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ENHANCED OIL RECOVERY METHODS



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SNPJ JSC provides a range of solutions to enhance oil recovery and intensify oil production, ensuring maximum efficiency and profitability. The technologies are aimed at optimizing the parameters of hydrocarbon production from productive formations and at long-term operated fields, as well as involving undrained and residual oil reserves in development.



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SANDAXE TECHNOLOGY FOR RETAINING WEAKLY CEMENTED ROCK



Appointment

The **SandAxe** line of reagents is designed to reduce sand production from the reservoir with minimal impact on productivity in oil, gas, and gas-condensate wells. They prevent destruction of the bottom-hole zone of the reservoir. Using SandAxe can significantly increase the inter-repair period and the time between failures of downhole equipment; it reduces the вынос of mechanical impurities from the reservoir; and it has strong adhesion in the bottom-hole zone of the reservoir. The reagent is a solution in hydrocarbons and is inert to acids. The minimum effective volume is from 4% to 8% in a solution with UV.



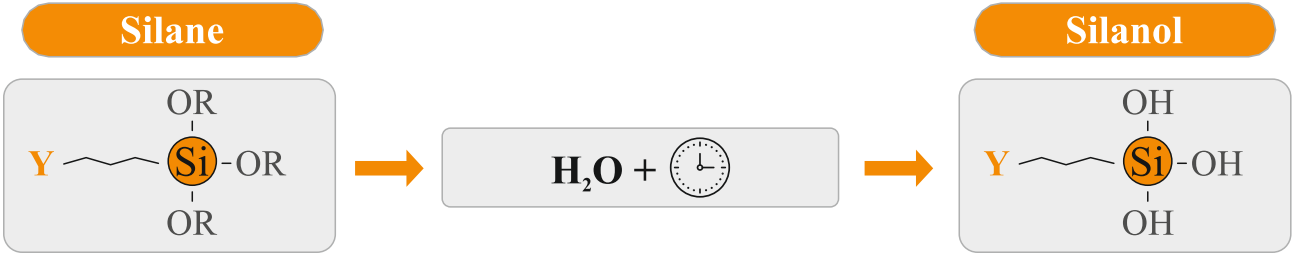
Specifications

- It is a silicon-organic oil-soluble compound.
- The reagent molecule contains hydrolyzable residual groups. Upon contact with formation water, it forms primary chemical bonds with sand grains, which leads to the formation of a flexible visco-elastic network within the aqueous phase.

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Advantages

- Strong adhesion in the near-wellbore zone (NWZ).
- Water-binding reagent, fully inert and soluble in hydrocarbons (HC).
- Inert to acids.
- Short well downtime and workover without complications.
- Simple application process.
- Formation consolidation with minimal loss of permeability.
- Viscoelastic composition; does not break down under high depressions.
- Chemical composition penetrates the formation to a depth of 1 meter or more.
- Suitable for formations with temperatures from 10°C without an upper limit.
- Prevents formation destruction.
- Simultaneous use with mechanical sand control methods significantly extends their service life.

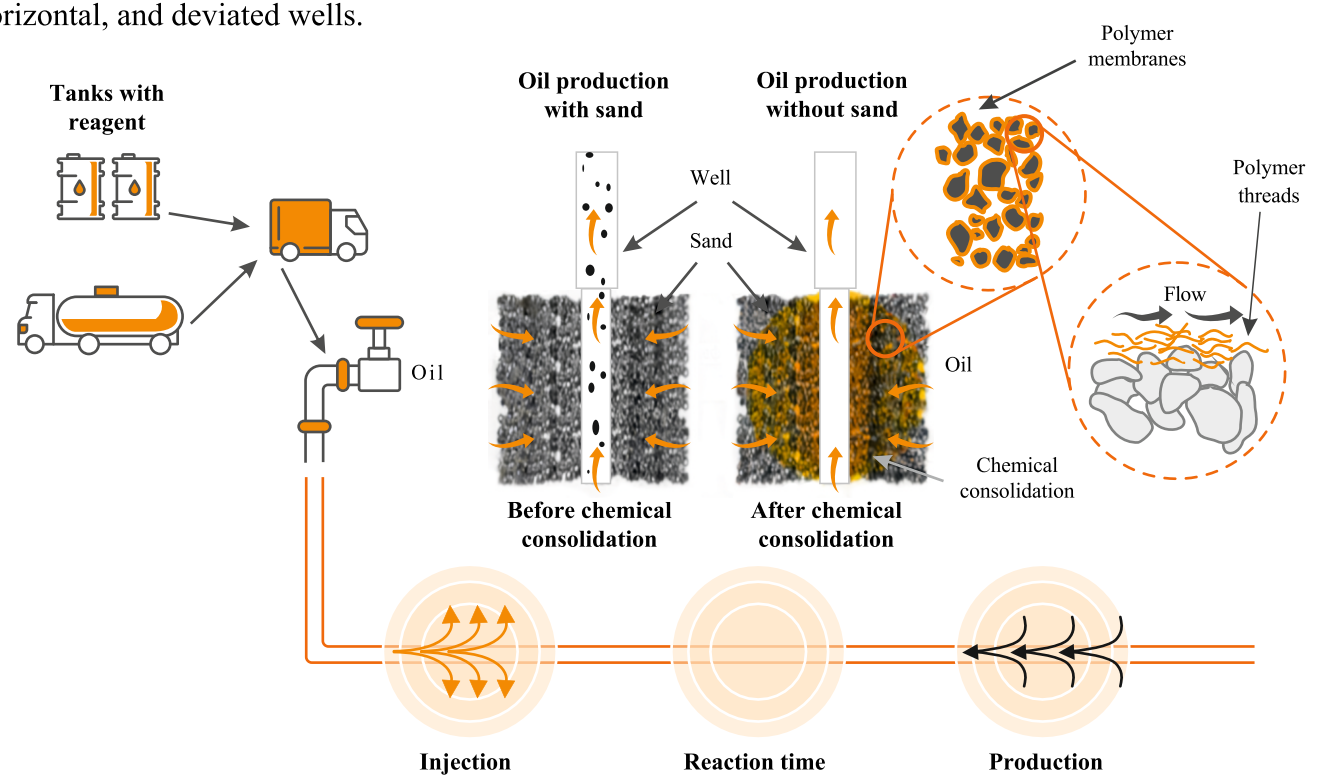


Soluble in petroleum products

After reaction with water

APPLICATION TECHNOLOGY

Implementation of SandAxe technology for consolidating weakly cemented formations in vertical, horizontal, and deviated wells.

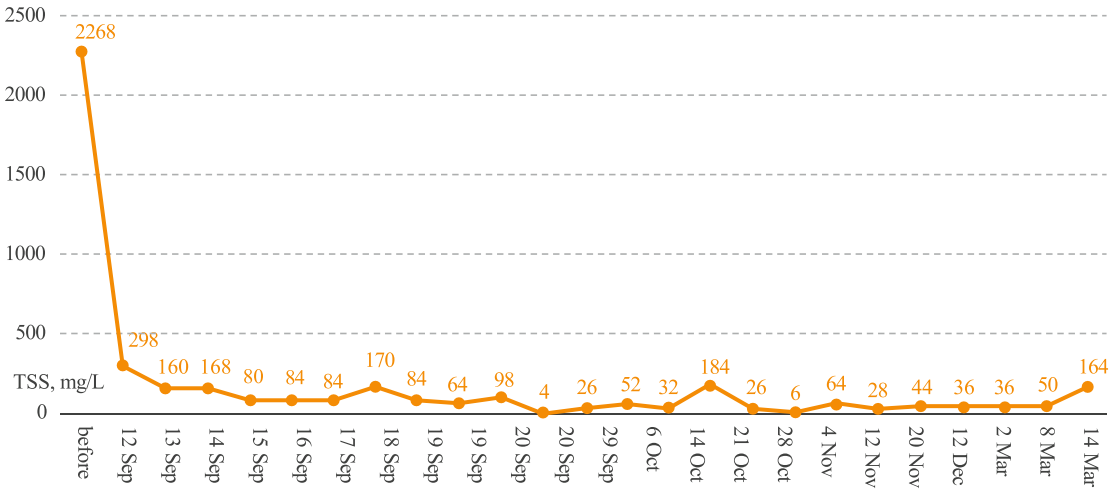


- Simple deployment
- Provision of a NWZ consolidation design
- Supervision workover operation
- Turnkey operations.
- Minimal chemical usage (from 4% to 8% in a hydrocarbon solution).

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EXAMPLE OF TREATMENT OF A PRODUCING WELL USING NWZ CONSOLIDATION TECHNOLOGY

Graph of reduction in sand production



Stage 1	Oil preflush – displacement of free water from the near-wellbore zone (NWZ) with oil (m^3)	4,6
Stage 2	Injection – Main stage, sand control product solution in oil (m^3)	8,7
	Mass of sand control chemical product (t)	0,525
Stage 3	Oil afterfluch (m^3)	3,1



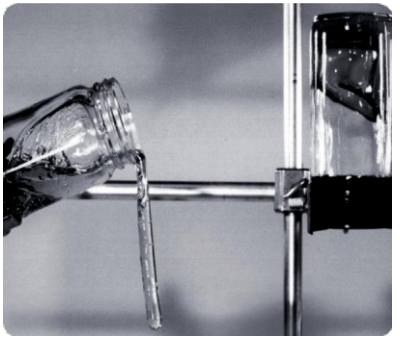
TECHNOLOGIES FOR LEVELING THE RECEIVING STRENGTH PROFILE AND LIMITING WATER INFLOW

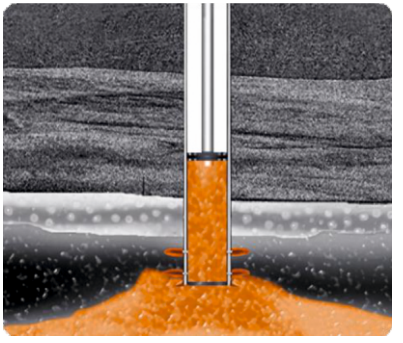
CROSS-LINKED POLYMER SYSTEMS

The use of cross-linked polymer compositions (CPCs) based on water-soluble polyacrylamides
is one of the effective technologies for increasing reserve recovery, increasing flood coverage, and decrease oil production decline

SOLUTION

- **Polyacrylamides SNPH-PM**
- **Crosslinkers SNPH-LK**
- **Destructor SNPH-DS**





