



CNPC R&D (DIFC) Company Limited

CNPC R&D Symposium: Waterflooding Sweep Efficiency Enhancement

14-15 November 2023

Le Royal Meridien Beach Resort & Spa
Dubai, U.A.E.

www.cnpcrd.com

Symposium Program



Message from the CEO of CNPC R&D

Welcome to CNPC R&D Symposium,

The Symposium is about the future. It is collaborative, idea-generating in informal format that stimulate new ideas and innovation to meet upcoming challenges to the Oil & Gas E&P industry.

The Symposium format is intended to create an atmosphere that encourages the open exchange of thoughts and views among all participants. The CNPC R&D Symposium is "off-the-record", the presentations are Confidential and extensive notetaking is prohibited.

An event that brings together top technologists, innovators from IOCs, NOCs, SOCs and Academia to address specific industry challenges.

Speakers present what they did, the results of their actions, talk about current best practices and technologies used in the field now and their conclusions based on those results.

Experts are invited to participate in 2 days of the future and how to shape it. The Symposium is international in scope, drawing technical leaders worldwide.

The Symposium is limited attendance to 100 invited participants who are encouraged to contribute actively to all sessions. To be invited to attend the CNPC R&D Symposium is a clear indication that the invitee is recognized as an expert or future thought leader on the subject. The Symposium Round Table gather the best minds to exchange thoughts and views and produce revelations and new ways of looking at things that could not otherwise be achieved. Participants focus on where the technology needs to go, generate ideas, and have peer-to-peer discussion.

The Symposium provide opportunities for networking outside the session room through social events, joint meals, and breaks.

Participants are expected to attend the full duration of the Symposium.

Looking forward to seeing you in our Symposium.



Dr. Zewu Lai
Chief Executive Officer



CNPC R&D (DIFC) Company Limited

About CNPC R&D

World-class technical center providing optimized solutions for sustainable energy development.

Integrated organization, covering the entire upstream technical disciplines: Subsurface, Wells and Facility Engineering.

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CNPC at a glance (2022 figures)

\$485,7bn
Revenue

\$25,765bn
Earning

\$358,4bn
Market Capitalization

Oil Production 3.7 mbd

Gas Production 177 bcm



Research institutes

95

Key laboratories and testing bases

56

National R&D and innovation platforms

14



Organizing Committee

Co-Chair



Mr. David D. Smith
President and
Principal Advisor
Oilfield Conformance
Consulting LLC



Prof. Baojun Bai
Program Head, Petroleum
Engineering Director, Particle Gel
Conformance Control Consortium
Missouri University of Science and
Technology

Committee Members



Dr. Xinmin Song
Chief Geoscientist, CNPC R&D
Director, China State Key
Laboratory of Enhanced Oil
Recovery



Mr. Ahmed Sharif
Senior Reservoir Engineer
Schlumberger Ltd.



Dr. Guilin Luan
Chief Advisor/
Acting Technical VP
CNPC R&D



**Dr. Mohammed Saad
Al Kobaisi**
Associate Professor
Khalifa University of Science
and Technology



Mr. Flavien Maire
Senior Specialist, Reservoir
Engineering, Subsurface
Excellence Division
ADNOC Thamama Center



