ENERGY INDUSTRY INSIDER

Advanced Drilling Technology

June | 2020

BULLETIN

FutureBridge

WHAT'S INSIDE!

- Silicon quantum dots based nanofluids for enhanced oil recovery (ultra-small sized silicon quantum dots coated with a zwitterionic surfactant)
- Novel Cissus Populnea nanoparticles based nanofluids (The novel CPNF increased the oil recovery by 26% and was effective at high-temperature high-pressure (HTHP) reservoir condition)
- Gemini surfactant-stabilized nanoemulsions functionalized with partially hydrolyzed polymer/silica nanoparticles
- Carbon-based nanofluid for enhanced oil recovery in tight reservoirs

01

University of North Dakota (USA) and Northeast Petroleum University (China) developing silicon quantum dots based nanofluids for enhanced oil recovery

02

Universiti Teknologi Malaysia, Universiti Malaysia Sarawak, Universitas Islam Riau (Indonesia), and Asia Pacific University of Technology (Malaysia) experimenting with polymeric nanofluid for enhance oil recovery

03

Indian Institute of Technology (Indian School of Mines) investigating the effect of Gemini surfactant-stabilized nanoemulsions functionalized with partially hydrolyzed polymer/silica nanoparticles in enhance oil recovery process

04

China University of Petroleum (East China) experimenting with carbon-based nanofluid for enhanced oil recovery in tight reservoirs

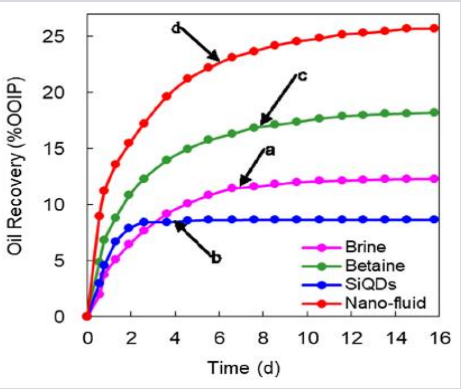

Fig 1: Spontaneous imbibition experiments at 80 °C.
Curve a: the control of 15 wt% synthetic brine.
Curve b: the control of SiQDs solution.
Curve c: the control of betaine solution.
Curve d: the nano-fluid.

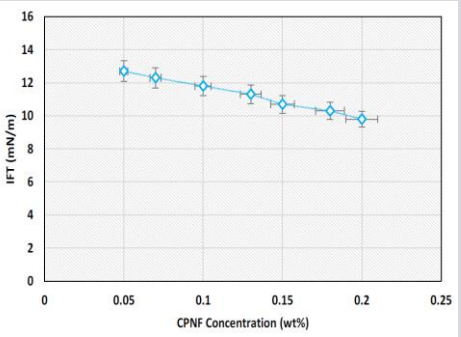

Fig 2: Effect of CPNF concentration on IFT

1 June 2020

University of North Dakota (USA) and Northeast Petroleum University (China) developing silicon quantum dots based nanofluids for enhanced oil recovery

- A novel nano-fluid was developed using ultra-small sized silicon quantum dots coated with a zwitterionic surfactant.
- The nano-fluid showed good stability in synthetic high salinity brine containing divalent cations at high temperature. It also showed capabilities to reduce interfacial tension and altering wettability.

Experimental results showed that the developed nano-fluid recovered 25.72 %OOIP (original oil-in-place) from core samples by spontaneous imbibition, which was 7.49 % OOIP higher than using surfactant alone.

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5 June 2020

Universiti Teknologi Malaysia, Universiti Malaysia Sarawak, Universitas Islam Riau (Indonesia), and Asia Pacific University of Technology (Malaysia) experimenting with polymeric nanofluid for enhance oil recovery

- Ascorbic acid was used to synthesize Cissus populnea nanoparticles (CPNP). The interfacial properties of CPNF were studied at various concentrations and temperatures.
- The influence of salinity and their interaction with ultrasound was investigated.

