

UNCONVENTIONAL OIL & GAS RESEARCH INSTITUTE



Forward

Kerui Unconventional Oil & Gas Research Institute

Kerui Unconventional Oil & Gas Research Institute, located in Dongying city, Shandong province, was established in 2010 as Kerui Petroleum Engineering Technology Research Institute. In 2014, it has been merged with the Unconventional Oil & Gas Technology research Center established in collaboration with the University of Calgary, Canada. The operational entity is Shandong Ruilin Energy Technology Co., Ltd. (referred to as "Ruilin"), founded in 2023. Ruilin is a wholly-owned subsidiary of Shandong Kerui Petroleum Technology Co., Ltd., focusing on energy development, oil and gas field production enhancement, technical research, scheme formulation, and integrated services, aiming to create a technology-sharing platform for Kerui Petroleum.

Business Overview:

The company's scope includes oil and gas fields, clean energy (natural gas, coalbed methane, shale gas, etc.), and new energy (geothermal) development technology services. It provides clients with exploration and development schemes, integrated services, comprehensive solutions for the treatment of mature oil fields, water flooding in high-water-cut oil reservoirs, sand control technology services, wax removal technology, heavy oil cold production, and other specialized technology services. Additionally, the company offers supporting services such as indoor experimental research and testing, oilfield chemical additives, downhole tools, and more.

Technical Expertise:

The institute is currently staffed with 66 technical experts and researchers. This includes 12 individuals with Ph.D. degrees, 21 with master's degrees, and 23 with bachelor's degrees. Among them, 7 are experts, 19 are senior engineers, and 31 are engineers. Their expertise covers exploration and development, drilling and production engineering, surface engineering, and oilfield chemistry.

Discover innovation and excellence with Kerui Unconventional Oil & Gas Research Institute – your partner in advancing energy technologies.

CONTENT

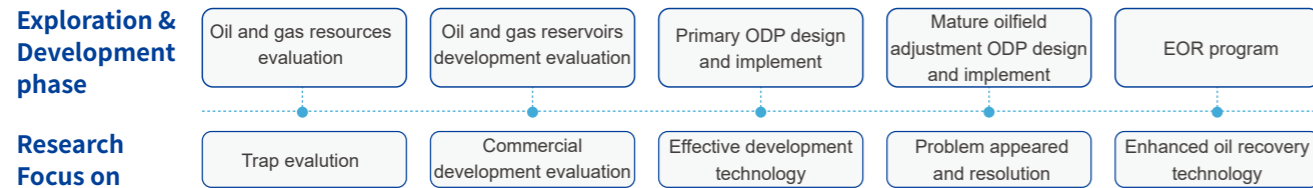
- 01 Oilfield Exploration and Development Comprehensive Research
- 02 High-pressure, Rapid Mass Water Injection Technologies for Tight Oil Reservoirs
- 03 Balanced Displacement Technologies in High WC Reservoirs
- 04 Composite Cold Recovery Technologies for Heavy Oil
- 05 Sand Control Technologies
- 06 Paraffin Control & Removal Technologies
- 07 Experimental Research and Testing
- 08 Chemical Products for Oilfield Production Enhancement
- 09 Downhole Tools

Oilfield Exploration and Development Comprehensive Research

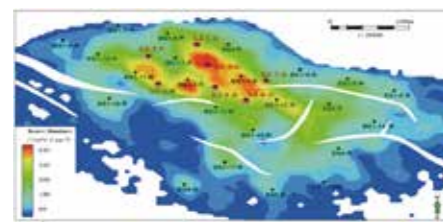
Technical Introduction

Integrated exploration and development research for oil and gas reservoirs
 Design of integrated development plans
 Ten innovative techniques for oil and gas reservoir development

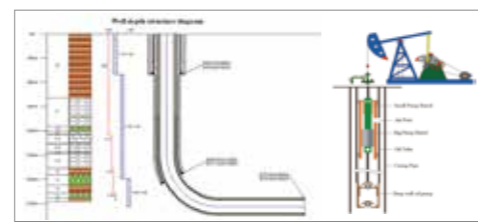
Integrated exploration and development research



