inflow control

Making Better Wells®

Enhanced Oil recovery by controlling the water production with the Application of Autonomous Inflow Control Valves: A Case Study.

Ismarullizam Mohd Ismail, Phd
Vice President Subsurface
InflowControl AS

Devex 2023, Aberdeen, UK
June 20th, 2022

DEVEX 2023

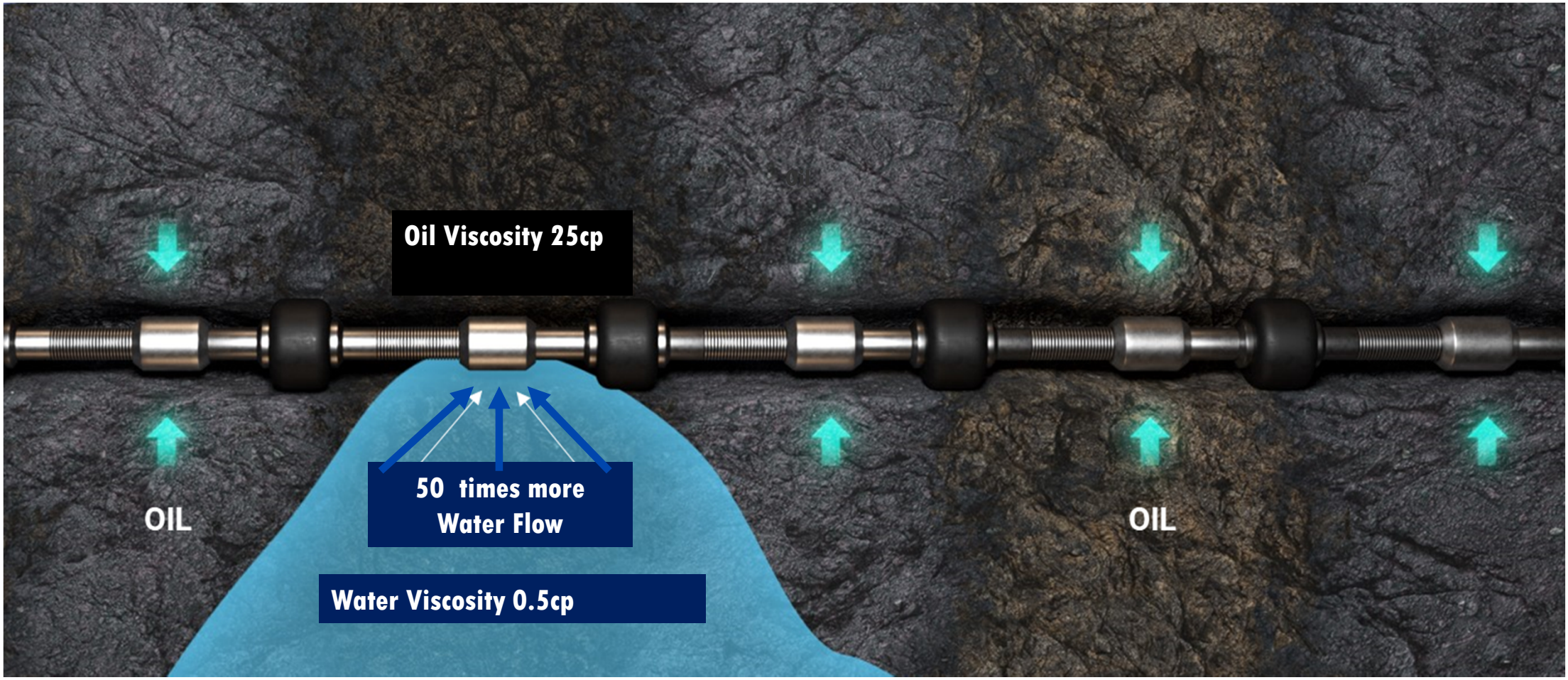
Contents

Field Description

South America Fields

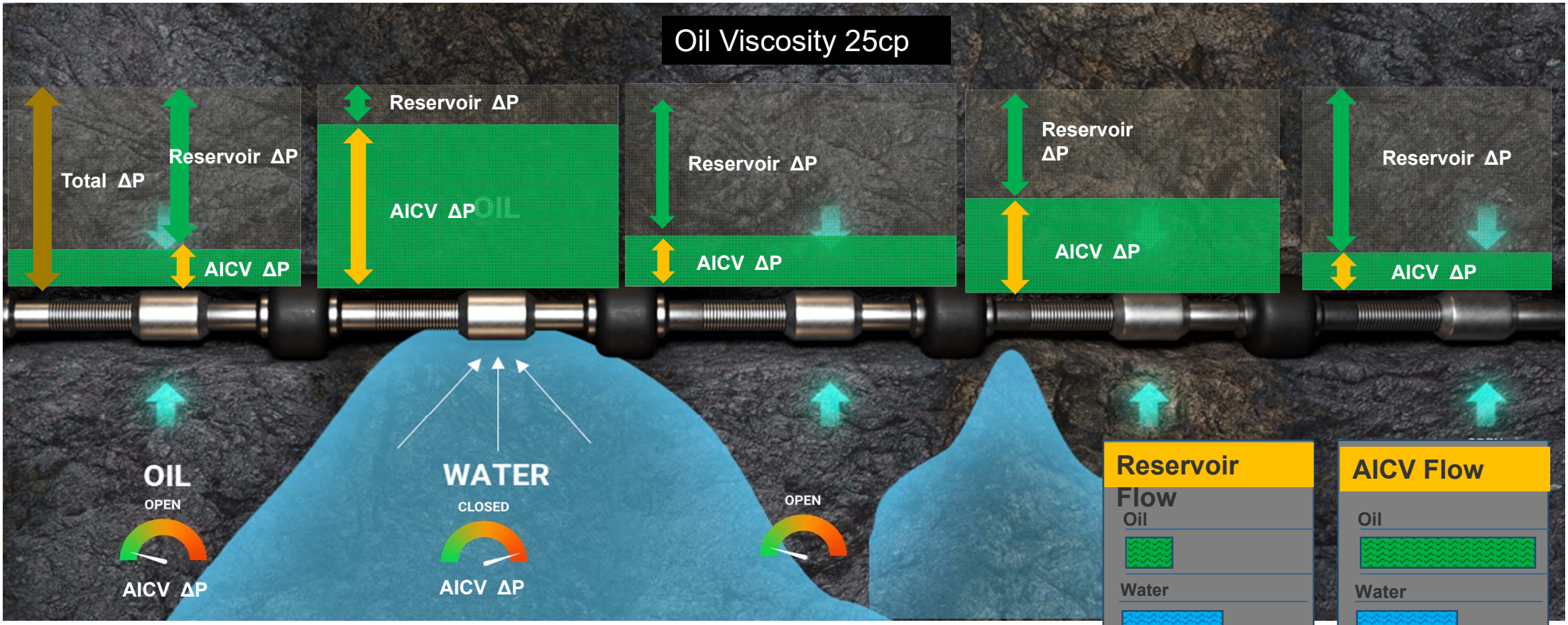
- Discovered in 1992
- Production mainly from Formation with 17° - 19° API
- Consolidated Sandstone
- Permeability: 1 – 5 D
- Recent wells: 1,000 – 2,500 ft horizontal sections

