

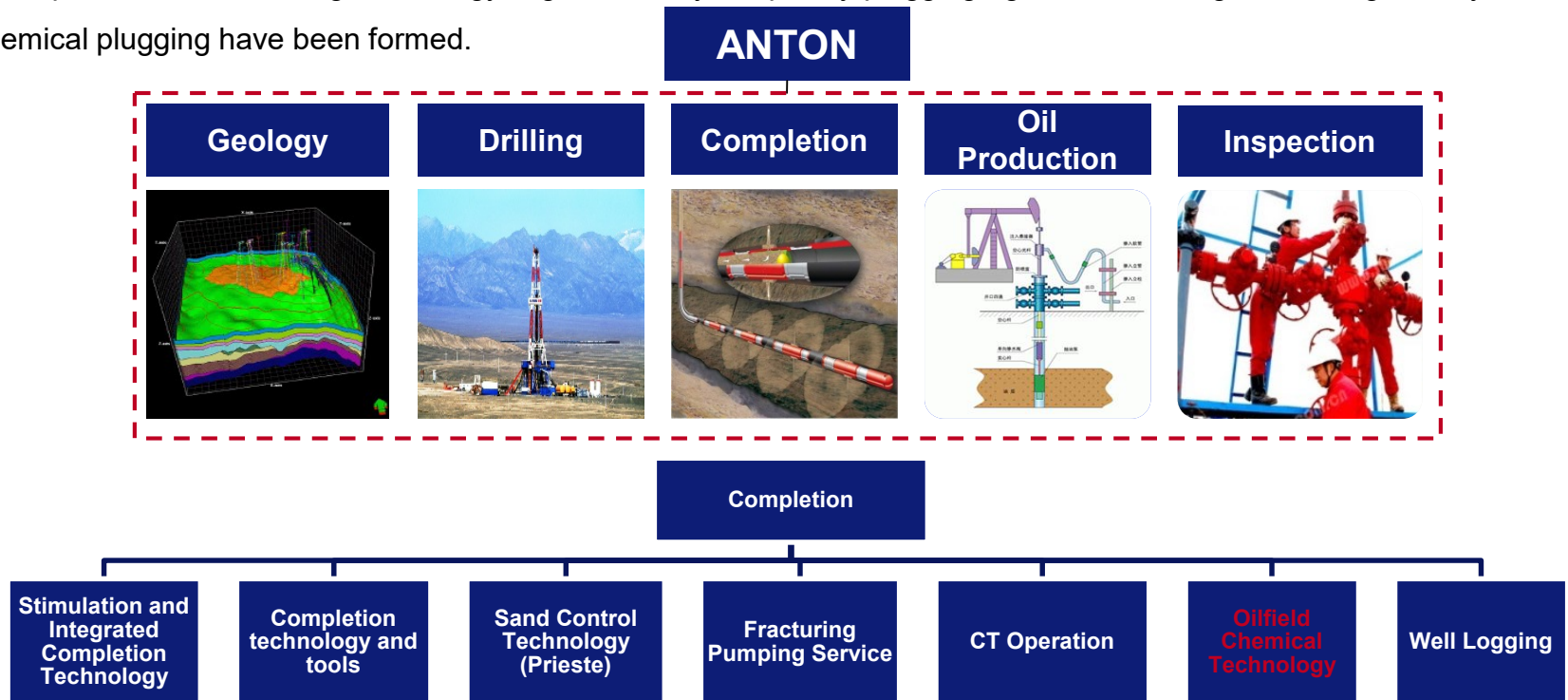
ANTON 安東

A blue-tinted photograph of an oilfield landscape. In the center, a tall metal derrick stands against a backdrop of rolling hills. The foreground shows some industrial structures and a fence. The overall scene is dimly lit, suggesting dusk or dawn.

Services of Oilfield Chemical Branch

东方智慧 全球分享
Oriental wisdom , Global sharing

Anton oilfield chemical technology is a one-stop chemical technology service for oil and gas reservoir stimulation, injection stimulation measures, chemical products and on-site process implementation. It is a comprehensive platform to provide oil and gas field chemical technology services for emerging global oil and gas markets. It has the capability of laboratory testing and evaluation of chemical system and single chemical agent, small-scale physical model experiment technology, liquid system design and on-site process implementation. A series of technologies featuring nano-composite fluid, quantum tracer testing technology, high efficiency temporary plugging agent, low damage fracturing fluid system and chemical plugging have been formed.



Contents

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Stimulation Materials

02

Temporary Plugging Fracturing Technology

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Chemical Plugging Technology

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Quantum Tracer Technology

05

Nano-composite Liquid Technology

1. Fracturing fluid system

- Various fracturing fluid systems to meet different reservoir stimulation needs

1. Ultra-low concentration fracturing fluid system

- Low Temperature Fracturing Fluid: 10-60 °C
- Medium Temperature Fracturing Fluids: 60-120 °C

2. Clean Fracturing Fluid System

- VES fracturing fluid
- Synthetic polymer fracturing fluid
- Cellulose Fracturing Fluid

3. Ultra-high Temperature Fracturing Fluid System

- Carboxymethyl guar gum ultra-high temperature fracturing fluid (< 180 °C)
- Synthetic Polymer Ultrahigh Temperature Fracturing Fluid (< 220 °C)

4. Salt-resistant Slick Water

5. Anhydrofracturing Fluid System

- LPG anhydrous fracturing fluid
- Liquid CO2 Fracturing Fluid
- Oil-based fracturing fluid

6. Foam and Emulsion Fracturing Fluid System

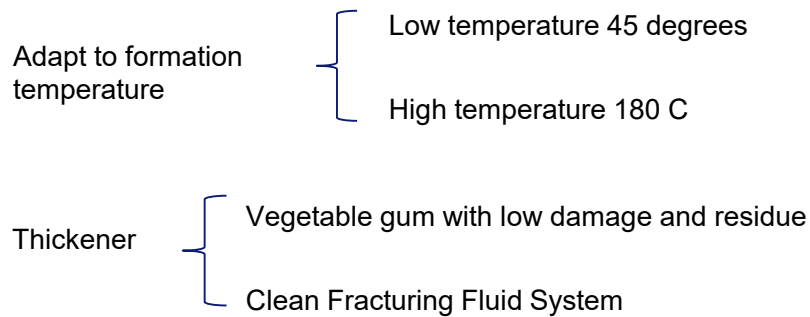
- Nitrogen foam fracturing fluid
- CO2 acid crosslinked foam fracturing fluid
- emulsified fracturing fluid

7. Enhanced Environmentally Friendly Fracturing Fluid System

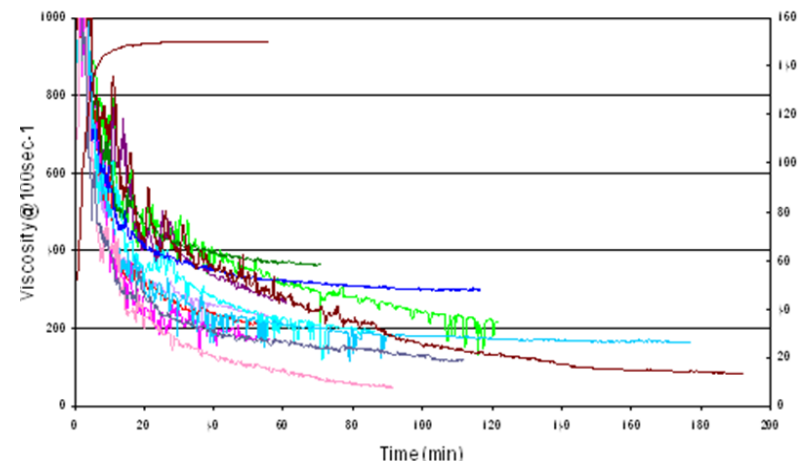
8. Phase Changing Fracturing Fluid

1. Fracturing fluid system

Fracturing fluid system characteristics:

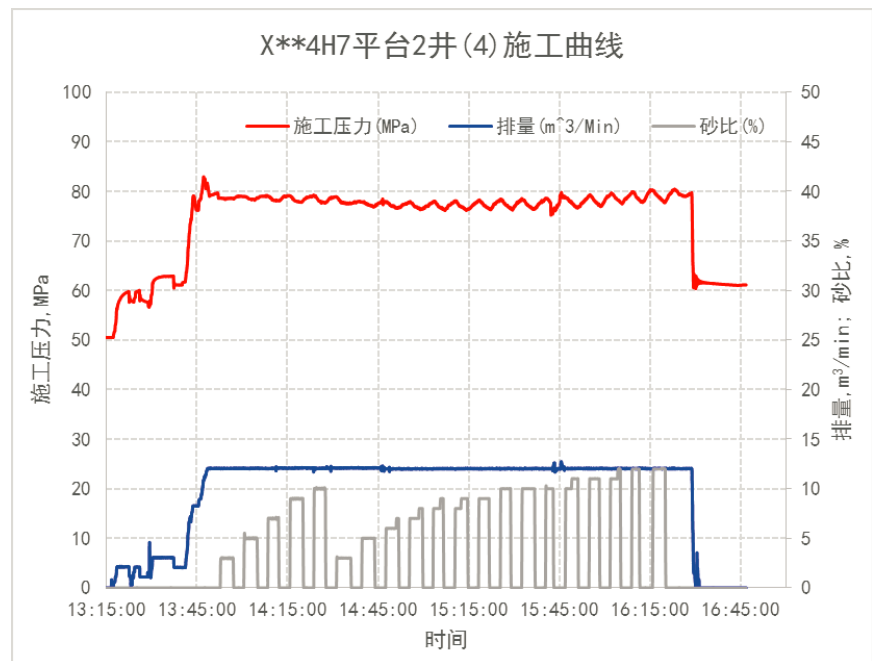


Alcohol-based fracturing fluid system
Cryogenic fracturing fluid system
Medium temperature fracturing fluid system
High temperature fracturing fluid system
Bubble discharge fracturing fluid system
Recoverable Fracturing Fluid



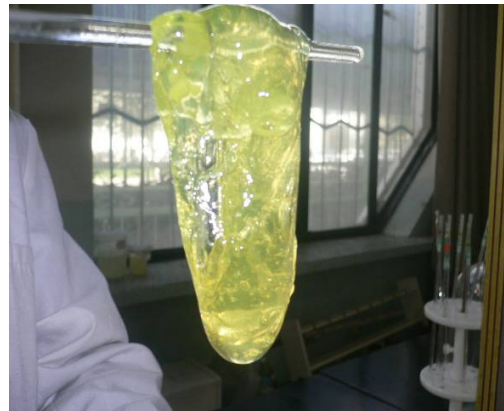
2. Low Friction Slick Water

- Major Component
 - 0.08-0.1% Friction Reducer
 - 0.2-0.3% Surfactant (Demulsifier and flowback aid)
 - 0.1% Bactericide
 - Clay Stabilizer
- Main Features
 - Low friction, friction reduction rate 75-80%.
 - Instant solving, continuous mixing
 - No residue, low adsorption, less damage
 - Salt-tolerant, suitable for high salinity water



3. Acid System

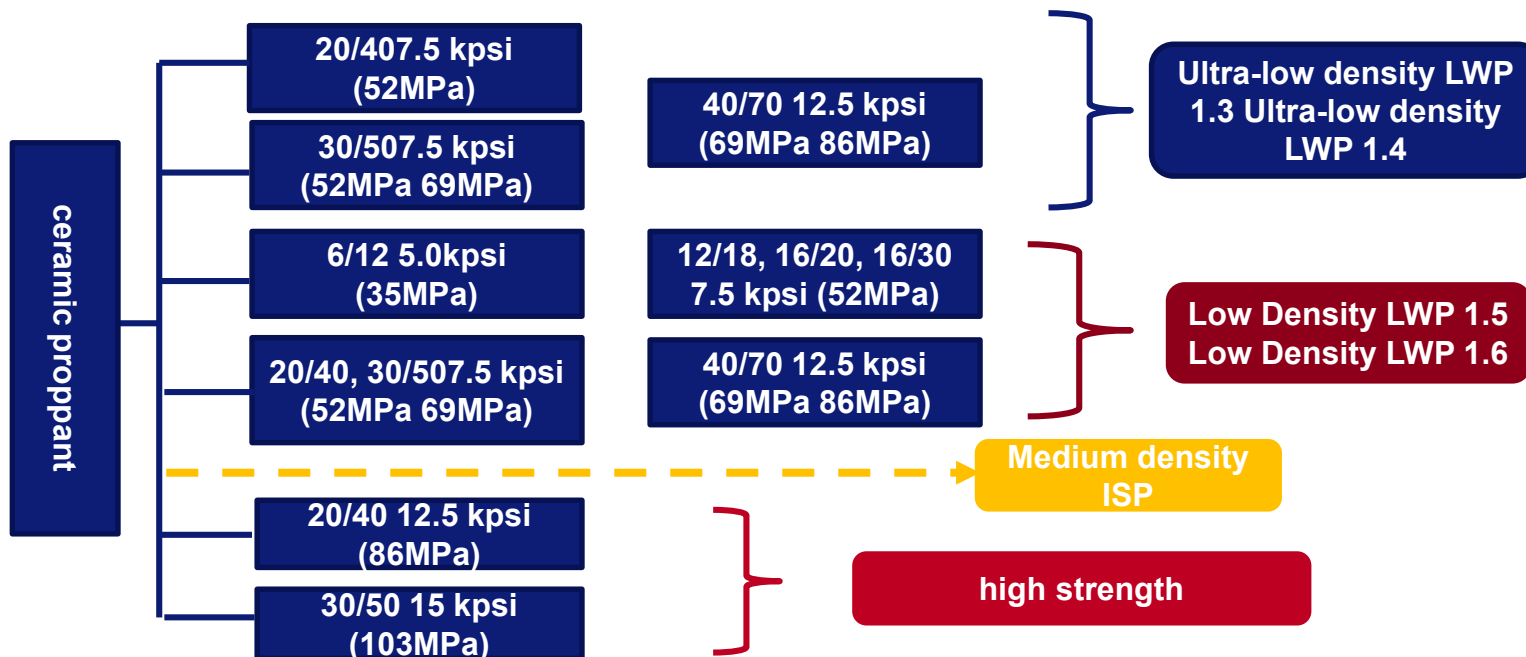
Various acid systems suitable for carbonate and sandstone reservoir (acid can be used for formation temperature up to 240 °C)



- Conventional acid
- Gelling acid
- X-linking acid
- Friction-reducing acid
- Foam acid
- Emulsified acid
- Diverting acid
- Sandstone acid system
- Compound organic acid system

4. Ceramic Proppant

Anton Advanced Material Co. Ltd is a professional proppant research and development, production company. It has 2 environmental friendly ceramic proppant production line and professional product development and testing laboratory. The annual output can reach 100,000 tons. The indexes of ultra-low density 1.4 series, low density 1.6 series and high density 1.8 series products are in the leading position in the world.



The products offered cover the whole range of ceramic proppants.