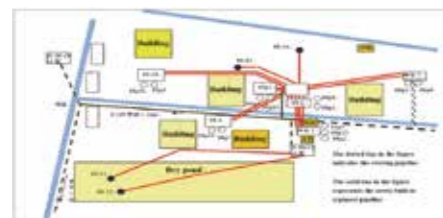
Design of integrated development plans



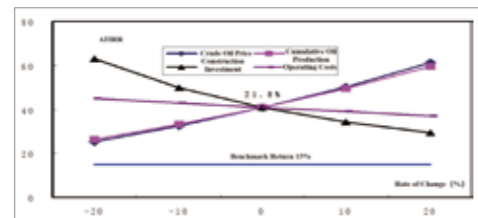
Development Plan for Oil Reservoir



Drilling & Production Engineering Plan



Ground Engineering Plan



Economic Evaluation Plan

Ten Characteristic Technologies for Oil and Gas Reservoir Development

- Water control technology for high water-cut reservoirs
- Composite thermal recovery technology for ultra-heavy oil reservoirs
- Composite cold recovery technology for conventional heavy oil reservoirs
- High-Pressure Water Injection in Low Permeability Reservoirs
- Effective development technology for complex fault-block reservoirs
- Chemical flooding technology for medium-high permeability reservoir
- CO₂ injection to enhance oil recovery technology
- Coalbed methane and tight gas development technology
- Effective development technology for condensate gas reservoirs
- Effective development technology of brine minerals

High-Pressure Water Injection in Low Permeability Reservoirs

Technical Introduction

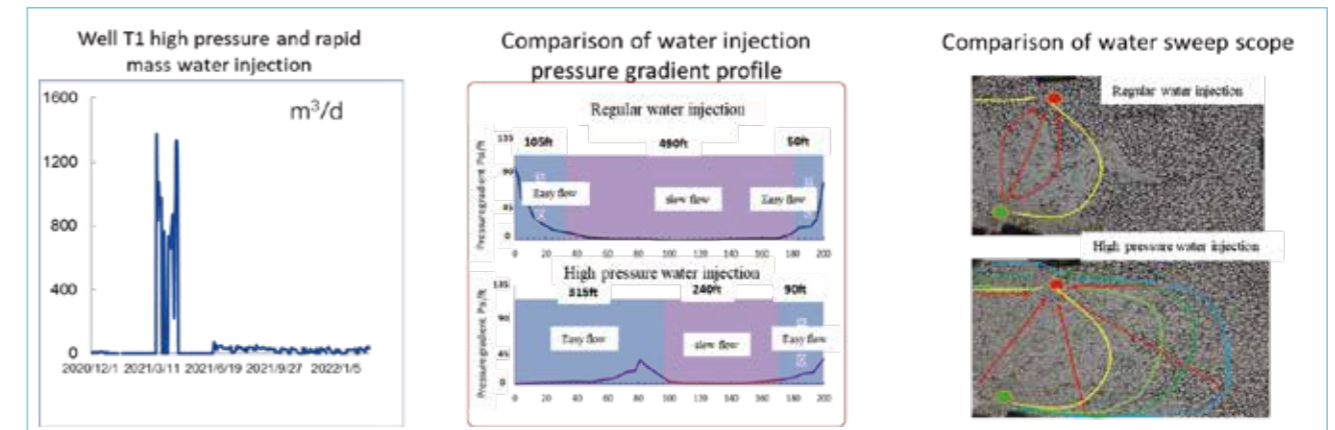
For low-permeability and ultra-low-permeability reservoirs with poor reservoir properties and limited benefits from conventional fracturing and water injection, we have developed integrated technologies for low-permeability reservoir, through the well pressurization to realize the large displacement water injection to replenish the reservoir energy quickly.