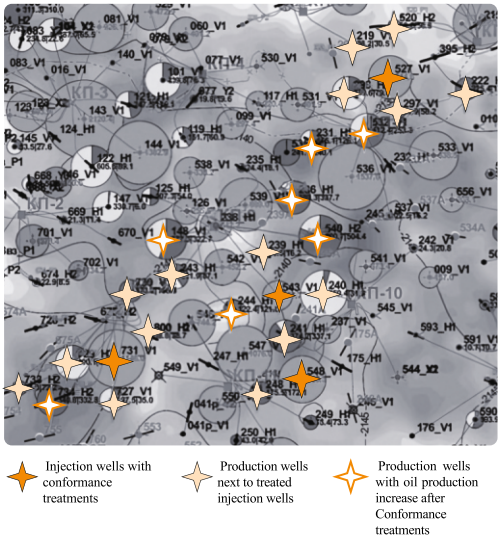


PAP: from 5% to 15% of the volume of the washed canal

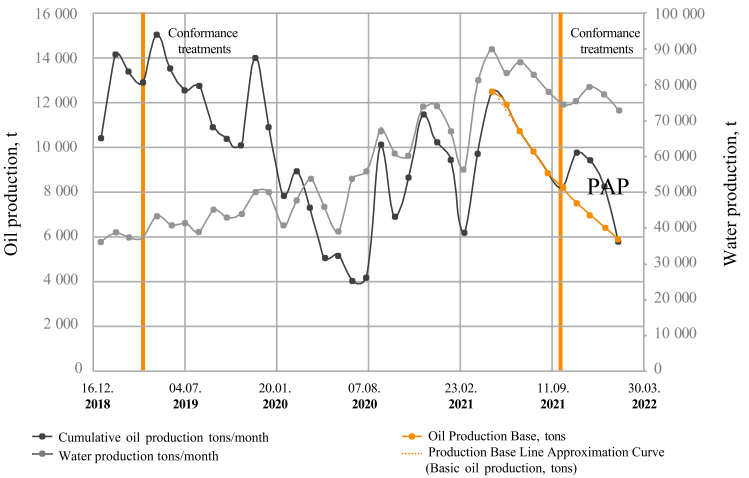
CRITERIA FOR POLYMER GEL APPLICATION

Technology	Reservoir temperature	pH	Mineralization, ppm	Type of rock
Medium-temperature gels	$T_{mp} < 80^0C$	6-8	< 300,000	Sandstones and carbonates
High-temperature gels	$80^0C < T_{mp} < 120^0C$	6-8	< 25,000	Sandstones and carbonates
	$80^0C < T_{mp} < 120^0C$	6-8	< 300,000	Sandstones and carbonates

EXAMPLE OF A PROJECT IMPLEMENTATION FOR PAP OPERATIONS



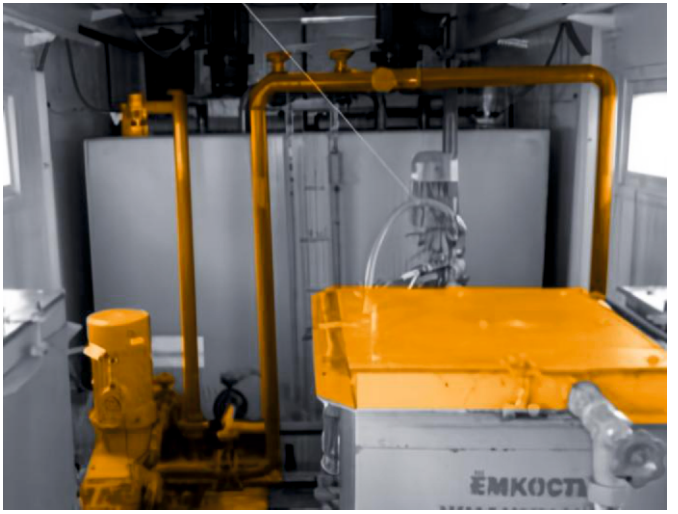
Oil production after conformance treatment



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EQUIPMENT







WATER INFLOW CONTROL BASED ON WATERAXE CHEMICAL PRODUCT

Purpose

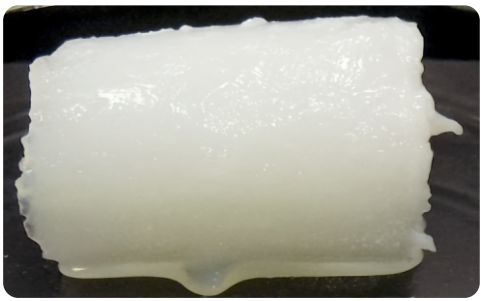
WaterAxe is used as a reagent to reduce water production from the productive reservoir with minimal impact on oil and gas productivity. This reagent is fully soluble in hydrocarbons and forms a gel or precipitate upon interaction with water. It is most effective for sandstones — hydrophilic reservoirs, where it can act as a blocking agent in cases of high water saturation in the pore space, or serve as a phase permeability modifier by reducing water permeability. In hydrophobic reservoirs (carbonates), it is applied after wetability change with specific surfactants

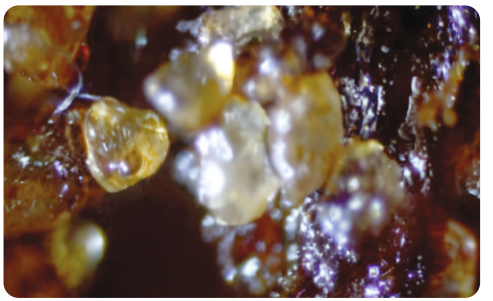
Characteristics

- WaterAxe is a silicon-organic oil-soluble compound.
- The reagent molecule contains hydrolyzable residual groups. Upon contact with formation water, primary chemical bonds are formed with sand grains, resulting in the creation of a flexible viscoelastic network within the water phase.

Reaction

The reaction is initiated upon interaction with water or connate water.





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Application area

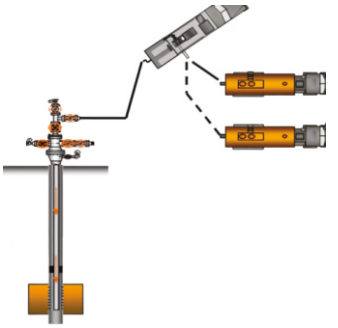
- Vertical, directional, horizontal wells (including after hydraulic fracturing). Oil, gas, gas condensate wells, UGS wells
- Reservoir temperature: up to 150°C
- Thickness of the formation: not limited
- Ambient temperature: up to -60°C
- Reservoir type: Sandstones / carbonates
- Water content of products: up to 100%
- Mineralization of formation water: up to 300 g/l
- Type of water influx: breakthrough of injected water, bottomwater influx, cone formation, inter-well flows, casing failure, etc.

Advantages

- Strong adhesion in the near-wellbore zone (NWZ).
- Water-binding reagent, fully inert and soluble in hydrocarbons (HC).
- Acid-resistant.
- Short downtime and workover period without complications.
- Simple application process.
- Reduction of permeability in flushed zones while preserving permeability in oil- saturated intervals.
- Viscoelastic composition; does not degrade under high drawdown pressures.
- Chemical composition penetrates more than 1 meter into the reservoir.
- Suitable for formations with temperatures starting from 10°C and without an upper temperature limit.

Example of well treatment

Stage 1	Oil displacement - displacement of free water from a well and a wellbore zone by oil (m^3)	1 - 4.6 (depending on geological conditions and type of processing)
Stage 2	Injection is the main stage, reagent solution in oil (m^3)	8,7
	Mass of chemical product (t)	0,525
Stage 3	Oil displacement (m^3)	3,1



SEDIMENT-FORMING COMPOSITIONS

Purpose

- Selective isolation and limitation of formation water influx by sequentially injecting the **SNPH-8909 grade B** modifier and an aqueous solution of the multifunctional reagent **SNPH-SG grade B1**, thereby reducing the filtration and capacity characteristics of water-saturated intervals and engaging low- permeability oil-saturated zones into production.

Description

- When the **SNPH-8909 grade B** modifier interacts with an aqueous solution of the **SNPH-SG grade B1** multifunctional reagent, erosion- resistant sediment-forming systems are formed, blocking water flow into the well. Due to the selective treatment and reduced associated water production, the inflow profile of the produced fluid is modified.

Scope of application

- Production and injection wells drilled in carbonate or terrigenous formations with reservoir temperatures up to 100°C, characterized by high water content (more than 80%).

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EMULSION COMPOSITIONS

SNPH-9633, SNPH-9640

- for low reservoir temperatures (up to 60°C), reagent **SNPH-9633** has been developed

- for higher reservoir temperatures (60–105°C), reagent **SNPH-9640** has been developed

Production Wells

The technology for limiting water inflows is based on UK ПАВ (SNPH-9633, SNPH-9640).

The technology is designed to reduce the water cut in the extracted product and increase the oil production rate in carbonate and terrigenous reservoirs with a high water cut (60–99 %) and varying mineralization of the water that is flowing into the well.

The technology is based on blocking the water-saturated zones of the reservoir with high-viscosity reverse-type emulsion systems that form during the injection of the reagent. The reagent significantly reduces water permeability and does not impair the permeability of oil-saturated interlayers. It has a hydrophobizing effect, is capable of dissolving and dispersing ASPS, and reduces the viscosity of oil.

To increase the effectiveness of the use of CC surfactants, it is recommended to introduce a modifier and/or filler into its composition. The introduction of additives makes it possible to increase not only the rate of formation of emulsion systems and their stability, but also their viscosity and strength. This helps to enhance the blocking properties, reduce sensitivity to depression, and reduce the possibility of removing the emulsion from the reservoir.

Application Experience:

Indicator	SNPH-9633	SNPH-9633 with modifier and/or filler
Number of well treatments	more than 2000	more than 900
Additional oil production (t/well treatment)	1000	more than 1200
Average daily oil rate increase (t/day)	2,0-5,0	2-6,5
Success rate	more than 70%	more than 75%
Reduction of Produced Water Volumes (t/well treatment)	more than 2000	more than 2500
Effect duratio	1 year in terrigenous reservoirs. More than 2 years in carbonate reservoirs	1,5-2,5 years

In the first months after treatment with SNPH-9640 (with modifier and/or filler), most wells demonstrated a reduction in produced water cut and increase in oil production rate

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Injection wells

Technology of HC-SC impact on the oil reservoir through injection wells.This technology is designed to improve oilfield development performance in heterogeneous reservoirs with varying salinity of formation and injection waters, and high water cut in production wells. The method is based on the ability of the “hydrocarbon solvent–surfactant composition–mineralized water” system to form viscous, stable gel-like emulsions with an external hydrocarbon phase. This contributes to redistribution of filtration flows and leveling of the displacement front in injection wells. Ultimately, this leads to reduced water cut and increased oil production in producing wells.Additionally, the technology has a hydrophobizing effect, can dissolve and disperse asphaltene–resin–paraffin deposits (ARPD), and reduce oil viscosity

FIELD APPLICATION EXPERIENCE OF SNPH-9633 TECHNOLOGY (114 sites):	• additional oil production – more than 2,000 t/well treatment; • success rate – **78%**.

