Society of Petroleum Engineers

IOR/EOR Practices for Enhanced Efficiency in the Evolving Carbon-Conscious Environment

11–12 JUNE 2024 | JAKARTA, INDONESIA

Encapsulated Polymer Technology for Enhanced Oil Recovery in Offshore Subsea Wells

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SNF

DVP Technology

January, 2023

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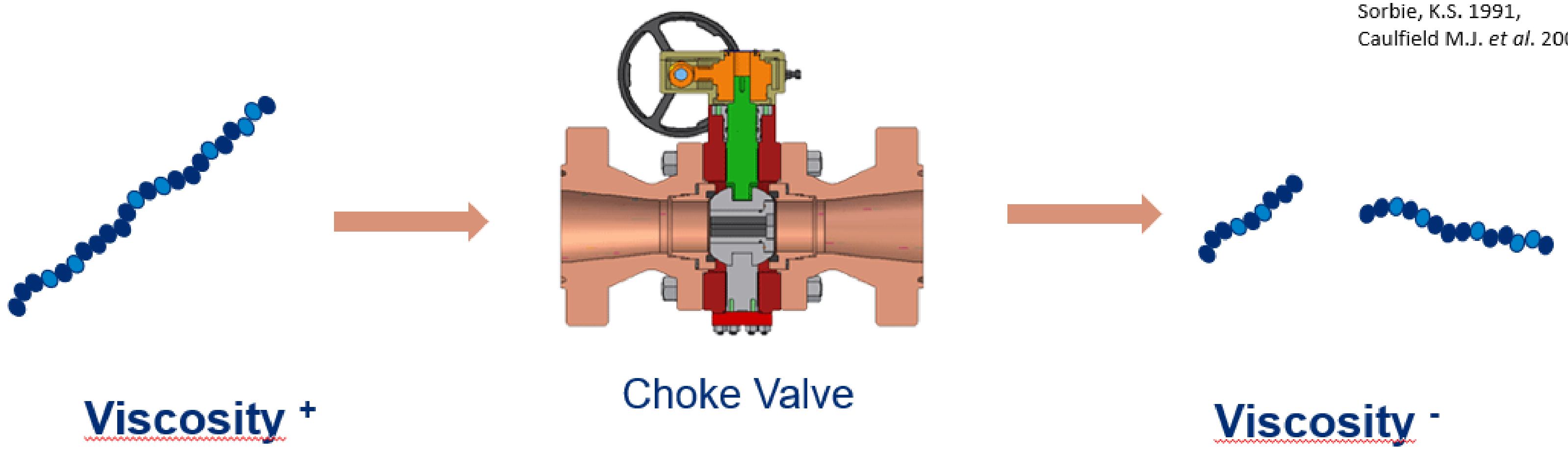
Introduction

One of the major operational and economic challenges in polymer flooding applications for mobility control are shear degradation during injection. Shear degradation of conventional HPAM polymers through injection facilities can lead to significant losses of up to 70% of viscosity yield. This is especially important in offshore environments where high-shear subsea chokes may be necessary for flow distribution control

Maerker, J.M. 1975,
Seright, R.S. *et al.* 1983,
Sorbie, K.S. 1991,
Caulfield M.J. *et al.* 2002).

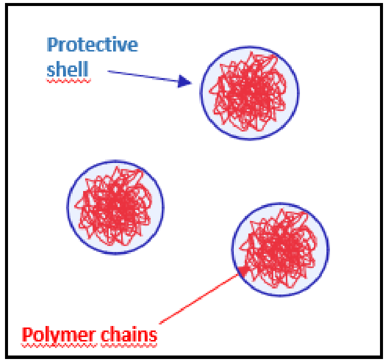


How to prevent polymer chains from mechanical degradation ?

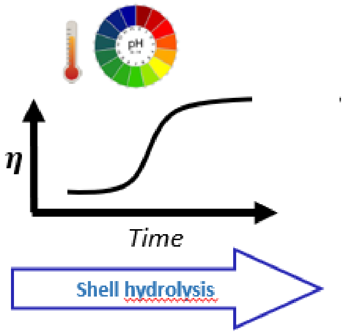
DELAYED VISCOSITY POLYMER (DVP) TECHNOLOGY

DVP concept

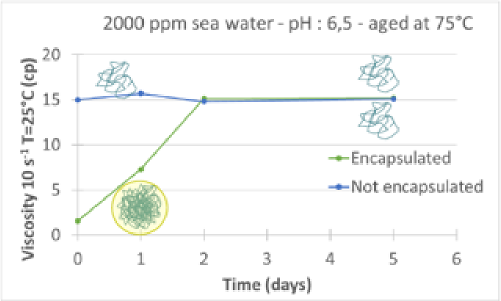
- How does the DVP work ?

