
- **Oil permeability is reduced**
- **Brine permeability is increased**
- Relative permeability effects are present after application of the CI via matrix flow

Are We Applying The Correct Test Method ?

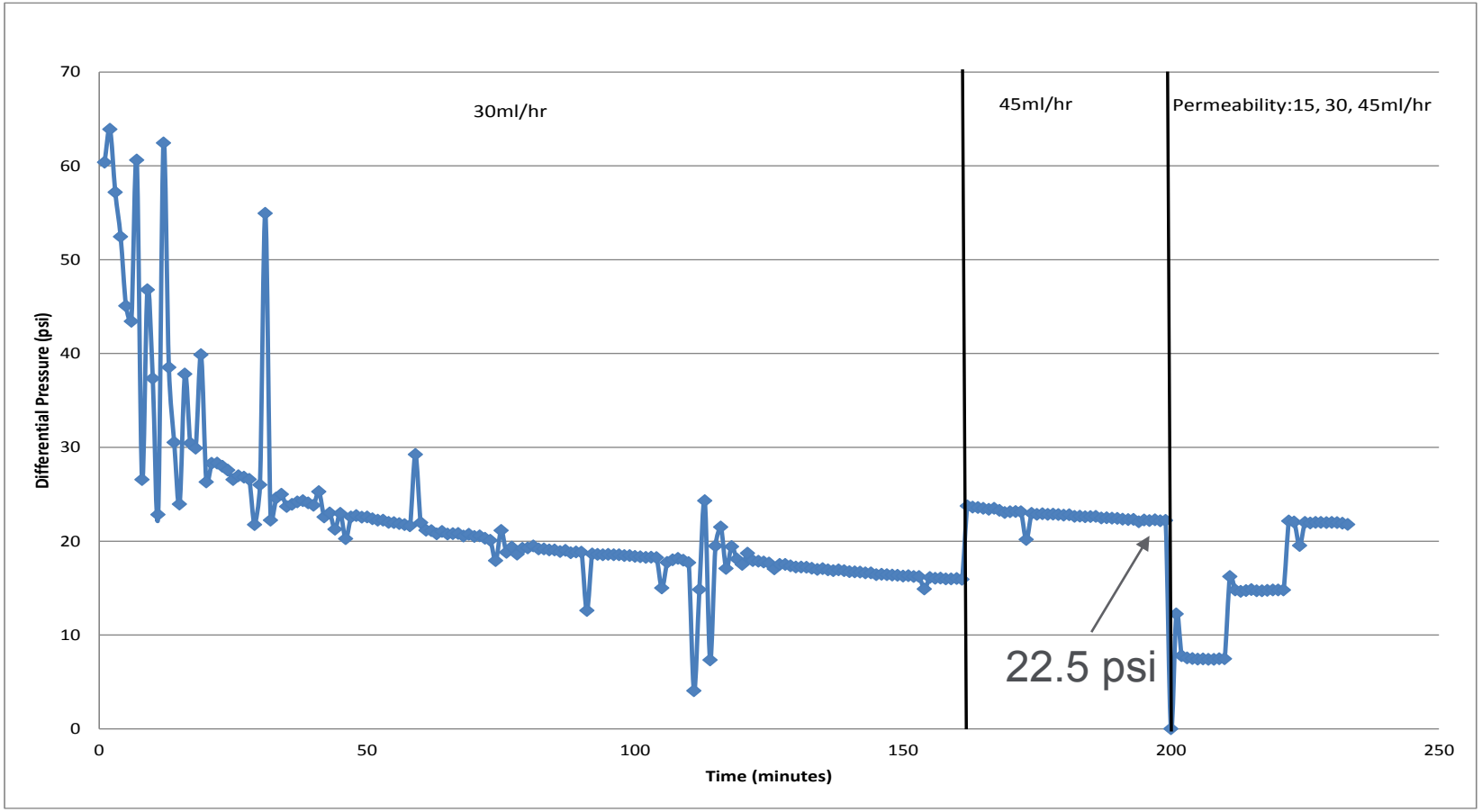
Does the Lab Test = Field Application ?