Advantages and Distinctive Features of HC-SC (SNPH-9633, SNPH-9640) and Their Related Technologies:

- Low pour point (below minus 55°C);
- does not promote clay swelling;
- capable of binding a large amount of water;
- promotes dissolution and dispersion of ASO;
- standard oilfield equipment is used;
- supplied in a commercial form, does not require dilution;
- low viscosity (usually 1.5 mm^2/s);
- low interfacial tension at the interface with water (10^{-2}–10^{-4} mN/m);
- selective effect.

SNPH-9777

The SNPH-9777 emulsifier is designed for:
- Killing off oil and gas wells;
- As a base reagent for preparing process fluids used in enhanced oil recovery processes and for well workovers;
- During the development of oil and gas condensate fields at any stage of waterflooding to increase oil recovery;
- Prior to acid stimulation of oil recovery to temporarily isolate highly productive water-contaminated layers.

The emulsion-based kill fluid is an invert emulsion:
- The dispersion medium is a hydrocarbon solution of emulsifier SNPH-9777;
- The dispersed phase is water mineralized with various salts.

The viscosity and density of the kill fluid are regulated by the ratio of the phases and the degree of water mineralization.

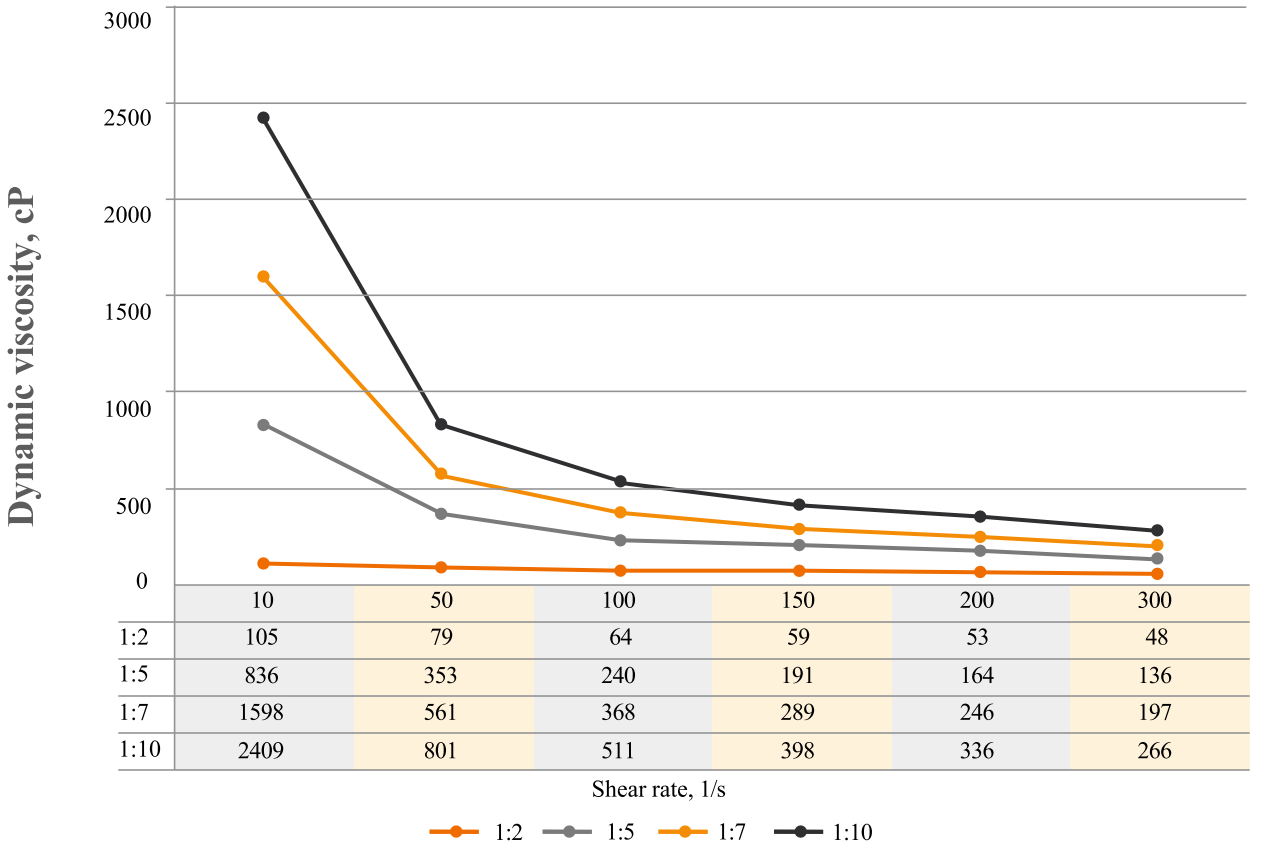
ADVANTAGES

- Preservation of the reservoir properties of the productive formation; bringing the well to operating mode as quickly as possible, without losing oil production,
- With a possible reduction in the water cut of the product;
- Adjusting the density of the drilling fluid within a wide range from 1.0 to 1.6 g/cm^3;
- Thermal stability up to 90°C.

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Dependence of dynamic viscosity on the amount of dispersed phase in the emulsion

Initial data: emulsifier SNPH-9777, water – $CaCl_2$ (density 1.358 g/mL)



	10	50	100	150	200	300
1:2	105	79	64	59	53	48
1:5	836	353	240	191	164	136
1:7	1598	561	368	289	246	197
1:10	2409	801	511	398	336	266

SNPH-9777 WITH MODIFIED ADDITIVE (MA)

Results of filtration studies on changes in reservoir model permeability after treatment with an emulsion based on SNPH-9777 with 0.7% MA:

№	Component	Model length	Water permeability (initial), μm²	Volume of injected reagent, ml	Permeability to emulsion, μm²	Water permeability (initial), μm² / pressure, MPa	Observations
1	Emulsion	50	3,78	85	0,07	0,015/0,8	Emulsion breakthrough at 0.8 MPa. Displaced from the model as low-viscosity flakes.
2	Emulsion with MA	50	3,37	85	0,38	0,015/1,6	Emulsion breakthrough at 2.0 MPa. Emulsion remains stable.

The addition of MA to SNPH-9777 emulsifier promotes the formation of a viscoelastic emulsion with water, which is stable under reservoir depressions and has high penetration capacity.

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Technology of directed acid treatment of highly water-contaminated formations (DCOVT)

The technology is designed to increase the efficiency of acid treatments in conditions of heterogeneous carbonate or terrigenous reservoirs with different mineralization of the produced waters with high water content (more than 80%).

The method is based on increasing the efficiency of acid treatments by blocking areas with increased permeability. Blocking of permeable zones is carried out using viscous gel-like emulsion systems of the reverse type, formed by contact of CC surfactants with mineralized waters flooding the well. The acid injected subsequently is directed not to the high-permeability zones, but to the oil-saturated, low-permeability zones that were previously not subjected to the treatment.

APPLICATION EXPERIENCE (46 wells):

- Increase in oil flow rate by 1.5 to 5 times;
- Additional oil production – over 800 tons per well;
- Reduction in produced water volume – over 1,000 tons per well;
- Average duration of effect – over 1 year;
- Method success rate – over 70%.

PG-UWS TECHNOLOGY

BY INJECTION OF POLYMER-CLAY AND HYDROCARBON OIL-WASHING SYSTEM

Purpose of the technology

Increase reservoir sweep efficiency during waterflooding, followed by enhanced displacement efficiency of injected water. Achieved through sequential injection of a polymer-clay system and a hydrocarbon oil-washing composition.

Application object characteristics

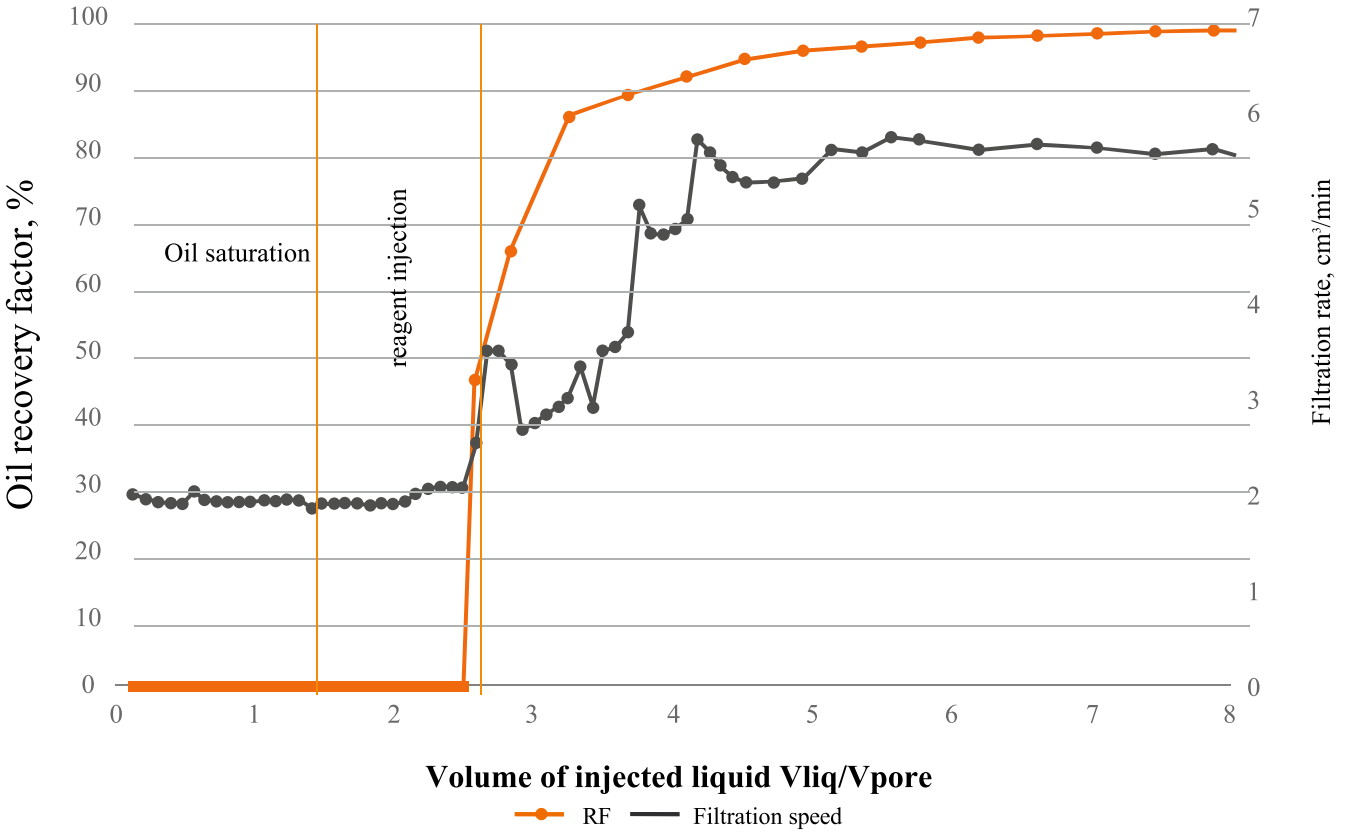
- Waterflooded terrigenous reservoirs of any water salinity. Heterogeneous in permeability with no communication between oil-saturated and water-saturated intervals exposed by the injection well.