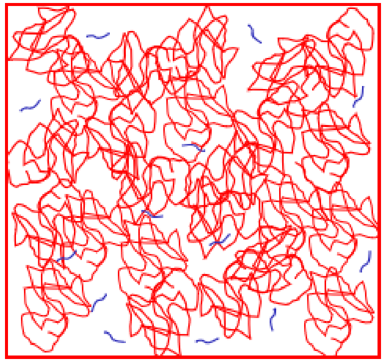


$1 < \eta < 1.5$



Release of the polymer chains





η constant

Goal:

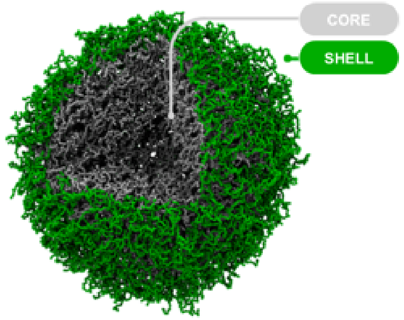
Water-like viscosity during injection + shear resistance

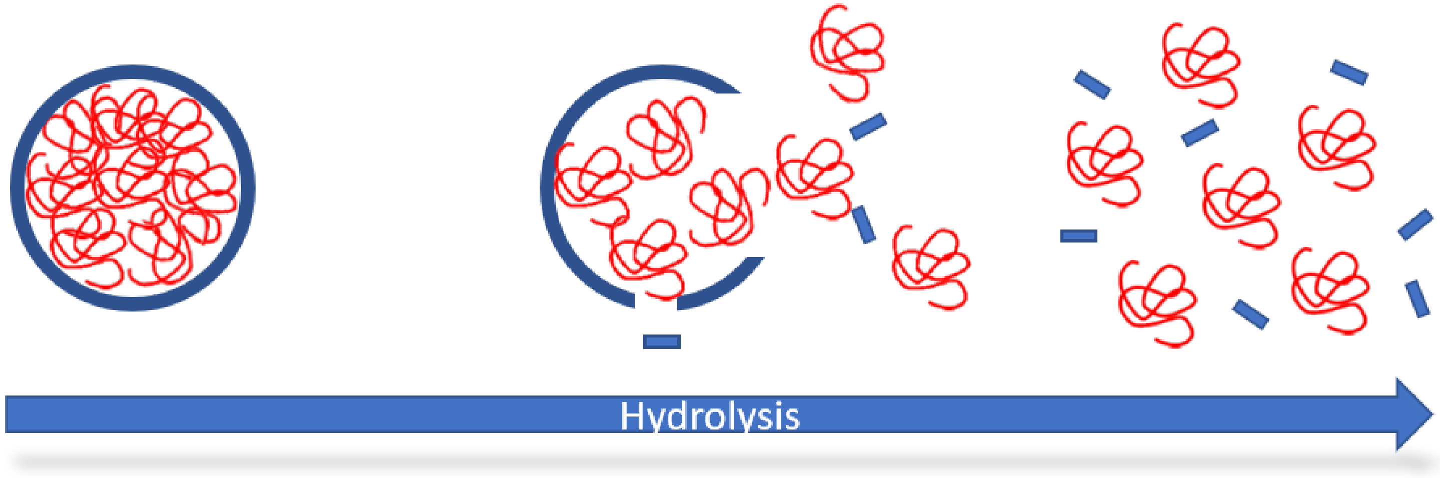
Viscosity release in reservoir conditions

Braun O.; Lauber L. *FR3075219B1*, 2019
Favéro C.; Braun O.; Lauber L. *FR3092329B1*, 2020