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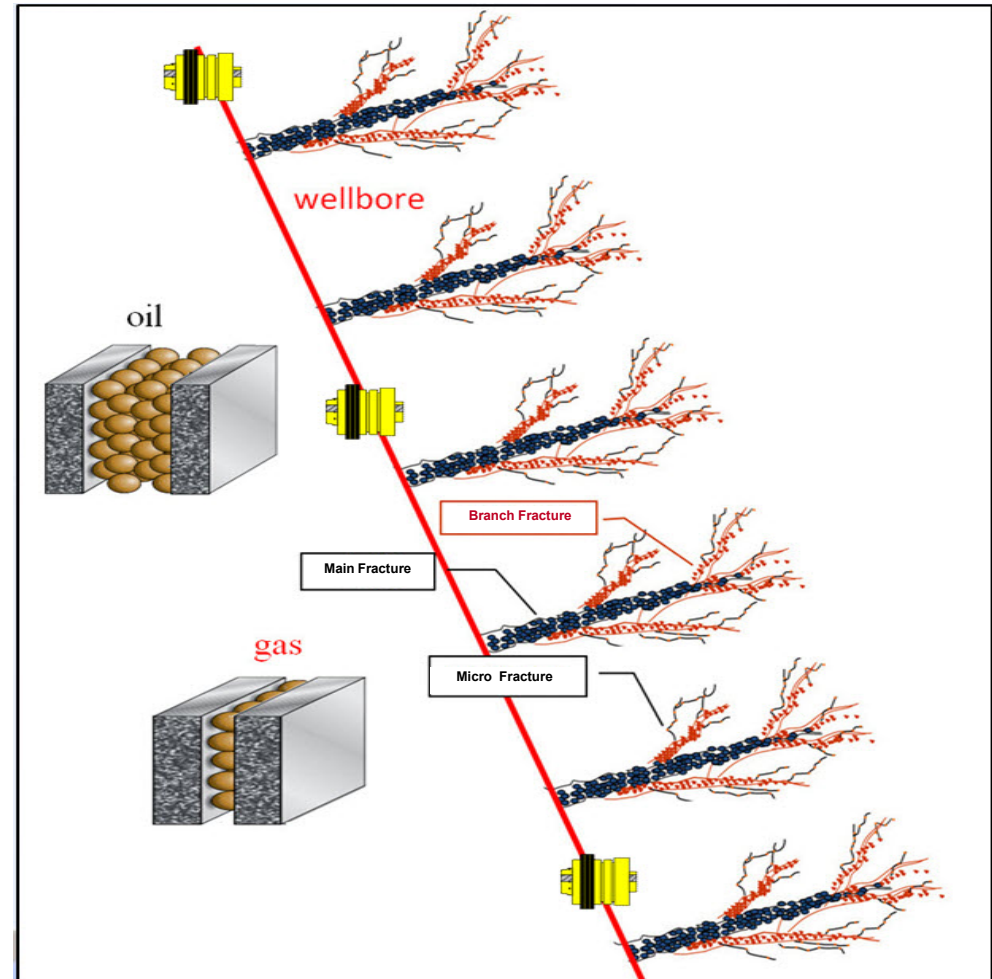
Quantum Tracer Technology

05

Nano-composite Liquid Technology

Temporary plugging fracturing technology

Definition: In fracturing construction, by adding plugging agent, the plugging agent gathers at the desired fracture location, changes the direction of fracture extension, improves the bottom hole net pressure, promotes the opening of new fractures, and ultimately achieves the purpose of increasing the stimulated volume and improving the effect of fracturing reconstruction. The plugging agent is soluble material, which dissolves automatically after construction and restores conductivity.



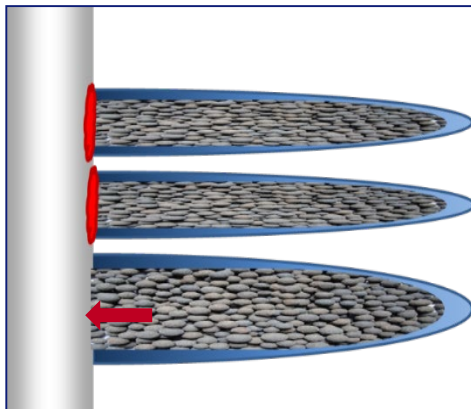
Application of Temporary Plugging Fracturing: Repeated Fracturing in New Wells and Multi-fracture Fracturing in Old Wells

Objective: To communicate the remaining oil areas of old fractures in a wider range and expand the drainage area of oil wells.

Series I: Inter-layer Diverting Fracturing

Series II: Intra-layer Diverting and create new fractures from the existing fracture opening

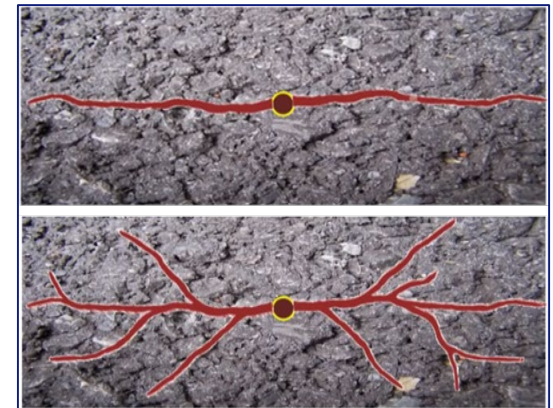
Series III: Activate old fractures and diverting from inside to create new fractures



1. Temporary plugging multi-layer fracturing in vertical wells

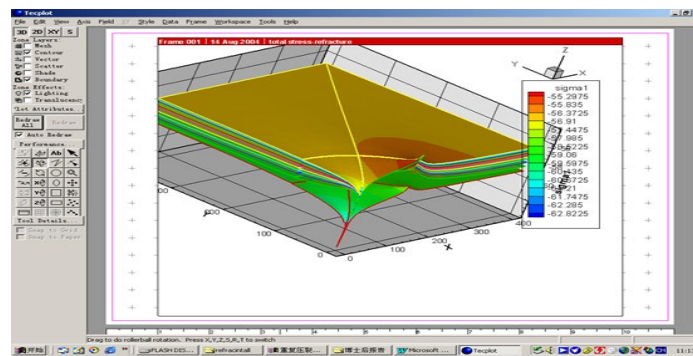
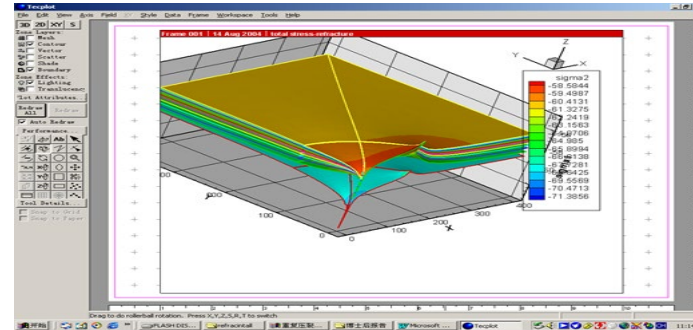
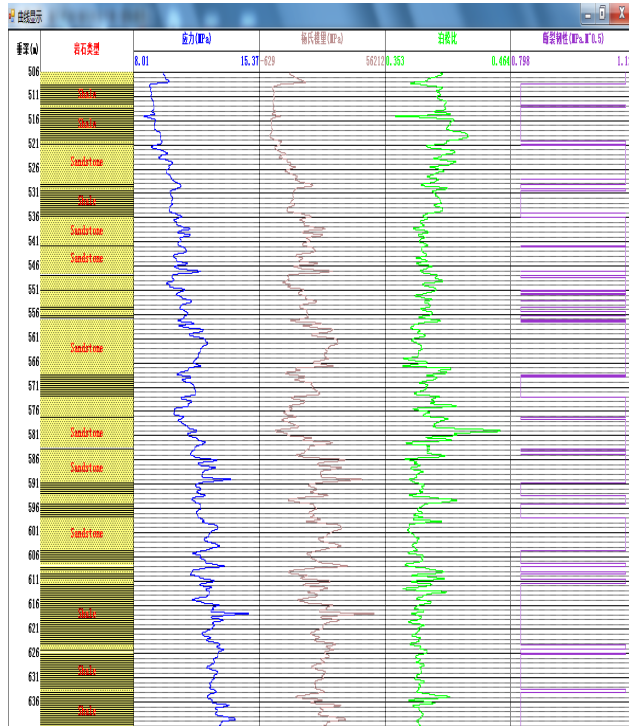


2. Diverting fracturing by temporary plugging of fracture opening



3. Temporary plugging and diverting from inside of fracture

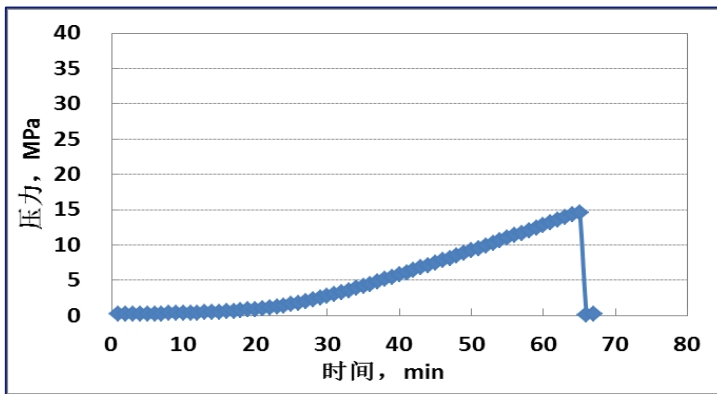
1). Temporary plugging fracturing design software to evaluate the applicability of composite temporary plugging



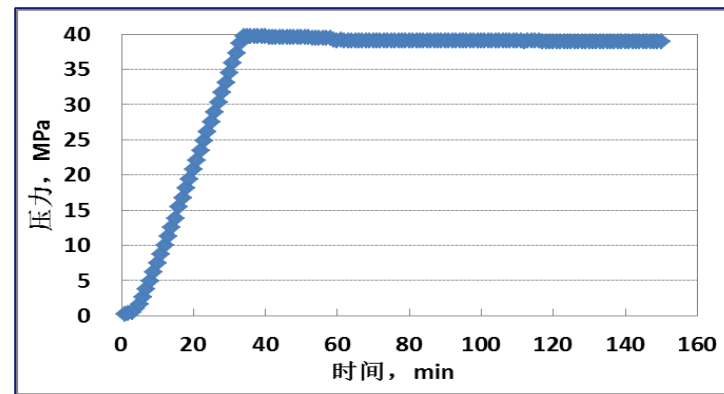
Stress difference is the precondition: the variation of in-situ stress in wellbore direction is calculated according to the software of in-situ stress continuous profile analysis, which provides a basis for the calculation of stratification (subsection) and fracture height, and the setting of model parameters of temporary plugging agent addition.

2) Plugging evaluation data of mass physical model experiment, optimizing key parameters such as particle size ratio, paving concentration and filling thickness, etc.

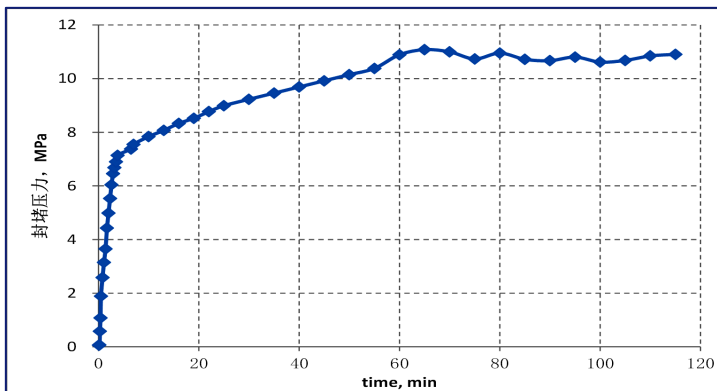
Plugging: plugging effect and effectiveness



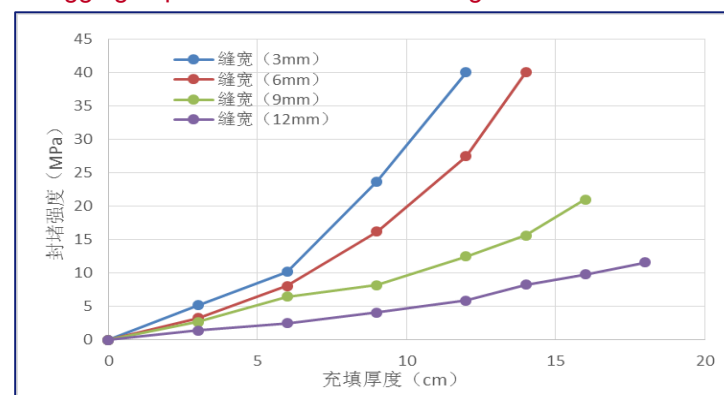
Plugging experimental curve with filling thickness of 3 mm



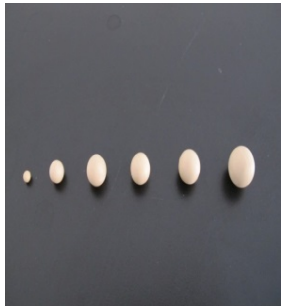
Plugging experimental curve with filling thickness of 10 mm



Experimental Curve of Flow Plugging



3) Complete patent product system



TP Balls



TP Fiber



Fracture Opening
TP granule



TP particles in
fracture



Expansive granule

Particle size = 2.1mm

Particle size = 3.7mm

Particle size = 4.3mm

Particle size = 4.7mm

Particle size = 5.4mm

Particle size = 6.7mm



Initial state

2min

5min

16min

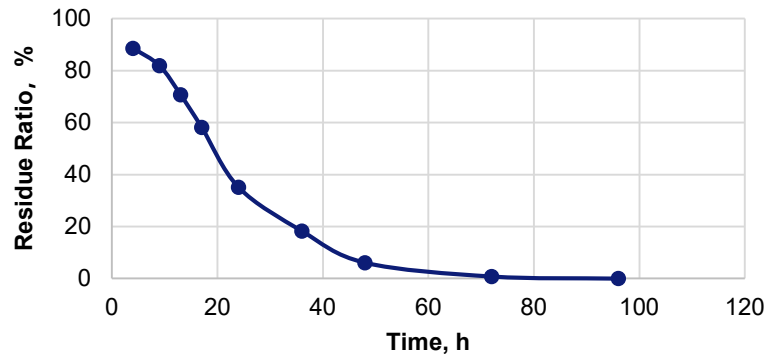
30min

60min

Particle plugging agent expands continuously when encountering water, the surface dissolves and increases viscosity, and each particle size temporary plugging agent binds to play a plugging role.

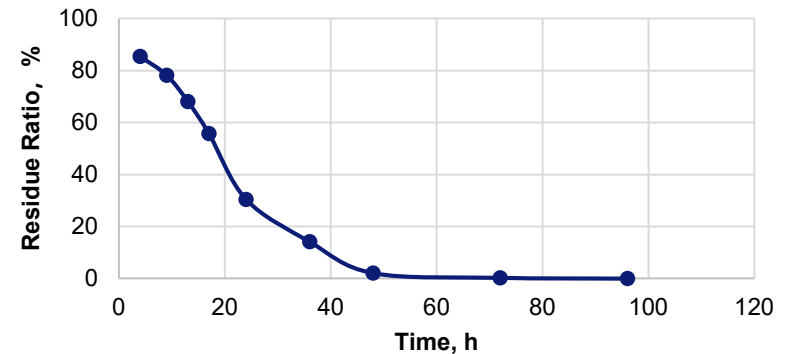
4) Customized dissolution time to meet the pressure and dissolution requirements of different temporary plugging fracturing processes