Reservoir Challenge: Horizontal well



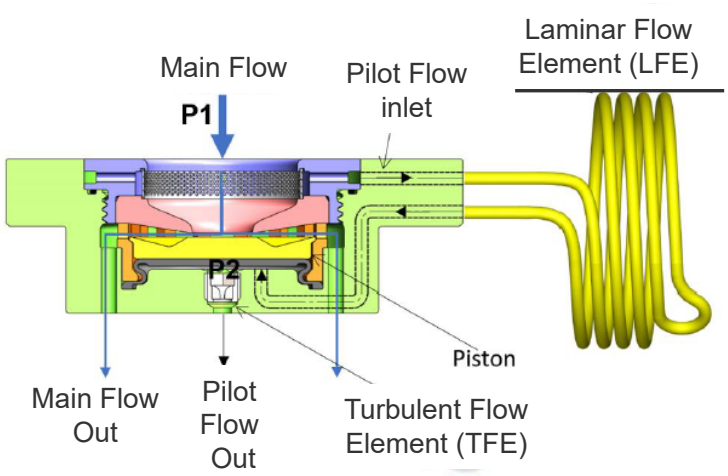
Mobility Ratio: When Water Breakthrough, it flow 50 times more

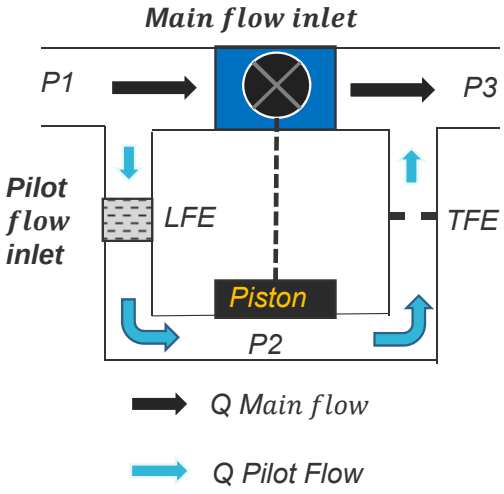
Reservoir Challenge: Horizontal well

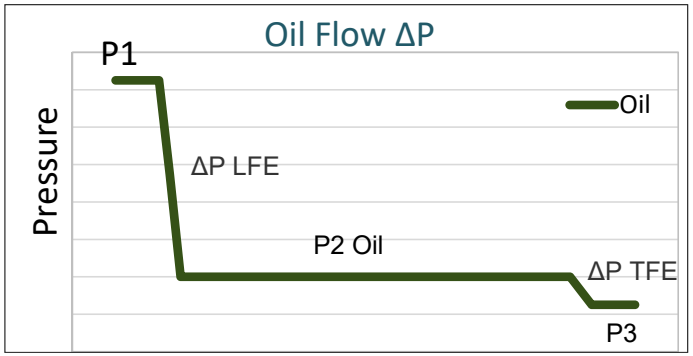


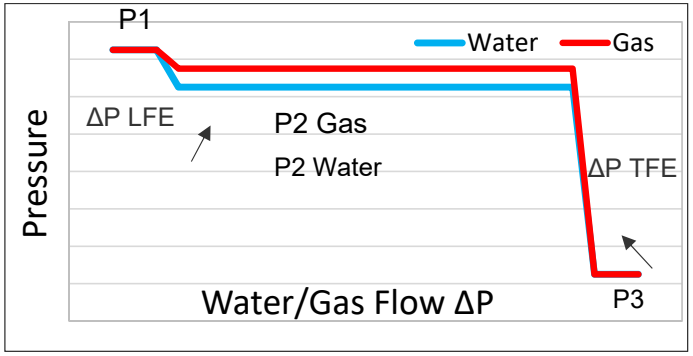
Total Drawdown = Reservoir ΔP + Inflow Control Technology (AICV) ΔP

AICV Principle









$$(LFE)\Delta p = \frac{32\,\mu\,v\,L}{D^2} \qquad (TFE)\ \Delta p = \mathrm{k}\cdot\frac{1}{2}\rho v^2$$

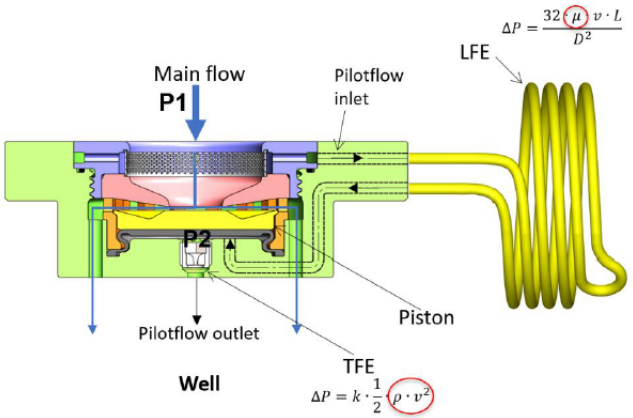
ΔP = Differential Pressure
μ = Viscosity
L = Length
D = Diameter
V = Velocity