Mr. Carlos Mascagnini
Petroleum Engineering Lead
Baker Hughes



Dr. Omar Al-Farisi
AI Senior Technology Advisor
to CTO Dragon Oil



Speakers



Dr. Song Xinmin
Chief Geoscientist

Mr. Liu Huifeng
Principal Well Engineer

Mr. Wang Yucai
Chief Engineer



Mr. David Smith
President



Mr. Saleh Ali Al Sayari
Team Leader

Dr. Kristian Mogensen
Senior EOR Specialist

Mr. Dorzhi Badmaev
Sr. Specialist in Cognitive Reservoir Management

Schlumberger

Mr. Jobin Cherian
Reservoir Simulation Engineer

Mr. Coriolan Rat
Team Lead



Dr. Ibnelwaleed Ali Hussein
Professor



Dr. Baojun Bai
Professor

HALLIBURTON

Mr. Giuseppe Ambrosi
Technical Manager



Dr. Hu Guo
Professor



Mr. Carlos Sirlupu Ruiz
Production Advisor



Dr. Ben Shiau
Associate Professor



Dr. Li Yong
Vice President

Dr. Cui Longlian
Overseas Engineering Director

Replacement Speaker
Session 8



Participants

أرامكو السعودية
saudi aramco



MISSOURI
S&T



中国石油大学(北京)
CHINA UNIVERSITY OF PETROLEUM

Dragon Oil

أدنوك
ADNOC



جامعة قطر
QATAR UNIVERSITY

Schlumberger



Oilfield
Conformance
Consulting LLC

HALLIBURTON



شركة تنمية نفط عُمان
Petroleum Development Oman



جامعة خليفة
Khalifa University

BAKER
HUGHES



中国石油勘探开发研究院
RESEARCH INSTITUTE OF PETROLEUM EXPLORATION & DEVELOPMENT



About CNPC R&D's Carbonate Reservoirs Waterflooding Sweep Efficiency Control Symposium

More than half of the world's recoverable oil resources are concentrated in the Middle East, primarily within carbonate reservoirs.

Waterflooding has been widely used to improve the recovery factor from carbonate reservoirs to around 35% on average.

However, the sweep efficiency of waterflooding processes is significantly impacted by the development strategy, operation issues, and the typical challenges arising from carbonate reservoirs:

- The high heterogeneities
- The mineral compositions of the carbonate rocks
- The water channeling features

CNPC, increasingly active in developing Middle Eastern oilfields, has first-hand experience dealing with waterflooding challenges. Given our focus on carbonate reservoirs, we recognize the urgency of addressing these challenges.

CNPC R&D, the technical center of CNPC in the Middle East, is organizing a symposium to bring together experts and decision makers from around the globe. The goal is to exchange insights on enhancing the sweep efficiency of waterflooding operations and boosting recovery factors.

- As operator: you will hear challenges, lessons learned and best practices.
- As service provider: you can present your technologies and solutions.
- As research professional: you can inform about the latest innovation and breakthrough technologies.

This 2-day symposium is planned in the form of technical plenary sessions and roundtable discussions to maximize the benefits:

- Day 1 and the morning of Day 2 will consist of plenary sessions divided into eight categories.
- Day 2 afternoon will feature a roundtable discussion, focusing on the most relevant waterflooding challenges.

Join us as we collaborate, innovate, and harness the untapped potential of waterflooding in carbonate reservoirs.

Session Highlights

- **Maximize the period and oil recovery of water-free and low water-cut production through optimized development planning, catering for active waterflooding sweep efficiency control as the main focus and dealing with water problems as supplementary measures.**
- **Candidate Selection and Problem Understanding**
- **Wellbore Intervention Solutions**
 - Mechanical methods to control sweep efficiency
 - Chemical methods to control sweep efficiency
 - Cements and VSF methods to enhance sweep efficiency
 - Well stimulation while maintaining sweep efficiency
- **AI and machine learning for Improving Sweep Efficiency**

Attendees:

Professionals involved in:

- Petroleum Engineering Managers
- Petroleum Engineers
- Completion and Production Engineers
- Geoscientists
- Researchers in Academia
- Service providers in Waterflooding Sweep Efficiency Control

Program Quick View

Tuesday, 14 November 2023

08:00 - 08:50	Arrival of Delegates and Registration
08:50 - 09:00	Safety Announcement
09:00 - 09:05	Welcome Remarks
09:05 - 09:15	Keynote Address
09:15 - 10:15	Session 1: Opening
10:15 - 10:30	Coffee and Tea Break
10:30 - 11:30	Session 2: Reservoir Characteristics Based Waterflooding Design
11:30 - 12:30	Session 3: From Monitoring in Injectors and Producers to Candidate Selection and Problem Understanding
12:30 - 13:30	Lunch
13:30 - 14:30	Session 4: Wellbore Interventions Solutions: Mechanical Methods to Control Sweep Efficiency
14:30 - 16:00	Session 5: Wellbore Interventions Solutions: Chemical Methods to Control Sweep Efficiency
16:00 - 16:30	Coffee and Tea Break
16:30 - 17:30	Session 6: Wellbore Interventions Solutions: Cements and VSF Methods to Control Sweep Efficiency
17:30 - 18:00	Breakout/Poster Session ***
18:00 onwards	Welcome Dinner ***

