TBC ENERGY enhanced oil recovery

THERMO-BARO CHEMICAL METHOD

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THERMO-BARO CHEMICAL METHOD

AGENDA

- Introduction
- The history of the technology
- The reasons for the decline in well productivity
- Traditional technologies of intensification
- Main purpose of technology
- Basic principles
- Revolutionary technology
- Advantages
- Impact of hot gases and reaction inside the formation
- Chemistry of the process
- Basic chemical reactions
- Comparative indicators of intensification
- Types of impact on the well
- Conducting experimental industrial work
- Diagram
- HSE
- Termo Baro Chemical impact

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THERMO-BARO CHEMICAL METHOD

INTRODUCTION

The productive capacity of oil, gas and condensate wells is determined mainly by the hydrocarbonaceous reserves of the field and the condition and permeability of the bottom-hole formation zone (BFZ), which decrease due to drilling, development and exploitation of productive horizon. A number of deposits which have been recently placed in operation have a natural low permeability of reservoirs, which is further reduced by development of wells.

It is a widely known fact that between 40 to 60 percent of oil and gas cannot be extracted from the formation because they remain chemically bound to the deposit rock in the hydrate and clathrate compounds.

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THERMO-BARO CHEMICAL METHOD

HISTORY OF TECHNOLOGY

Our technology is the result of two decades Research &Development. It commenced with researching of combustion mechanisms and problems of hydrogen energy.

1980’s:

Scientific base of our technology come from the late Soviet labs developing special fuels. Those technologies were adopted to be used for civil purposes

1990’s:

the Thermo-Baro Chemical method approach was tested & improved in Ukraine & Russia

Late 2000’s:

UK-based TBC Energy successfully performing in Southern Asia & CIS countries

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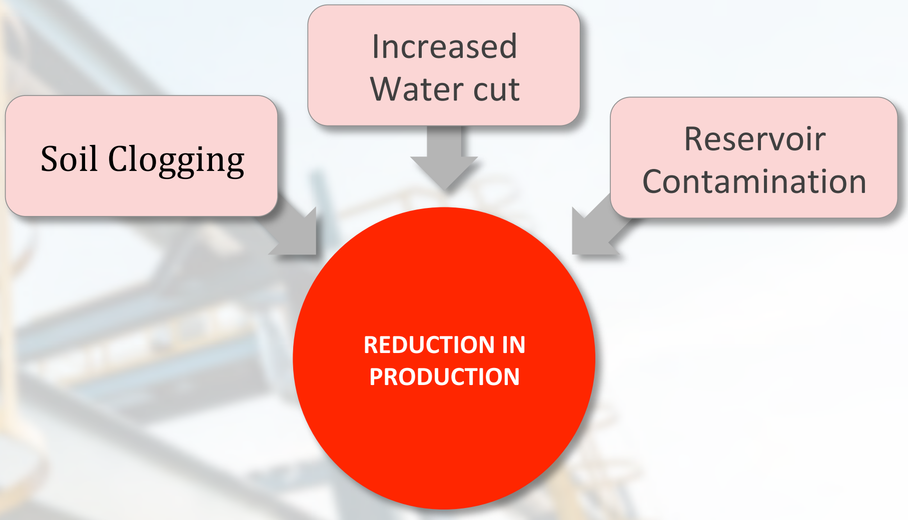
THE MAIN REASON OF PRODUCTION DECLINE

- Colmatation (contamination) of bottomhole formation zone- with drilling and cement fluids;
- Increased a water cut in productive zone;
- The contamination of the collector by asphaltene-resin-paraffin deposits (heavy and hard oil fractions – asphaltenes, goudron, resins, paraffins)



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TRADITIONAL TECHNOLOGIES OF INTENSIFICATION

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- Thermal action.
- Acid treatment.
- Alkali treatment.
- Acid and alkali treatment + physical action (vibration, ultrasound, cavitation).
- Cycling process (gas is injected into formation).
- Hydraulic explosion of a formation.
- Technologies of combusting and exploding: thermo-physical action of products of combusting and explosive chemical energy sources reaction in the zone of uncovered formation.