Degradation of TP agent at 40-90°C



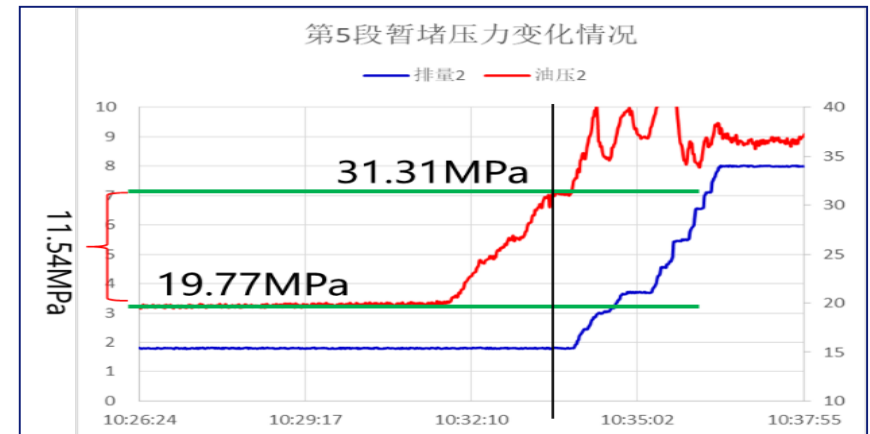
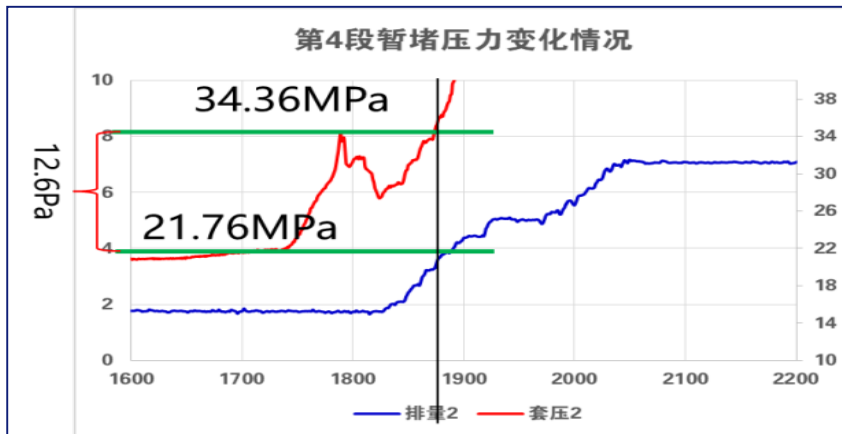
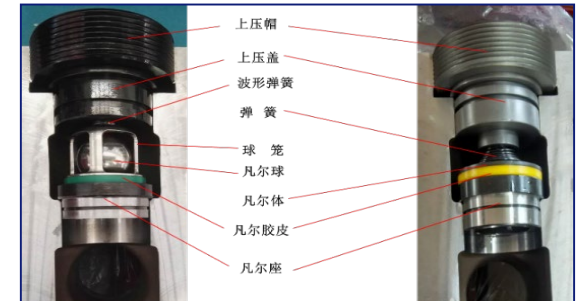
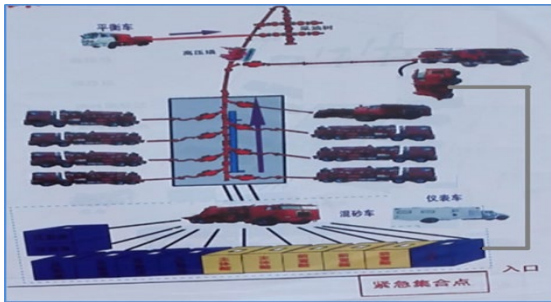
Time, H	Residual percentage of temporary plugging agent, %
4	88.6
9	81.9
13	70.7
17	58.2
24	35.1
36	18.3
48	6.1
72	0.8
96	0

Degradation of TP agent at 90-120°C



Time, H	Residual percentage of temporary plugging agent, %
4	85.5
9	78.3
13	68.2
17	55.8
24	30.5
36	14.2
48	2.1
72	0.3
96	0

5) Matching special batch mixing and adding equipment to solve the contradiction between particle size of temporary plugging agent and pump injection, and the effect of plugging steering is remarkable.



When temporary plugging agent arrives at the fracture, the pressure rises obviously and the plugging effect is apparent.

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I. Introduction of ATCEM Chemical Plugging Technology

What is ATCEM – A Kind of Special Polymer

External Channeling

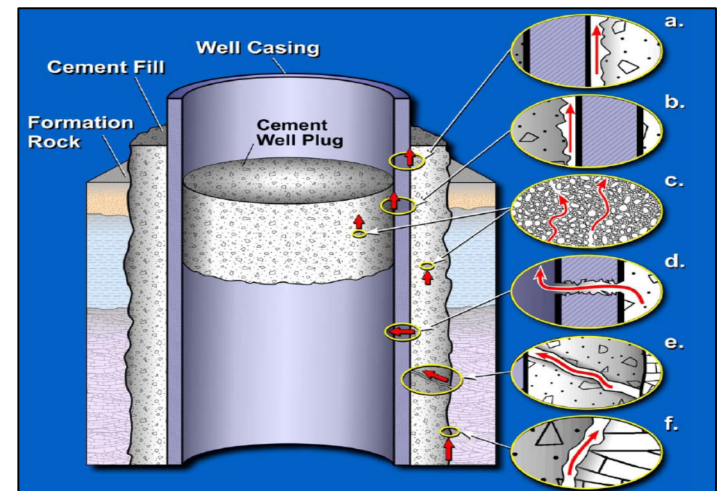
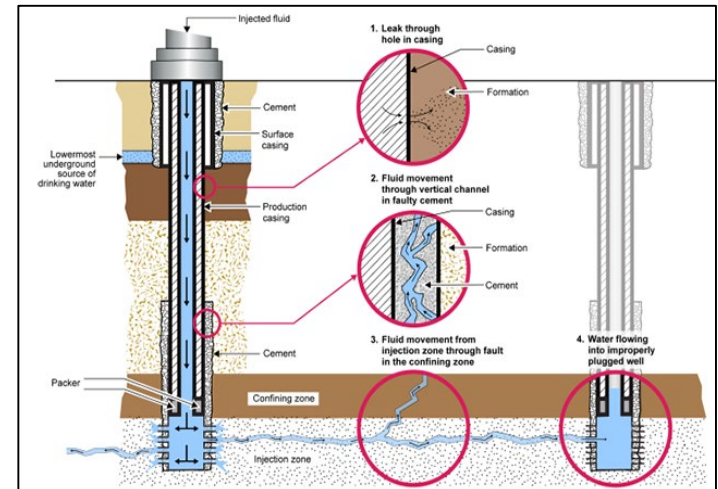
Plugging of annulus with pressure

Plugging of external water channeling

Secondary Cementing

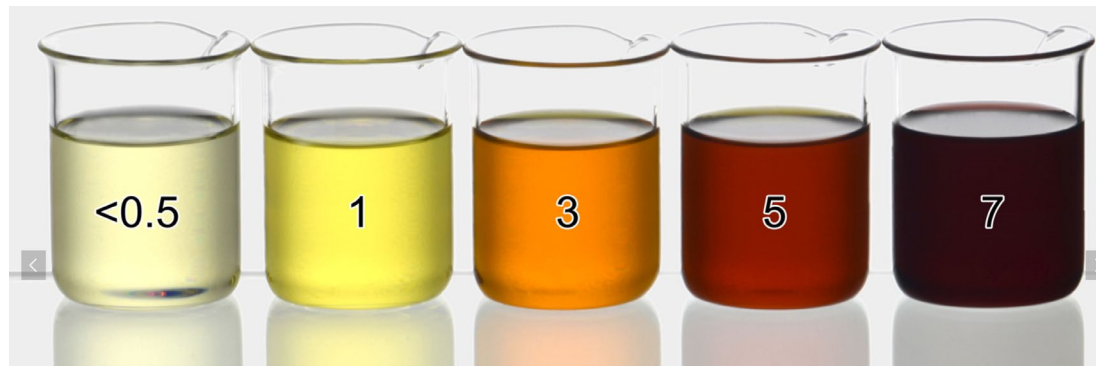
Water Plugging of H-well

Damage of tubing & Casing



2. Specifications

- The system does not contain any particulate matter, its insoluble in water and oil, and is not affected by formation water salinity.
- The curing temperature ranges from $-20\sim 200\text{ }^{\circ}\text{C}$ (curing environment temperature).
- The specific gravity of the system can be adjusted from 0.65 to 2.8.
- The viscosity of the system before curing is 10 - 60 mPa. s. The viscosity can be adjusted by liquid tackifier.
- Curing time: 5 min~10 hours



2. Specifications

- Strength:
 - Compressive strength: > 100MPa;
 - Tensile strength: > 20 MPa;
 - Flexural strength: > 19 MPa;
 - Bond strength: > 40 MPa;
- Temperature resistance: 0 ~ 400 °C;
- Shrinkage: No shrinkage.
- Corrosion resistance: strong acid resistance, alkali resistance, H₂S and CO₂ corrosion resistance after curing;



3. Product Series:

CEM 80 + CI30: Can be used to plug wellhead and casing leakage at - 20 - 90 °C environment

CEM 80 + CI40: Can be used to plug leakage, water plugging and so on in 30-90 °C environment.

CEM 120 + CI60: Can be used to plug leakage, water plugging and so on in 90 ~ 180 °C environment.

CEM-HT+CI100: Can be used to plug leakage and water plugging in steam injection at 350 °C.



4. The plugging performance is much better than that of cement plugging.

Parameter	Cement	ATCEM
Water permeability, mD	> 300	< 1
Compressive strength, MPa	45	206
Bending Strength, MPa	10	59
Bending failure rate, %	0.32	2.5
Young's modulus, MPa	3800	2120
Tensile strength, MPa	1	69
Density,	> 1.5	0.7-2.8
Curing at right angles	no	yes



5. Drillability and Degradation Treatment

- It will have good drillability after solidification. Drilling speed can reach 8-20 m/h. It is suitable for all kinds of drill bits.
- After curing, it can be degraded by special "organic degrading agent" in 12 - 72 hours.



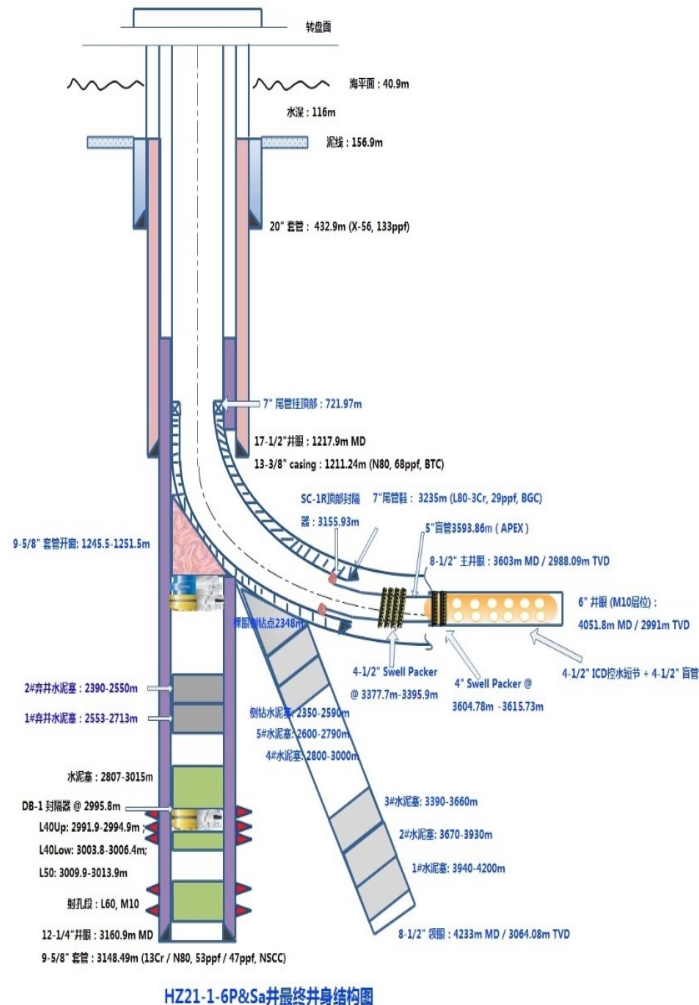
6. Ground Mixing Steps

- ① Transfer the required volume of ATCEM from the barrel to a convenient and safe dispensing container.
- ② Measure the ambient temperature of the surface to ensure the correct temperature/working time, and design according to the temperature requirements given by the customer engineer;
- ③ Add tackifier (using mixing device or circulating liquid mixing) at high speed according to the design, agitate/circulate for 15 minutes;
- ④ Add curing agent as the pre-designed formula. Mix for 5 minutes until it is completely dispersed in the whole plugging agent system;
- ⑤ Make sure the sample is taken and then put into the heating system to test the solidification time;
- ⑥ Now all plugging agents are ready to be placed in the storage tank, and then connect the pipeline to prepare for pumping.

Case 1: HZ21-1-6Sa / Hui Zhou OILFIELD , CNOOC/ Jun.12 2018

The main problems: on December 5, 2017, the water content was about 98% since it was put into producing. On December 20, 2017, well HZ21-1-6Sa was opened again. Only an hour later, the water cut rose rapidly to more than 96%. At present, the water content is 97%, and there is no sign of any improvement.

The purpose of ATCEM construction: To plug water in the mudstone section between the top of M10 (3584.8m) and the bottom of L60 (3503m), and to form a compact separator in the annulus area by twice squeezing ATCEM plugging agent, so as to seal the oil layer and water layer and prevent the water layer in the upper part of L60 from channeling into the oil layer. Make the well normal production. The construction is divided into two steps. First, 1 m of the project hole is drilled at 3570 m, and the plugging agent is sealed with the lower reservoir. The lower passage is sealed to ensure that the water does not flow through the annulus to the M10 layer.



Level	HZ21-1-6Sa 井分层数据表						
	HZ21-1-6Sa (RKB-40.9m)						
	Top			Bottom			Thick
	m MD	m TVD	m TVDSSL	m MD	m TVD	m TVDSSL	m TVD
K08	2607.90	2430.20	2389.30	2629.70	2449.64	2408.74	19.44
K22	2741.15	2548.53	2507.63	2763.21	2568.10	2527.20	19.57
L30A	3140.01	2855.77	2814.87				
L30	3166.90	2871.00	2830.10	3174.00	2875.00	2834.10	4.00
L40UPA	3206.56	2891.40	2850.50				
L40UP	3210.87	2893.50	2852.60	3239.22	2906.50	2865.60	13.00
L40LOW	3242.84	2908.10	2867.20	3253.04	2912.50	2871.60	4.40
L45	3289.63	2926.98	2886.08	3300.75	2931.07	2890.17	4.09
L50A	3311.56	2934.87	2893.97				
L50	3320.70	2938.00	2897.10	3351.00	2947.95	2907.05	9.95
L60	3378.00	2956.27	2915.37	3503.00	2981.50	2940.60	25.23
M10A	3584.80	2987.62	2946.72				
TD	4051.80	2991.00	2950.10				



Case 2: Sha 7-25/No.1 Oil Production Plant of Jiangsu Oilfield 2016 - 12 - 23

Abandonment Plugging

Challenge

- It is required to plug in 2096.5m-2111.5m production zone with serious formation leakage and water absorption of 0.2m³/min at 14MPa.
- Cement plugging has been used three times, and the expected results have not been achieved. The micro-pore can not be effectively plugged and the plugging strength is insufficient, and the validity period is short.
- The well temperature reaches 79 C, and the initial setting time of traditional cement slurry is short. The initial setting cement slurry is difficult to squeeze into the formation and affects the construction safety.

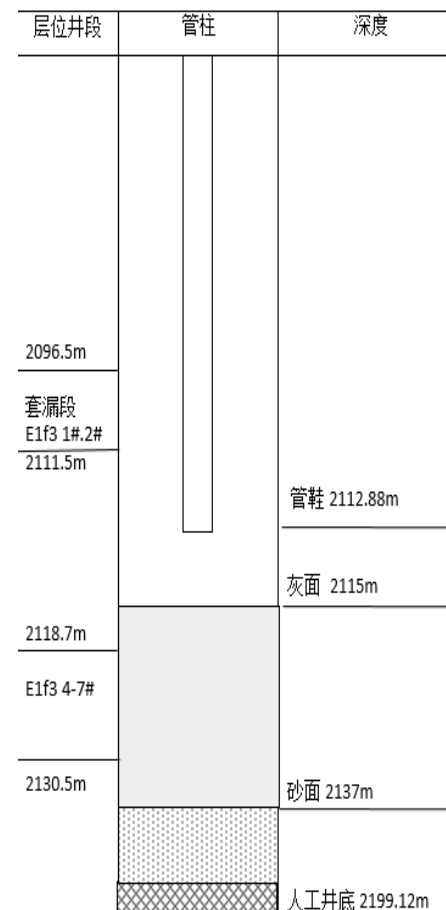
Solution

- Ultra-fine cement fills large pore channels and builds up squeeze injection pressure, then squeezes ATCEM polymer plugging agent to plug micro-pore, forming high-strength plugging near wellbore.
- Using ATCEM special polymer plugging agent, it has no solid particles and good fluidity, and can enter deep formation distance.
- By accurately adjusting the curing time by adding curing initiator for 2.5h, the right angle curing can be realized and the construction safety can be guaranteed.

Effect

- After drilling the plugging agent plug, the pressure test was 12 MPa, and the pressure did not drop for 30 minutes. The plugging was successfully implemented.
- A successful blockade, since putting into operation, scraping and eyemarking operations have not been lost.