Technical Principles

High-speed water injection for rapid energy increasing

High-pressure water flooding to stabilize energy

Overall high pressure for volume displacement



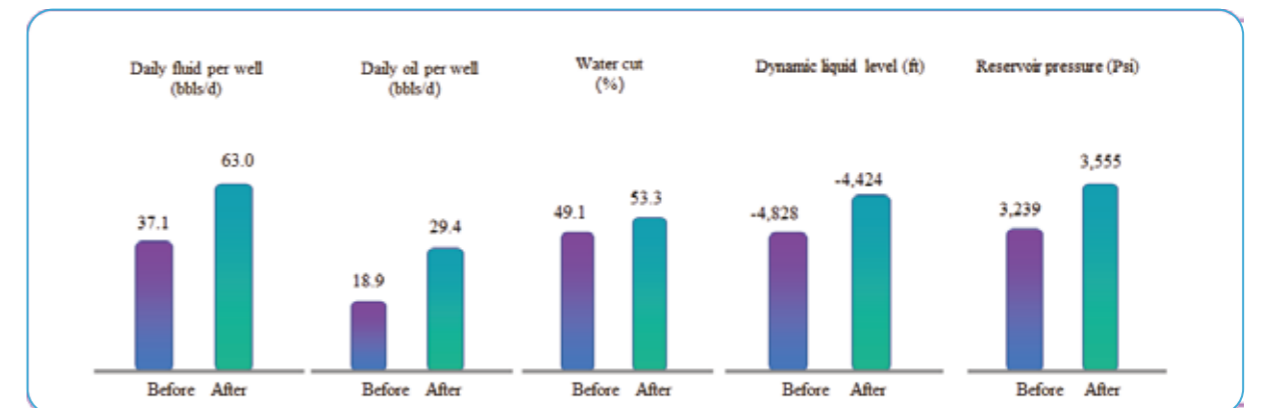
Technology & Service

High pressure water injection design, water injection and production engineering service and surface engineering facilities service.

Technical Application

Implementation: 400+ Pressure Flooding Well Groups, Shengli Oilfield

Achievements: Cumulative Water Injection: 17.45 million cubic meters /Cumulative Oil Production: 3.90 MMbbls



Balanced Displacement Technologies in High WC Reservoirs

Technical Introduction

The issue of water production from oil wells is a common challenge throughout the entire process of oilfield development. Comprehensive water cut control management is fundamental to the long-term and profitable development of oilfields. The technology development for balanced displacement in high water-cut reservoirs effectively addresses the challenges faced by clients in developing high water-cut oilfields, which include: water shutoff and profile control technology, and layering water injection technology.

Profile Control and Water Plugging Technology

1. Integrated Water Shutoff and Profile Control Technology

Basic decision-making process for profile modification and water plugging;
 Selecting agent base on the reservoir type, development status and function of different slugs;
 Injection parameters design.

2. Water Shutoff and Profile Control Technology System

Low-to-Medium Permeability Reservoir Water Shutoff and Profile Control System



DSDJ-1 (Gel)
 Temperature: 30°C to 120°C
 Mineralization: 10x10⁴mg/L
 Permeability: 1-1000mD



DSDJ-2 (Microsphere)
 Temperature: <150°C
 Mineralization: 20x10⁴mg/L
 Permeability: 1-1000mD

High-Strength Water Shutoff and Profile Control System



GQM (Strong Gel)
 Temperature: 30-150°C
 Mineralization: <20x10⁴mg/L



FHGQ (Gel+Particles)
 Temperature: 30-150°C
 Mineralization: <20x10⁴mg/L

Thermal Enhanced Oil Recovery Water Shutoff and Profile Control System



SD-1 (Gel)
 Temperature Resistance: <260°C
 Mineralization: <20x10⁴mg/L
 Temperature Control



SD-2 (Flexible Particle)
 Temperature: >300°C
 Mineralization: <30x10⁴mg/L
 Flexible deformation, effective water shutoff without blocking oil

High-Temperature and High-Salinity Resistant Deep Water Shutoff System



KWJD-1
 Temperature: <150°C
 Mineralization: 6000mg/L to 240000mg/L
 pH: 5 to 8

Balanced Displacement Technologies in High WC Reservoirs

High-Volume Long Distance Water Shutoff System



TQDJ-1
 Temperature <75°C
 Mineralization: <10,000mg/L



TQDJ-3
 Temperature: 90-120°C
 Mineralization: <7,000mg/L



TQDJ-2
 Temperature: 75-90°C
 Mineralization: <5,000mg/L

Application Cases:

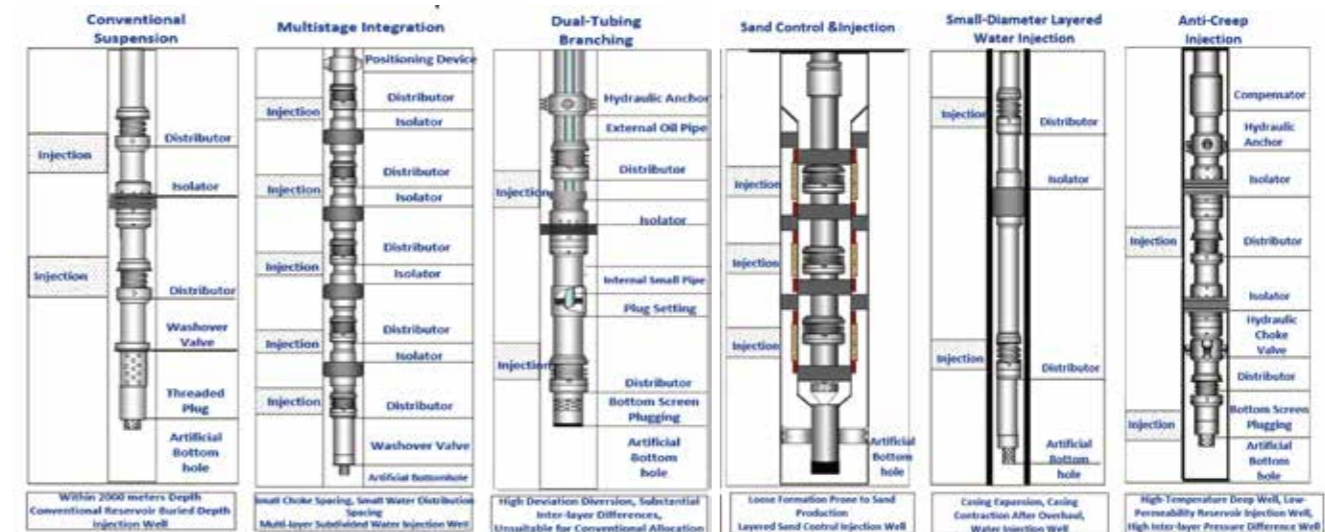
From 2001 to 2021, the company implemented a total of 1085 water shutoff and profile control projects for different types of reservoirs, resulting in a cumulative oil increase of 4.45MMbbls.



Separated Zone Water Flooding Technology

Development: 6 Water Injection Technique Series.

Apply for: Meets EOR Requirements for Different Reservoirs and Well Conditions.



Application Case:

Total 23 wells were implemented with separated zone water injection technology in Sinopec. The qualification rate of the water injection intervals increased from 46.5% to 90.1%, resulting in an additional effective water injection of 15Mbbbls/d. The development performance of the block significantly improved, with a 1.5% decrease in water cut for oil wells, an accumulated oil increase of 270Mbbbls, a 2.4% increase in recovery rate, and a cost-effectiveness ratio of 1:2.8.

Sand Control Technologies

Chemical sand control

It includes various sand control technologies such as mesh resin sand control, coating sand control, curing agent resin sand control, furfural resin sand control, and sand stabilizer sand control.

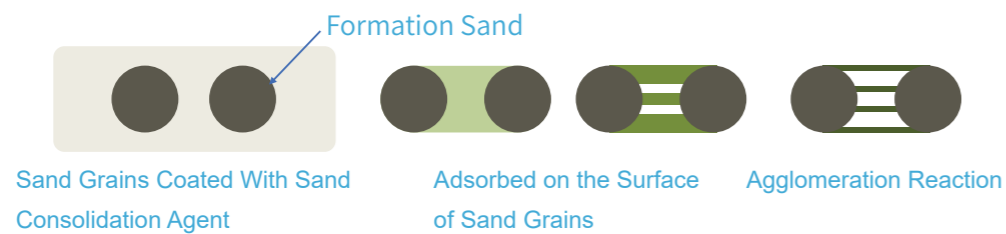
Non-plugging Solid Sand Control Technology

The non-plugging solid sand control agent is a mixture of multiple components of unsaturated resins, divided into A agent and B agent.



Appearance	Brown Liquid	Blue Liquid
Viscosity	40-70mPa·s	60-85mPa·s
Blend Viscosity	80-120mPa·s	
Compressive Strength	1.5-3MPa	
pH Value	6-7	
Applicable Temperature	At room temperature, the system operates between 20-100 °C, while the high-temperature system can withstand temperatures up to 350 °C.	
Applicable Mineralization	No specific requirements	
Permeability Loss	Oil phase: 5% for 40-60 mesh, 8-12% for 60-80 mesh, 15% for 100-120 mesh. Water phase: 10-17% for 40-60 mesh, 15-24% for 60-80 mesh, 22-30% for 100-120 mesh.	

Mechanism: The sand consolidating agent undergoes agglomeration reaction at a certain temperature, forming a fibrous consolidated structure to solidify the formation sand.



Performance Characteristics:

Does not consolidate the formation, preserving reservoir integrity; Leaves no plugging in the wellbore, facilitating construction; Exhibits selective water shutoff effects; High-temperature resistance, can be easily removed, and low viscosity.

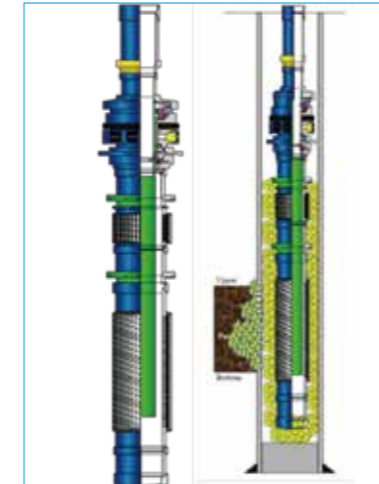
After consolidation, it can be easily removed: Under normal conditions, removal can be achieved in 4-5 hours with an alkaline solution, and in 2-4 hours at 50 °C.