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MAIN PURPOSE OF TECHNOLOGY

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The purpose of this technology is to clear pore space of the remnants of drill fluid sand asphalt-resin-wax depositions, to create additional conjugated fractures in the productive strata, to increase rock permeability and well capacity of the exploited wells.

It is proved that the unique properties of the new chemical energy sources can selectively provide formation processing of high-molecular components of the fluid only. The longer the molecules are, the easier it is to destroy them (their activation energy is lower) to flash gasoline and flash fractions.

As a result, the porosity and permeability of the reservoir rises sharply and, consequently, increases the capacity of oil, gas and gas-condensate wells.

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BASIC PRINCIPLES OF METHOD

- **Destruction of the hydrate and clathrate hydrocarbon compounds with the nonorganic part of reservoir, complete extraction of the fluid;**
- **Additional cracking and possible reservoir fracturing, opening of closed pores with atomic hydrogen;**
- **Formation cracking and pyrolysis of high-molecular hydrocarbons and their conversion into flash gasoline and flash fractions (gas produces gas).**

The chemical solutions used for the resolution of this problem are a new generation of oxidation-reducing mixtures (ORM), and Catalyst of decomposition the paraffins (CDP). Significantly, they do not form compounds which are dangerous to human health and do not have a negative impact on the environment.

After treatment, there is no even a smell of oil.

Thermo-Baro Chemical Method proves to be more efficient compared with commonly applied intensification technologies of hydrocarbon raw materials inflow:

- In oil wells output increases by **1.5 up to 10 times**;
- In gas wells output increases by **3 up to 27 times**;
- In gas condensate wells output increases by **3 up to 20 times**

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THERMO-BARO CHEMICAL METHOD

REVOLUTIONARY TECHNOLOGY

DISRUPTIVE TECHNOLOGY, UNPARALLELED IN THE INDUSTRY

Today, there are various methods to obtain additional debit of oil or gas. The most widely used is hydraulic fracturing, or “fracking”.

Fracking is expensive and is not as efficient for the completeness of recovery of hydrocarbons remaining in the productive horizon than the method which is our company offers.

The method Hydraulic fracturing of formation (GRP) additionally will give the inflow of fluids up to 25-35%. of hydrocarbons which are in the formation. At that time our method allows us to extract the remaining 40 -60% of all non-recoverable hydrocarbons in the formation/ reservoir.

The combination of these two methods, either sequentially or simultaneously, holds the most promise for the stimulation of the flow of hydrocarbons.

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ADVANTAGES

The working medium of the process is a mixture of heated gases, the dominant role played by atomic and molecular hydrogen.

Several oxidizers participate in the combustion reactions, the main oxidizer being water (ballast of the well). The reagents used are more power consuming systems. The thermo-dynamic potential of the system is realized mainly in the formation, not in the casing pipe. In preflame oxidation (final stage of the process) active radicals of atomic oxygen are generated.

The effect of combustion products on fluid and rock is multifunctional, and is mainly of a chemical nature:

This is the in-situ transformation of high molecular weight paraffins into gas and gasoline (cracked pyrolysis), hot acid-base treatment and expansion of pores, additional cracking, removal of the skin effect, strengthening of loose rocks, etc.)

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ADVANTAGES

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Stages of processes:

At the first stage - the system is dehydrated and the HRC-(hydro-reactive compounds) is burned in water with the release of hot hydrogen, which in rapid combustion goes into the formation.

At the second stage, the decomposition of COM-(Combustible-oxidant mixtures), which starts with the action of heat from the exothermic reactions of the first stage, ensures the supply of a large number of gases and strong oxidants to the formation. Hydrogen oxides of carbon and nitrogen, oxygen and water vapor, volatile acids and other gaseous products are added to hydrogen. The process proceeds with considerable self-acceleration.

At the third stage - all combustible components of HRC and COM, burn in oxygen, which is formed from nitrate and nitric acid. There is pyrolysis of the fluid and combustion of high-molecular hydrocarbons. At the same time, the pressure rises sharply, the wave phenomena of the combustion processes in the near-wellbore zone that are transmitted to the column of the borehole fluid increase and lead to the appearance of new impulses of influence. The minimum number of vibrational movements in the near-wellbore zone increases to 7 (seven).