沙 7-25 井身结构示意图



Case 2: Sha 7-25/No.1 Oil Production Plant of Jiangsu Oilfield 2016 - 12 - 23

Abandonment Plugging

Construction materials:

SNo.	Name	Code name	Consumption
1	Superfine cement		1.05m ³
2	ATCEM	CCA100	1.1m ³
3	Curing initiator	C60	2.83 kg (0.25%)
4	Cleaning agent	FRK-Cleaner 100	0.3m ³



Ultrafine Cement Slurry



Special polymer plugging agent CCA100

Construction process:

- Pump 1.05m³ ultra-fine cement slurry with density 1.6g/cm³. Extrude into formation for 0.62 m³, maximum extrusion pressure 18 MPa, reverse circulation wash out excess cement slurry.
- Displace 1.1m³ ATCEM and 5.8m³ water. When the plugging agent reaches the target formation, close the casing valve and squeeze the plugging agent into the formation.
- POOH 5 tubing and shut-in with 6 MPa pressure for solidification.
- After 12 hours of solidification, PDC bits were used to drill plugging plugs in 2090-2115 m interval with a penetration rate of 8 m/h.



PDC bit and cuttings

Case 3: Anfeng 32/No.1 Oil Production Plant of Jiangsu Oilfield, 2017 - 01 - 07

Plugging of Pipe External Channeling

Challenge:

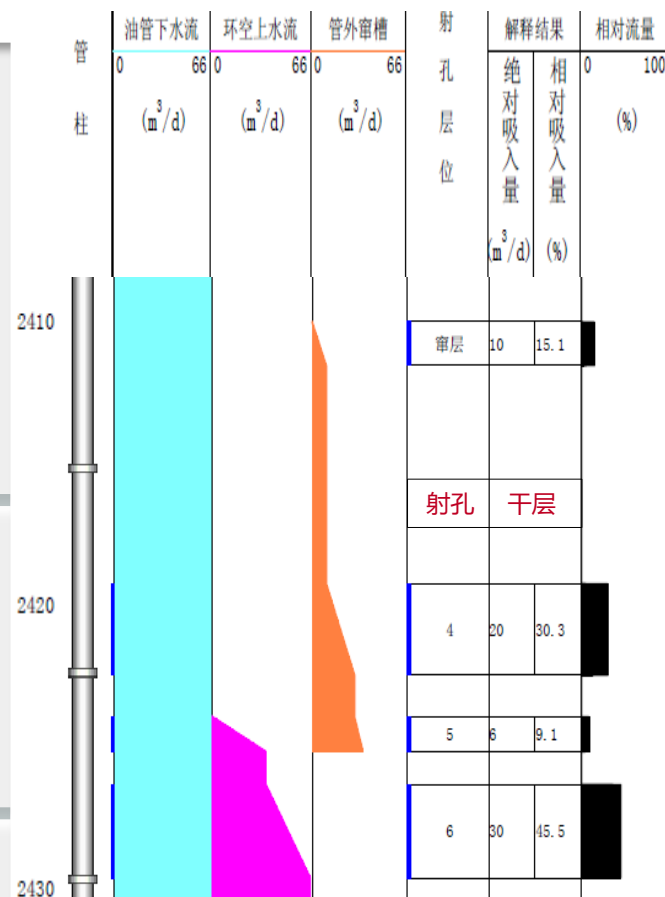
- Well Anfeng 32 is a production well. The cement sheath outside the casing of #4, #5 and #6 pay zones has channeling links with 2409-2411m. The oil well produces a lot of water and dirt.
- It is designed to seal channeling by squeezing ultra-fine cement in 2416.9-2417.9m perforation between producing layer and channeling layer. The new perforation layer is dry layer with porosity of 5% and water absorption of 70L/min in 24MPa.
- Ultra-fine cement can not plug micro-channeling and form an effective anti-channeling barrier in perforation section.

Solution:

- ATEM special polymer plugging agent is solid-free and fluidity is good, easy to enter any shape of micro-pore.
- With high strength and good plastic deformation ability, the plugging agent is compacted when it enters channeling solidification, and a small amount of plugging agent can achieve the plugging purpose.

Effect:

- After blocking, pressure test was carried out, and the pressure did not drop for 30 minutes at 16 MPa. The blocking channeling was successfully implemented.
- After plugging, the water cut is reduced by 12%, and the oil well returns to normal production.



Continuous tracer correlation logging curves show that tracer injected into layer 5 channels up the outer casing channel to the channeling layers above 4 # and 4 #.

Case 3: Anfeng 32/No.1 Oil Production Plant of Jiangsu Oilfield, 2017 - 01 - 07 Plugging of Pipe External Channeling

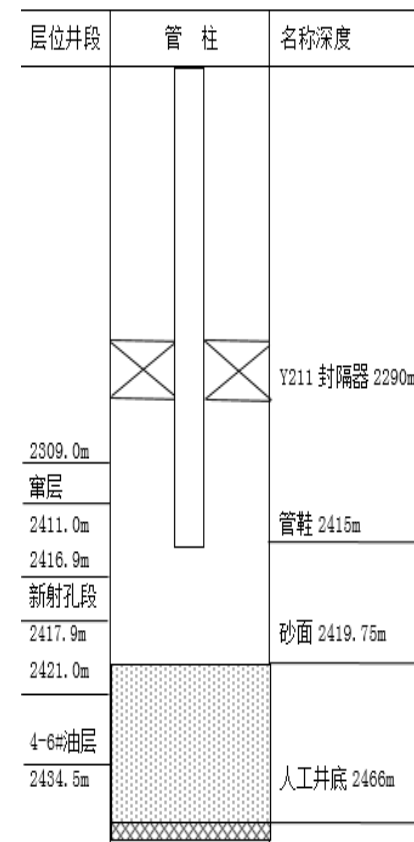
Construction materials:

Serial number	Name	Code name	Consumption
1	ATCEM	CCA100	0.8m3
2	Curing initiator	C100	4.96kg
3	Cleaning agent	FRK-Cleaner 300	2m3

Construction process:

- A 102-gun 89 projectile perforation was used to perforate 2416.9-2417.9m horizon with a hole density of 25 holes/m. Sand filling to 2419.75m to protect reservoir.
- Pump in cleaning agent FRK-Cleaner 300 for 2 M3 to clean perforation hole, change the wettability of casing outer wall, and increase the cementing strength of CEM special polymer plugging agent.
- The positive plugging agent and clear water displacement fluid are replaced, and the plugging agent reaches the designed position. Upper riser string 10, seating Y221 packer, seating load greater than 8 t.
- The plugging agent is 0.5m3 and the maximum injection pressure is 22 MPa.
- The well is shut down for condensation at pressure of 5 MPa. The plugging agent plug is drilled through after fully solidified for 12 hours.

安丰 32 井封窜管柱示意图



The use tubing with bottom packer to squeeze plugging agent.

Case 4: LFLZ9XN18/Binnan Oil Production Plant of Shengli Oilfield, 2017 - 01 - 24 Casing damage well treatment

Challenge:

- Artificial bottom hole 1087m, water layer 1009-1014m casing diameter reduction, tool resistance, down into the wash cone grinding milling outlet returned a large number of cement blocks.
- The sealing horizon is shallow and the well temperature is 48 °C.
- The permeability is 2.7 μm^2 and the porosity is 37%.The leakage is serious. The water absorption of 5MPa is 400L/min.

Solution:

- Using curing initiator C30 and catalyst D30, the special polymer plugging agent ATCEM can be cured at low temperature.
- The temporary plugging polymer system PAF is used as the precursor fluid to plug the large pore channels and reduce the loss of plugging agent.The viscosity is 150 mPa.s.
- 1000 mesh solid powder was added to the plugging agent to make the plugging agent evenly enter the formation channels and play the role of squeeze injection signal.



CCA100 (left) and special polymer plugging agent with different solid powders

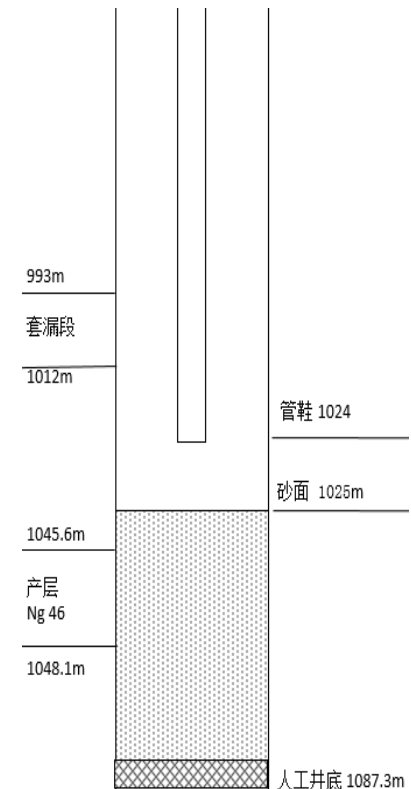
Case 4: LFLZ9XN18/Binnan Oil Production Plant of Shengli Oilfield, 2017 - 01 - 24 Casing damage well treatment

Construction materials:

Serial number	Name	Code name	Consumption
1	Temporary plugging polymer system	PAF	2m ³
2	ATCEM	CCA100	1.33m ³
3	Curing initiator	C30	8.22 kg (0.6%)
4	Catalyzer	D30	4.11 kg (0.3%)
5	Solid phase powder	FRK-Powder	200 kg (15%)

Construction process:

- The reservoir is protected by sand filling up to 1025 m after well washing.
- Put the plugging string down to 2m above the sand surface and wash the well thoroughly to reduce the well temperature.
- The temporary plugging agent for PAF is 2m³, and the special polymer plugging agent for CA100 with 15% solid powder is 1.33m³. Close the casing gate before leaving the tubing shoes and squeeze the PAF temporary plugging polymer into the formation.
- When the injection pressure rises obviously, CCA100 plugging agent is squeezed into the formation, and 0.87 m³ is squeezed into the co-direction formation. The maximum injection pressure is 10 MPa. The shutdown pressure is reduced to 8 MPa. The solidification time of plugging agent was designed for 1 h.
- After 6 hours of waiting, the plug surface was 990 M. After the drill plug reaches 1025 m, the pressure test is 12 MPa qualified.



Tubing Diagram

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01 Stimulation Materials

02 Temporary Plugging Fracturing Technology

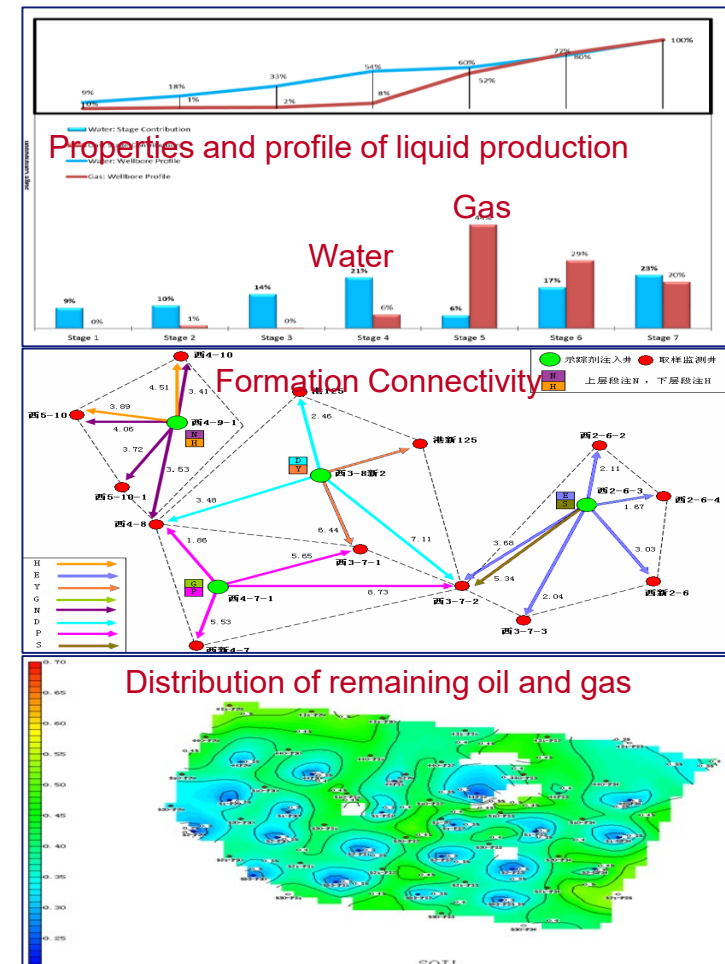
03 Chemical Plugging Technology

04 Quantum Tracer Technology

05 Nano-composite Liquid Technology

Principle of tracer testing technology: By injecting tracer into formation and measuring tracer type and quantity in surface sampling, oil and gas reservoir production information can be obtained.

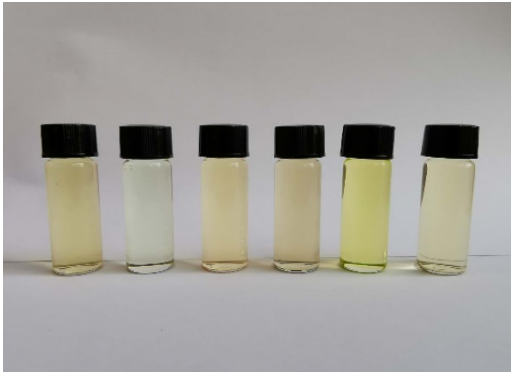
- Contribution Ratio of Well Stage Production (Static and Dynamic)
- Well section production data
- Judgment of liquid production properties (oil/gas/water)
- Evaluation of Residual Oil and Gas Distribution
- Evaluation of Formation Connectivity
- Evaluation of Water Flooding Speed
- Downhole Tool status monitoring



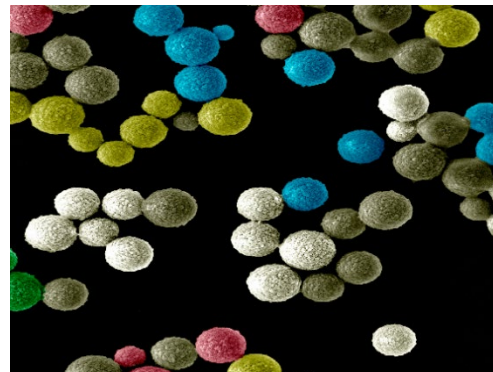
What is Quantum Tracer?

- Based on six special substances, different tracer with distinct characteristics is formed by combination of them.