Application Overview:

Accumulated applications in 904 wells, including Shengli Oilfield, Huabei Oilfield, Daqing Oilfield, Bohai Oilfield, Xinjiang region, and more. Among them, 24 wells were constructed in Huabei Oilfield, with a success rate of 87.5% for chemical sand consolidation, an average effective period of 759 days, and an average daily liquid production of 14.1 cubic meters.

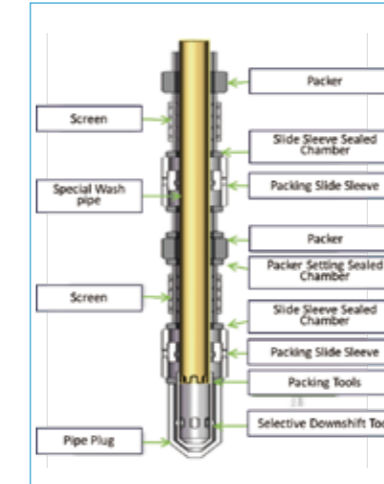
Sand Control Technologies

Mechanical Sand Control Process



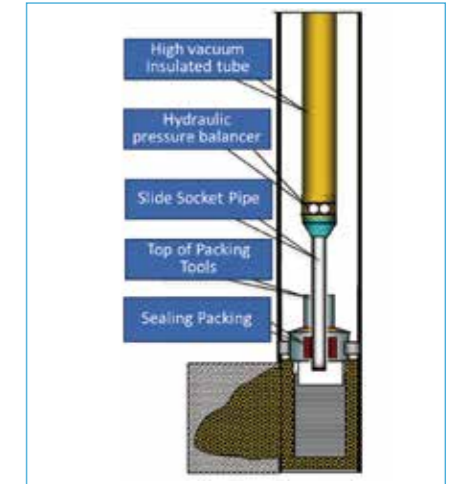
Forward Fracturing Packing Technology

Vertical Wells, Deviated Wells with an Inclination $\leq 45^\circ$.



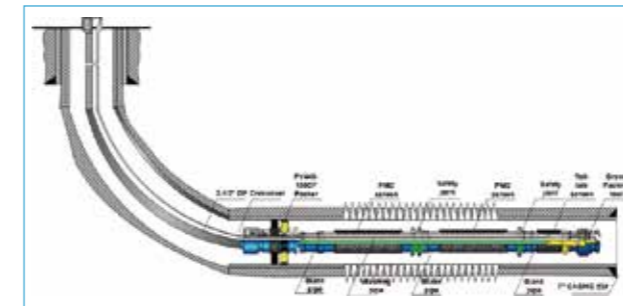
One-Time Multi-Layer Gravel Packing Technology

Straight wells and directional wells with large interlayer spacing and significant differences in interlayer properties.



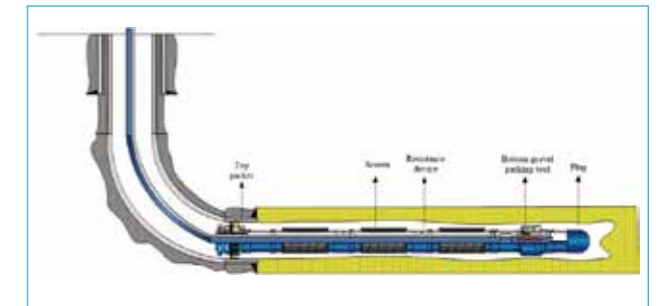
Integrated Sand Control and Gas Injection Technology

Mechanical sand control for thermal recovery wells; insulation pipe/casing annulus



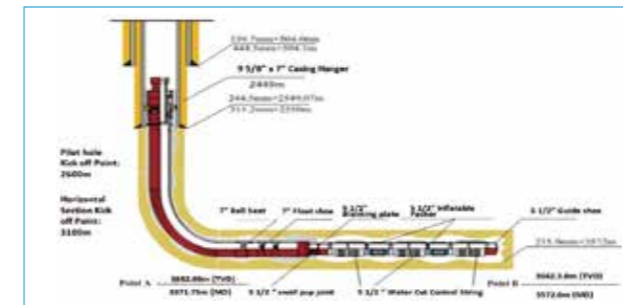
Horizontal Well Inside Casing Reverse Gravel Packing Technology

High-pressure wells, gas wells, wells with high gas-to-oil ratios; vertical wells, deviated wells, directional wells, horizontal wells.