ADVANTAGES

The positive effect of thermochemical treatments on BHFZ – (bottomhole formation zone) is explained by the following factors:

1. Evaporation of light oil fractions,
2. By reducing its viscosity,
3. Reduction of surface tension between formation fluids,
4. Thermal expansion of liquids in the formation,
5. Transition to the liquid phase of some solid deposits.

It is proved that the effect of systems forming hydrogen is not only thermal but also, primarily, chemical, and the efficiency is much higher than the thermal one.

According to the experiments, the purely thermal effect for asphalt and bitumen oil, with heavy components, is negative. High temperatures (above 473 K), obtained with ordinary heating, contribute to the formation of coke-like deposits, which clog the pores of the rock, i.e. A purely thermal (high-temperature) action does not cause cracking and pyrolysis of high molecular weight fractions of the fluid.

Thus, for thermochemical treatments, using hydrogen-forming reagents, the first place for operating parameters should be set not by its calculated calorific value, but by its gas productivity by hydrogen.

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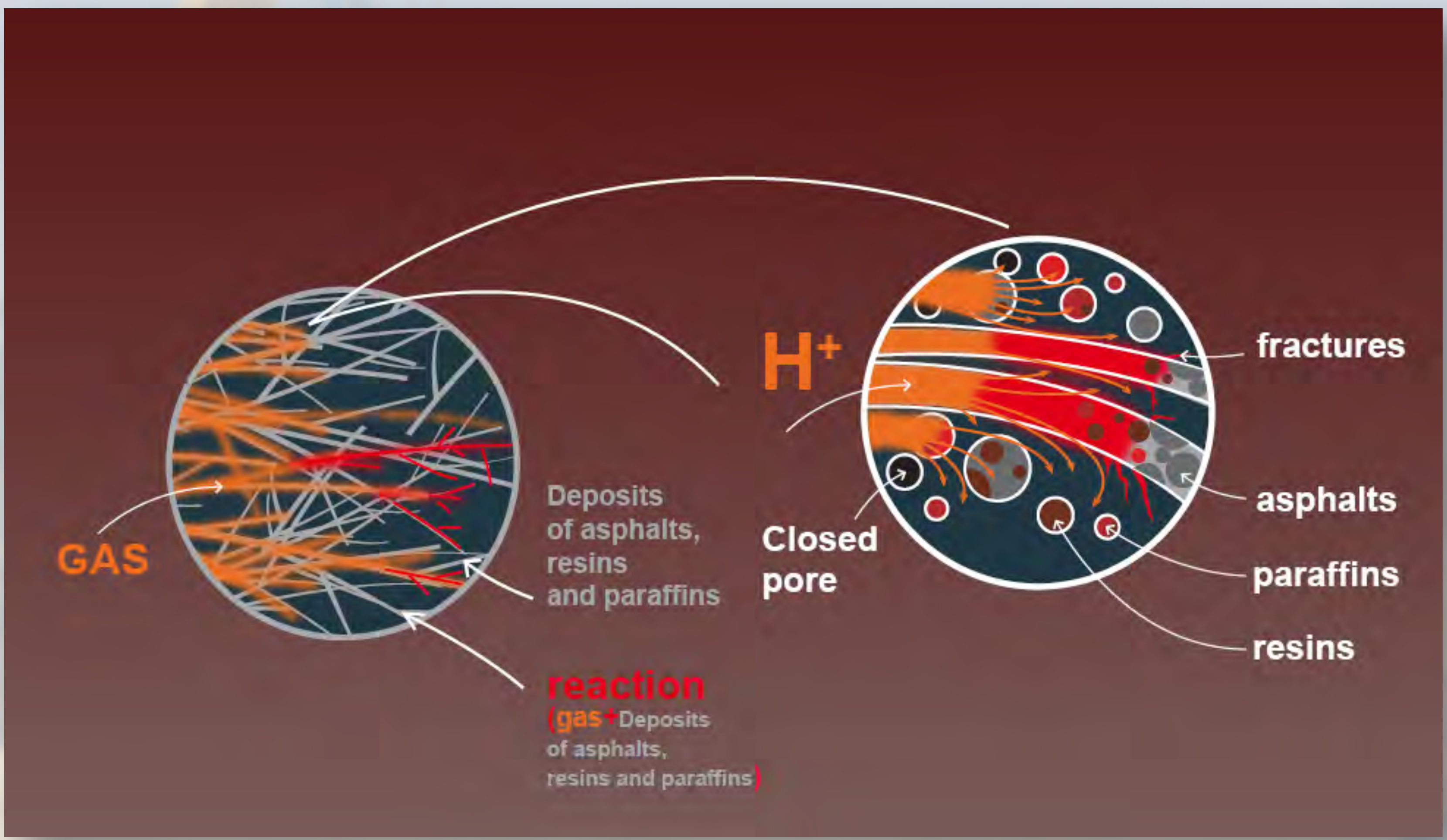
IMPACT OF HOT GASES AND REACTION INSIDE THE FORMATION