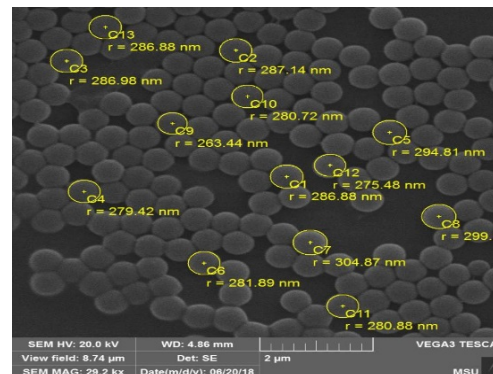
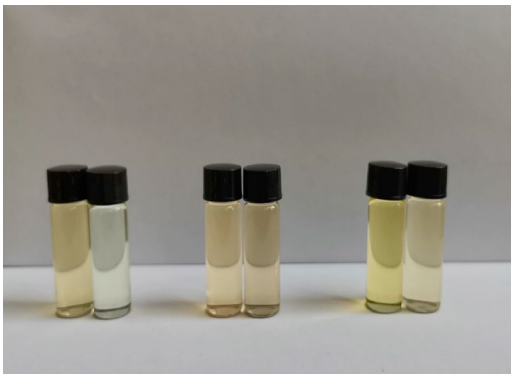
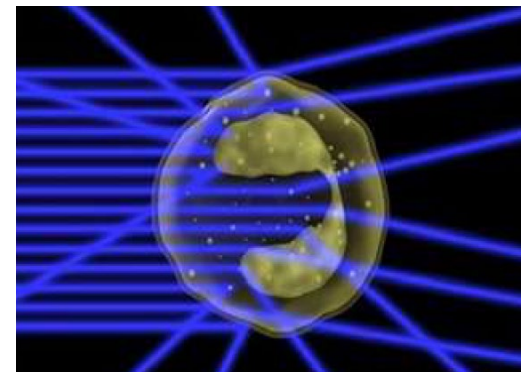
Basic Substance



Quantum Tracer



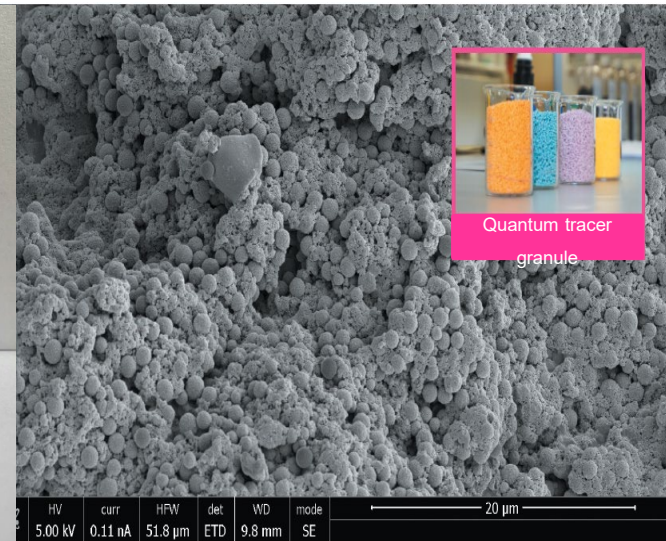
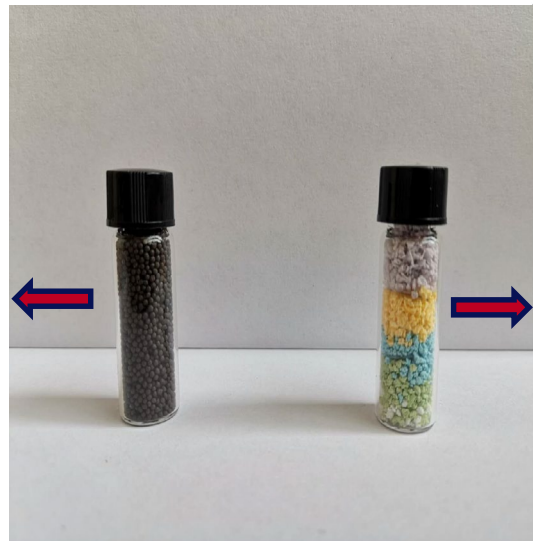
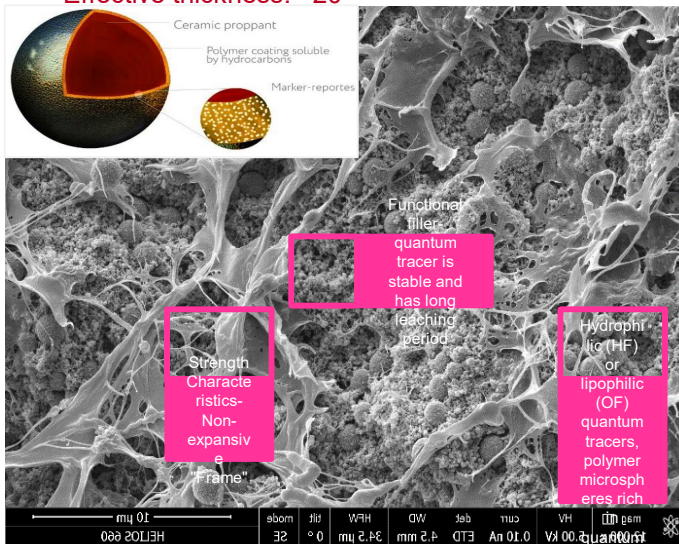
Laser Identifying



Using electromagnetic spectrum (laser) to irradiate tracers, different quantum dots produce different quantum events due to quantum confinement effect.

Product Form

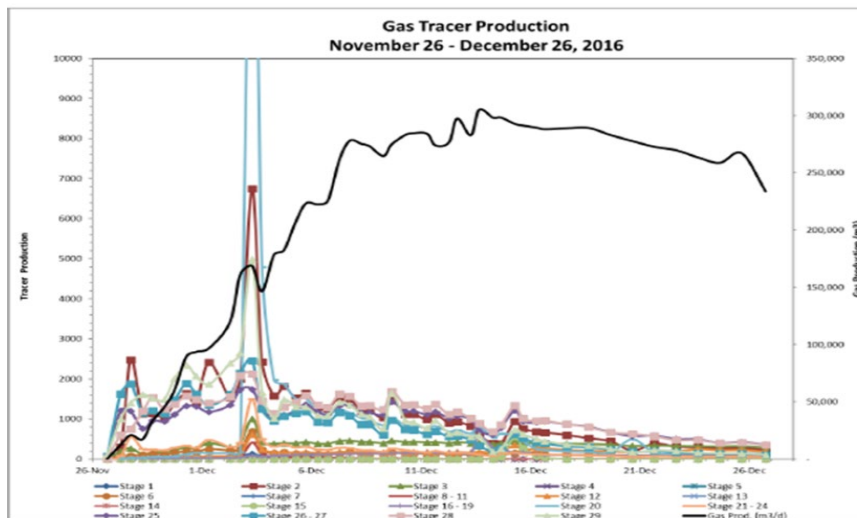
Effective thickness: <20



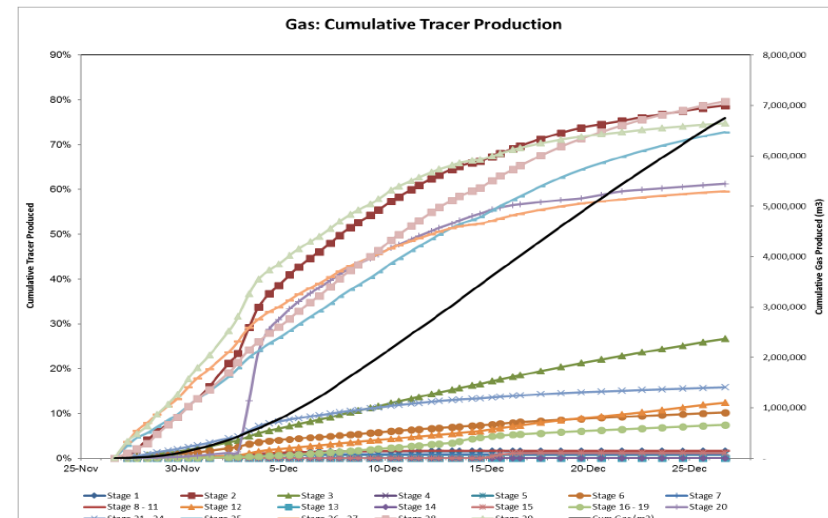
Feature 1: Test Results are Intuitive

- Fluid state of each section: oil/gas/water
- Static data: production data at a particular time
- Dynamic data: continuous production data

Real-time Change Chart

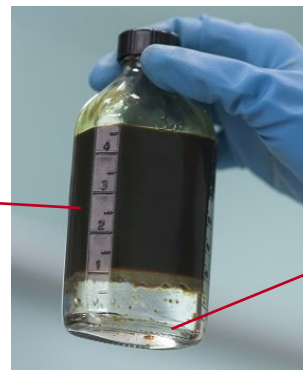


Cumulative Chart



Feature 2: High Accuracy & Long Validity Period of Quantitative Testing

- No environmental interference: Laboratory synthesis, non-natural existence
- Lossless: No adsorption, No natural loss.
- Slow-release: Solid morphology is less affected by liquid scouring, maintaining stable and slow-release.
- Large quantity: 1 kg coated proppant contains 10^{12} quantum tracers
- Detection accuracy: Single quantum tracer can be identified (test stable concentration is more than 10 units)
- Long validity period: 2-3 years for proppant coating and 3-5 years for tool filling.
- Corresponding Uniformity: Oil, Gas and Water Phases do not interfere with each other

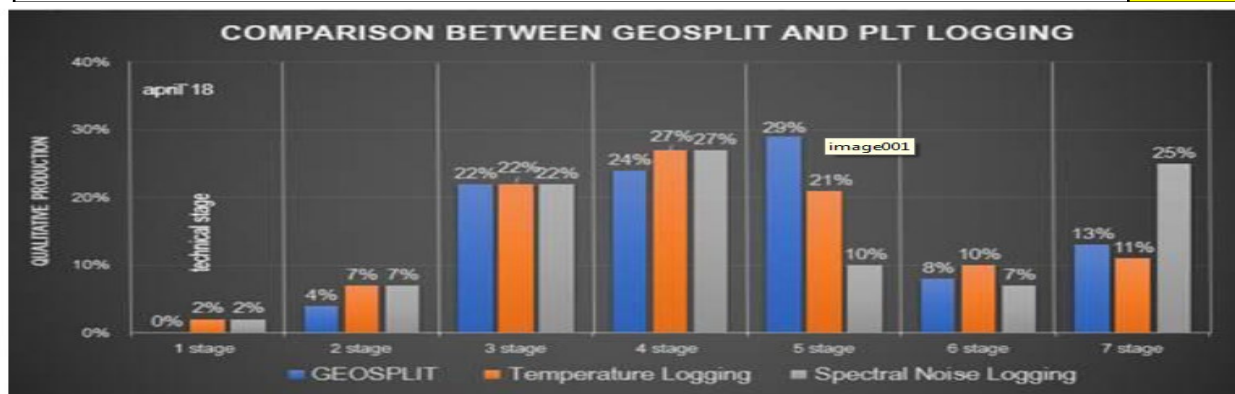


Feature 2: High Accuracy & Long validity period of Quantitative Testing

Laboratory testing

Ratio and Codes Identified by ANTON				Real Ratio and Codes Mixed by Customer					Discepancy
Mixture	Cipher	SNo.	%	Mixture	Cipher	SNo.	%	Mass, g	%
1	WT	1	24	1	WT	1	24.99	24.995	0.99
	WG	2	25		WG	2	25.34	25.335	0.34
	WR	3	16		WR	3	14.99	14.998	1.01
	WU	4	0		WU	4	0	0	-
	WP	5	35		WP	5	34.68	34.688	0.32
	合计				100	合计			100
2	AR	6	29	2	AR	6	26.78	27.376	2.22
	AQ	7	18		AQ	7	18.16	18.562	0.16
	AT	8	11		AT	8	12.37	12.647	1.37
	AY	9	13		AY	9	12.32	12.595	0.68
	AW	10	29		AW	10	30.37	31.050	1.37
	合计				100	合计			100
									0.94

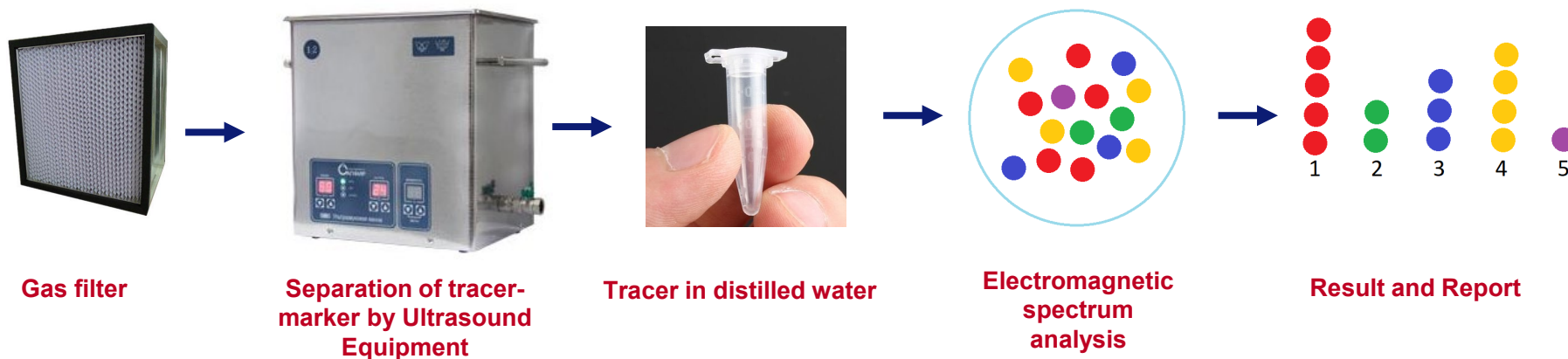
Comparison with well measurement data



The average coincidence rate is over 98%.

Feature 3: Complete Product Series

Product type	Max QTY of stage monitoring	Monitoring cycle (day)	Number of samples in a Monitoring cycle to
Gas phase	46	Sampling for a test cycle in 2-3 days	10-15 samples
Aqueous phase	46		Sampling 10-15 bottles (1 bottle = 1000ml) Sampling at intervals of 30-60 minutes
Oil phase	46		



Feature 4: Wide Adaptability

- High Temperature Resistance: 175 °C
- Applicable pH: 1-14
- Applicable salinity: <300,000 mg/L



Feature 5: Safety and Environmental Protection


Федеральное медико-биологическое агентство
Федеральное государственное бюджетное учреждение здравоохранения
Головной центр гигиены и эпидемиологии

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АТТЕСТАТ АККРЕДИТАЦИИ
№ RA.RU.710138

УТВЕРЖДАЮ
Зам. руководителя Органа инспекции
А.И. Петухов
М.п.

от «04» 12 20 18 г. № 28041/2018

ЭКСПЕРТНОЕ ЗАКЛЮЧЕНИЕ
по результатам санитарно-эпидемиологической экспертизы продукции

на основании заявления № 4785/18 от 29.11.2018 от организации-заявителя по договору с ФГБУЗ ГЦГ и Э ФМБА России: ООО «Сервиль», Россия, 142281, г. Протвино, проезд Северный, 3-65

Организация-получатель экспертного заключения: ООО «ГеоСплит»
Адрес: 121205, Россия, город Москва, Территория Сколково инновационного центра, бульвар Большой, дом 42, строение 1, эт. 3, пом. 1233

Организация-изготовитель: ООО «ГеоСплит»
Адрес: 121205, Россия, город Москва, Территория Сколково инновационного центра, бульвар Большой, дом 42, строение 1, эт. 3, пом. 1233

Наименование продукции: Песок маркированный полимернопокрытый марки GEOSPLIT

Код ТН ВЭД: 2505900000, 2505

Область применения: проведение маркерной диагностики и мониторинга профилей притоков нефтяных и газовых скважин.