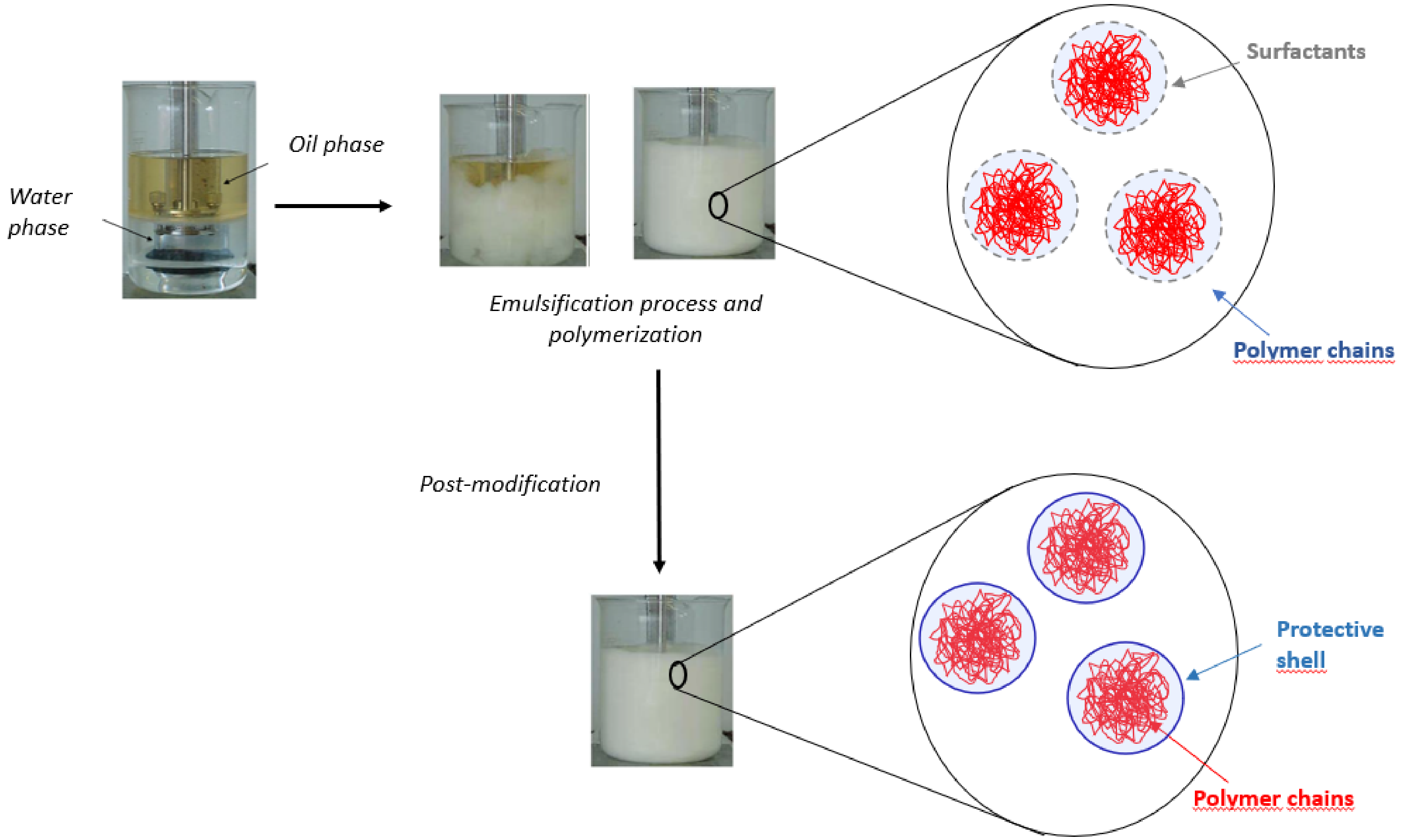
DVP concept

- The idea is first, to prepare the linear polymer chains in emulsion and then, to add a protective shell surrounding each particle to delay polymer release.
- No crosslinked structure = No damaging interim state
- DVP stands for Delayed Viscosity Polymer