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THE CHEMICAL PROCESS

The role of hydrogen.

Hydrogen does not dissolve in oil, but reacts with other components (including paraffin), starting with the isomerization of the molecule (isomerization is also accompanied by development of gas), for example:

$$C_4H_9{-}CH_2{-}CH_2{-}CH_2{-}C_4H_9 + \underline{\mathbf{H_2}} \quad C_4H_9{-}\overset{\displaystyle C^*H_3\atop |}{C^*H}{-}C_4H_9 + \underline{\mathbf{CH_4}}$$

(Molecule of paraffin)

Isomer decomposes instantly:

$$C_4H_9{-}\overset{\displaystyle C^*H3\atop |}{C^*H}{-}C_4{}^*H_9 \qquad {-}C_4H_9 + {-}C^*H_3 + C_4H_{10} + \underline{\mathbf{C^*}}$$

Active carbon is converted into HRC and reacts with formation waters:

$$\underline{\mathbf{C^*}} + \mathbf{H_2O} = \mathbf{CO} + \underline{\mathbf{H_2{}^*}}$$

$$-C_4H_9 + H_2O = C_4H_9OH + H^+ \quad \text{(acidic medium + spirit)}$$

$$-C^*H_3 + -C^*H_3 = C_2H_6$$

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THE CHEMICAL PROCESS

Reactions in the reservoir may also go the other way, for example:

$$C_4H_9{-}CH_2{-}CH_2{-}CH_2{-}C_4H_9 + \underline{\mathbf{H_2}} \quad C_4H_9{-}\underset{}{\overset{C^*H_3}{\overset{|}{C^*H}}}{-}C_4H_9 + \underline{\mathbf{CH_4}}$$

(Molecule of paraffin)

Isomer decomposes instantly:

$$C_9H_{19}{-}\overset{C^*H3}{\overset{|}{C^*H}}{-}C_4{}^*H_9 \qquad {-}C_9H_{19} + {-}C^*H_3 + C_4H_{10} + \underline{\mathbf{C^*}}$$