$\rho = Density$
$k = Drag\ coefficient$
P1 = Inlet Pressure
P2 = Piston Pressure
P3 = Tubing Pressure

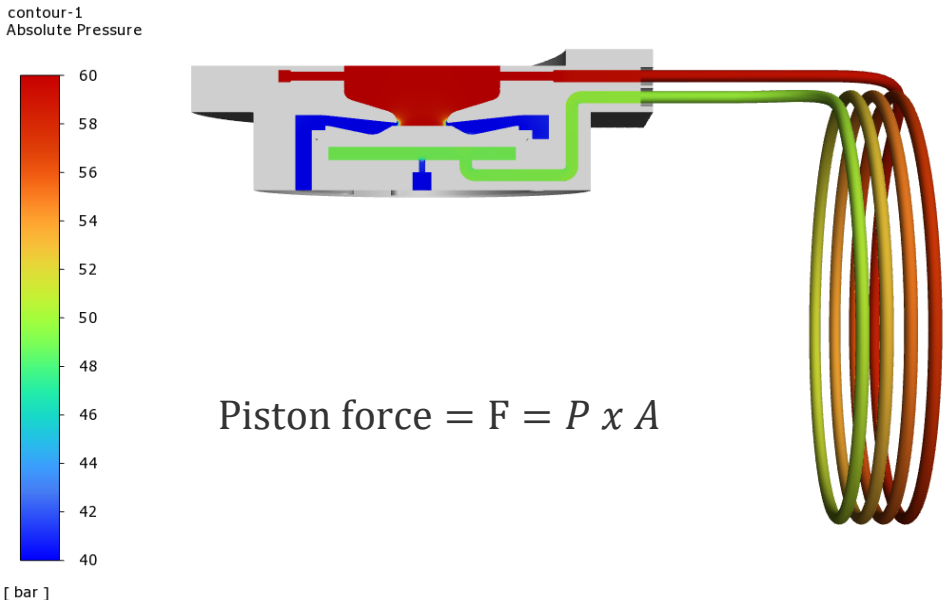
Main Flow choke/close when low viscosity fluids flow through pilot flow

Ref: SPE145737-MS, IPTC-21450-MS

AICV Principle

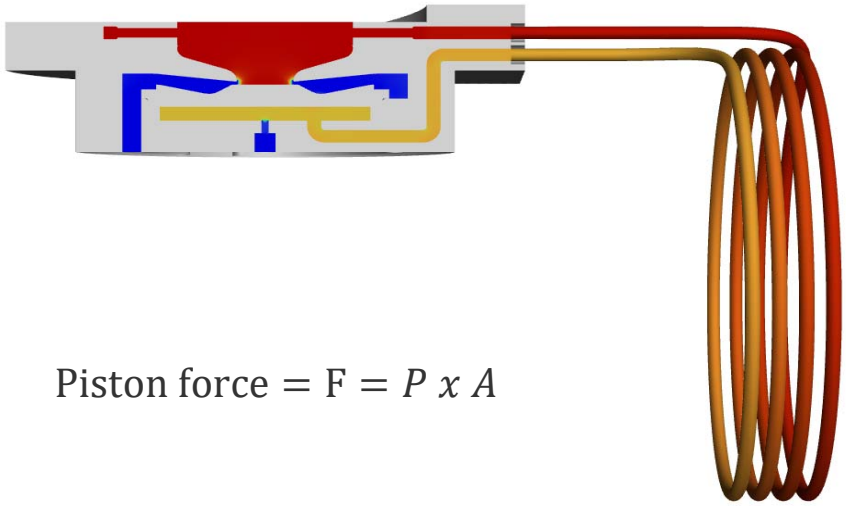


Oil - 5 cP:



Piston force = F = $P\ x\ A$

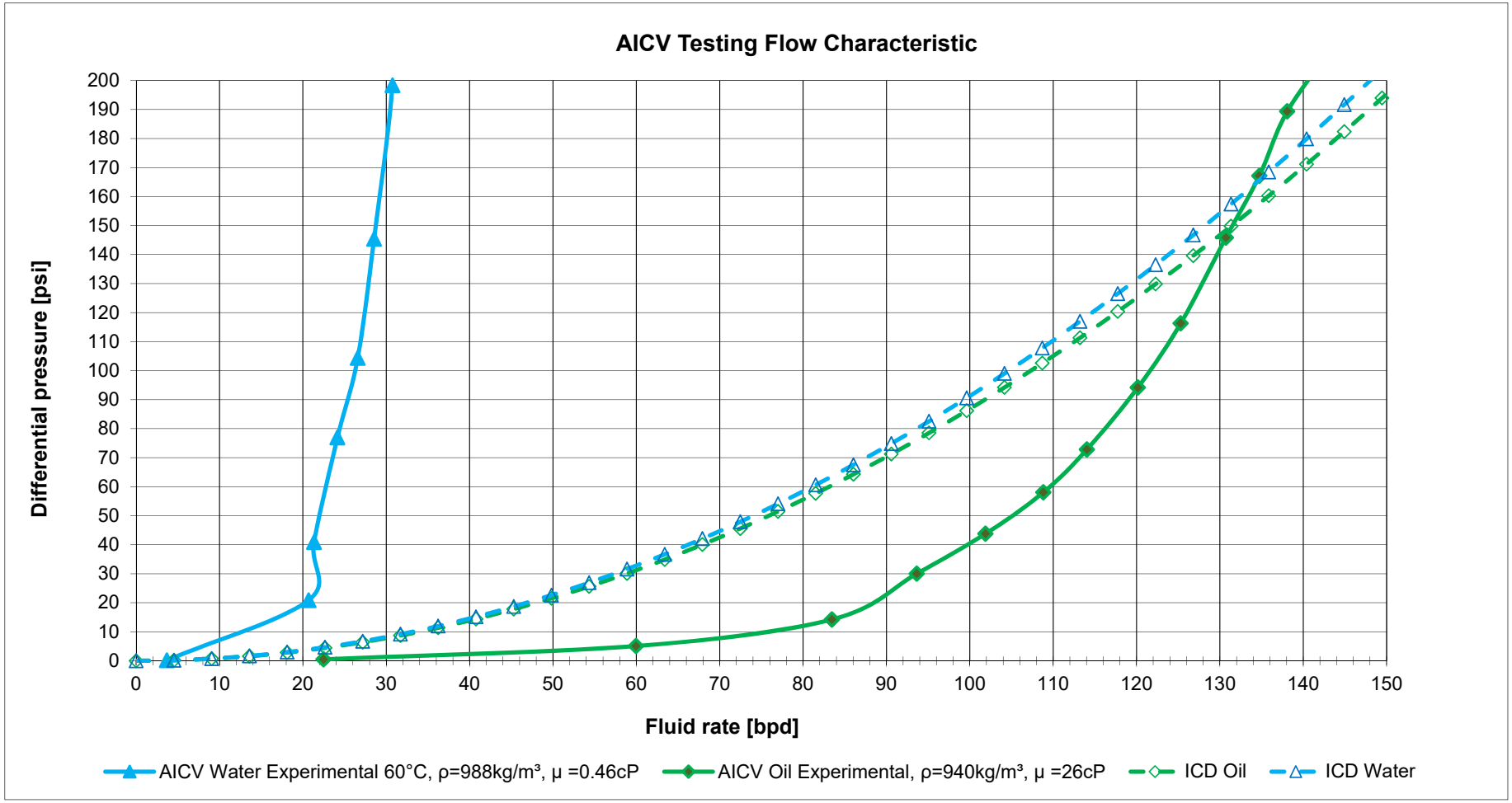
Water - 0.5 cP:



Piston force = F = $P\ x\ A$

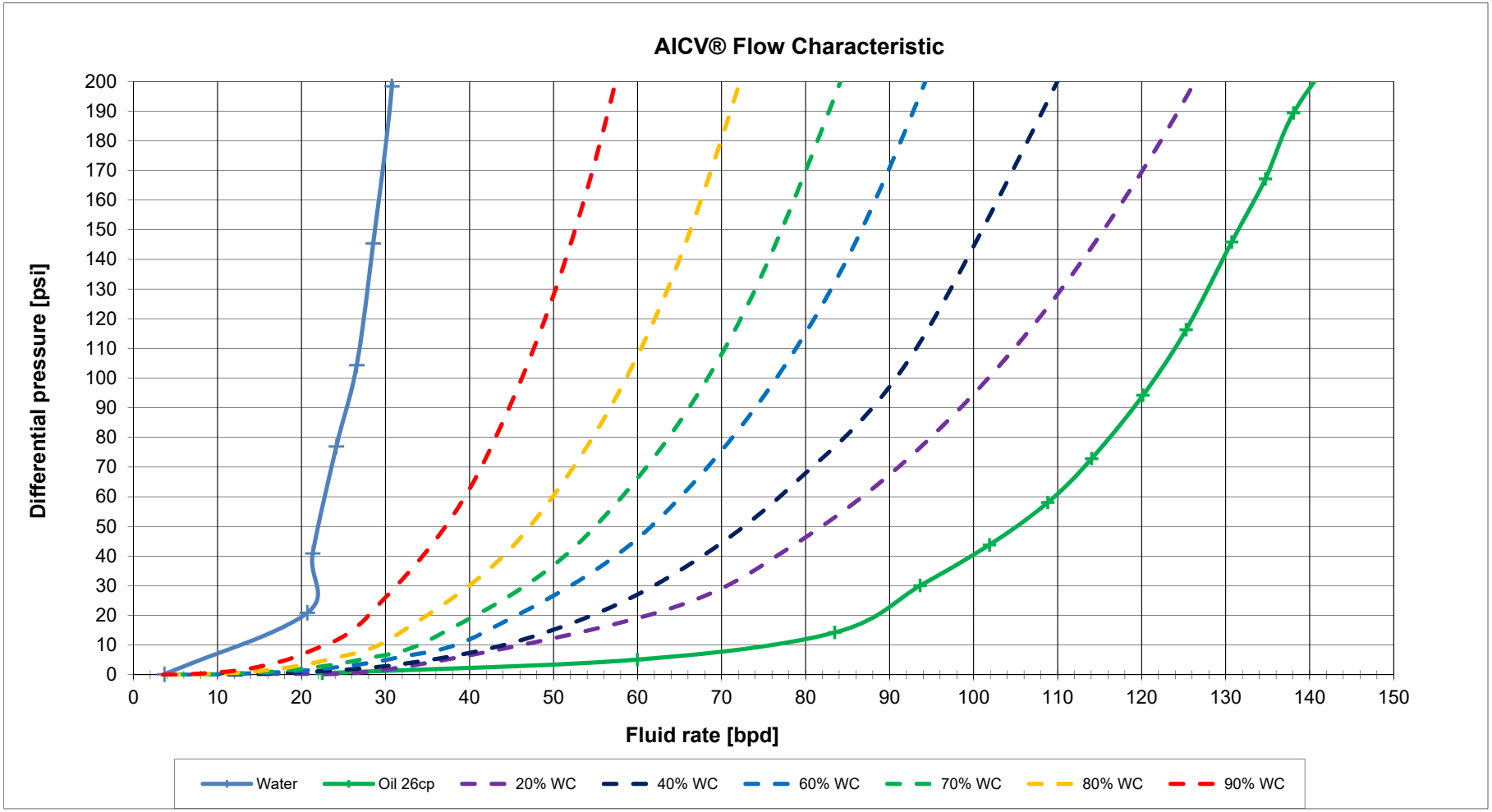
High pressure under the piston push the piston to close position