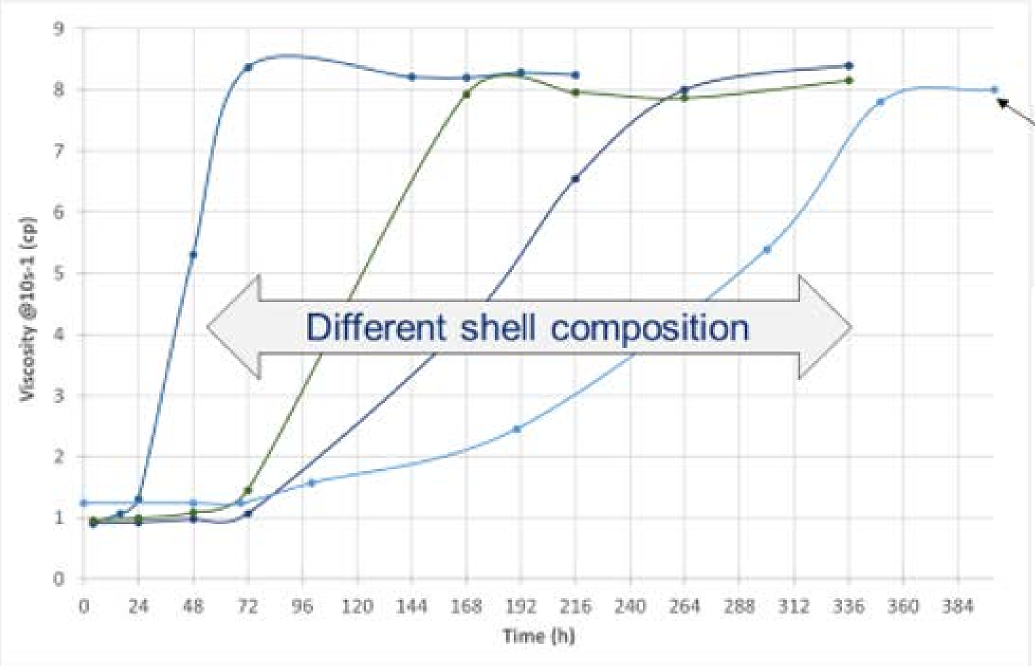
Synthesis strategy

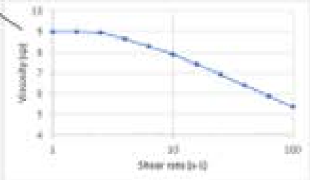


Kinetics of release

Aging at 60°C

- Measurement at 25°C,
- Concentration= 1000ppm,
- Brine: SSW





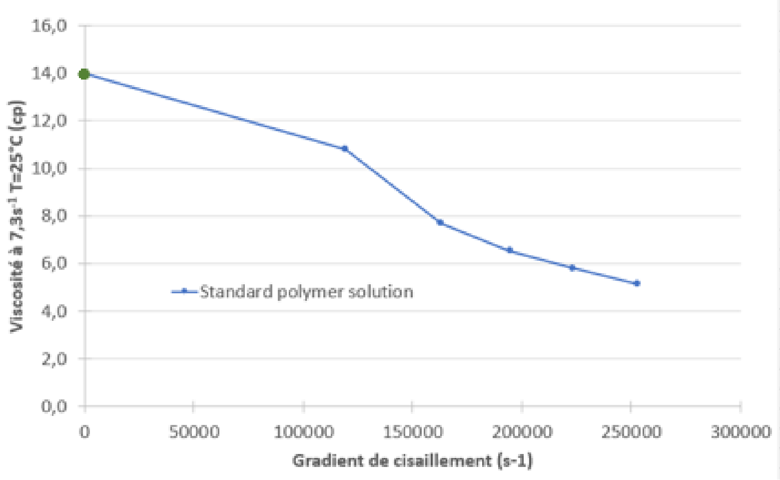
At 60°C, η($10s^{-1}$)= 4,5cP
FR(1,2 µm, 2 bars)<1,3

Shear resistance

- Shear resistance study of Standard HPAM

Flowing through a capillary at various flow rates results in exposure to different shear stresses

14 cP



Injection in porous media

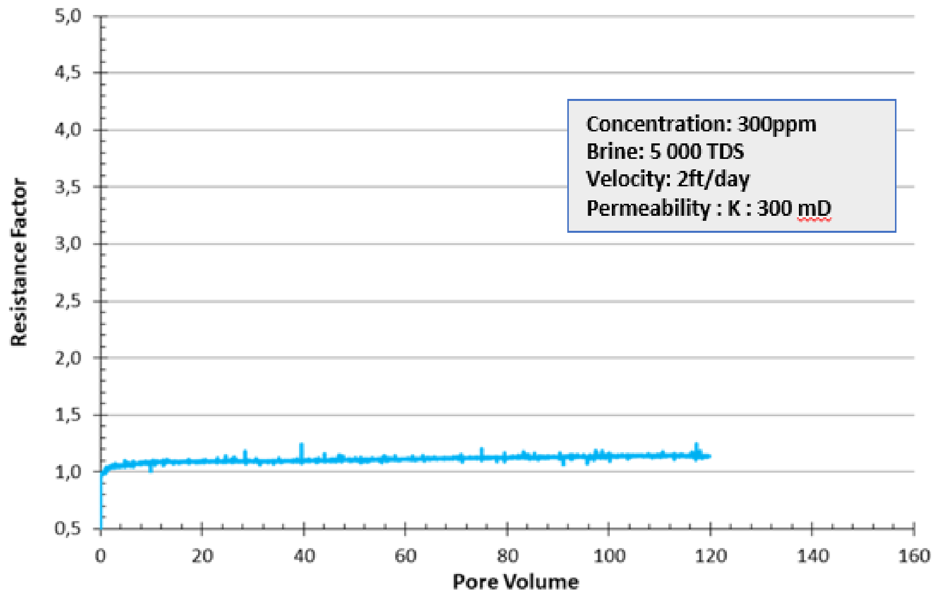
- Injectivity study of unreleased DVP

Highlight:

No impairment during injection at near wellbore conditions

Experimental Conditions

- 80 mL/h
- 30°C
- Brine: 5000ppm TDS
- Throughput >100 PV
- Shearing Valve 1500 PSI
- 10cm-SP



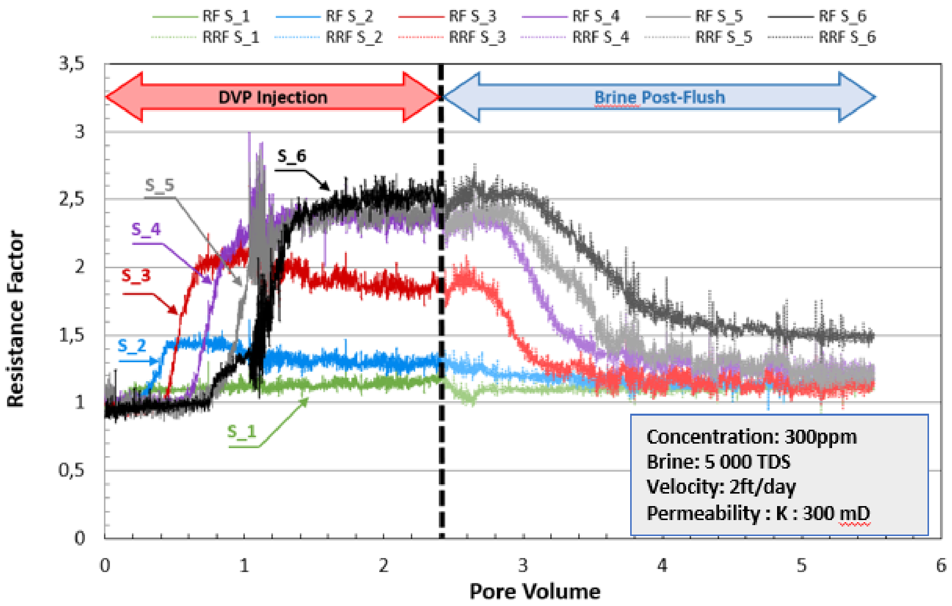
Injection in porous media

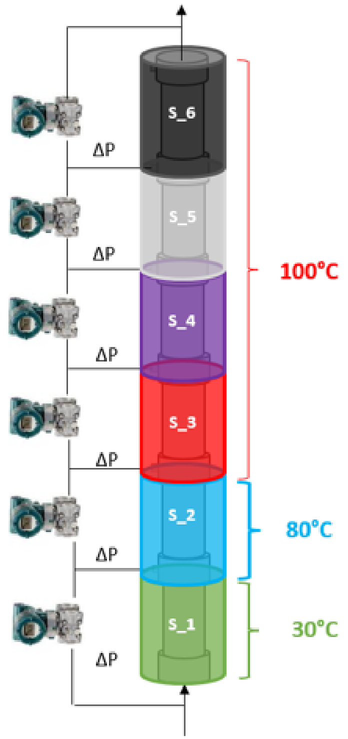
- Injectivity study : Viscosity deployment in the reservoir – Follow-up of the interim state

Highlight:

No damaging interim states during propagation

- Viscosity release triggered by temperature in the reservoir
- No impairement during deployment - No damaging interim states.
- Full deployment was achieved (similar RF on Sections 4, 5 and 6)





Injection in porous media

Injectivity Conditions:

- 5000 ppm brine, 200 – 300 ppm active & K < 400 mD

Near wellbore

- No injectivity issue at high rate over 100 PV (encapsulated particles)
- Good injection & good propagation in 200/400 mD
- Resistance factor about 1,2 in sand pack and about 2,0 in Berea sandstone

Viscosity deployment

- Viscosity release successfully observed in sand pack experiments
- No impairment during viscosity release - No damaging interim states.
- Viscosity release in sand pack in agreement with data obtained in static conditions
- Low residual resistance factor after brine flush (1,1 < RRF < 1,5)

THANK YOU