Experimental results show that CPNF was effective in lowering IFT at oil-water (O/W) interface and altered the wettability of the sandstone cores to water-wetting condition. The novel CPNF increased the oil recovery by 26% and was effective at high-temperature high-pressure (HTHP) reservoir condition.

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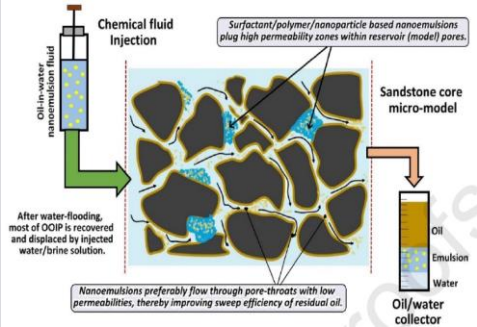

Fig 3: Effect of CPNF concentration on IFT

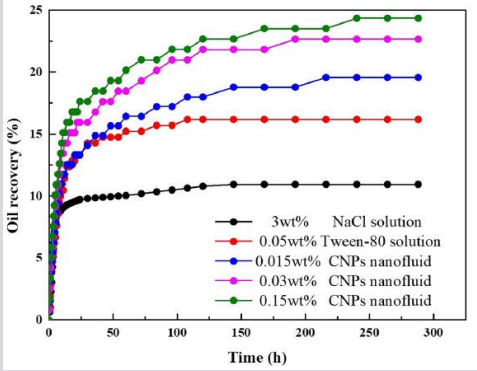

Fig 4: The oil recovery of 3 wt% NaCl solution, 0.05 wt% Tween-80 solution and CNPs nanofluid of different concentrations

10 June 2020

Indian Institute of Technology (Indian School of Mines) investigating the effect of Gemini surfactant-stabilized nanoemulsions functionalized with partially hydrolyzed polymer/silica nanoparticles in enhance oil recovery process

- The objective was to investigate the functionality of robust nanoemulsions comprising of gemini surfactant/polymer/silica nanoparticle assemblies.
- Nanoemulsion systems, consisting of (N,N'-bis(dimethyltetradecyl)-1,6- hexanediammonium bromide) surfactant, partially hydrolyzed polyacrylamide (PHPA) polymer and/or silica (SiO_2) nanoparticles, were prepared by high energy technique.

Core-flooding experiments showed that enhanced oil recoveries of nanoemulsions improved over conventional aqueous fluids to 21-27% range of original oil in place (OOIP).

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11 June 2020

China University of Petroleum (East China) experimenting with carbon-based nanofluids for enhanced oil recovery in tight reservoirs

- Carbon-based nanofluid was prepared using hydrophilic carbon nanoparticles (CNPs) and Tween-80. The particle size of CNPs was b10 nm and CNPs nanofluid showed excellent stability at high temperature and high salinity.
- CNPs nanofluid exhibited a stronger ability to reduce interfacial tension and change wettability than brine. 0.15wt% CNPs nanofluid decreased the interfacial tension to 11.2mN/m and changed the wettability to neutral wetting.

The oil recovery of 0.15 wt% CNPs nanofluid for simulated oil can be up to 24%.

Read this story

Ultra-small sized silicon quantum dots coated with a zwitterionic surfactant

- A novel nano-fluid was developed using ultra-small sized silicon quantum dots coated with a zwitterionic surfactant.
- The nano-fluid showed good stability in synthetic high salinity brine containing divalent cations at high temperature. It also showed capabilities to reduce interfacial tension and altering wettability.
- Experimental results showed that the developed nano-fluid recovered 25.72 %OOIP (original oil-in-place) from core samples by spontaneous imbibition, which was 7.49 % OOIP higher than using surfactant alone.
- Similar results were obtained in the core flooding tests, where 41.98 %OOIP was finally recovered by the nanofluid, compared to 30.28% in surfactant case.