Operational conditions

- Secondary perforation of the reservoir before or after treatment is not performed
- Hydrodynamic connection between injection and production wells is required
- Water cut of produced fluids: 50%–98%
- Fluid rate: at least 50 m^3/day

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PRIMARY OIL DISPLACEMENT FROM THE MODEL AFTER INJECTION OF SNPH-9633 M.S1 REAGENT



Increase in Oil Displacement Efficiency (EOR factor) from 73.6% to 98.2%.

TECHNOLOGIES BASED ON SNPH-9110 REAGENT



Purpose

The reagent is designed to regulate reservoir sweep efficiency during water flooding and to control water inflow in production wells



Technology Description

When treating the reservoir with SNPH-9110, the oil displacement efficiency increases due to the redistribution of flow within reservoir layers. This occurs as a result of reduced filtration-capacity properties in high-permeability intervals and the subsequent involvement of low-permeability zones in production



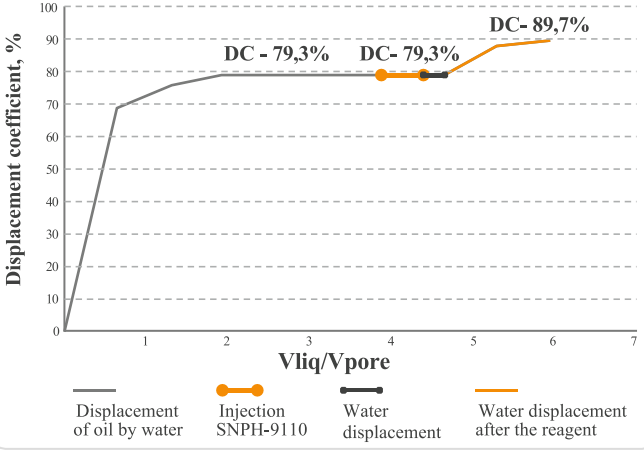
Advantages

Preservation of reservoir properties of the productive formation quick well recovery to operating mode without oil production losses, with potential reduction of water cut in produced fluids

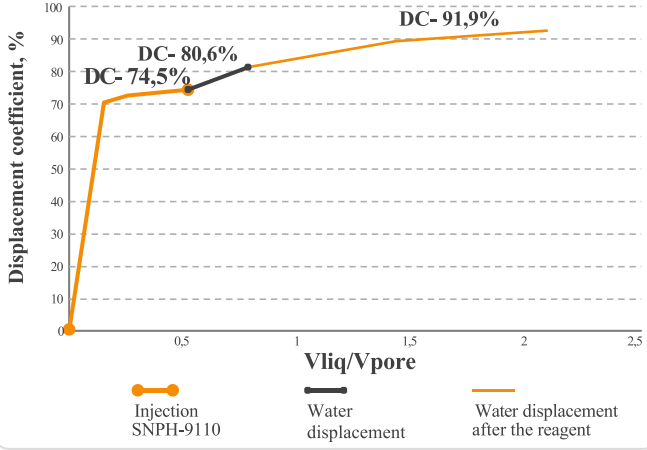
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FILTRATION STUDIES TO ASSESS THE EFFECTIVENESS OF SNPH-9110 REAGENT Treatment Forecasting

Change in the oil displacement factor from a reservoir model with residual oil saturation after SNPH-9110 treatment. Model No. 1.



Change in the oil displacement factor from an oil-saturated reservoir model after SNPH-9110 treatment. Model No. 2.



Study results

Model No.	Oil Volume in the Model, ml (% o.o.)	Oil Volume Displaced by Water, ml (% o.o.)	Additional Oil Displaced, ml (% o.o.)	Oil Displacement Factor Before SNPH-9110 Injection, %	Oil Displacement Factor After SNPH-9110 Injection, %	Increase in Displacement Factor
1	58 (74,9)	46 (59,4)	6 (7,8)	79,3	89,7	10,4
2	62 (79,8)	-	57 (73,4)	79,3*	91,9	12,6

The SNPH-9110 reagent demonstrated effectiveness in enhancing the oil-displacing properties of water in the model, both during primary oil displacement from the reservoir and under residual oil saturation conditions.



CHEMICAL FLOODING TECHNOLOGY

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CHEMICAL FLOODING TECHNOLOGY

Description

The compositions for chemical flooding with specified parameters, based on the SNPH-PM polyacrylamide line and the SNPH-SM surfactant compositions / the SNPH-96 micellar formulation, are selected individually for the conditions of a specific field based on the results of laboratory studies and the design of the chemical flooding process.

Polymer flooding (polyacrylamides SNPH-PM)-is a technology for increasing oil recovery from reservoirs by increasing the reservoir coverage factor — ensuring a more uniform distribution of the displacing agent across the reservoir — and reducing residual oil saturation in the washed-out zone.

ASP-polymer flooding (polyacrylamides SNPH-PM and reagents SNPH-SM / micellar composition SNPH-96) is an additional method for increasing the oil displacement coefficient; it allows reducing the residual oil saturation even in those zones of the reservoir that have already been washed with water. The effect is achieved by reducing the value of residual oil saturation.

Water flooding using foam-forming agents (SNPH-SM reagents)-is a method of enhancing oil recovery based on the sequential introduction of foam-forming compositions into the reservoir and the formation of foam under reservoir conditions, which significantly increases the reservoir coverage coefficient and the displacement coefficient.

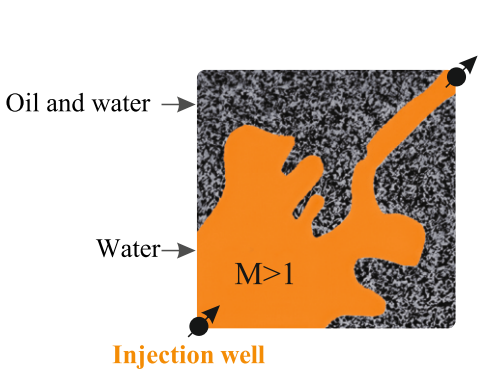
Application criteria

- Mobility of injected agent (water) higher than that of displaced oil
- Low water injection efficiency
- Premature water breakthroughs
- High residual oil saturation

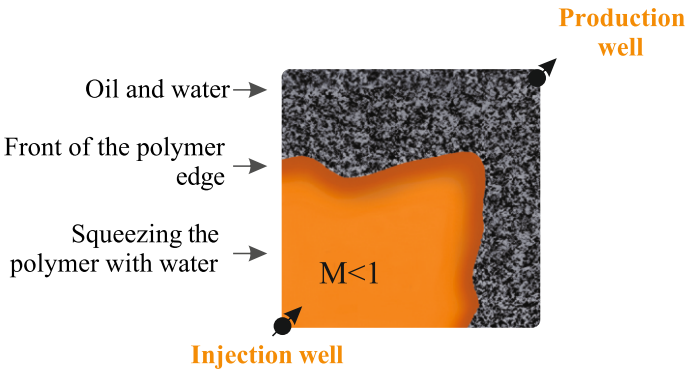
Solution

- Polyacrylamides from the **SNPH-PM** series;
- Surfactant compositions from the **SNPH-SM** series and the micellar composition **SNPH-96**;
- Crosslinkers from the **SNPH-LK** series.

Water injection



Polymer flooding



TECHNOLOGY ADVANTAGES

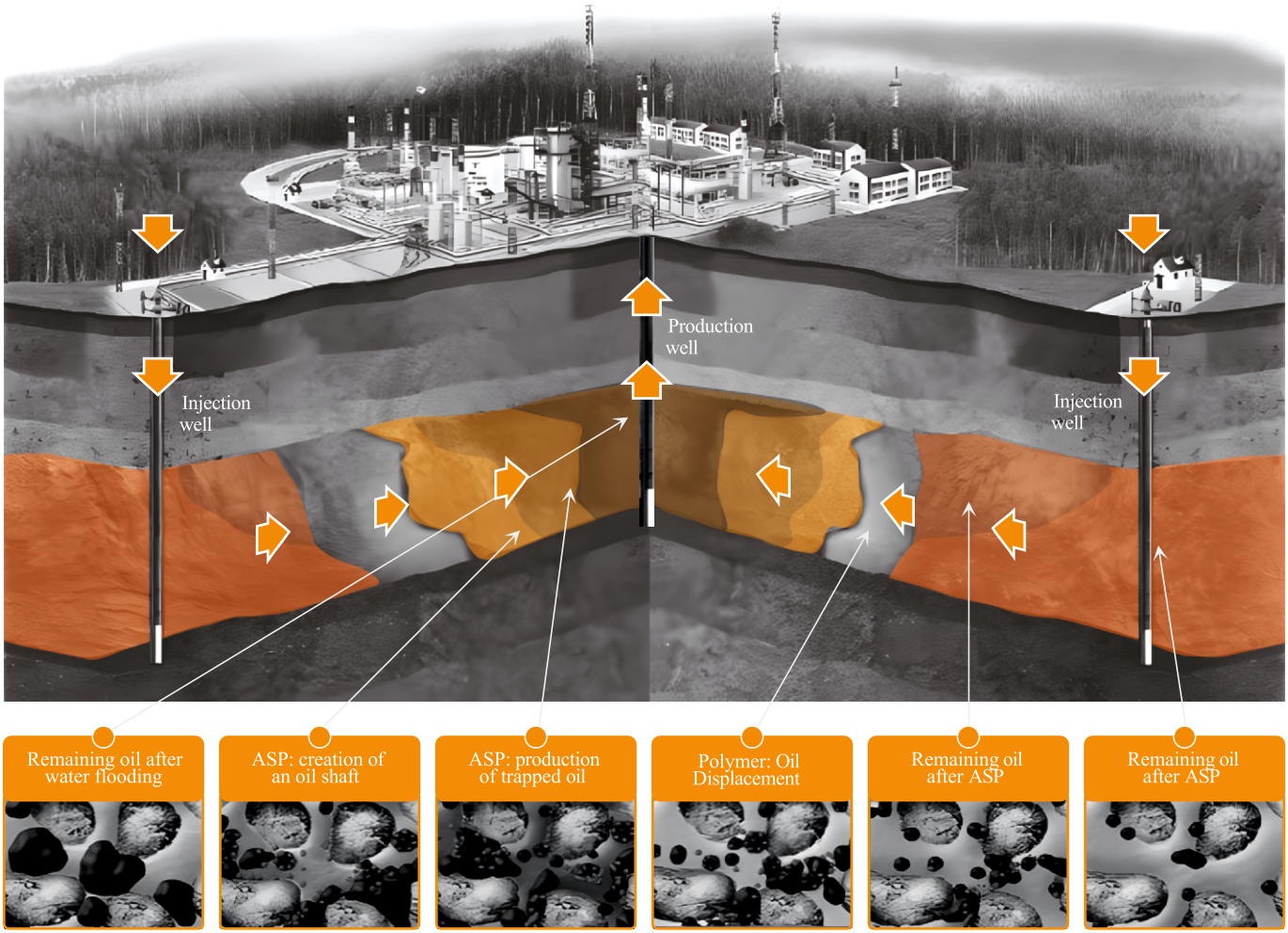
- Improves oil displacement efficiency
- Reduces formation of water channels
- Lower water cut compensates for reagent costs

