

# ENERGY DEVELOPMENT PARTNERS

## EOR WATER-OIL ISOLATION

We use newest patented environmentally safe biodegradable compositions to isolate the underground water from oil layers to increase the hydrocarbons recovery and extract oil separated from water.

Our water isolation methods are classified below:

- **Polymer compositions method.**
- **Formation of Mineral Blockers method.**
- **Formation of Hydrophobic Films method.**

Water sips into oil layers through water coning contact, through global increase of water and oil layers, through high permeability formations, through fractures connecting aquifer with oil layers and other ways.

Our water isolation methods are applicable for well with depth in the range of 1000 - 6000 meters, temperature range in perforated zone formations from +60°C to +190°C (140 – 374 °F ), pressure in perforated zone formations from 1.2 MPa – 25MPa (P isolation structure: 3700psi/ m).

### **Polymer Compositions Method**

By injecting polymers into water layer, a hard marble structure will be made in front of water layer, resisting water penetration into oil layer. Polymers, injected into well, penetrate all formation's capillaries, but react only with water, and create the hard marble structure, preventing water from coming to well.

Polymers do not react with hydrocarbons, they block the water capillary channels, isolating water from oil. As a result, blocking the water filled capillaries increases the formation's pressure and hydrocarbons recovery.

Polymers have large molecules, decreasing the capillary's permeability for water. Permeability of oil capillaries is much more high due to molecular oil structure This method is used for oil wells up to 6000 meters deep.

Polymers create the strong crystalloid layer with water at the bottom of wells, isolating water from extracted oil, stabilize the oil production without water and increase the permeability of formation by improving surfactant properties of the formation. The duration of isolating layer and enhanced oil recovery effect lasts up to 3 years.

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## Formation of Mineral Blockers Method

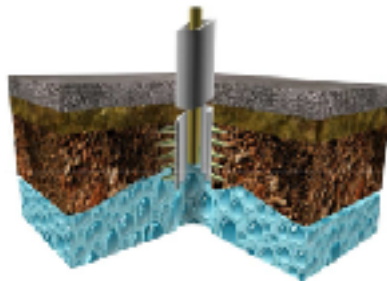
Gas wells have lower permeability in comparison with oil wells, so it is necessary to use materials with smaller molecules for deeper penetration into the formation's capillaries.

We designed the chemical mineral blockers with smaller molecule (compared to polymer composition) to create blocs to isolate water from hydrocarbons and specific application for EOR gas wells treatment.

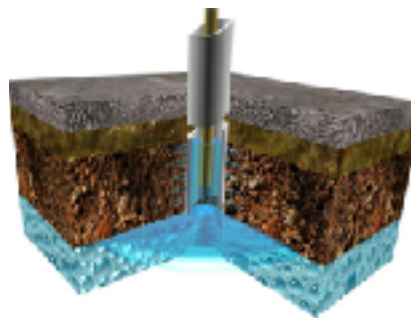
Mineral blockers are injected into gas wells and create (with only water) the hard crystal like layer to separate the water from oil well.

- The mineral blockers method is used for Gas reservoirs.
- The water level in and around the well will be decreased.
- Crystal stability and water isolation from hydrocarbons lasts up to 5 years.
- The mineral blockers decrease the density of hydrocarbons.
- The crystal like hard layer of mineral blockers prevents the mixing of water with oil in hydrocarbon reservoirs, decreasing the water content in recovered hydrocarbons and increasing the recovery rate of hydrocarbons.

Step 1: The water cone in perforated zone area is lifted by mineral blockers;

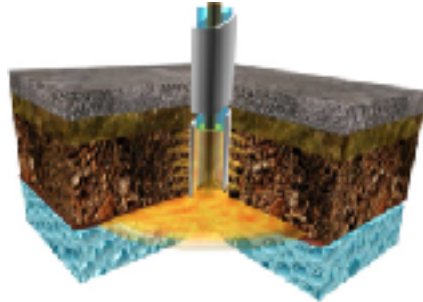


Step 2: The injected natural gas pushes down the water cone in perforated zone area;

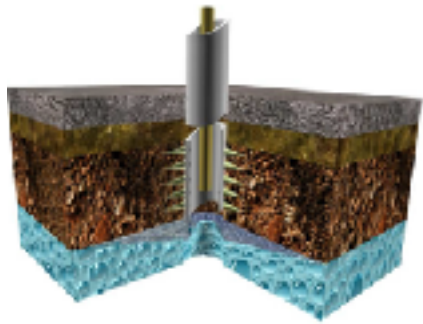


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Step 3: Injecting mineral blockers into well and pushing down the water cone in perforated zone area;



Step 4: The crystal like isolation layer is created by crystal blockers and water, isolating water from hydrocarbons.