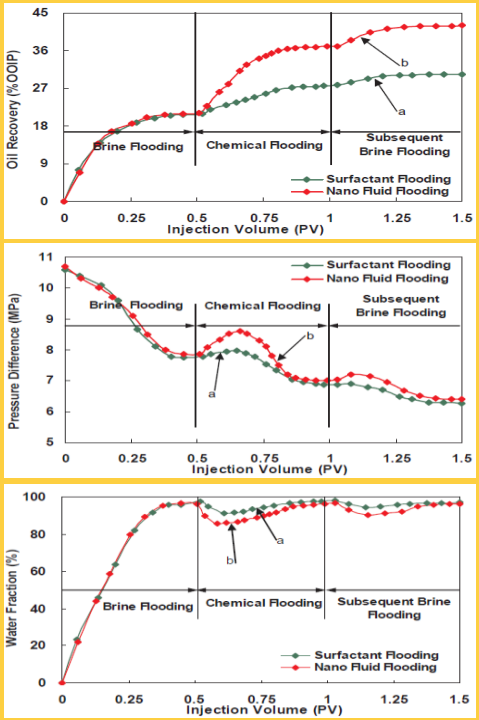

Fig 5: Dynamic production curve of Bakken core sample at 80 °C. (A) Oil recovery of surfactant betaine flooding (a); and SiQDs based nano-fluid flooding (b).
(B) Pressure difference of surfactant betaine flooding (a); and SiQDs based nano-fluid flooding (b).
(C) Water-cut of produced liquid of surfactant betaine flooding (a); and SiQDs based nano-fluid flooding (b).

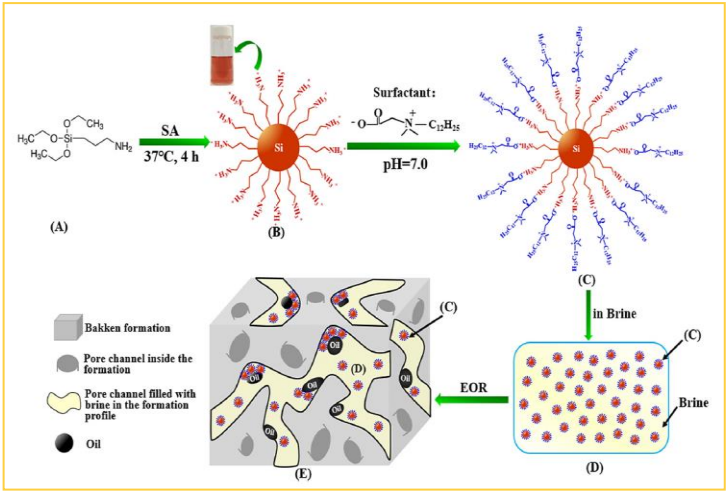

Fig 6: Schematic diagram of the designed nano-fluid. (A) APTES. (B) SiQDs. (C) SiQDs-augmented surfactant nano-composite. (D) Nano-fluid prepared by synthetic brine. (E) The application of the nano-fluid on Bakken formation to recover oil.

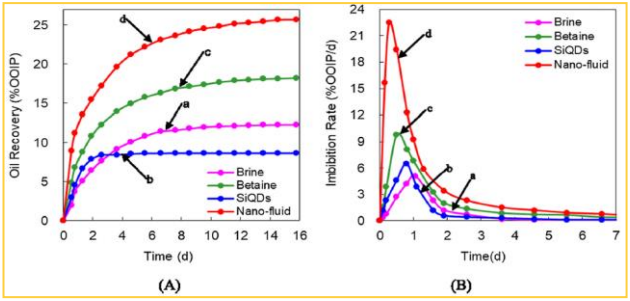

Fig 8:
Spontaneous imbibition experiments at 80 °C.
(A) Oil recovery of different imbibition liquids in 16 d.
Curve a: the control of 15 wt% synthetic brine.
Curve b: the control of SiQDs solution.
Curve c: the control of betaine solution.
Curve d: the nano-fluid.

(B) Imbibition rate in different imbibition liquids in the first 7 days.
Curve a: the control of 15 wt% synthetic brine.
Curve b: the control of SiQDs solution.
Curve c: the control of betaine solution.
Curve d: the nano-fluid.

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