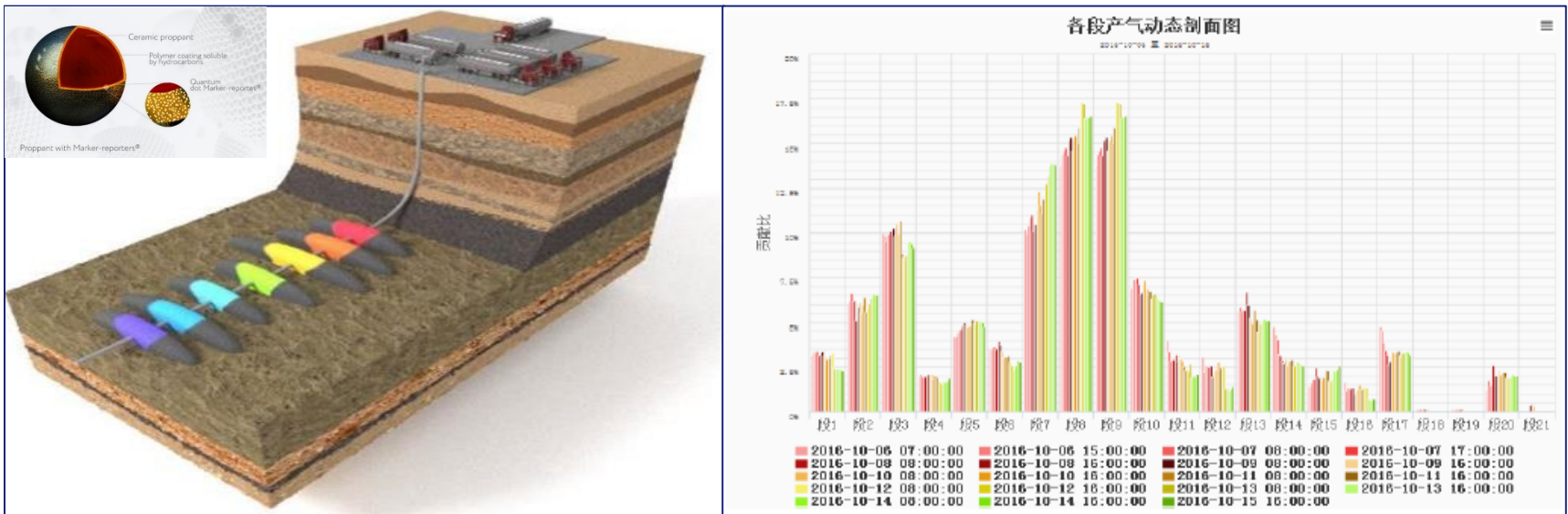
Продукция изготовлена в соответствии с: документацией изготовителя, ТУ 08.12.11-004-58342509-2018

Перечень документов, представленных на экспертизу: заявление на проведение экспертизы, устав, свидетельство о государственной регистрации юридического лица, свидетельство о внесении записи в ЕГРЮЛ, свидетельство о постановке на учет в налоговом органе, лист записи ЕГРЮЛ о внесении изменений в сведения о юридическом лице, приказ о назначении генерального директора, протокол испытаний, ТУ 08.12.11-004-58342509-2018

1. Fluid Production Profile Testing of Multi-stage Frac Wells

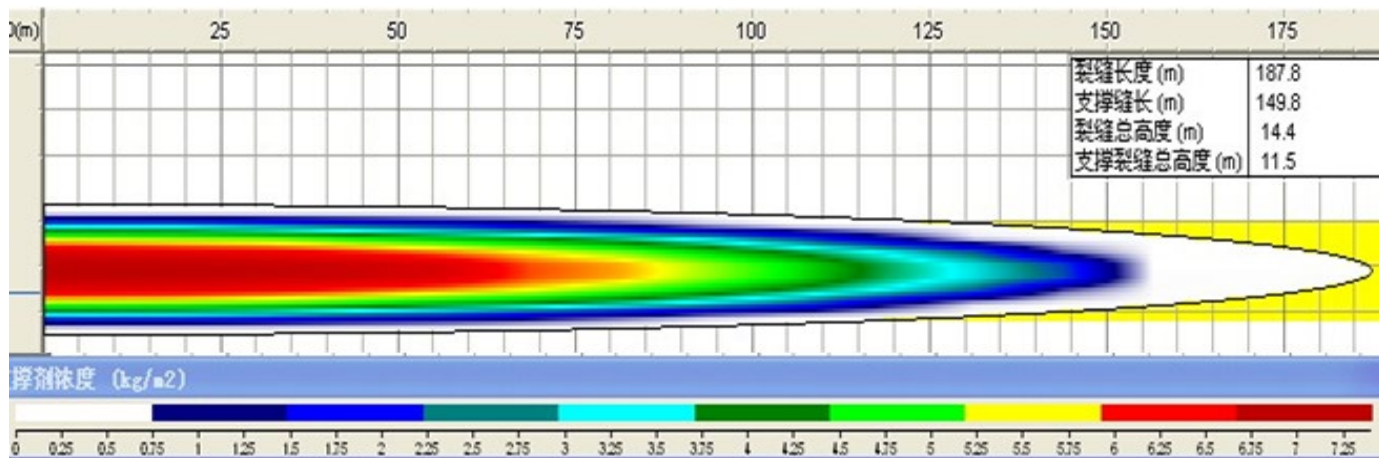
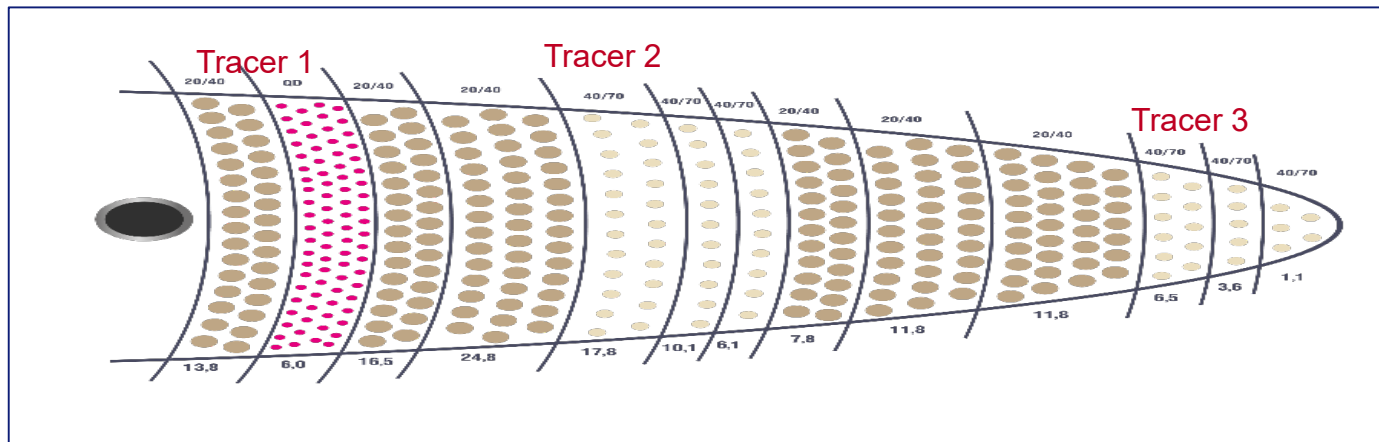
Application 1: Testing the fluid-producing properties (oil/gas/water) and contribution rate of each fracturing stage, optimizing the subsequent fracturing design

- Long-term monitoring of oil and gas production profiles in each section
- According to the production data of each section, guide the basis of fracturing layer selection and fracturing design
- Judgment of Water Production Level in the Later Period.



1. Fluid Production Profile Testing of Multi-stage Frac Wells

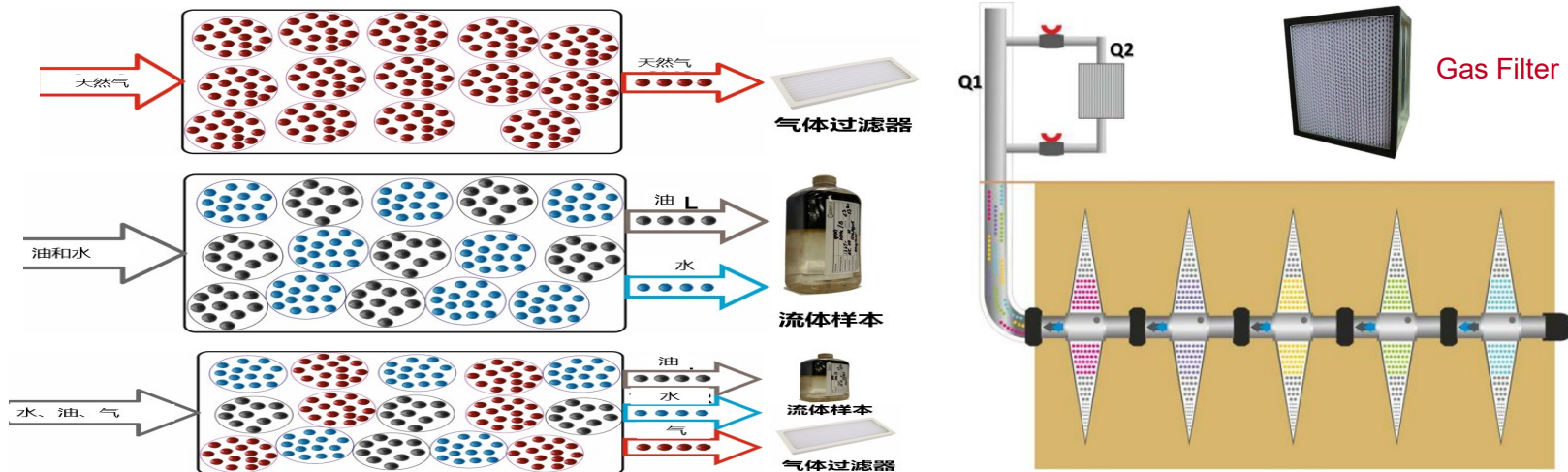
Application 2: Testing fluid production contribution of different parts of fracture



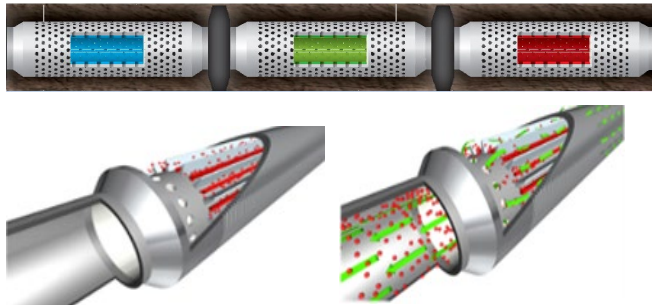
1. Fluid Production Profile Testing of Multi-stage Frac Wells

Usage and dosage

Type	Dosage	Period of validity	Fracture Flow Requirements
Gas phase	1-2 tons (including proppant weight)	2~3 years	Less than $10 \times 10^4 \text{m}^3/\text{d}$
Oil phase	6-15 tons (with proppant weight)	2~3 years	$< 50 \text{m}^3/\text{d}$
Aqueous phase	6-15 tons (with proppant weight)	2~3 years	$< 50 \text{m}^3/\text{d}$

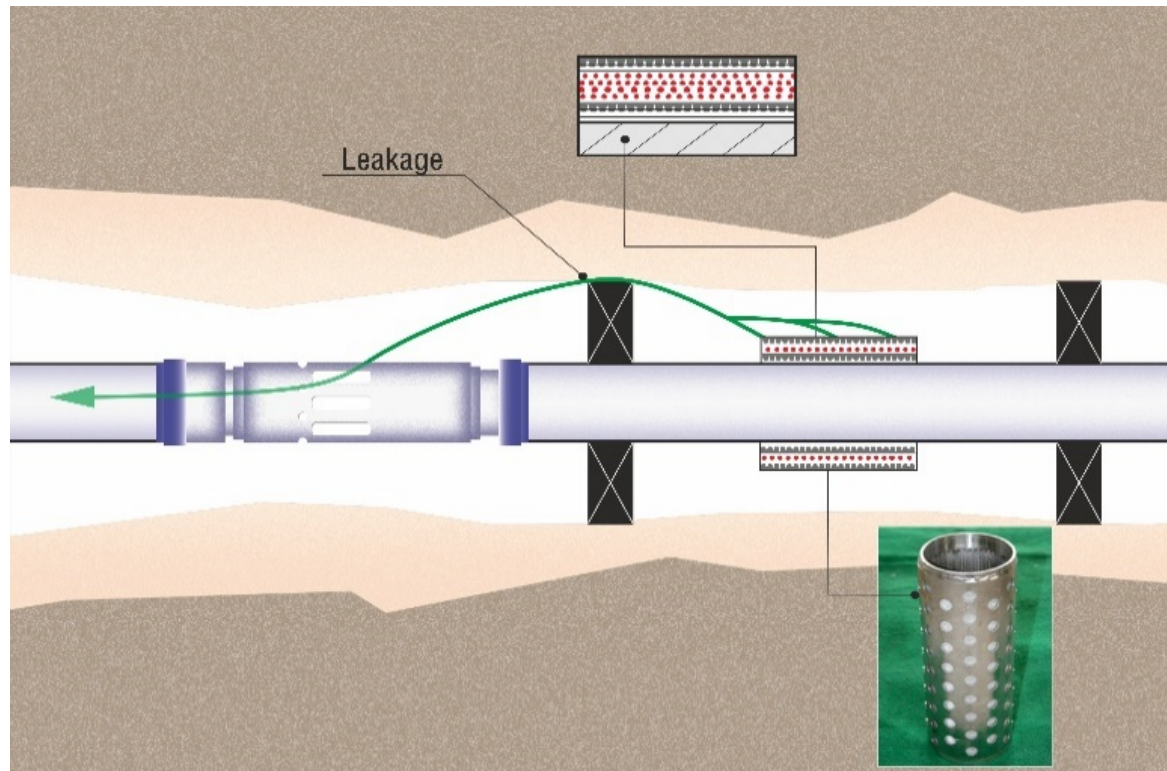


2. Combine with Screen Pipe or Casing to Test the Fluid Production Profile of Different Well Sections.

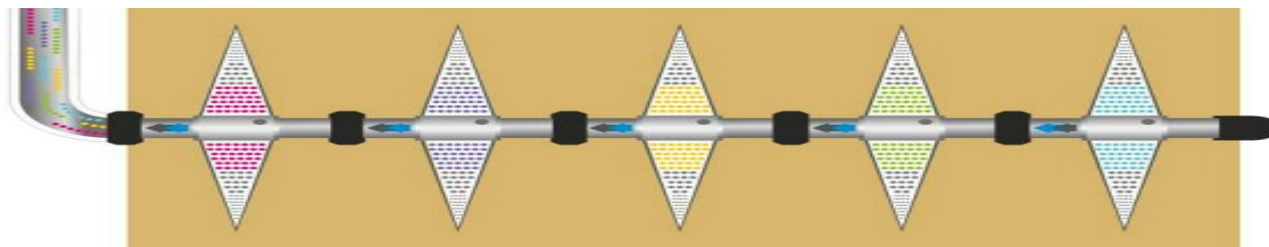
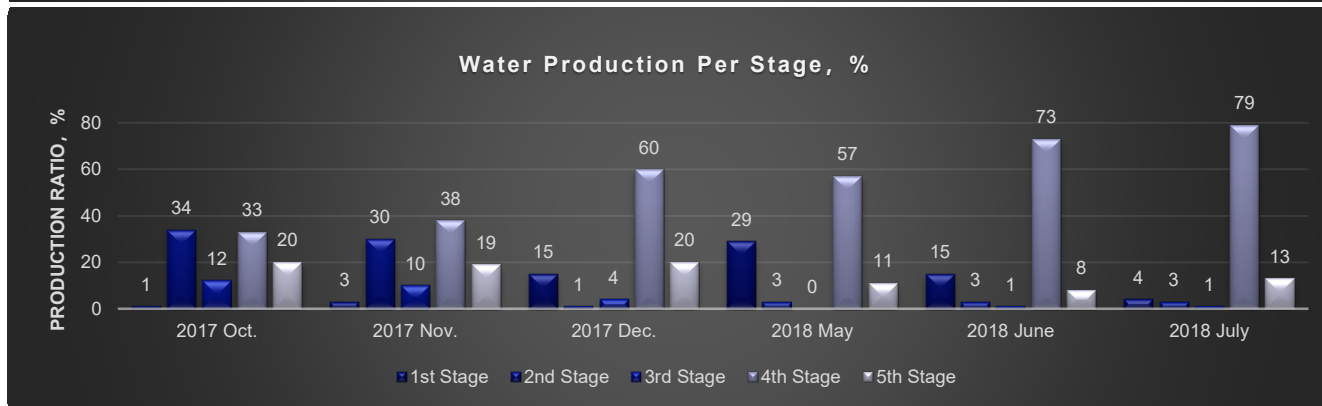
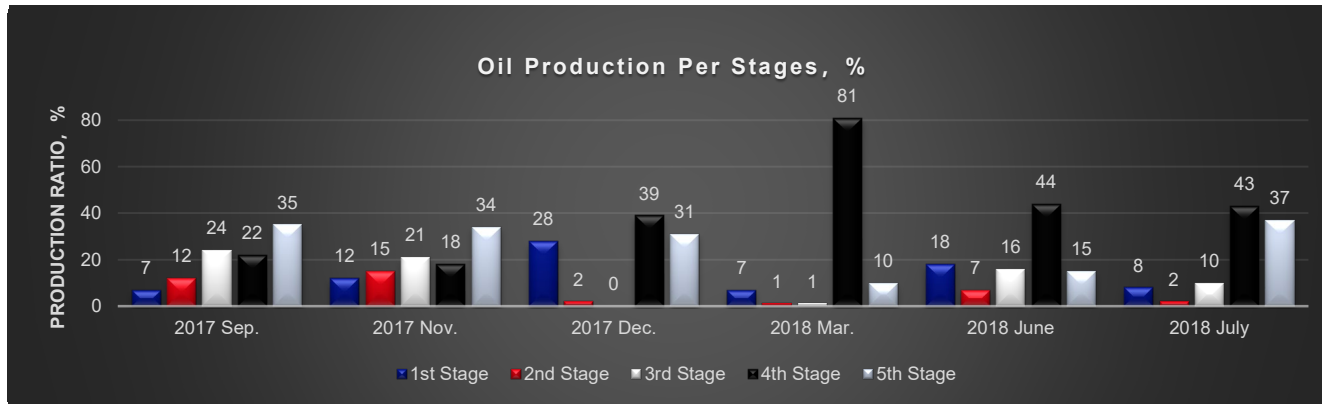