AICV vs ICD Testing at 25cp Oil



AICV choke the water when breakthrough

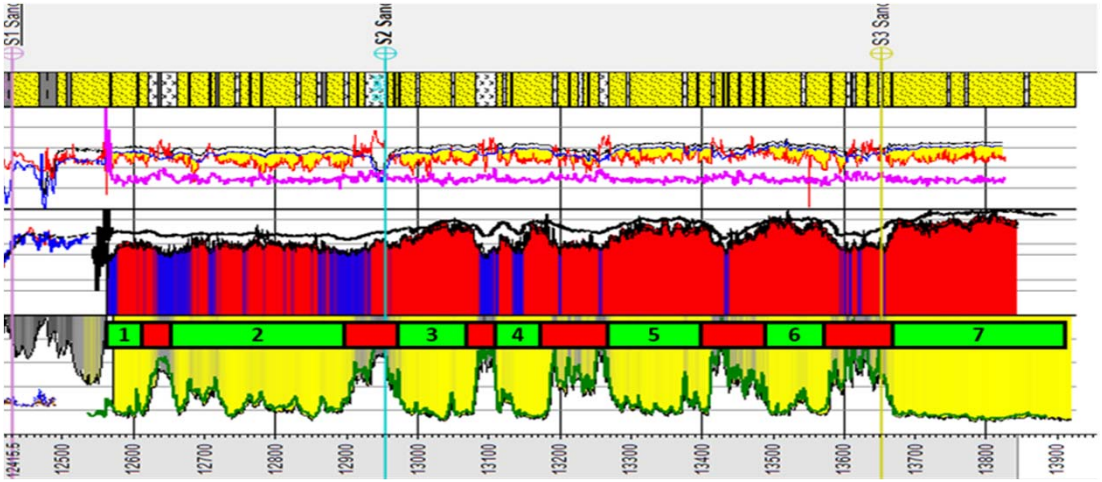
AICV Performance in Multiphase

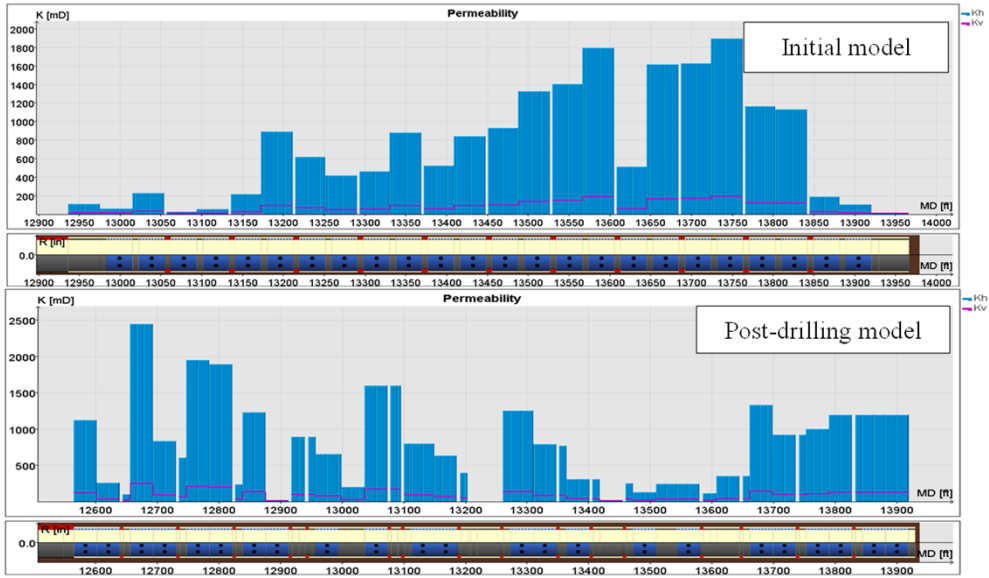


AICV choke when water cut increase

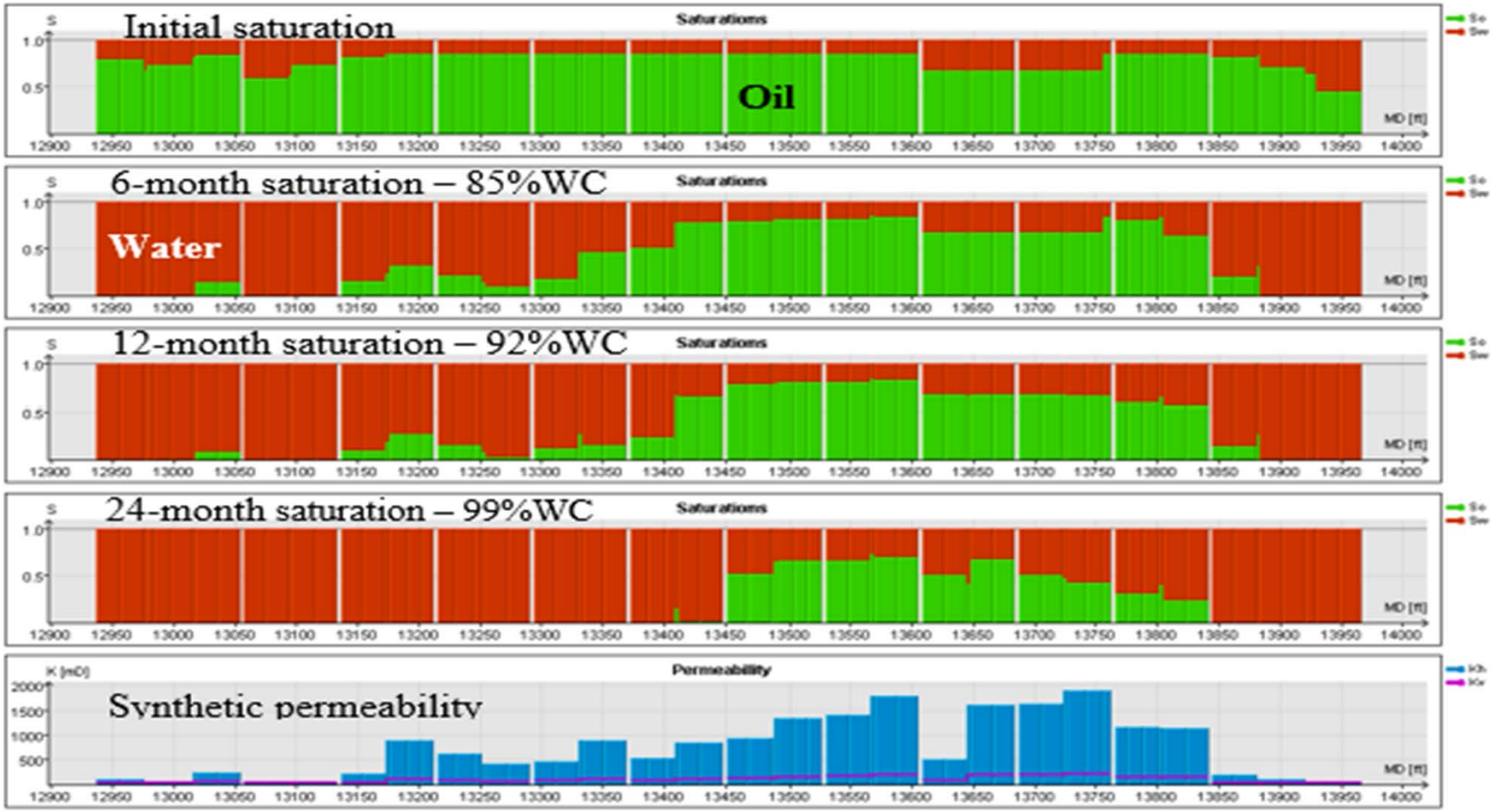
Well Completion Design and Operations

- LWD logs used to calibrate the model