Treatment Program (SPE 137622) – Shallow vs Deep Fluid Penetration

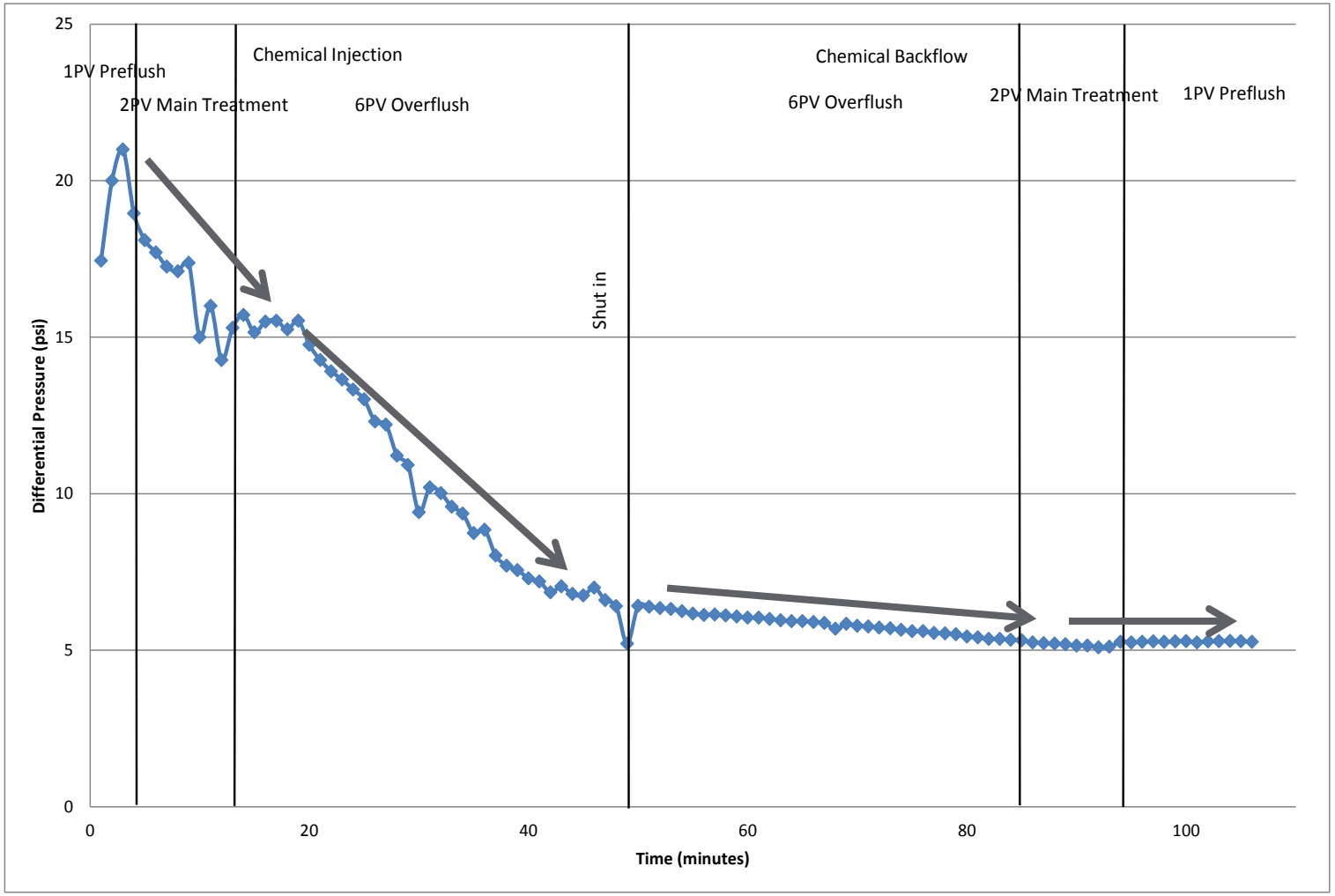
- “the calculated volume of inhibitor is bull headed as a 10% CI solution in diesel directly into the tubing string. Chemical pill is them pushed into the near wellbore formation using an overflush of one tubing volume”
- “Tubing volume” is pumped but not a “Tubing Volume” plus acid fracture volume
- Impact of the above - the CI solution may in fact have a very shallow fluid penetration from fracture face, more like a “fracture/matrix” flow test.