Type	Dosage	Periof of validity	Flow Requirement
Gas phase (particle or patch)	1 ~ 2kg	3~5 years	Less than $10 \cdot 10^4 \text{m}^3/\text{d}$
Oil phase (particles or patches)	4 ~ 6kg	3~5 years	< $50 \text{m}^3/\text{d}$
Aqueous phase (particles or patches)	4 ~ 6kg	3~5 years	< $50 \text{m}^3/\text{d}$

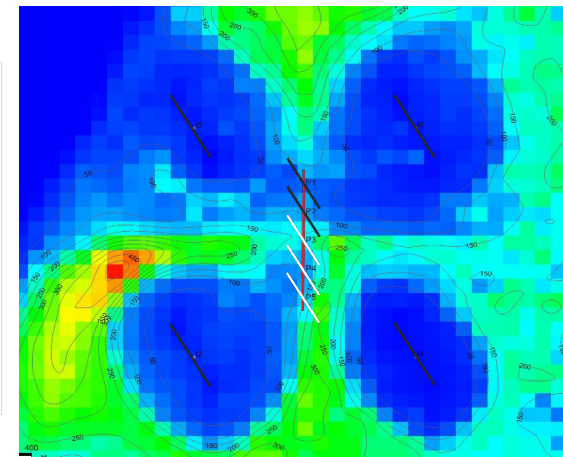
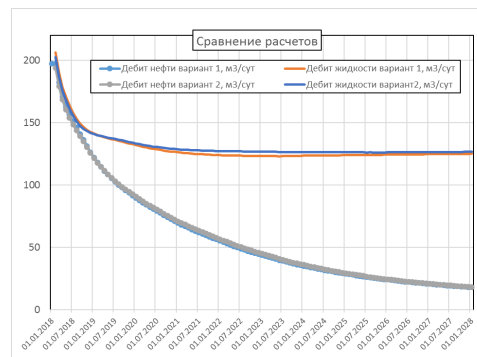
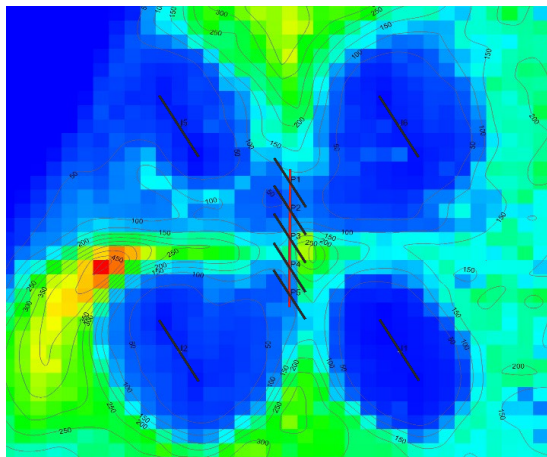
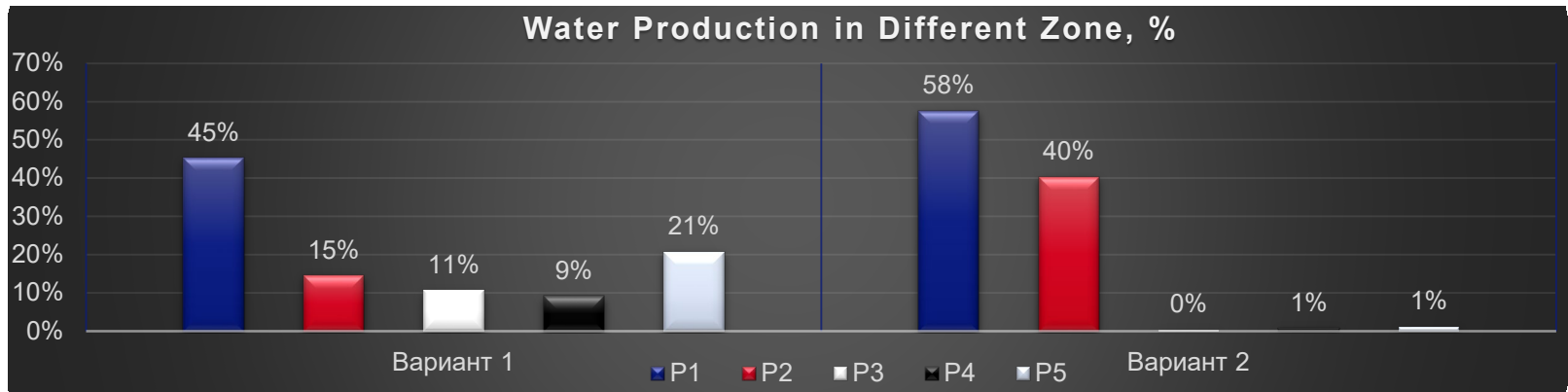
3. Combine with Completion Tools to Monitor Their Working Status (Opening, Closing, Failure)



1. Field Application – Post-frac Liquid Production Profile



2. Field Application - Formation Connectivity and Water Flood Efficiency



Quantum tracer test technology has high accuracy, simple and convenient operation compared with cable test, and has obvious technical advantages over trace element tracer at present.

Contrastive items	Quantum tracer	Trace element tracer
Product form	solid state	liquid
Monitoring cycle	2-3 years	1-3 months (production)
usage	Variety of usage Fracturing proppant wrapping Casing or sieve prefabrication Tool performance monitoring	Liquid addition

Contents

01

Stimulation Materials

02

Temporary Plugging Fracturing Technology

03

Chemical Plugging Technology

04

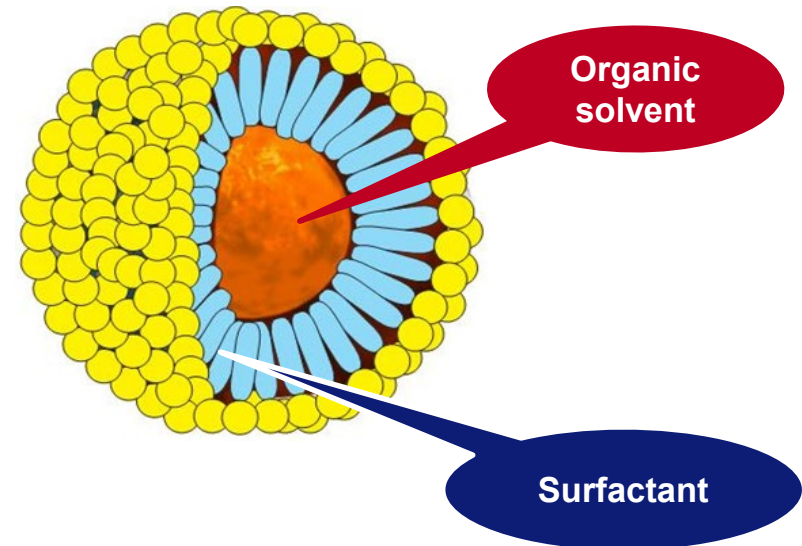
Quantum Tracer Technology

05

Nano-composite Liquid Technology

1. Nano-technology for increasing production and injection

- **Surfactant**
 - Reducing surface tension
 - Change wettability
- **Organic Solvent**
 - Dissolved organic precipitation
- **Nanometer Size**
 - Large surface areas can be uniformly treated with a smaller amount
 - Permeate into the micro-pore of reservoir

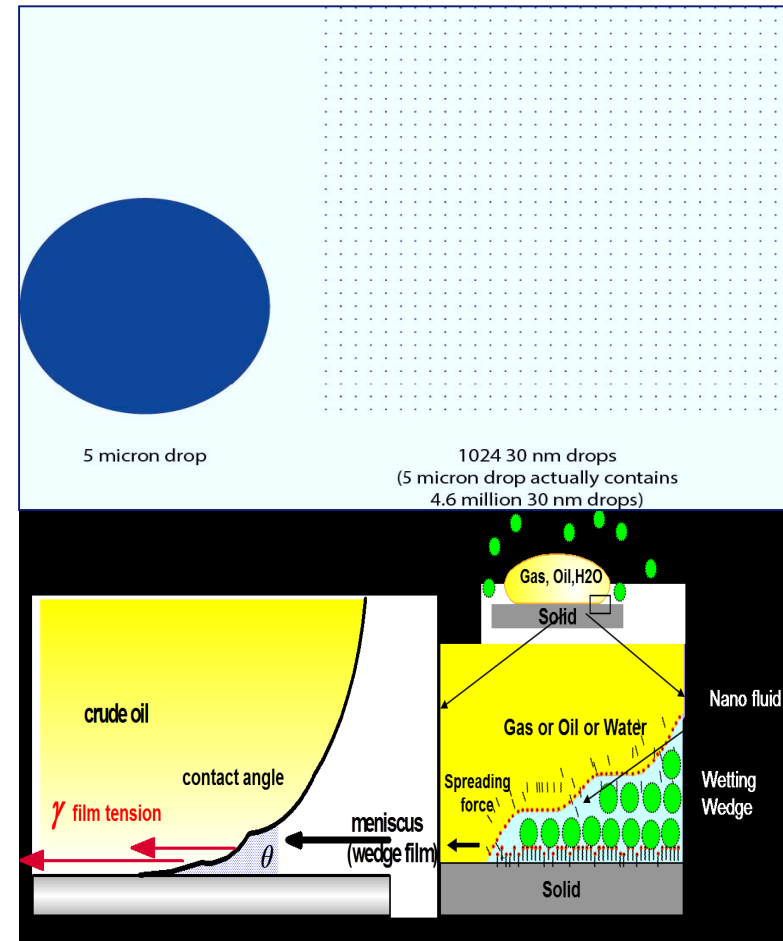


2. Technical characteristics

(1) Large number of micelles in the same volume and wide acting area

A 5-micron droplet can contain 4.6 million 30-nanometer particles.

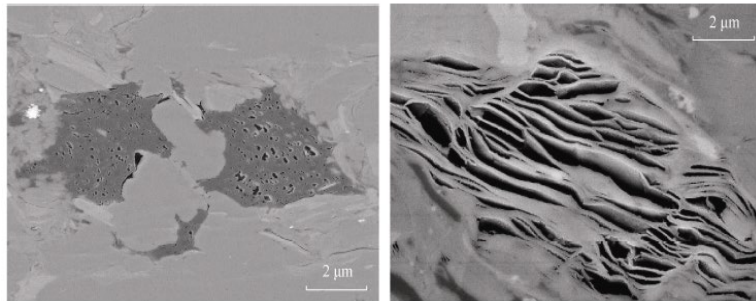
In the contact area of a conventional micelle, there will be countless nanomicelles playing a role, which is much more refined and larger than a large micelle.



2. Technical characteristics

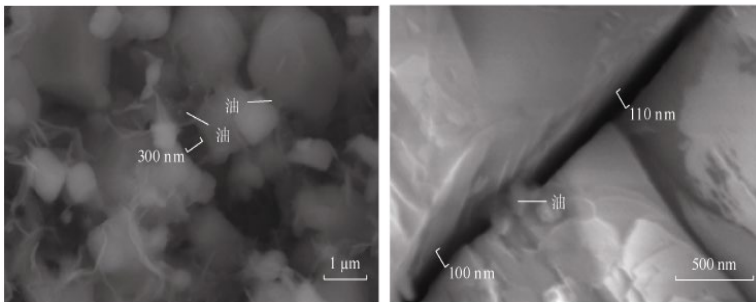
(2) Access: nano-sized micelles that can enter all reservoir spaces

The diameter distribution of tight oil and gas pore throat is concentrated in 30-500 nm, which requires nanotechnology.



(a) 四川盆地威201井志留系页岩有机质内孔，孔喉直径100~200 nm

(b) 鄂尔多斯盆地张2井上三叠统延长组7段页岩片状绿泥石基质孔，孔喉直径40~300 nm



(c) 鄂尔多斯盆地宁57井上三叠统延长组致密砂岩纳米级孔喉中含油

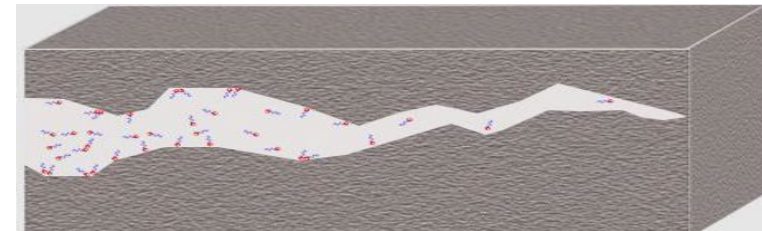
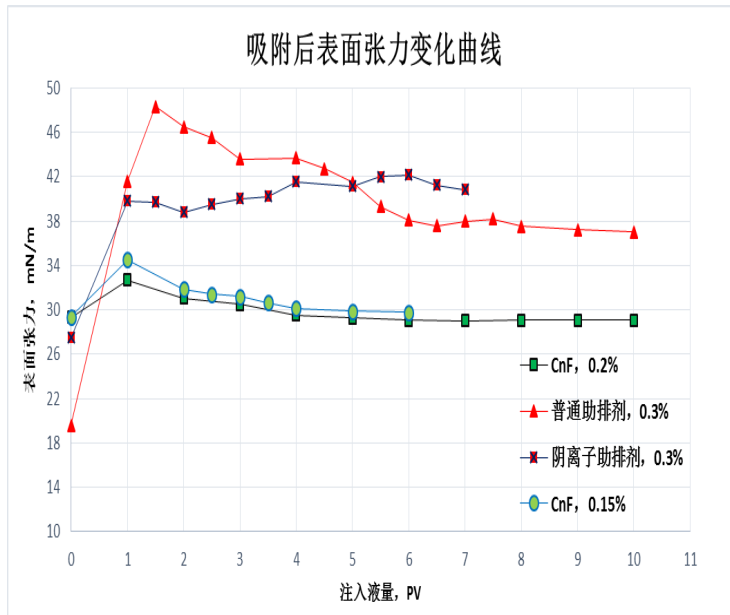
(d) 四川盆地公22井侏罗系致密砂岩纳米缝内含油