$$-C_9H_{19} + -C^*H_3 = C_{10}H_{22}$$

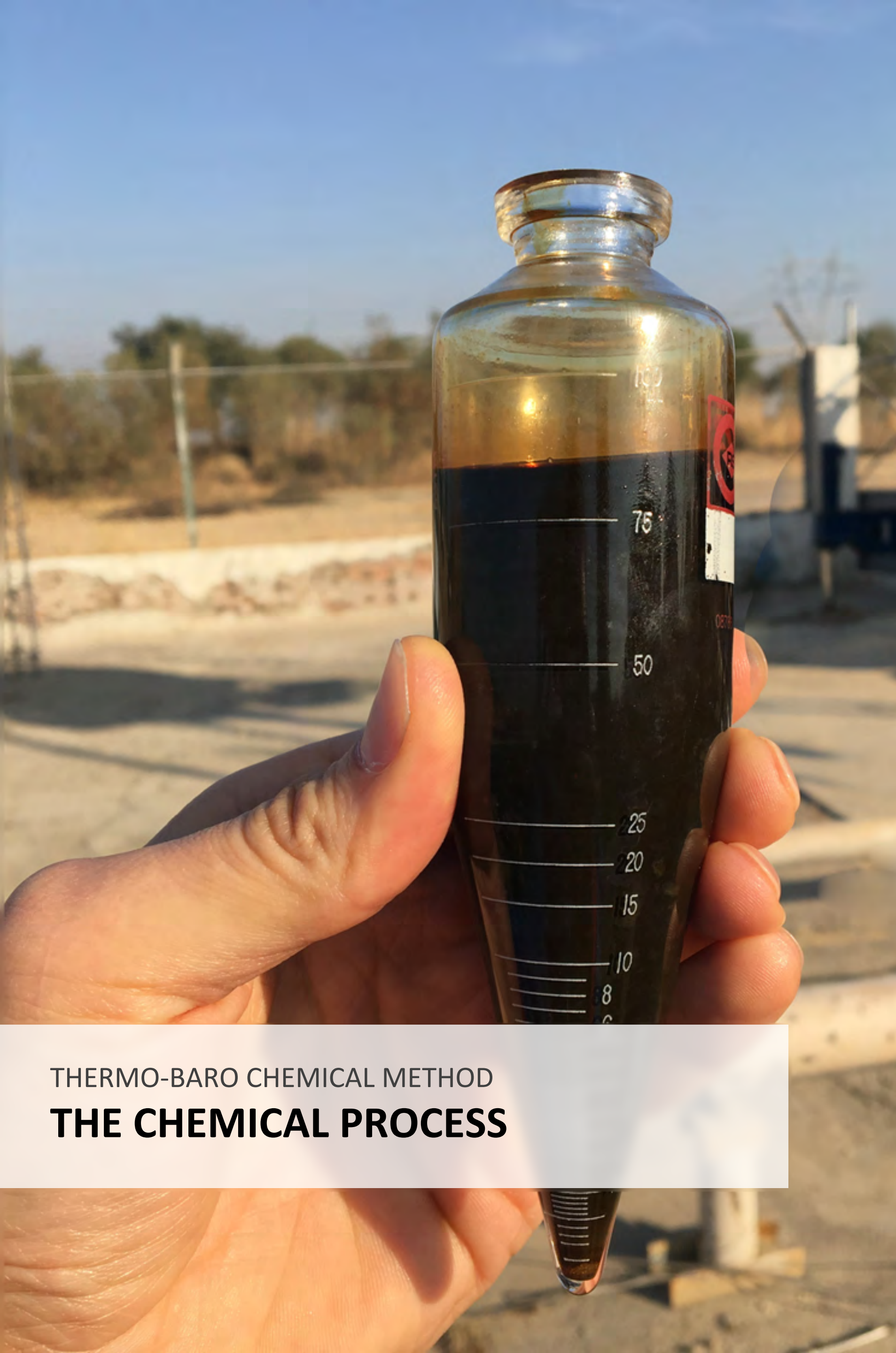
Active carbon is converted into HRC:

$$\underline{C^*} + H_2O = CO + \underline{H_2{}^*}$$

Burning with Thermo Baro Chemical impact is a three-step process and the minimum number of vibrational pulses on reservoir is six. Each pressure boost pulse is transferred to a well killing fluid, the oscillatory motion of which is fixed by the seismic device when the well is treated with TBC technology.

With the use of nitric acid and micro additives, which are the source of active combustion centers, which increase the completeness of combustion, the maximum temperature reaches 871-879 K. And the combustion front motion is accelerated to 8.7-8.9 mm / min**.**

As a result of the passage of filtration combustion, permeability on sandstone increases by 15-20 times, on denser permeable reservoirs by 20-140 times, depending on the composition and structure of the rock**.**



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THE CHEMICAL PROCESS

Moving along the front of the filtration combustion, it can be created by the thermo-chemical action of hydrogen and the flow of oxygen and other COM gases behind it.

The combustion front in the presence of boron-containing additives is accelerated to 8.7-8.9 mm / min.

It should be noted that the high-temperature zone in a radius of 1.7 m, containing 22 318 036 kJ of heat, in turn heats the surrounding rock, being the source of further initiation of the fluid (but only thermal) and its full or partial gasification. So in the warm-up zone up to 773K there is a complete "oil distillation". In the process of heat and mass transfer of the temperature, the ISC-(in situ combustion) will pass at a level of 400 degrees Celsius.