Open-hole Horizontal Well Reverse Gravel Packing Technology

Wells inclination $>45^\circ$, including deviated wells, directional wells, and horizontal wells.



AICD (Autonomous Inflow Control Device) Sand Control and Water Control Technology

Sand control and water control for reservoirs with significant physical differences, edge-bottom water reservoirs; horizontal wells.

Paraffin Control & Removal Technologies

● Photovoltaic Circulation Heating Paraffin Removal Technology

Connection: Utilizes wellhead washover joint and surface washover pipeline. thermal washing medium into tubing under controlled pressure.

Fluid Mixing: Blends reservoir production fluid with thermal washing medium within the tubing.

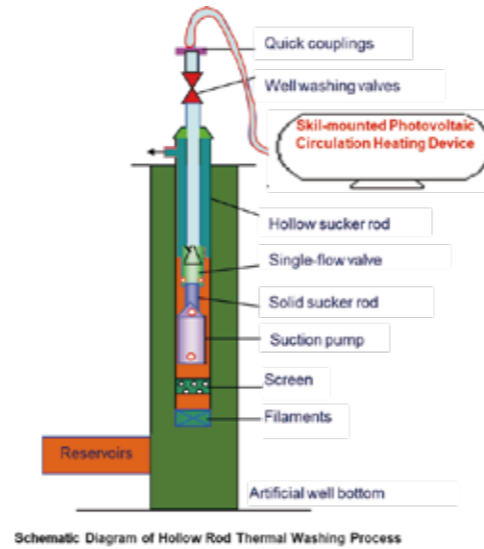
Wax Treatment: Designed to melt and flush wax deposits from tubing walls.

Discharge: Mixed fluid is discharged from tubing into the surface collection pipeline.

Recirculation: Cycles combined fluid through the photovoltaic circulation heating device for continuous thermal washing.

Objective: Complete melting and removal of all clustered wax from the system.

Application cases: Implemented over 100 wells in China, savings equivalent to 280,000 kWh per well, CO2 emission reduction of 170 tons.

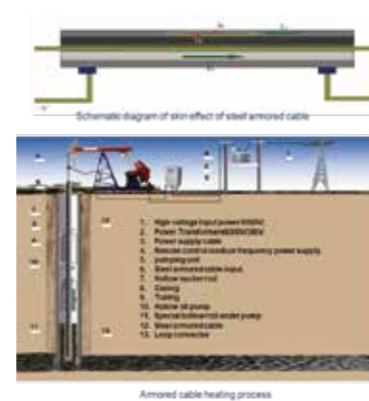


● Armored cable heating paraffin-removal technology

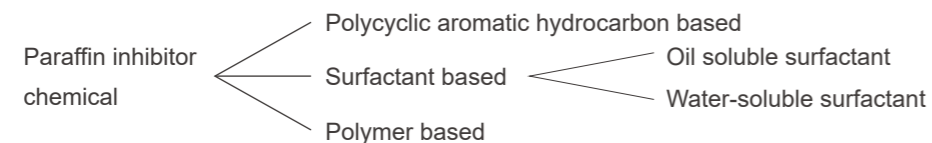
Principle: When alternating current passes through the copper core of the heating cable, the inner wall of the steel armored cable produces a skin effect to removal the paraffin.

Application scope: This technology is suitable for oil production wells with lifting processes such as screw pumps, pumping units, electric submersible pumps, and self-blowout wells.

Application cases: Implemented 5 wells in Xinjiang oil fields. The average hot washing cycle, 30d \uparrow 90d, the average maintenance-free period: 166d \uparrow 281d, the average liquid production: 66bbls/d \uparrow 111bbls/d, and the average oil volume: 28bbls/d \uparrow 48bbls/d.



● Chemical agent paraffin removal and prevention technology



Application cases:

Total 12 wells were treated in SINOPEC:

- **Maximum Load:** Average reduction of 5-42KN, with a significant improvement in the maximum load.
- **Upstream Current:** Noticeable decrease in upstream current in oil wells, with a reduction range of 1.5A-12A.

Composite Cold Recovery Technologies for Heavy Oil

● Process Principle

The main principle involves the use of high-pressure gases such as N₂ for energy enhancement and shear effects, along with the oil-solubilizing and phase mixing extraction effects of CO₂. This is complemented by the dispersing action of viscosity reducers to break down large molecular clusters and reduce the viscosity of crude oil, providing a driving force for heavy oil cold production.