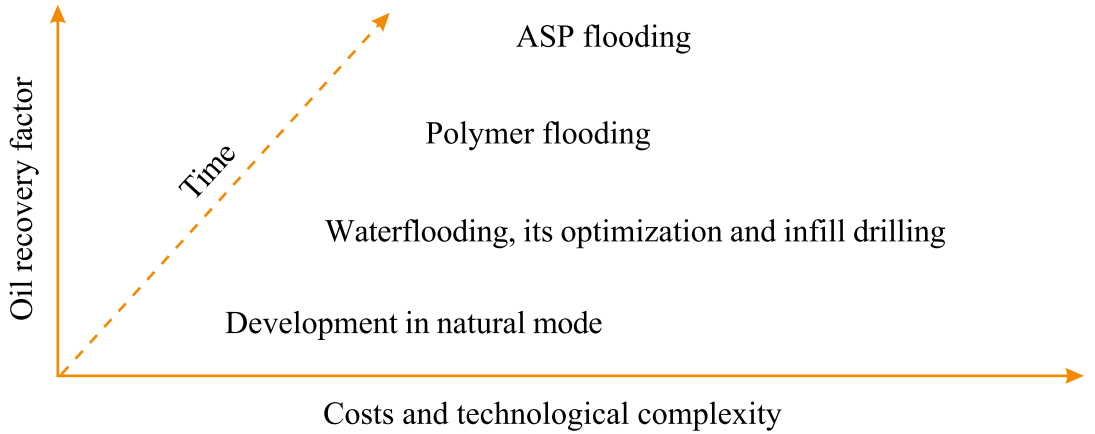
Surfactant/Polymer chemical flood application:

- Light and high-viscosity oils
- Hydrophobic reservoirs with residual oil saturation above 25%

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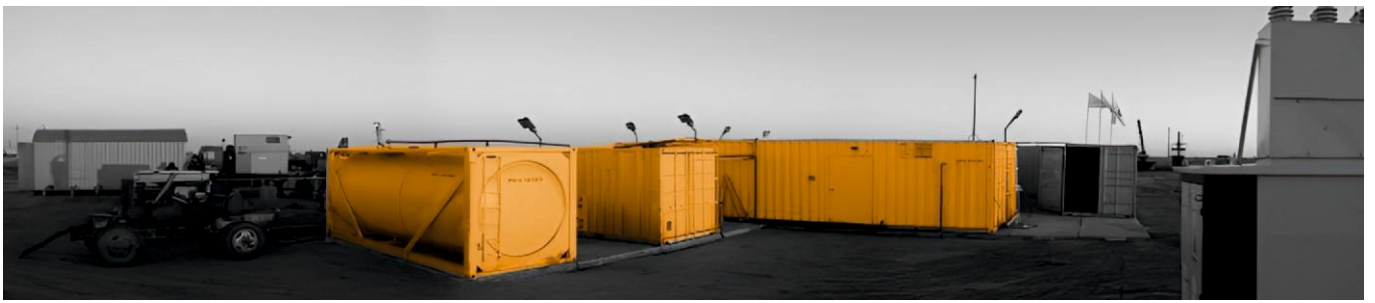
ASP chemical flood





Comprehensive service support

- Chemical flooding process feasibility study and design
- Detailed modeling and effect calculation
- Selection and supply of polymers and other necessary chemicals
- Installation and maintenance of polymer injection equipment
- Implementation of the polymer flooding project at the field using in-house engineering and field personnel





OIL PRODUCTION INTENSIFICATION TECHNOLOGIES

ACID COMPOSITIONS

- **SNPH-9010Zh** composition — well treatment in carbonate reservoirs or terrigenous reservoirs with carbonate cement

- **SNPH-9021, SNPH-9030** composition — well treatment in terrigenous reservoirs

The technologies are designed to intensify oil production from carbonate and terrigenous reservoirs, prevent the formation of oil emulsions, and effectively clean the bottom-hole zone.

ADVANTAGES

- Thermal stability up to 100°C
- Ability to stabilize Fe^{3+} ions
- Inhibition of scale formation processes
- Optimization of raw material base
- Competitive cost

Effect achieved through:

- Increasing the radius of active drainage in the near-wellbore zone by partial dissolution of the rock framework and dispersion of clay particles
- Cleaning pore channels from mechanical impurities, dispersed clay, and ASP deposits
- Reducing capillary forces at the oil–water interface
- Preventing the formation of oil-acid emulsions
- Effective cleaning of the near-wellbore zone from formations that clog the porous medium.

EXPERIENCE WITH SNPH-9010J:

Development Site	Tournaisian and Bashkirian Layers	Bashkirian Layer, Vereysk Horizon	Kashiro-Podolsky Horizon
Additional Oil Production per Well (t/well)	1270	600 – 1000	860
Success Rate (%)	93	85	90
Average Increase in Oil Rate (t/day)	2,0	2,1	2,3

EXPERIENCE WITH SNPH-9021 AND SNPH-9030

Development Site	Kynovsky and Bobrikovsky Horizons	Melensky Horizon	Achimov Suite	Vasyuganskaya, Megionskaya, and Vartovskaya Suites
Additional Oil Production per Well (t/well)	1145	600	1360	1300
Success Rate (%)	100	-	100	82
Average Increase in Oil Rate (t/day)	2,1	1,6	1,6-6,0	2,0-20,0 (cp. 6,0)

PHYSICOCHEMICAL METHODS FOR ENHANCED OIL RECOVERY (EOR)

TREATMENT WITH ACID COMPOSITION SNPH-9010J COMBINED WITH ULTRASOUND

The technology is based on combining chemical and physical methods to enhance oil recovery. The use of chemical reagents together with physical fields creates a synergistic effect, significantly increasing the effectiveness of the treatment.
The innovative method involves injecting an acid composition (SNPH-9010J, SNPH-9021/9030, or hydrochloric acid modified with SNPH-8903A additive) into the formation and treating it with acoustic waves.

Combined application allows for:

- Several-fold increase in the penetration of the acid composition into the formation;
- Controlled activation of the chemical reaction in the zone of acoustic influen

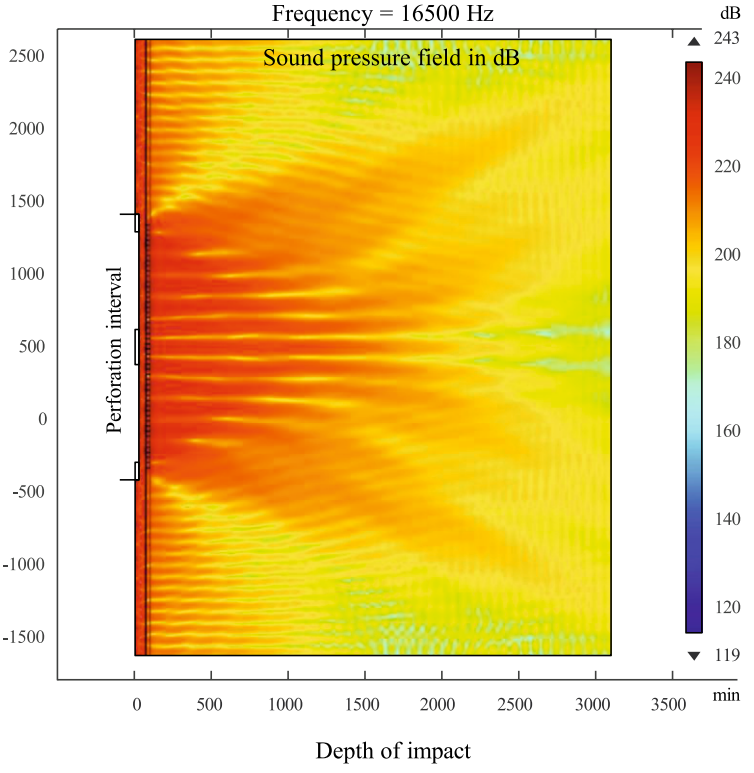
Depending on the characteristics of the wells being treated, ultrasonic acoustic waves and acoustic shock waves can be used.



SNPH

LABORATORY RESEARCH RESULTS:

- Acid composition alone: permeability of the model formation to oil increased 1.9 times.
- Acid composition combined with ultrasound: permeability increased 3.3 times.
- Acid + ultrasound enhances formation de-colmatation, increasing oil permeability 2 times compared to acid treatment alone.
- After ultrasonic treatment, permeability to high- viscosity oil (172–255 cP) increased 1.3–1.8 times.
- Oil viscosity decreased by 20–30% after ultrasound treatment.