油气类型	构造背景	源储关系	油气聚集类型	孔隙度/%	孔喉直径	渗透率/ $10^{-3} \mu\text{m}^2$	典型实例	
高孔渗砂岩油气	构造高点	源上	背斜构造气藏	1.1~22.4 平均 12.8	0.8~32 μm , 平均 3.69~5.24 μm	0.004~1770.15, 平均 51.46	塔里木盆地库车克拉2气田 3 600~4 000 m, 探明储量 2 840.29 $\times 10^8 \text{ m}^3$	
中低孔渗砂岩油气	盆地中心 斜坡、基底	源内 源下	透镜体岩性油藏 地层油气藏	2~14 6~20	6~40 μm 10~250 μm	0.05~960 0.005~1 100	渤海湾胜利牛庄透镜体油藏, 单井日产油 30 t 塔里木盆地英买力志留系砂岩潜山, 平均日产油 300 t, 平均日产气 10 000 m^3 , 勘探深度 5 000~5 500 m 库车最大勘探深度 8 000 m, 可探明储量 $1 \times 10^{12} \text{ m}^3$; 鄂尔多斯盆地苏里格气区, 探明地质储量 $2.85 \times 10^{12} \text{ m}^3$, 年产量 $105 \times 10^8 \text{ m}^3$, 勘探深度达 2 500~4 300 m; 四川须家河组可探明储量 $3 \times 10^{12} \text{ m}^3$ 以上	
致密气	盆地中心、斜坡	源上、源储 间互	连续型致密气	<10	40~1 400 nm	0.1~0.3	鄂尔多斯盆地三叠系延长组、四川盆地侏罗系、松辽盆地白垩系扶杨油层、准噶尔盆地二叠系等, 各层系可探明储量 $5 \times 10^8 \text{ t}$ 以上	
致密油	盆地中心、斜坡	源上、源储 间互	连续型致密油	0.5~12.0	30~900 nm	0.1~0.5	鄂尔多斯盆地三叠系延长组、四川盆地侏罗系、松辽盆地白垩系扶杨油层、准噶尔盆地二叠系等, 各层系可探明储量 $5 \times 10^8 \text{ t}$ 以上	
碎屑岩 储集层 油气	海相	台内坳陷、斜坡	源内	典型的连续型页岩气 平均 0.9~2	0.4~2.8, 平均 0.9~2	10~900 nm	0.005~0.955	四川盆地志留系、寒武系页岩气, 勘探深度 1 500~4 000 m, 预计发现储量 $2 \times 10^{12} \text{ m}^3$ 以上
	陆相	盆地中心、斜坡	源内	典型的连续型页岩气	1~6	90~300 nm	0.01~1.05	四川盆地三叠系须家河组一、三、五段及二、四、六段夹层, 资源量大于 $1 \times 10^{12} \text{ m}^3$
	交互相	坳陷、斜坡	源内	典型的连续型页岩气	1~8	80~200 nm	<0.1	鄂尔多斯盆地上古生界源内滞留远景资源量 $1 \times 10^{12} \text{ m}^3$ 以上, 勘探深度 2 000~4 000 m
	页岩油	盆地中心、斜坡	源内	典型的连续型页岩油	1~5	80~200 nm	<0.1	中国松辽、渤海湾等盆地页岩油资源量 $476.4 \times 10^8 \text{ t}$, 可采资源量 $159.7 \times 10^8 \text{ t}$
	油页岩	盆地中心、斜坡	源内	典型的连续型油页岩	1~4	50~150 nm	<0.1	中国松辽、渤海湾、柴达木等 47 个盆地地质资源量 $7 199.4 \times 10^8 \text{ t}$, 可采资源量 $2 432.4 \times 10^8 \text{ t}$, 勘探深度 1 000~3 000 m
油砂	浅层—近地表	源上	准连续型油砂	5~26	8~50 μm	0.05~2 000	准噶尔、塔里木、羌塘等 24 个盆地地质资源量约 $60 \times 10^8 \text{ t}$, 可采资源量 $23 \times 10^8 \text{ t}$, 勘探深度 100~1 500 m 中国 2 000 m 以内的煤层气地质资源量和可采资源量分别为 $32.86 \times 10^{12} \text{ m}^3$ 和 $13.9 \times 10^{12} \text{ m}^3$, 有利勘探深度小于 2 000 m	
煤层气	盆地中心、斜坡	源内	典型的连续型煤层气	1.15~7.69	80~200 nm	0.01~10		

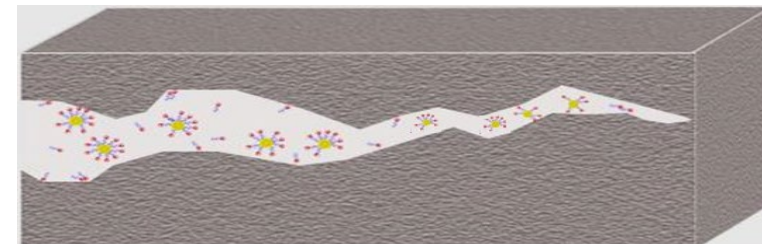
2. Technical characteristics

(3) Going far: The solid surface adsorbed less, reaching all the areas affected by the liquid.

Several spherical micelles were formed in CnF system, which reduced the amount of surfactant adsorbed at the solid-phase interface, and maintained the effective concentration of surfactant, which could penetrate into tiny pore throats.



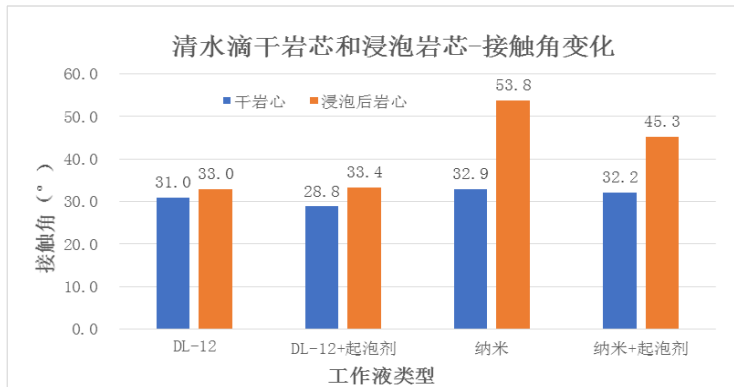
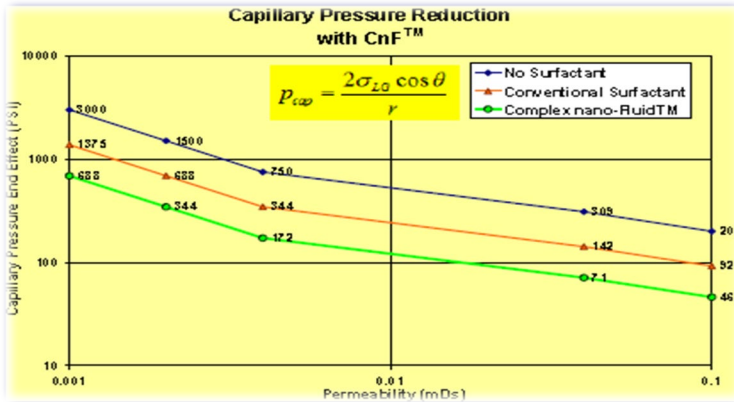
Conventional surfactants are easy to be adsorbed at high concentration on rock surface, resulting in serious loss and difficult to reach deep formation.



The nano-system reduces the amount of adsorption at the solid-phase interface and makes the adsorption more uniform, thus going further.

2. Technical characteristics

(4) Come out: the capillary force is reduced by more than 20% than that of conventional surfactant.



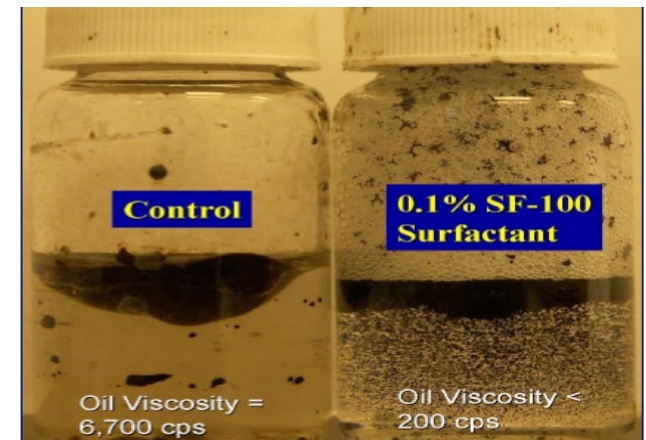
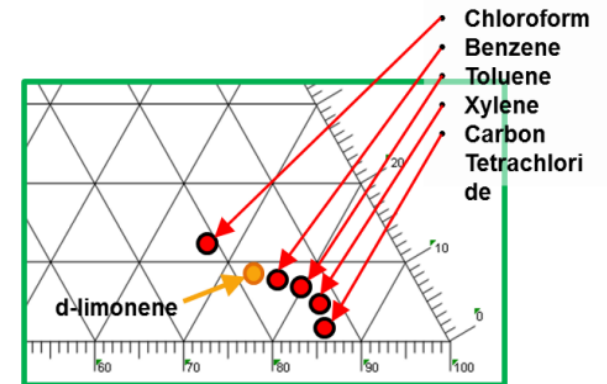
Comparing Clear Water, Conventional Surface Activator and CnF Capillary Force

2. Technical characteristics

(5) Washing: It has the dual function of organic solvent and micelle solubilization, and its solubility is strong.

- Its dual dissolving function can be used for plugging removal and viscosity reduction.

Limonene (in orange peel) is the best solvent for petroleum precipitates. Limonene is similar to aromatic solvents in structure and solubility to xylene. It can dissolve heavy oil, wax, asphaltene, keratin, etc.



2. Technical characteristics

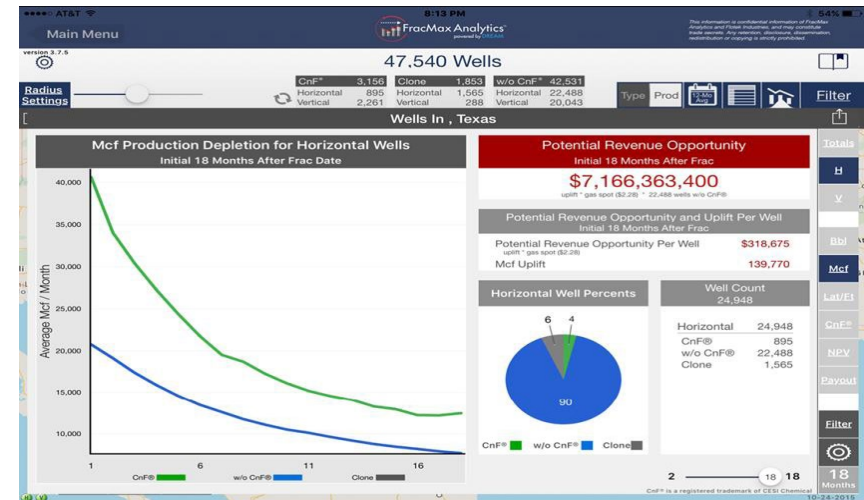
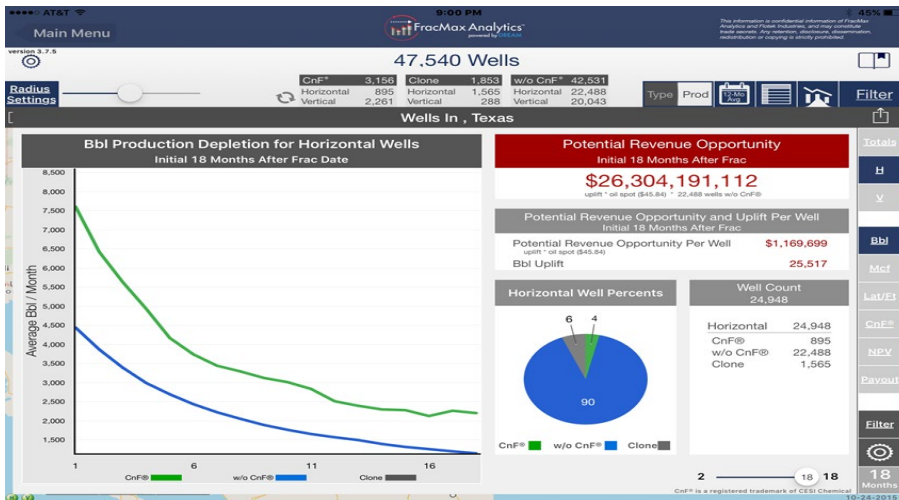
(6) Wide adaptability

- Normal performance under **350°F**.
- Composite liquid system can play an effective role under the condition of **250,000 mg/L** salinity.
- Acidity and alkalinity have a wide range of adaptability, and **pH range from 1 to 10**.
- **Not limited by lithology**: sandstone, shale, carbonate, igneous rock, coal
- Limonene Safety and Environmental Protection (GRAS)
- **Individualized** Formula Based on Reservoir Characteristics

3. Application cases

Oversea fracturing application cases:

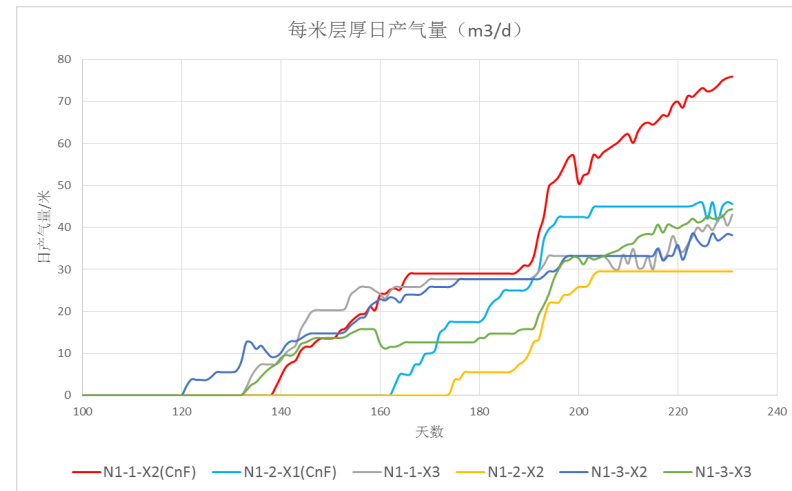
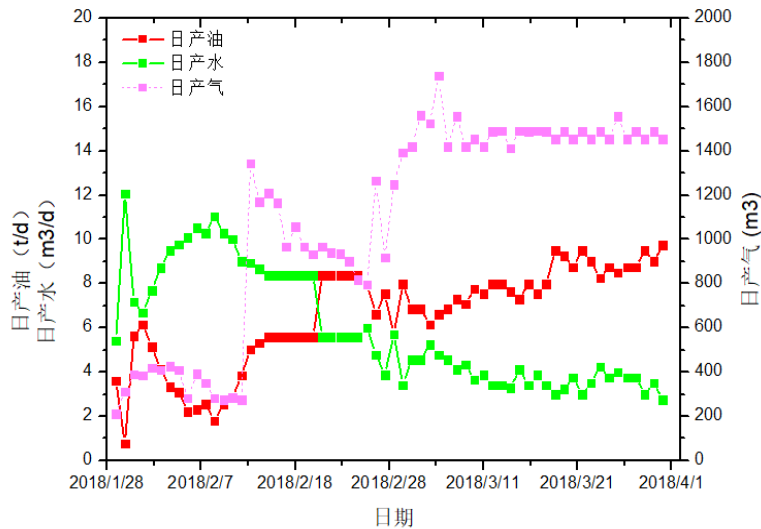
- Compared with 3156 oil wells added CnF® fracturing, the cumulative production has been greatly increased.
- Average CnF for each fracturing well increases oil production by 4057m3 in 18 months
- The average initial yield after pressing was 39.75 m3/d, without adding CnF 23.83 m3/d, and the increase rate was 66.8%.
- After 18 months, the average yield was 12.19 m3/d, without adding CnF 5.3 m3/d, and the increase rate was 130%.



3. Application cases

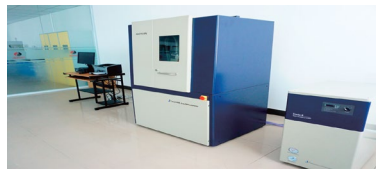
Fracturing application cases in China:

- The daily fracturing production of Sulige gas well is $2.27 \times 10^4 \text{ m}^3/\text{d}$, which is about 21.4% higher than that of adjacent wells.
- The average daily oil production of oil wells in 30 days is 6.94 tons, which is 44.2% higher than that of adjacent wells.



The experimental evaluation center of stimulation technology includes fracturing fluid comprehensive laboratory, acid fluid comprehensive laboratory, proppant evaluation laboratory, core flow laboratory and enhanced oil recovery comprehensive laboratory. It has more than 20 sets of scientific research instruments and equipment, which can meet the evaluation, testing and research of various fracturing, acidizing working fluid, temporary plugging agent, proppant and oil recovery chemical materials. It can undertake comprehensive scientific research projects from reservoir evaluation, stimulation process optimization to effect evaluation.

(1) Reservoir evaluation equipment



(2) Materials R&D and evaluation equipment



(3) Evaluating system of proppant conductivity



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THANKS!

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