● Application Scope

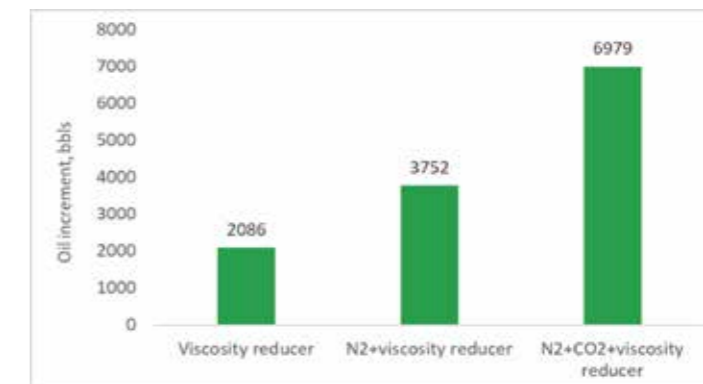
This technology avoids the technical drawbacks of conventional cold production, steam huff and puff, and conventional chemical viscosity reduction. It has a broad application prospect in conventional heavy oil, extra-heavy oil, and even ultra-heavy oil.

● Composite Viscosity Reduction System: N₂+CO₂+Viscosity Reducer (VR)

CO₂: Dissolved gas drive; Improved fluidity ratio; Miscible; Expansion and energizing; Unblocking of pore; Dissolve in oil and reduce viscosity.

N₂: Expansion Viscosity Reduction; Reservoir Energy Enhancement; Extraction and Dissolution.

Viscosity Reducer: Conventional Viscosity Reducer; High Molecular Weight Surfactant Viscosity Reducer.

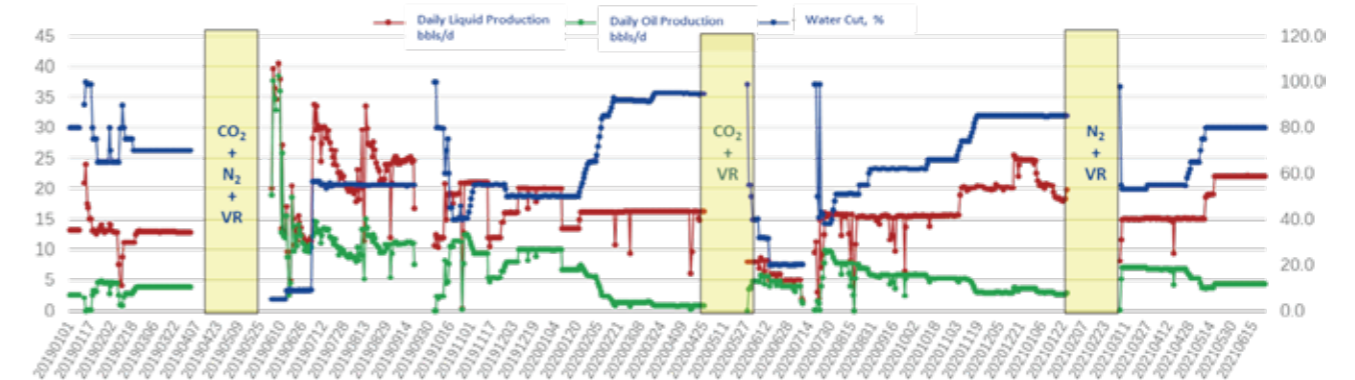


● Application situation

Successful Implementation On-site: 112 Wells;

Average Cumulative Oil: 5747 bbls/well/cycle;

Example Well L101H: Initial Daily Oil Increase: 236.6 bbls/d; Average Daily Oil: 49 bbls/d.



Experimental Research and Testing

Brief Introduction

10 major laboratories and one unconventional oil gas exploration & development research center

- On-site and mobile laboratory
- Laboratory of rock and mineral composition
- Petrophysical laboratory
- Laboratory of core gamma ray scanning
- Organic geochemistry laboratory
- Rock mechanics laboratory
- Reservoir stimulation Laboratory
- Laboratory of sedimentation and conductivity
- Physical simulation laboratory
- Laboratory of drilling fluid evaluation



Scop of research and testing:

- Geochemical analysis of source rocks and hydrocarbon
- Analysis and evaluation of reservoir and cap rock
- Experiments for EOR

Service Targets: Domestic and international oil companies, geological survey organizations, research institutions, and higher education institutions.