Ultrasound exposure model

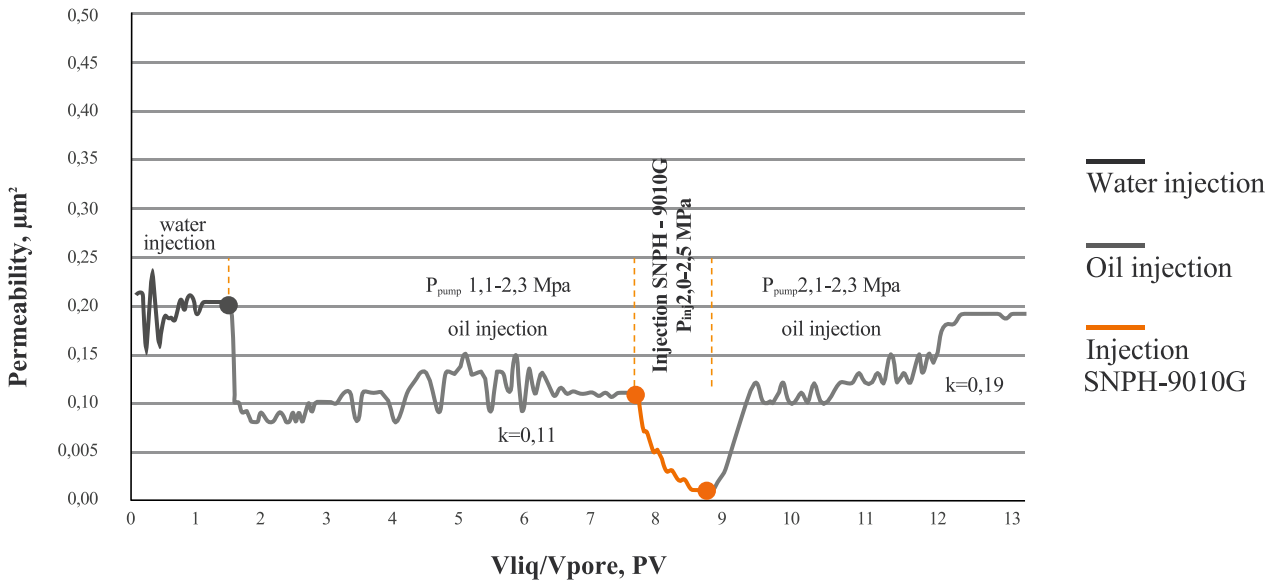
Casing: 146 mm
Wall thickness: 7 mm
Cement: 23 mm
Perforation: 5 mm
Medium: porous

FILTRATION STUDIES TO DETERMINE CHANGES IN FORMATION MODEL PERMEABILITY

Formation Fluids

Parameter	Value
Oil viscosity, cP	15,01
Oil density, kg/m^3	888
Produced water viscosity, cP	1,08
Produced water density, kg/m^3	1150

Model 1. Change in oil permeability of a bulk model after injection of SNPH-9010G



SNPH

Summary of Studies on Barium Sulfate Dissolution Using Solvent SNPH-54R on Packed Models, With and Without Ultrasonic Treatment

Experiment №	Type of Treatment	Water Mineralization	Model Length, cm	Pore Volume, ml	Permeability to Water (initial), μm²	Permeability to Barium Sulfate Slurry, μm²	Permeability to Water After Treatment, μm²	Permeability to Barium Salt Solvent, μm²	Final Permeability Water, μm²	Permeability Reduction	Recovery to Efficiency, %
1	Chemical Treatment 54R	50 g/l	44	109	0,31	0,004	0,02	0,10	0,22	1,4	70,97
2	Chemical Treatment 54R	50 g/l	44	104	0,29	0,004	0,03	0,07	0,19	1,5	65,52
3	Chemical Treatment 54R + Ultrasonics	50 g/l	44	106	0,35	0,004	0,01	0,27 (+Ultrasonics)	0,32	1,1	91,43
4	Chemical Treatment 54R + Ultrasonics	50 g/l	44	108	0,32	0,004	0,03	0,31 (+Ultrasonics)	0,29	1,2	90,63
5	Chemical Treatment 54R + Ultrasonics	50 g/l	44	106	0,25	0,005	0,03	0,17 (+Ultrasonics)	0,22	1,1	88,00
6	Ultrasonics	50 g/l	44	108	0,29	0,004	0,03	0,02 (Water Injection)	0,03	9,7	10,34

Filtration studies to determine the change in permeability of a linear bulk formation model clogged with barium sulfate, measured in water, before and after treatment with the SNH-54R barium sulfate solvent, both with and without ultrasonic treatment, showed:

• The SNH-54R barium sulfate solvent restores the permeability of the formation model with an efficiency of 65–71%.

• The effectiveness of restoring the permeability of the reservoir model when using the barium sulfate solvent SNH-54R together with ultrasonic treatment was 88–91%

• The effectiveness of restoring the permeability of the reservoir model from ultrasonic treatment was within 10%.

In 2019, pilot tests were conducted using chemical treatment technology combinedwith ultrasonic treatment (injection of an acid composition and ultrasonic treatment) in two wells of the Vereisky horizon (C2ver).

WELL № 5213

VERESKY HORIZON

Commissioning on C2ver

Achieved 100%
of planned flow rate.

Reduced commissioning time from 2–3 days to 10 hours.

WELL № 5273

STARO-KADEEVSKOE FIELD

Inflow Intensification

Increased initial well production by 80–100%.

SNPH

TECHNOLOGIES FOR MODIFYING ACID SOLUTIONS FOR WELL OVERHEAD TREATMENT

MULTIFUNCTIONAL ADDITIVE SNPH-8903

A multifunctional, comprehensive additive for modifying (enhancing) hydrochloric acid or a mixture of hydrochloric and hydrofluoric acids.

The additive is a balanced composition that includes: a reaction retarder with the rock matrix, a mutual solvent, a complexing agent, and a mixture of surfactants (PAV) that provide demulsifying properties and help remove ASPO (asphaltenes, paraffins, and other deposits).

ADVANTAGES

- Slows down the reaction rate of hydrochloric acid with carbonate reservoir rock.
- Ensures uniform penetration into high- and low-permeability zones, increasing the radius of active drainage and involving the entire thickness of the formation.
- Prevents the formation of emulsions and deposits during acid contact with formation fluids.
- Inhibits precipitation in the formation after the acid reacts with the rock.
- Reduces interfacial tension at the acid-oil contact
- Minimal costs for preparing the acid composition.

Application Experience:

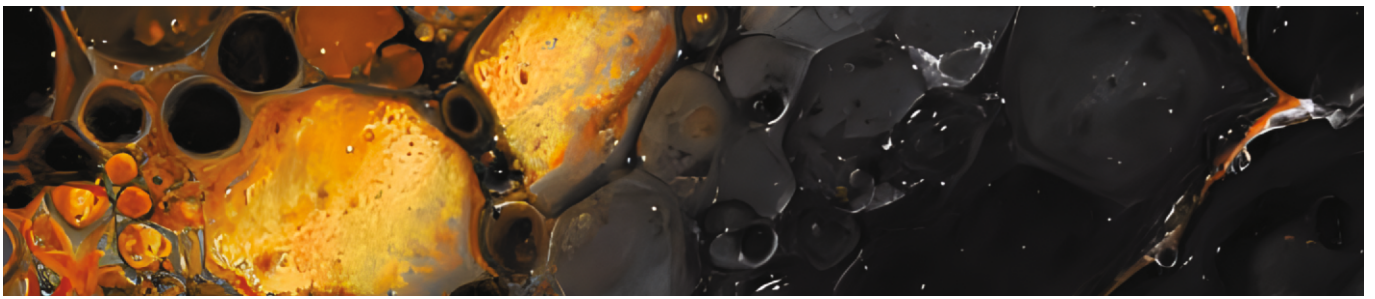
- Number of wells treated: 400
- Additional oil production: 300 tons per well
- Average oil rate increase per well: over 2.0 t/day
- Average duration of effect: more than 10 months
- Success rate of treatments: over 85%

IRON ION STABILIZER SNPH-8905

SNPH-8905 is designed to stabilize iron ions in the acid treatment of the near-wellbore zone. It reduces ferric ions (Fe^{3+}) to ferrous ions (Fe^{2+}). Dosage in the acid composition: 0.8–1.0 vol.% for 5000 ppm Fe^{3+}, 0.5–0.7 vol.% for 2500 ppm Fe^{3+}.

ADVANTAGES:

- Low freezing point (below -50°C).
- Prevents precipitation and formation of stable emulsions with formation fluids.
- Preserves the reservoir properties of productive formations.
- Can be used in combination with other acid components and with hydrochloric acid of various concentrations.
- Uses standard oilfield equipment.



SNPH

ACID CORROSION INHIBITOR SNPH-8904



Purpose

SNPH-8904 is used in acid formulations to reduce their corrosive aggressiveness toward metal surface



Description

The corrosion inhibitor SNPH-8904 is applicable in acid formulations with high HCI content and under reservoir temperatures up to 150°C

The specific corrosion rate of St35 steel at 120°C in 20% HCI with a concentration of 15 g/dm³ of SNPH-8904 is approximately 4.5 g/m²*h



Advantages

Suitable for reservoir temperatures up to 150°C

Low freezing point (below -50°C)

Can be used in combination with other acid components and with hydrochloric acid of varying concentratoins

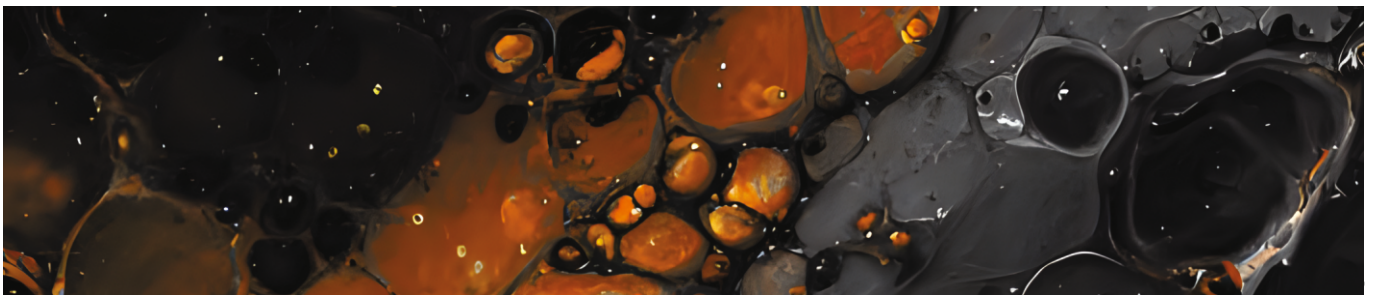
WELL REMEDIATION AND ISOLATION WORK REAGENT SNPH-8909

Purpose

SNPH-8909 modifier + acid composition (AC).
The reaction products of the modifier with hydrochloric acid promote the dissolution and removal of natural and man-made colmatants from porous media, while the surfactants contained in the composition increase rock wettability, slow the reaction rate, and prevent the formation of insoluble compounds.

