Tracers for remaining oil saturation determination

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Outline

• Who are we?
• Different tracer types
• How can tracers be used to gain information about the reservoir
• New possibilities
Tracer timeline at IFE

• 1950ies  Ground water, process equipment and different assignments for local authorities
• 1983    Tracers for oil field applications
• 1986    First interwell tracer study at Ekofisk
• 1991    Development of chemical tracers for reservoir studies (Tracer Club)
• 2001    Tracer studies of offshore process equipment
• 2005    Resman was established, partly based on IFE technology
• 2009    SPE award: For distinguished contribution to petroleum engineering in the area of reservoir description and dynamics
• 2012    Qualified tracers for Partitioning Interwell Tracer Test (PITT)
• 2013    Restrack was established, based on IFE technology
• 2016    Qualified tracers for Single Well Chemical Tracer Test (SWCTT)
A tracer gives information about a system

- A tracer is injected into a system and can be followed through this system and give information about it.

Different tracer categories:
- Passive tracers
- Partitioning tracers
- Reactive tracers
Passive tracers in inter-well tracer tests map fluid flow
Interwell tracer studies provide information about dynamic properties of the reservoir:

- Preferential flow directions
- Horizontal and vertical communication between wells
- Permeability
- Sweep volumes
- Large-scale heterogeneities
Partitioning tracers are used in two different field operations:

- **Single Well Chemical Tracer Test** (SWCTT) - 5 - 10 m
- **Partitioning Interwell Tracer Test** (PITT)

**Diagram:**
- Producer
- Injector
- SWCTT
- PITT

**Legend:**
- **SWCTT:** Single Well Chemical Tracer Test
- **PITT:** Partitioning Interwell Tracer Test
Partitioning inter-well tracer tests (PITT) measure SOR between wells
• Identification of IOR/EOR targets
• Evaluation IOR/EOR operations/ performance.
PITT tracer development at IFE

- 2013: Qualification of new group of PITT tracers

Viig et al, 2013; «Application of a New Class of Chemical Tracers to Measure Oil Saturation in Partitioning Interwell Tracer Tests”, SPE 164059.

PITT results:
- LAV-1: So = 24%
- LAV-2: So = 22%
- LAV-6: So = 11%

Core measurements LAV-1
- Zone A: 25%
- Zone B top: 28%
- Zone B base: 23%
PITT tracer development at IFE

- Work continues:

\[ K = \frac{C_O}{C_W} \]

Temperature

Oil composition

Water salinity
Single-well chemical tracer tests (SWCTT) measure SOR in the near well zone.
• Identification of IOR/EOR targets
• Evaluation IOR/EOR operations/performance.
SWCTT tracer development at IFE

• 2016: Qualification of new group of SWCTT tracers


What is new??
SWCTT tracer development at IFE

Original method:

- 100-500 kg EtAc injected
- 100-500 kg of IPA and NPA injected
- Injection time 1 day
- HSE
SWCTT tracer development at IFE

New method:

Status 2016:
- Four new tracer families (12 tracers)
- Injection amount 80g
- Pulse injection possible
New SWCTT tracers give new possibilities

- Investigation depth depend on K-value. This gives saturation estimate specific for each zone.

Cost-efficient data access
1. SoR
2. Fractional flow
3. Relative permeability
Studies have proved that tracers are a reliable tool to measure remaining oil saturation.

New tracers give new possibilities!
Thank you!