We have experimentally and practically proved the possibility of controlling the process of coke formation by changing the volatile components of HRC – (hydro-reactive compounds) in hydrogen, which opens the possibility for the organization of fluids of different viscosity and different contents of paraffin's on the deposits.

The total volume of gases with a reservoir porosity of 21% and its density of 1.26 m3, the volume of space that will occupy the gas is - 2 083 m3.

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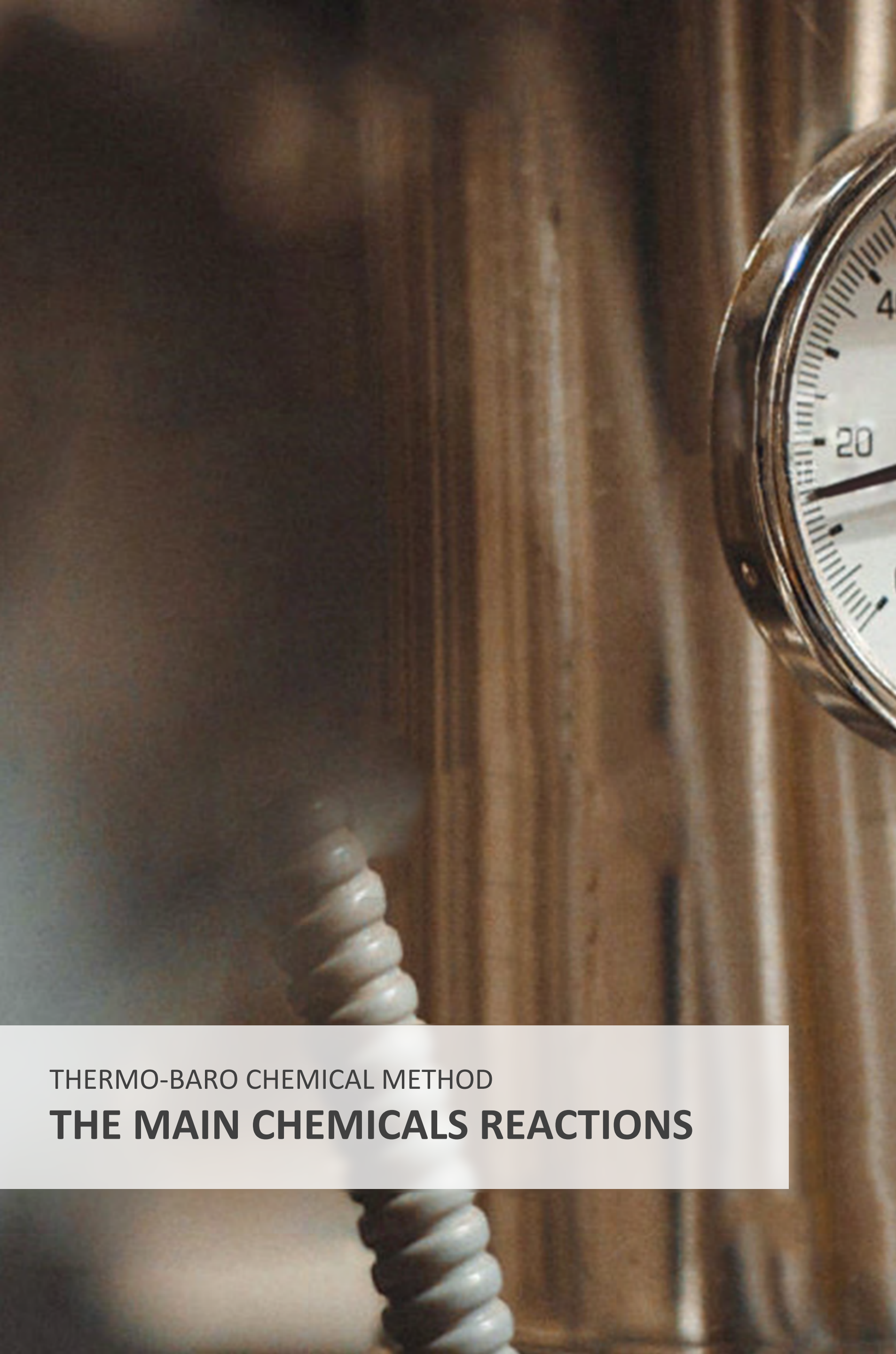