- Horizontal section of 1,361 ft (300 ft extra compared to modelling)
- 2 faulted sections straddled





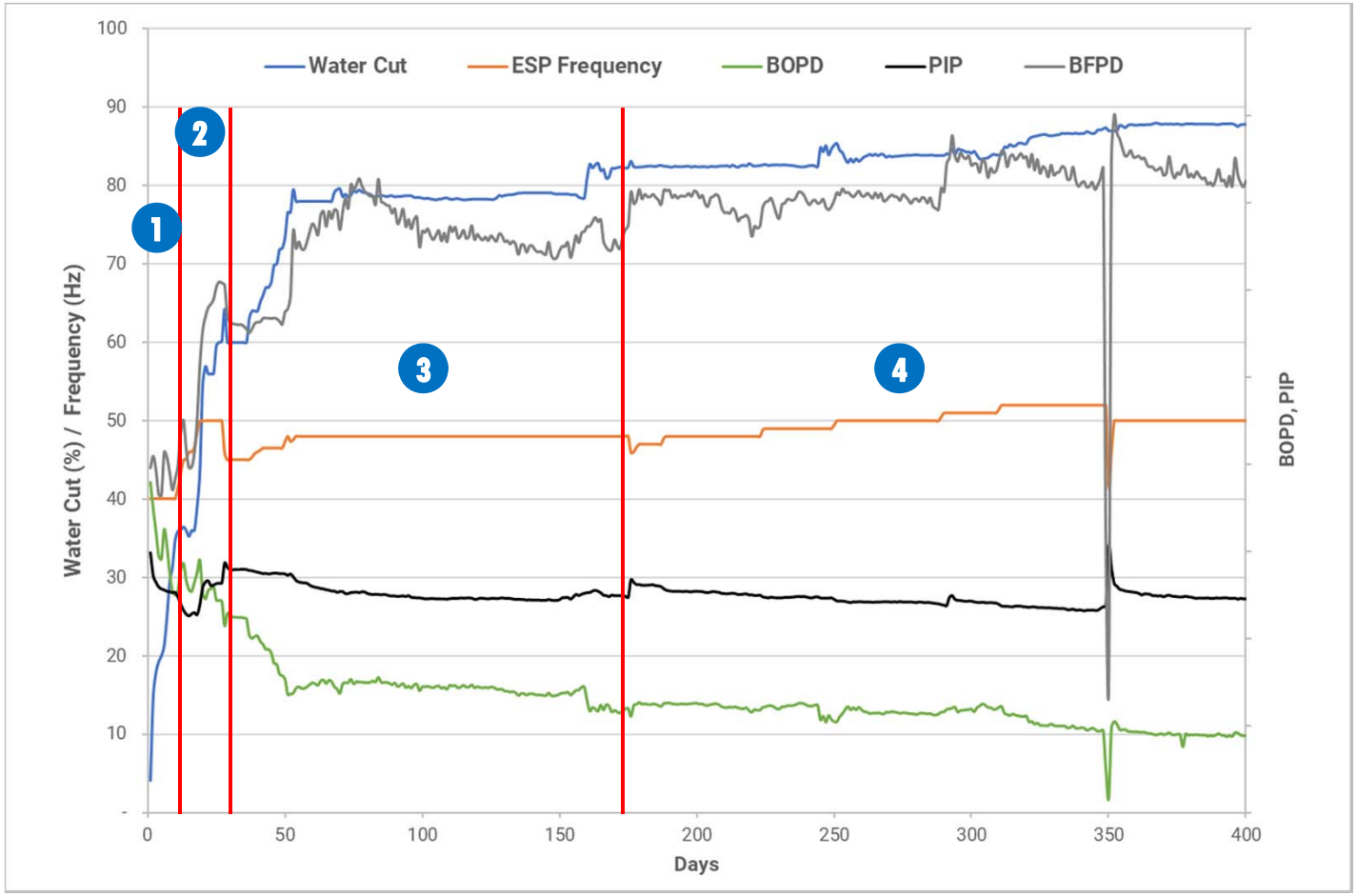
Reservoir Modelling



Well saturation over time

Production Results

1. $WC_{initial} = 4\%$
2. Emulsion window
3. WC stabilization
4. ESP frequency increases