### **Formation of Water Isolating Hydrophobic Films**

Hydrophobic Films method is used to prevent water – hydrocarbons mixing in wells at formations with hydrocarbons and water alternating layers. The water – hydrocarbons isolation is created in capillaries of formations with alternating hydrocarbons and water layers.

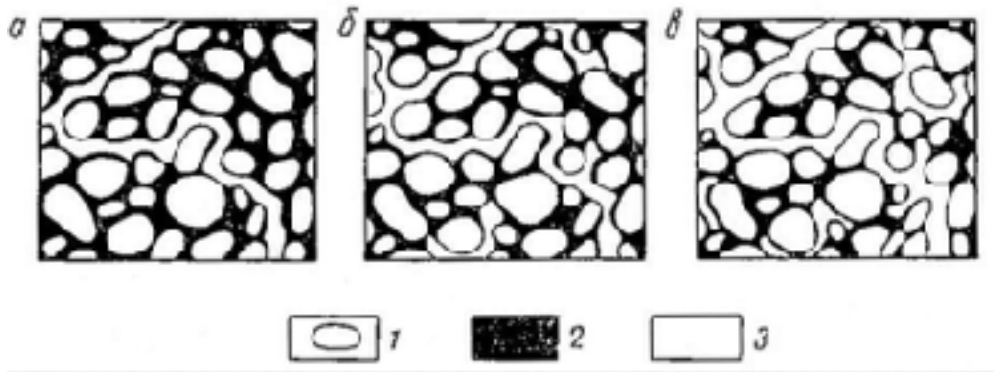
- Hydrophobic Films isolating method is used for Oil & Gas reservoirs.
- Wells with low permeability are especially applicable for Hydrophobic Films method.
- Hydrophobic Films method is very efficient to start hydrocarbons production in new constructed wells.

Hydrophobic Film composition, injected into well, penetrates formation's capillaries through perforated zone and creates isolating film inside on capillaries walls. Isolating film inside capillaries repulses the water and pass through hydrocarbons.

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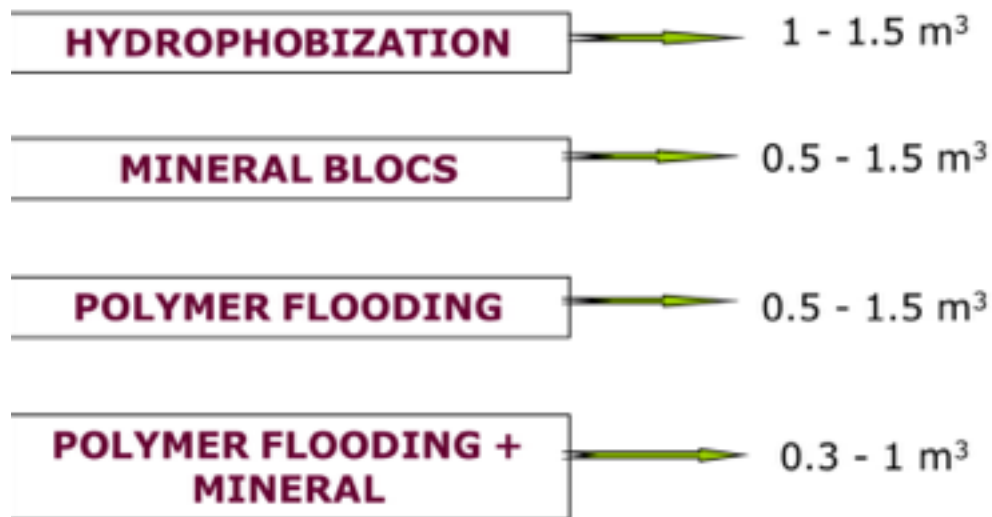
Repulsed water, trying to find the way in formation, pushes hydrocarbons from capillaries and increases the recovery of more pure hydrocarbons.

Schematic representation of chemical composition inside formation's porosities and capillaries is shown below:



After the isolating film is created in capillaries, the residual chemical composition is neutralized by 3% solution of citric acid and removed from well.

The amount of chemical compositions per one meter of perforated area is shown below:



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The efficiency of water – oil isolation methods for enhanced oil recovery (EOR) is shown below:

<b>Water – hydrocarbons isolating methods</b>	<b>Decreased water rate in recovered hydrocarbons</b>	<b>Increased EOR productivity after wells treatment by water – hydrocarbons methods</b>
<b>Conventional hydrochloric method</b>	<b>1% - 5%</b>	<b>Minus 85% - plus 50%</b>
<b>HYDROPHOBIZATION</b>	<b>25% - 50%</b>	<b>From 150% to 300%</b>
<b>MINERAL BLOCS</b>	<b>30% - 100%</b>	<b>+200% - +600%</b>
<b>POLYMER FLOODING</b>	<b>50% – 100%</b>	<b>+300% - +500%</b>
<b>POLYMER FLOODING + MINERAL BLOCKS</b>	<b>70% – 100%</b>	<b>+300% - +800%</b>