THERMO-BARO CHEMICAL METHOD

THE MAIN CHEMICALS REACTIONS

The main components of the system - the combustible-oxidizing mixture - the hydro-reactive compound (COM-HRC) in the presence of various catalysts and a controlled pH medium, can release a mixture of reactive gases according to the reaction equations, for example:

$B_6O + 8H_2O = 3B_2O_3 + 8H_2 + 41816$ кДж
$B_6O + 5H_2O = 6BO + 10H$
$2BO + H_2O = B_2O_3 + 2H$
$H + H = H_2$

$NH_4Cl = NH_3 + HCl$

Our HRC – Unique compounds. The 1 dm3 of the substance, They educe from the water from 3.81 to 5.64 m3 of hot hydrogen

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COMPARATIVE PERFORMANCE INTENSIFICATION

Intensification technology	Increase in well's output (as a result of the technology application)	Note
Heat treatment	1,1 times	Low Efficiency
Acid treatment	By 20-30% in rare cases by 70% (average index is much lower)	It is efficient only in formations with high content of carbonate inclusions
Ultrasound treatment of hole-bottom region	Insignificant increase (average 3-10%)	It is not commonly accepted Efficiency depends mostly on the cause and chemical content of contamination
Treatment by hydraulic explosion	2-3 times more efficient then acid treatment, gas recover increases 2-6 times	It is not efficient in methane wells of coal formations at considerable depths – elevated watering (natural + due to hydraulic explosion). It is exteremely complicated as far as technology is concerned.
Thermo-baro-chemical treatment	**In oil wells the output increased 1.5-7 times in gas wells the output increased from 3 up to 27 times; in gas condensate wells – increased from 3 up to 20 times; in methane wells of coal formations – 2 times.**	**It is efficient in petroleum, gas, gas condensate wells including watered, as well as in methane wells of coal formations. The technology was tested on terrigenous collectors, terrigenous with 30% of carbonate riders. Sandstones, etc.**

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IMPACTS ON WELL

All these gases influence the reservoir and the flow in different ways and the following four types of treatment can be reached:

Mode of cracking	Removal of paraffin cracking - pyrolysis of high-paraffin	Short-term in-situ burning	Mode of pre-ignition oxidation and hot acidalkali treatment
Gases are emitted in the form of four pulses for 2-3 minutes. 1. Reaction starting with the release of nitrogen. 2. GDS burning in water, 3 - STATE expansion, 4 - combustion in oxygen and nitric acid vapor) The thermodynamic potential of the system is implemented virtually all of the well casing.	Gases are emitted in the form of two pulses to form oxidized products of combustion. The basic thermodynamic potential of the system is implemented in the reservoir. It generates a gas gas - methane, ethane, propane, etc. + hydrogen. There is an assumption that the process chain and continues for several years.	Reaction smoothly run one after another, practically forming a pulse. In a medium strong oxidizing combustion in the reservoir begins with coke. The presence of coke or education determines the heat balance of the reservoir .. The critical diameter of the combustion wave in rock crevices of productive 0, 39 mm. The duration of the process depends on the amount of oxidant delivered into the well. The average duration of 48 hours.	Push system provides GOSGDS into the reservoir with liquid GDS, reacting with water in situ temperatures.

In practice, the most commonly used version is a combination of all four types of treatment (as the result, we receive the mixture of all the above gases) with the injection (pushing) of the condensed oxidation products (alkaline) from the casing into the reservoir.

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CONDUCTING EXPERIMENTAL INDUSTRIAL WORKS

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CONDUCTING EXPERIMENTAL INDUSTRIAL WORKS INCLUDES THE USE OF THE FOLLOWING TECHNIQUES AND DEVICES:

- Checked for tightness of the shut-off valves of the injection and suction lines;
- Coiled Tubing, with all the equipment necessary for workover of wells;
- A reservoir with a killing fluid,
- A container for solutions that are collected after treatment and washing of wells of appropriate volume;
- Source of electricity.