Experimental research and cases in research and testing projects:

- Test of shale for Paleozoic shale gas geological survey in Lower Yangtze area
- Viscosity-temperature curves and geochemical properties of crude oil in Weibei Sag
- Investigation and evaluation of unconventional oil & gas in and surround Qaidam Basin
- Test and evaluation of rock mechanical properties of shale in northeast China
- Fine characterization and evaluation of unconventional oil and gas reservoirs in Taipei Sag
- Test and analysis of coal and coalbed methane in Ma 76 and other Wells
- Study on the occurrence state of shale oil in the east of Jiyang Depression
- Microphysical simulation of sandstone reservoirs in Tuha Basin for tertiary oil recovery
- Test of physical and mechanical properties of unconventional reservoir in Erlian Basin
- Experiment and study on separation of Athabasca oil sands, Alberta, Canada

Contract sources:

China University of Petroleum (Beijing); Northeast Petroleum University; University of Calgary; Institute of Geology of Chinese Academy of Sciences; CNPC, Sinopec, CNOOC; China Geological Survey.

Chemical Products for Oilfield Production Enhancement

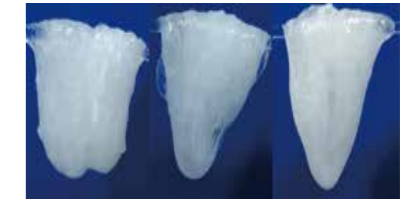
Brief Introduction

01 Shut-off & Profile Control Chemical Service

High-temperature resistant silicate resin Gel agent
Granular water-swelling composite powder & fly ash particles plugging agent
Polymer microspheres and reactive polymer agent
Phase permeability regulator and cross-linked polymer

02 Chemical agent services for fracturing fluid systems

Polymer surfactant cleaning fracturing fluid
Cross-linked polymer cleaning fracturing fluids
Instant guar gum fracturing fluid and suspended guar gum fracturing fluid
Small molecule surfactants clean fracturing fluids and alcohol-based fracturing fluids



03 Acidizing, Acid fracturing Chemicals and Related Services

Crosslinked acid service
Gelling acid, gelled acid service
High temperature corrosion inhibitor, demulsifier service
Self-diversion acid service



04 Tertiary Oil Recovery Chemicals and Related Services

Double heteroatom Surfactant agent
Molecular Membrane service
Nitrogen Foam Viscosity Reduction service
Surfactant + Polymer service
Supramolecular service



05 Paraffin Control & Anti Scale Agent Service

Calcium, magnesium scale inhibitor
Barium and strontium scale inhibitor
Polyether-type new paraffin inhibitor



06 Sand Control Chemicals Service

Low-viscous & high-strength sand consolidation agent service
High-strength, high-permeability multi-layer precoated sand and related service
Inorganic fiber high-strength crosslinking agent service
Carboxymethyl cellulose proppant and fracturing sand control service

07 Heavy Oil Recovery Chemical Service

High efficiency viscous-reducing agent service
High efficiency viscous-reducing+N2 compound flooding technology

Downhole Tools for Well Completion and Injection

It mainly includes downhole tools for separate injection and production, such as packers, water distributors, hydraulic anchors, bridge plugs, anti-collapse caving tools, and control-related downhole tools.



Downhole Tools for Sand Control

It mainly includes gravel packers, sand screens, layer isolation packers, and sliding sleeves.

1. Gravel Packing Tools: Top Fill Tools, Reverse Fill Tools.



2. Sand Control Screens: Precision Micro-pore Screens, Self-cleaning Variable Pore Plugging-resistant Screens, Plasma Cut Slotted Screens.



3. Separate Layer Tools & Sliding Sleeve



Downhole Tools for Production and Injection Enhancement

1. Segmented Fracturing Packers



2. screw pump



3. Submersible Centrifugal Pump



Downhole Fishing and Milling Tools

1. Salvage Tools: Mainly include various tools for salvaging pipes, rods, cables, and pump seals.



2. Casing Milling Tools: Milling Shoes, Casing Milling Reamer.



3. Casing Repair Tools: Mainly include casing whipstock dressers, pear-shaped expansion devices, tapered patches, and casing repair connectors.



Downhole Tools for Cementing

1. Cementing Accessories: Mainly include various types of float collars, float shoes, centralizers, cement plugs, and anti-backflow devices with pressure ratings of 35MPa, 50MPa, and 70MPa.



2. Dual-Stage Cementing Tool: Mechanical Perforation, Differential Pressure Perforation.



3. Liner Hanger(single/ double cone, top packing)



4. Well Completion Packer- Expansion Packer: Includes two types: expandable and self-expanding packers.