Wednesday, 15 November 2023

08:00 - 08:50	Arrival of Delegates and Registration
08:50 - 09:00	Safety Announcement
09:00 - 10:00	Session 7: Well Stimulation while Maintaining Control of Sweep Efficiency
10:00 - 10:15	Coffee and Tea Break
10:15 - 12:15	Session 8: Computational methods including AI and data-driven approaches to improve Sweep Efficiency
12:15 - 12:30	Group Photo
12:30 - 13:30	Lunch
13:30 - 15:30	Round Table Session: Key Challenges and Solutions to Solve Sweep Efficiency Problems
15:30 - 16:30	Summary and Closing Remarks



Technical Program (as of 18 Oct 2023)

Tuesday, 14 November 2023 | 09:15 - 10:15

Session 1: Opening

In this opening session, our keynote speaker, Dr. Song Xinmin, professor and chief geoscientist of CNPC R&D, is going to share his strategy on how to maximize the waterflooding efficiency through structured approach from field development planning, well design and production strategy, catering for “active” sweep efficiency control as the main focus and dealing with waterflooding problems as the supplementary measures. Our Co-Chair, Mr. David Smith will provide his insights on the critical elements required to effectively solve waterflooding sweep efficiency problems. Both presentations will challenge us to maintain focus on clear strategy for waterflooding development design and solving the appropriate problem through understanding of the connection between root causes and effective solutions to improving sweep efficiency in the waterflooding projects.

Water Injection Development and Water Control Strategy for Carbonate Reservoirs

Dr. Song Xinmin
Chief Geoscientist
CNPC R&D

Conformance Engineering – Overview of the process approach to solving sweep efficiency problems

Mr. David Smith
President
Oilfield Conformance
Consulting LLC

Tuesday, 14 November 2023 | 10:30 - 11:30

Session 2: Reservoir Characteristics Based Waterflooding Design

In this session, our speakers will discuss the methods of improving water distribution within and across reservoir formations and layers, as well as achieving a high areal sweep efficiency. The pursuit of these goals encompasses several strategies, from optimized Field Development Plans (FDPs), pattern reorientation or redistribution, custom pattern orientations, to infill drilling and sidetracks. Enhanced Oil Recovery (EOR) methods designed to alter residual oil saturation, such as surfactant flooding, CO₂ or miscible flooding will not be covered; while polymer flooding to address mobility control with some influence on permeability alteration across the entire field will be discussed. Discreet utilization of chemical methods will be covered in Session 5, Chemical to Control Sweep Efficiency.

Carbonate Reservoir re-development leveraging on down spacing and long horizontal

Mr. Saleh Ali Al Sayari
Team Leader
ADNOC RE

Water injection Development of Carbonate Reservoirs: Situation, Challenge and Corresponding Technical Measures

Dr. Li Yong
Vice President
CNPC-RIPED



Technical Program (as of 18 Oct 2023)

Tuesday, 14 November 2023 | 11:30 - 12:30

Session 3: From Monitoring in Injectors and Producers to Candidate Selection and Problem Understanding

This session will focus on the importance of designing and executing proper diagnostics to generate a complete understanding of the sweep efficiency or conformance problem. This includes a focus on monitoring the movement of the injected and produced water which is critically important in the various phases of the field development, e.g., appraisal, piloting, development plan execution and production operation, providing the basis for proactive water control measures. The monitoring and testing can be done around wellbores and in the reservoir formations, which requires different technologies, tools, and operating procedures. This session will discuss methods, experiences, and best-practices in water monitoring and how this knowledge can be used to understand sweep efficiency problems.