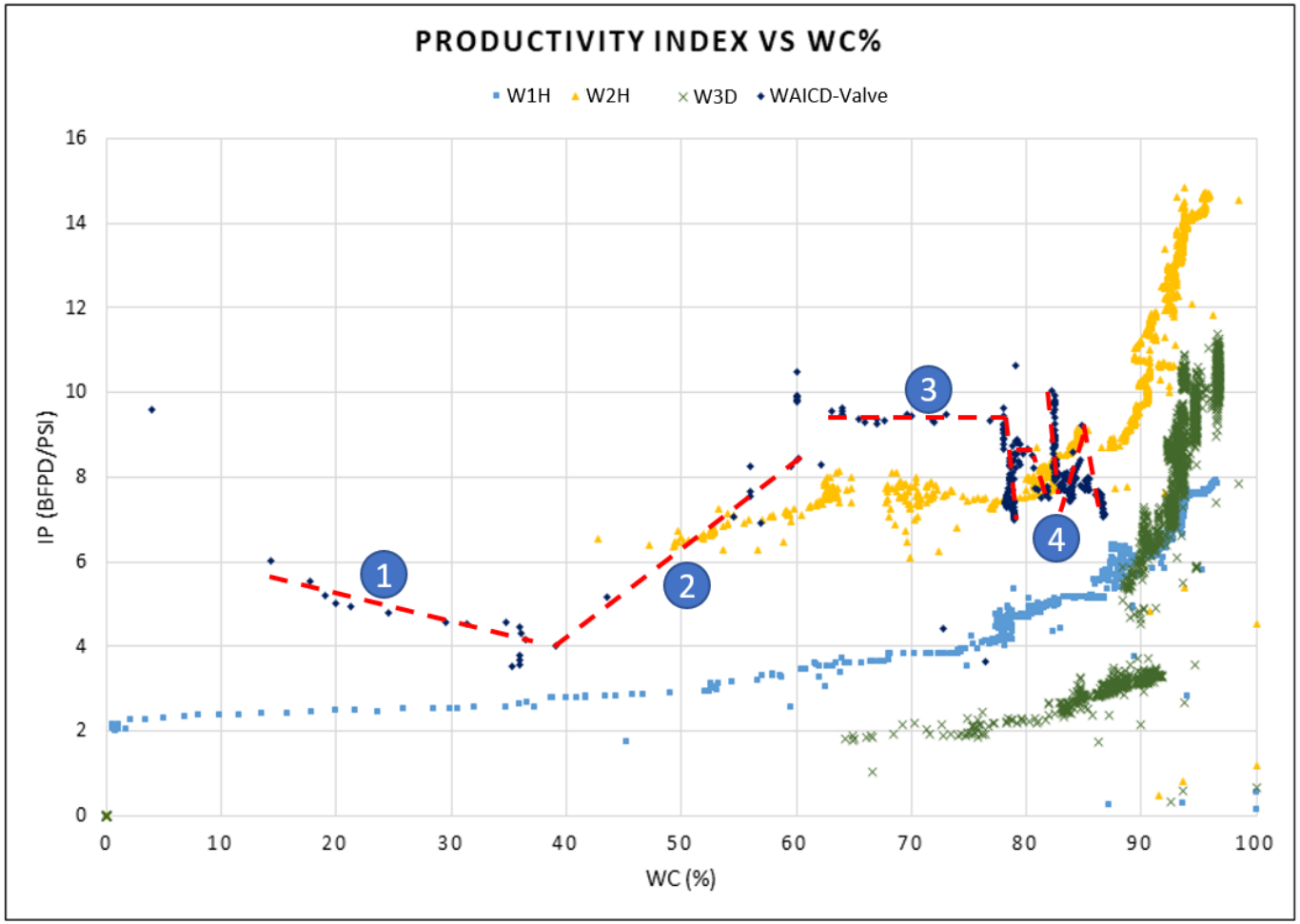


Production Results

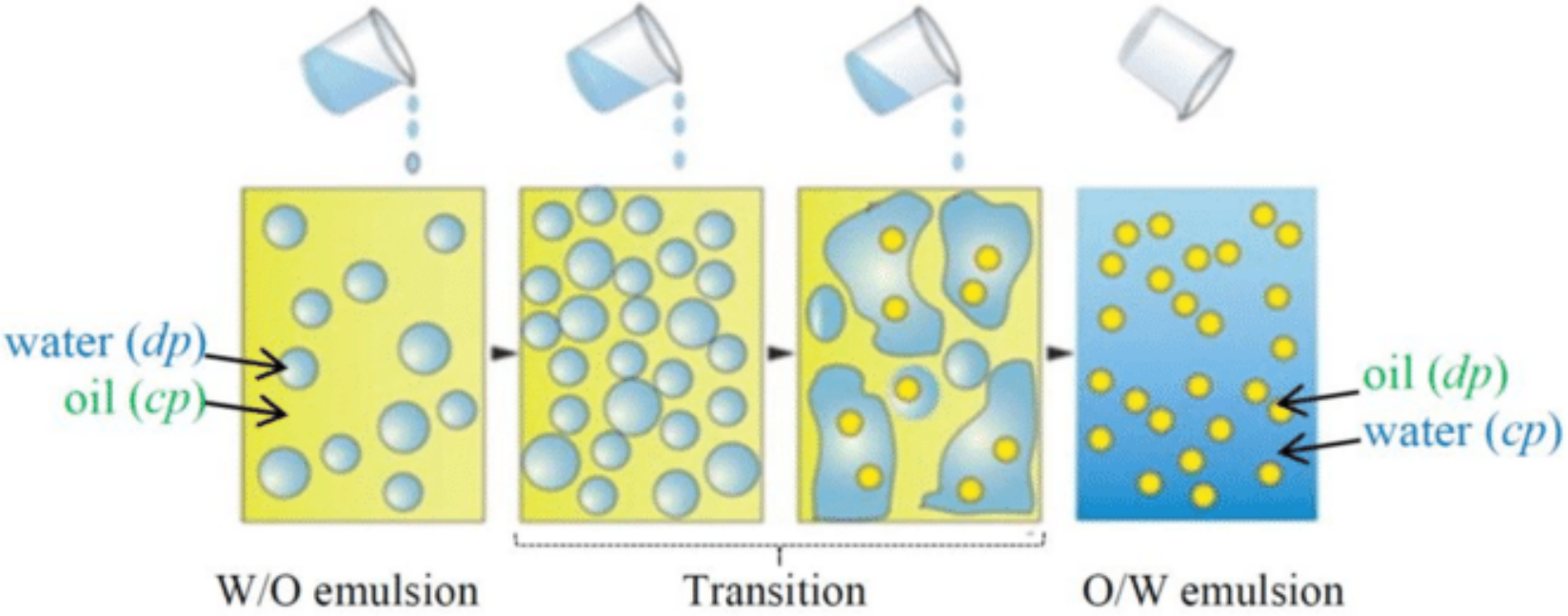
1. Well start-up
2. Emulsion window
3. PI stabilization
4. ESP frequency increases