“Fracture/Matrix” Flow

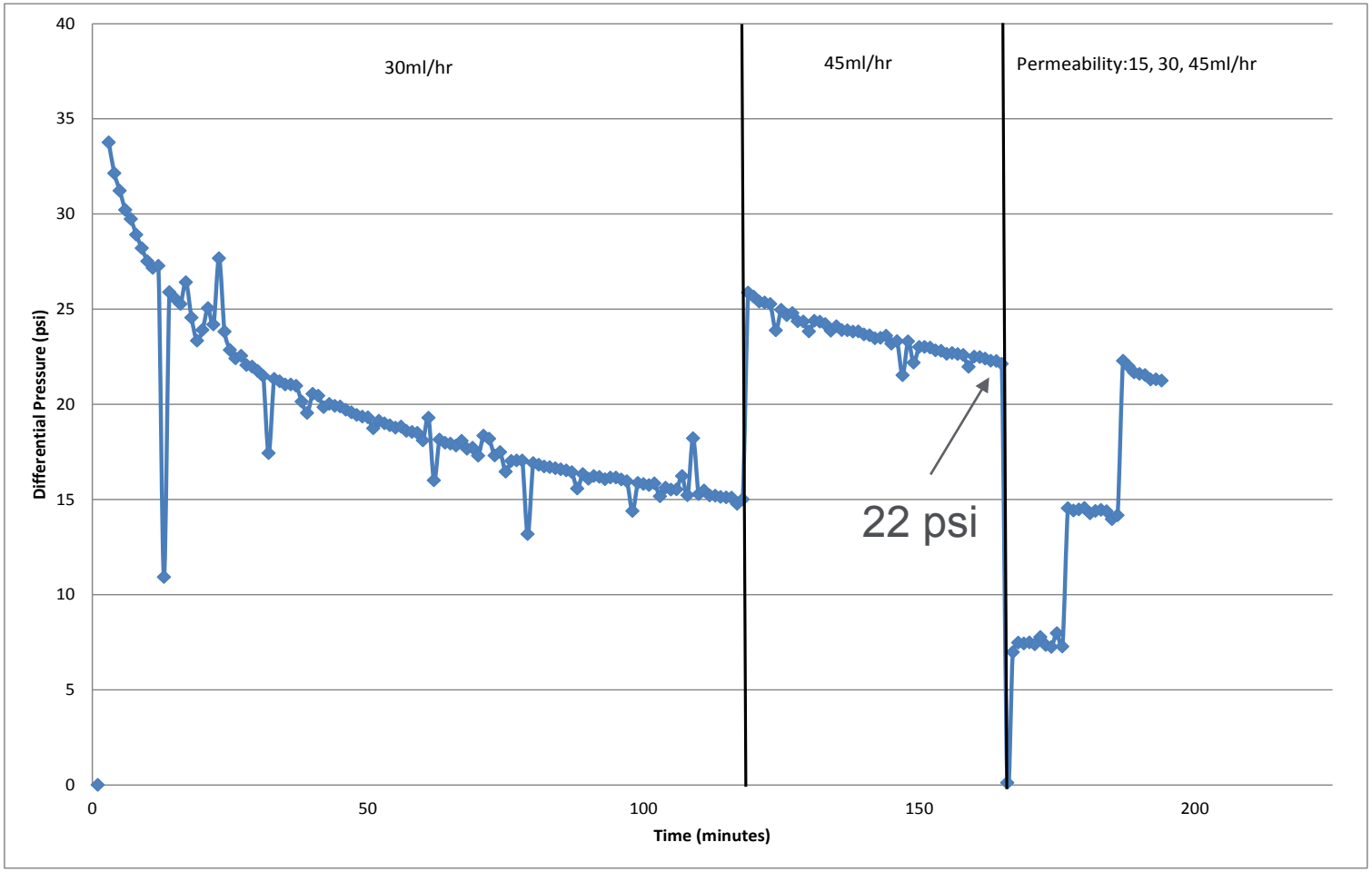
Oil Saturation Cycle Pre Chemical



Chemical Injection, Fracture/Matrix Flow



Oil Saturation Cycle Post Chemical



Pre Chemical
22.5 psi

“Fracture/Matrix” Flow Permeability Data

Test Stage	Pereability (mD)	% Change Due to Chemical Application
FW No.2	8.3	
Oil No.2	6.5	
Chemical Injection		
Oil No.3	6.7	3.2
FW No.3	8.2	-1.3

- Core with combined “Fracture” & matrix flow appears to show no reduced oil or increased brine permeability

Summary of 6 Coreflood Results

Test No.	Flow Regime	% Change in Oil Permeability Post CI-A	% Change in Brine Permeability Post CI-A
1	Matrix	-16.3	117.5
2	Matrix	-78.8	47.9
3	Fracture/Matrix	1.2	5.7
4	Fracture/Matrix	-8.8	-1.4
5	Fracture/Matrix	-5.2	-2.1
6	Fracture/Matrix	3.3	-1.3

- "Fracture/matrix" flow shows minimal relative permeability changes to the reservoir core

<10-15% change is not greater than experimental error in corefloods studies

Coreflood Study Conclusions

- “Classic” squeeze coreflood tests do not reflect the Batch CI “A” application in field treatments (acid fractured reservoirs) already published (shallow penetration depth) as no relative permeability formation damage has not been observed in the field.

- “Fracture/matrix” flow testing (flow along the fracture and some matrix flow most likely from imbibition) reflects more closely the current field treatments, show no negative impact on oil and brine permeability when Batch CI “A” is applied.

Implications

- Batch treatments of CI “A” to production tubing and filling the acid fracture volume will show no adverse impact on oil production.
- Excessive displacement beyond the tubing/fracture volume could result in wettability alteration and oil production impairment.
- It would appear that it will not be possible to extend the CI squeeze lifetime via matrix displacement (classic squeeze optimisation step) of the chemical “A”.
- Optimsation is still possible by filling the acid fracture volume and so exposing the CI chemical the full surface area of the reservoir rock within the fractures.

Future Work

- Development work is ongoing to find effective film forming corrosion inhibitors that dose not impact the relative permeability of the rock.

- An alternative approach under review is to develop a two stage treatment with a non-damaging squeeze CI applied to the reservoir prior to a film forming CI “A” being applied only to the tubing.

Acknowledgments

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