A workflow of water cut control

Mr. Liu Huifeng
Principal Well Engineer
CNPC R&D

Tuesday, 14 November 2023 | 13:30 - 14:30

Session 4: Wellbore Interventions Solutions: Mechanical Methods to Control Sweep Efficiency

Mechanical water control methods have been used for many decades to assist control of the near wellbore flow dynamics and improve sweep efficiency. In recent years, they have seen increased use in the Middle East to optimize the production/injection profiles along horizontal wells. Mechanical control of the wellbore can be designed for permanent control or temporary control to assist in the placement of other products. Mechanical control tools can also be utilized during the completion to offer a method for proactive or reactive water shut-off after breakthrough. These systems are generally termed "Smart Well" technologies and will be covered here. This session will discuss challenges, case studies, best practices, and available tools for mechanical control in wellbores and their implications for sweep efficiency improvements.

Inflow Control Device placement optimization using reservoir simulation

Mr. Jobin Cherian
Reservoir Simulation
Engineer
SLB

Segmented Injection and Production Profiles Control Technology for Enhanced Recovery in Horizontal Wells

Mr. Wang Yucai
Chief Engineer
CNPC R&D



Technical Program (as of 18 Oct 2023)

Tuesday, 14 November 2023 | 14:30 - 16:00

Session 5: Wellbore Interventions Solutions: Chemical Methods to Control Sweep Efficiency

In this session, we will discuss chemical methods designed for discreet area or single well treatments to alter the rock matrix permeability either near the wellbore or deeper into the reservoir. This will not include field wide or large section use of chemical injection systems like polymer flooding which is handled in session 2. The carefully developed chemical products are used to redirect injected water into the desired portions of the reservoir which have not been effectively swept. In production wells, they are typically used to block permeable layers or areas where water breakthrough has occurred and where the water-cut is extremely high. Some special systems can be used for void space conduit control, but they will be covered in Session 6 which covers VSFs (Void Space Fillers).

Polymer flooding in Carbonate, Learnings from Previous Field Tests

Dr. Hu Guo
Professor
China University
of Petroleum

AquaCUT TM, a water-based treatment
Hydrophilic high salt tolerant polymer (RPM)

Mr. Carlos Sirlupu Ruiz
Production Advisor
Baker Hughes

RPM- Relative Permeability Modifier for
Carbonate Formations

Mr. Giuseppe Ambrosi
Technical Manager
Halliburton

Novel water conformance control system for
waterflooding oilfields with low sweep efficiency
and lower oil recovery

Dr. Cui Longlian
Overseas Engineering
Director
CNPC - CPET

Tuesday, 14 November 2023 | 16:30 - 17:30

Session 6: Wellbore Interventions Solutions: Cements and VSF Methods to Control Sweep Efficiency

This session will address the utilization of cements and VSF (Void Space Fillers) tailored to tackle the most severe and often complex and historically difficult permeability control problems in our carbonate fields. We will cover both internal wellbores, near wellbore and deeper reservoir VSC control. Most cements and VSF's will have limited or modest contact with the formation so the influences of carbonate rock on the products functionality will only be discussed in case that the product is highly sensitive.

Development and Application of Re-cross linkable
Preformed Particle Gels (RPPG) for Conformance
Control in the Reservoirs with Fractures or Conducts

Dr. Baojun Bai
Professor, Missouri
University of Science
and Technology

Potential of Polysaccharides in Enhancing
Conformance Control in Oil and Gas Reservoirs

Dr. Ibnelwaleed Ali Hussein
Professor,
Qatar University



Technical Program (as of 18 Oct 2023)

Wednesday, 15 November 2023 | 09:00 - 10:00

Session 7: Well Stimulation while Maintaining Control of Sweep Efficiency

This session is dedicated to enhancing the injectivity and productivity of both injectors and producers while retaining the ability to manage sweep efficiency. The techniques we will explore range from short radius side-tracks, chemical stimulation methods (such as acidization), to various mechanical tools. These tools are used in, but are not limited to, hydraulic jetting, fracturing and multi-stage fracturing.