Compared to SL/ICD/AICD completions

- 3x-5x less water
- 3x-4x more oil

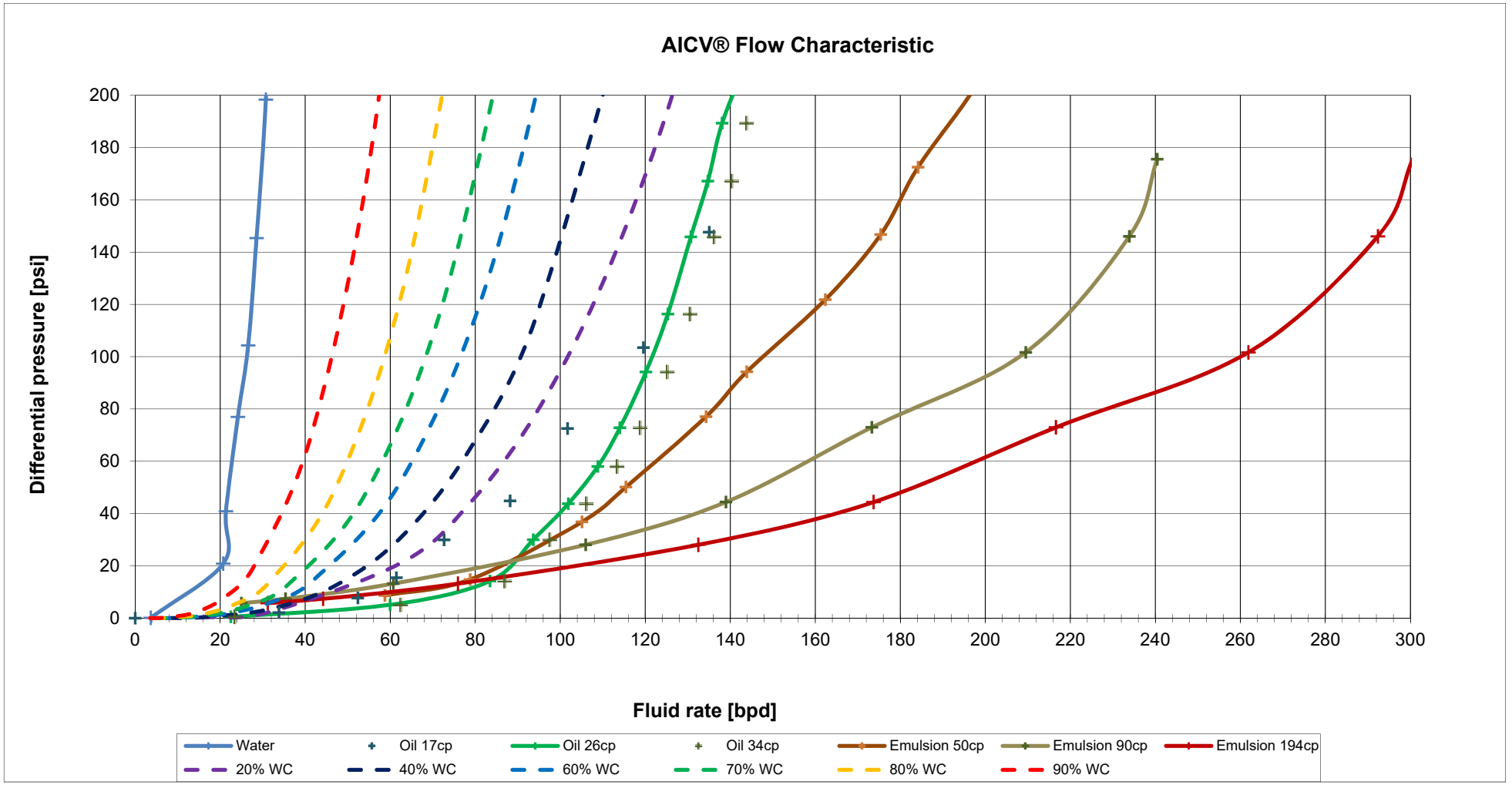


Lessons Learned



a) O/W emulsions are formed when oil droplets are dispersed in the continuous water phase; *dp* = dispersed phase, *cp* = continuous phase. Source: adapted from **Perazzo et al. (2015)**.

AICV Performance



AICV allow to produce emulsion

Conclusions

- The AICV technology has demonstrated an unparalleled and best-in-class water control in the field.

- Compared to other SL/ICD/AICD completions, the AICV technology has produced 3 to 5 times less water and 3 to 4 times more oil.

- This proves that the AICV Valve can drastically reduce the water production while maintaining/increasing the oil production, defeating the theory about the requirement of high levels of total liquid production to maintain oil production.

Thank you

Dr Ismarullizam Mohd Ismail,
Vice President Subsurface
isma.mohdismail@inflowcontrol.no
+44 7860 733 858

www.inflowcontrol.no