Description

The technology involves structural deformation of clays under the influence of the SNPH-8909 + AC.
The process is accompanied by changes in the mechanical properties of the clays: their sorption capacity is lost and their hydrophobic properties are altered. The use of this technology prevents the precipitation of poorly soluble compounds in the porous medium that arise during clay acid treatments.

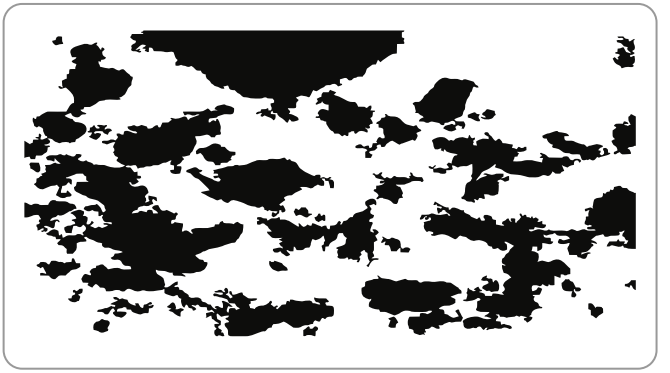


SNPH

MONTMORILLONITE STRUCTURE UNDER THE INFLUENCE OF THE SNPH-8909 + AC COMPOSITION (ELECTRON MICROSCOPY, 6000x)



Original sample

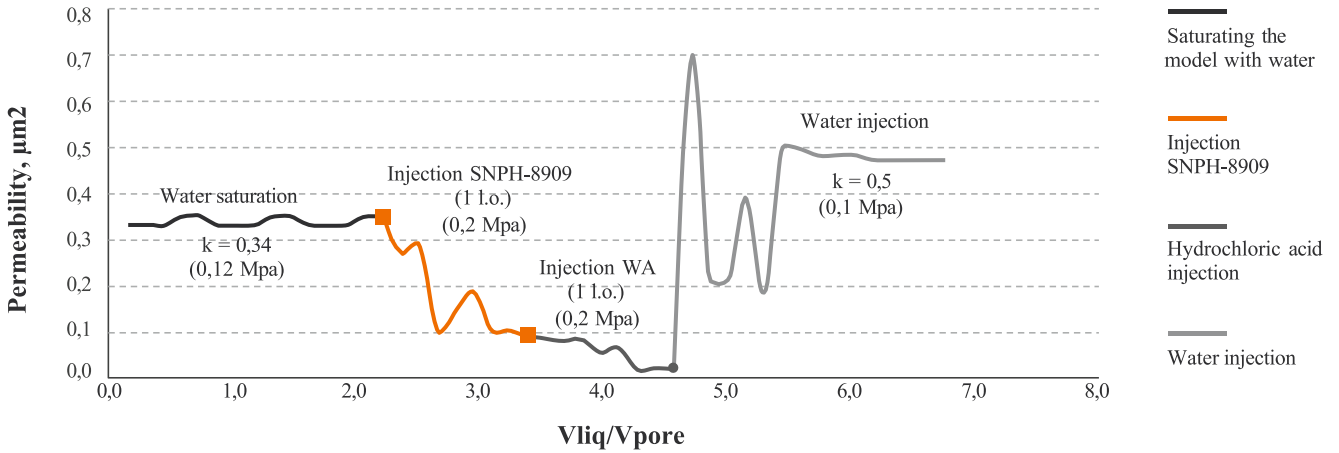


Treated with SNPH-8909 + AC



Filtration studies – evaluation of SNPH-8909 effectiveness

Change in reservoir model permeability after treatment with SNPH-8909 and a 12% hydrochloric acid composition



The combined action of the SNPH-8909 modifier with the acid composition on facies-heterogeneous reservoirs increases the solubility of the rock and salts that clog the porous medium, enhancing water permeability of the model by 1.5 times.

SNPH

HYDROPHOBIZER

The hydrophobizer **SNPH-GF**, available in several grades, is used in technological fluids for treating drilling muds and well-killing fluids. Its goals are to maximize the retention of filtration-capacity properties of the near-wellbore zone (NWZ), enhance oil recovery and injectivity, and reduce costs associated with prolonged well start-up and bringing wells to production mode after underground equipment replacement

Description

SNPH-GF is produced according to TU 20.59.59-443-05765670-2021 and is a water-alcohol-based fluid with a density of 800–1150 kg/m³ and a freezing point down to -50°C. The effective dosage of the surfactant hydrophobizer in technological fluids ranges from 0.1% to 3.0% by mass.

- Using the hydrophobizer in kill fluids helps prevent or reduce underground equipment downtime related to pumping out the kill fluid before pump intake or stopping its supply. Reduces or eliminates post-maintenance productivity drops in wells.

SNPH-GF can be transported by all means except air transport, in accordance with applicable cargo transportation regulations.

HYDROPHILIZERS

The use of hydrophilizers from the **SNPH-SM** line makes it possible to increase oil production with lower specific costs by mobilizing immobile reserves and to improve oil recovery from reservoirs on a long-term basis.
The **SNPH-SM** reagent changes the wettability of the rock from hydrophobic or mixed type to the most hydrophilic state. It is used in the treatment of production wells, during hydraulic fracturing, nd in the water injection system. It increases the displacement efficiency by $30 %$ or more.

Purpose

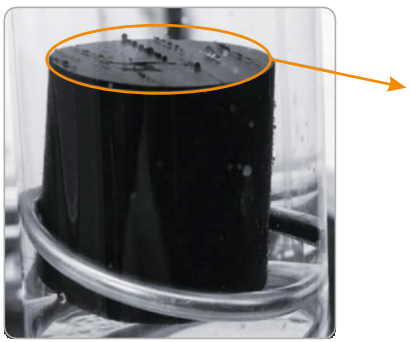
Increase the filtration area of the near-wellbore zone (NWP) of producing wells:

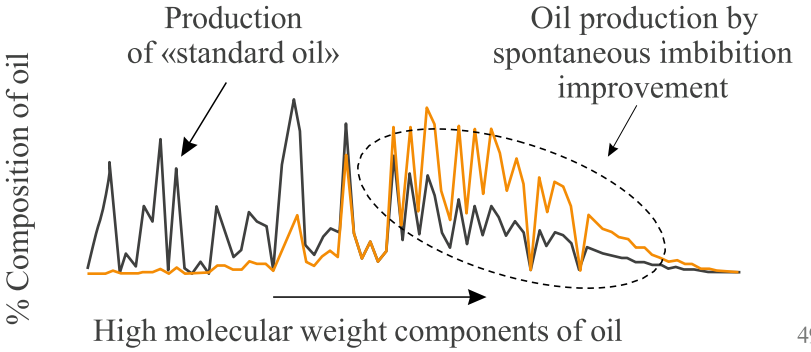
- NWP after hydraulic fracturing (HF)
- NWP to improve productivity index after drilling
- NWP during well completions

Waterflooding: improvement of sweep efficiency through wetting alteration

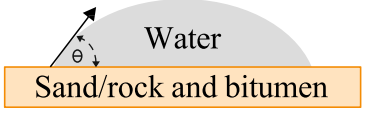
ADVANTAGES

- Reduced adhesion allows easier separation of bitumen from the rock or sand grains
- Significantly increases oil recovery factor (ORF)

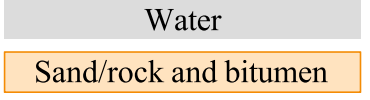




Hydrophilicity
(contact angle <90°)



Fully hydrophilic collector
(Contact angle = 0°)



Product	Contact angle	Contacte area (cm^2)
Water/Pure Steam	56°	0,12
SNPH-CM, 250ppm	9°	0,42



When processing SNPH-SM, time is needed to change the wettability of the rock = increased oil production

ADDITIVE FOR STEAM INJECTION

Purpose

The technological additive from the **SNPH-SM** line is designed to increase the displacement coefficient of high-viscosity oil under steam-thermal stimulation; to reduce the surface tension force in the “oil-steam” system; and to reduce the residual oil saturation behind the displacement front.

The steam additive based on the **SNPH-SM** reagent is a specialized steam additive recommended for use in PCO and SAGD. Studies show an increase in efficiency of up to 30% in oil displacement by steam with an additive based on the **SNPH-SM** additive compared to the injection of pure steam.