Smart Liners Offer Cost-Effective Stimulation of Carbonate Reservoirs

Dr. Kristian Mogensen
ADNOC Senior EOR Specialist
Thamama Center

Development of Nanoparticle-based Stimulation Fluids and Lessons Learne

Dr. Ben Shiau
Associate Professor,
University of Oklahoma

Wednesday, 15 November 2023 | 10:15 - 12:15

Session 8: Computational methods including AI and data-driven approaches to improve Sweep Efficiency

Over the history of waterflood operations many computational techniques have been used to enhance sweep efficiency through designing custom pattern reorientations or simply rebalancing fluid throughput. These techniques include Numerical Simulation, Streamline Modeling, Capacity Resistance Modeling (CRM), and now Artificial Intelligence (AI) and Machine Learning. AI is revolutionizing various aspects of modern lives, and the oil & gas industry is no exception. Many industry processes have significantly benefited from AI's optimization capabilities. This session aims to delve into a variety of computational methods, their advantages and limitations while looking specifically at AI as an active tool for sweep efficiency improvement. We'll explore areas where these methods can add values, such as advanced waterflooding modelling and reservoir management tools in carbonate reservoirs, predictive maintenance, and more.

Waterflood optimization for FDP using reservoir simulation

Mr. Coriolan Rat
Team Lead
SLB RE

Smart Reservoir Management, Data-Driven Production Injection Optimization

Mr. Dorzhi Badmaev
Sr. Specialist in Cognitive Reservoir Management
ADNOC

TBA

TBA



Technical Program (as of 18 Oct 2023)

Wednesday, 15 November 2023 | 13:30 - 15:30

Round Table Session: Key Challenges and Solutions to Solve Sweep Efficiency Problems

In this special session, we selected 5 questions:

Question 1: How does the increasing use of long horizontal wells influence sweep efficiency? Please review the pros and cons of this technology and how we might enhance the advantages and reduce or mitigate the disadvantages. Discuss the enablers: pattern flood design, well placement, lower completion, monitoring limitations and impacts on ability to implement physical intervention solutions.

Question 2: What do you feel are the most important needs to further improve our ability to solve or manage Sweep Efficiency or Conformance issues? (Examples: Better training, improved diagnostic tools, monitoring automation and digitalization, enhanced or different products for controlling permeability, enhanced or different products for controlling VSC problems, etc.)

Question 3: When it comes to the benefit analysis for sweep efficiency or conformance control initiatives, what should we consider in quantifying this value? (1) Business case for intervention, expected added value (2) quantification of realized value, instantaneous vs long term (3) Better quantification of the indirect cost savings, e.g., facility capacity for water management, and associated CAPEX/OPEX, contribution to emissions reduction...

Question 4: How does an integrated strategy for sweep efficiency and conformance control play a key role in the journey to carbon neutrality in maturing assets, and contribute to Oil & Gas industry sustainability ambitions? (Water related Carbon intensity)

Question 5: When leveraging computational methods to optimize waterflood / sweep efficiency (Data driven or AI approaches, reservoir simulation and streamlines, or hybrid models): how critical is the frequency, quality, and accuracy of the data input? (Discuss the value, justification, realities, and limitation of this data and its impacts / or restricted application)

A question at each table, 60-minute discussion with each table getting 15 minutes for a report back to the general audience



CNPC R&D SYMPOSIUM:

WATERFLOODING SWEEP EFFICIENCY ENHANCEMENT

SEE YOU AT THE EVENT!

Please click the link to see the location.

[Le Royal Méridien Beach Resort & Spa](#)

Please follow the signages from the entrance or parking lot to direct you to the venue.



OUR PARTNER HOTEL FOR ACCOMMODATION

[Millennium Place Barsha Heights Hotel](#)

HANNA FAYE RAMINTAS

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CNPC R&D will cover the registration fees.

The company of the participant shall bear their travel expenses.

Please use booking code "CNPC Symposium" to avail the corporate rate.