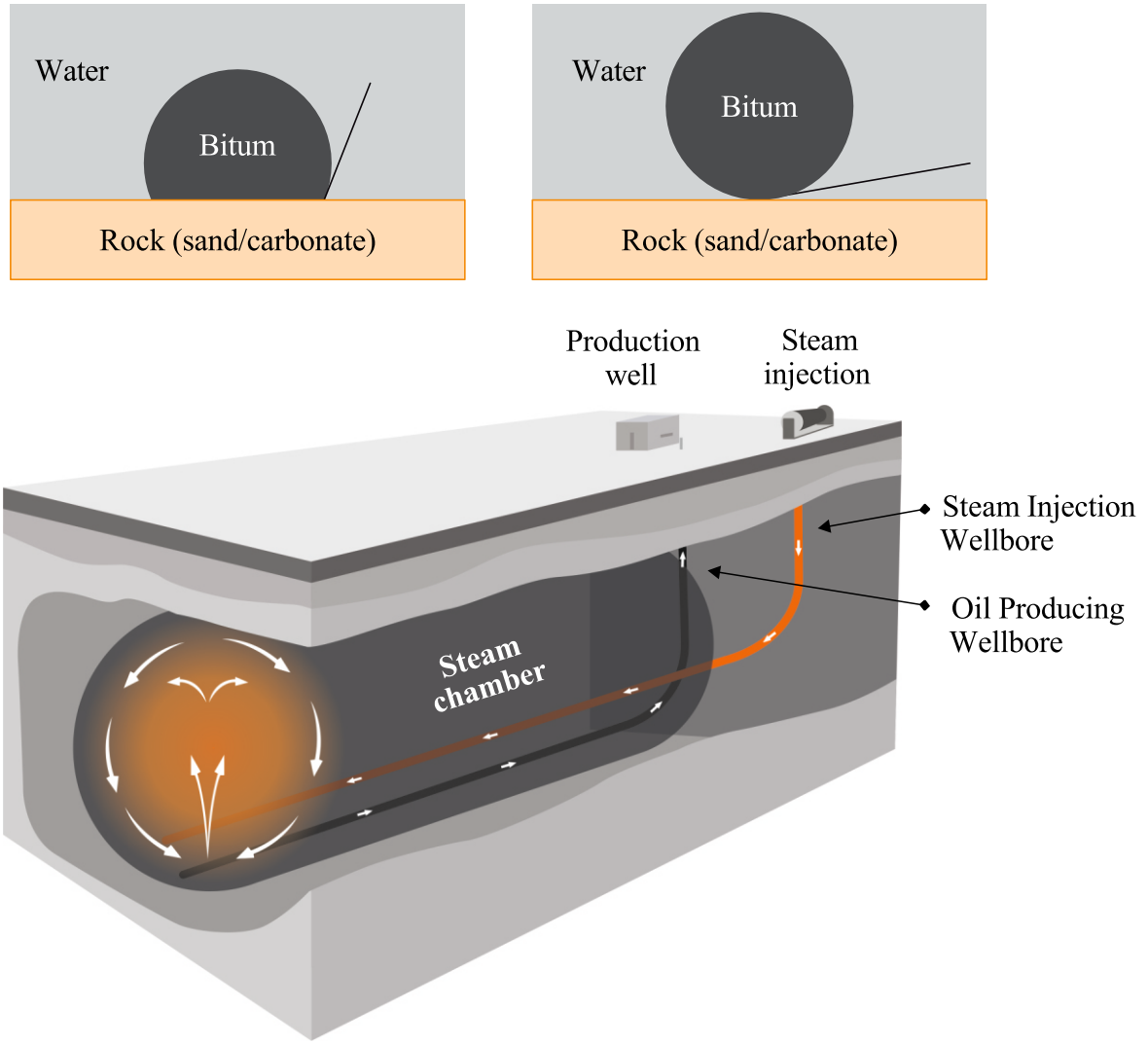
Heat and chemical transport:

- From the surface to the condensation zone
- Efficient distribution of the chemical additive due to reduced contact angle

Optimization of drainage processes:

- Bitumen displacement through reduced contact angle
- Reduced adhesion of bitumen to the rock
- Improved bitumen flow due to lower surface tension

- **The SNPH-SM additive allows achieving higher oil recovery at low residual oil saturation (SOR). SOR can be reduced by 30% or more to maximize the oil recovery factor.**


Water
Bitum
Rock (sand/carbonate)
Water
Bitum
Rock (sand/carbonate)
Production well
Steam injection
Steam chamber
Steam Injection Wellbore
Oil Producing Wellbore

CHEMICAL SOLUTIONS FOR HYDRAULIC FRACTURING (HF)

GEL FORMING AGENT – SNPH-3800

The liquid gel-forming agent SNPH-3800 is used as a gelling agent for hydraulic fracturing fluids and as a thickener for technological fluids to intensify well inflow.

LIQUID CROSS-LINKER – SNPH-3801

The liquid cross-linker SNPH-3801, based on borates, is used in guar-based fracturing fluids. It is available in two grades — M (instant-action) and N (low-temperature). It is intended for preparing cross-linked gels based on guar-containing gelling agents. The recommended concentration is from 0.5 to 5 L/m³, depending on the gelling agent load and the formation temperature.

DESTRUCTOR – SNPH-3802

Dry cross-linker SNPH-3802 based on boron-containing minerals with the addition of surfactants for preparing a suspension based on hydrocarbon solvents. It is used as a cross-linker in water-based hydraulic fracturing fluids. It is produced in two grades: M (immediate-action) and Z (delayed-action).

OXIDATIVE DESTRUCTOR SNPH-3803

The SNPH-3803 oxidative destructor is a persulfate destructor used to break down polymer-borate bonds in hydraulic fracturing fluids based on guar or its derivatives. The working concentrations depend on reservoir conditions, injection volume, and the required gel stability, and usually range from 0.05 to 1.0 kg/m³.

SLOW-RELEASE LIQUID STITCHER SNPH-3804

The delayed liquid crosslinker SNPH-3804 is a suspension-based delayed crosslinker and is designed for preparing crosslinked gels based on guar-containing gelling agents. The recommended concentration is from 2.0 to 10 L/m³, depending on the gelling agent load and the reservoir temperature.

SYNTHETIC GEL-FORMING AGENT SNPH-3820G (5)

It is a hydrocarbon solution of a polymer compound with rheological additives. It is used as a thickener for process fluids applied in the oil production process.

BIOCIDE SNPH-3810

Biocide SNPH-3810 is a soluble powdered bactericide (biocide) designed to control microorganisms in a wide range of oil and gas industry facilities, including water from artesian wells and surface sources before it is used for hydraulic fracturing operations. For the best effect, it is recommended to add it to the water before preparing the biopolymer solution.

SNPH-3820 FRICTION REDUCER

The friction reducer SNPH-3820 is a dispersion of a high-molecular-weight polymer; it is used as an additive in process fluids during drilling, hydraulic fracturing, and well repair to improve lubricity and reduce the friction coefficient.

CLAY STABILIZER SNPH-SG

The SNPH-SG clay stabilizer is used as an additive to drilling fluid and hydraulic fracturing fluids. It is designed to prevent the swelling and migration of clay particles.

DRY GEL-FORMING AGENT SNPH-3830

The dry gelling agent SNPH-3830 is a powder of fast-hydratable guar gum; it is used as a gelling agent in hydraulic fracturing fluids and as a thickener for process fluids for wells with formation temperatures up to 80 °C. It is produced in two grades — grade SS (medium flowability) and grade PS (high flowability).

DEEMULGATOR SNPH-4001G

SNPH-brand demulsifiers are water-soluble demulsifiers that are pumped into the well as part of the process fluids for hydraulic fracturing and do not require additional preparation. They can be used over a wide temperature range. The demulsifier content in the finished composition can vary from 0.1 to 0.5%.



SNPH

REPAIR AND INSULATION WORKS

SNPH

REPAIR AND INSULATION WORKS

REAGENT SNPH-9800

Purpose

The composition is designed to eliminate inter-zonal fluid flows, absorption zones, and water inflows during drilling and maintenance of oil and gas wells.

Technology Description:

- A mobile, low-viscosity two-component system.
- The polymerized composition based on SNPH-9800 is elastic and has high adhesion to metal and rock.
- Curing time can be adjusted from 4 to 48 hours.

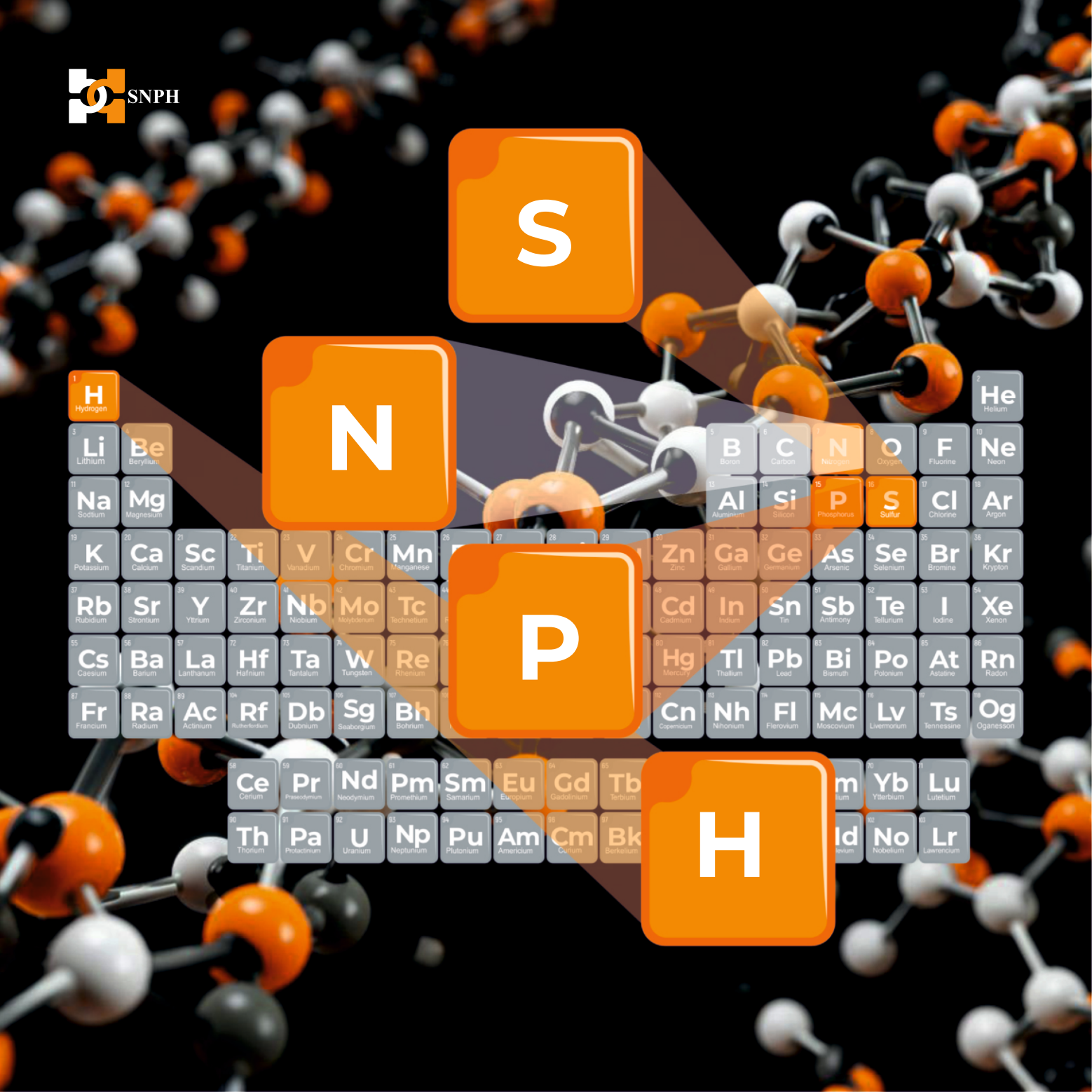
ADVANTAGES

- Technologically easy to use
- Environmentally safe
- Consumption per well: 1–5 tons
- The volume of the resulting polymer block equals the volume of the cementing slurry (no shrinkage)
- The cemented block is resistant to aggressive formation fluids and acid-alkaline solutions

Application Experience:

- Number of wells treated: **50**
- Success rate: **75%**

Notes


SNPH
S
N
P
H



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