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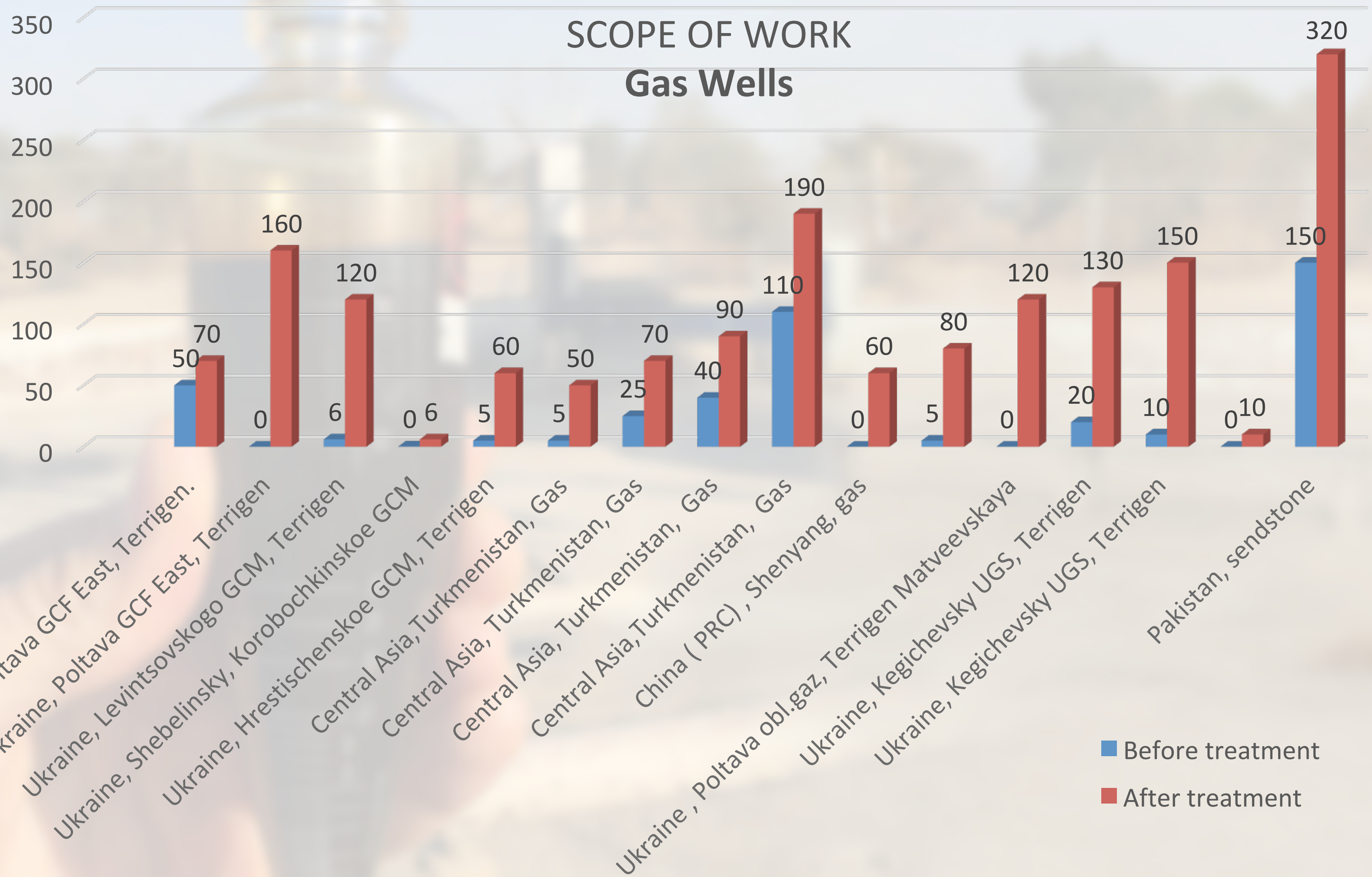
CONDUCTING EXPERIMENTAL INDUSTRIAL WORKS

Examples of work carried out according to the TBC method



CONDUCTING EXPERIMENTAL INDUSTRIAL WORKS

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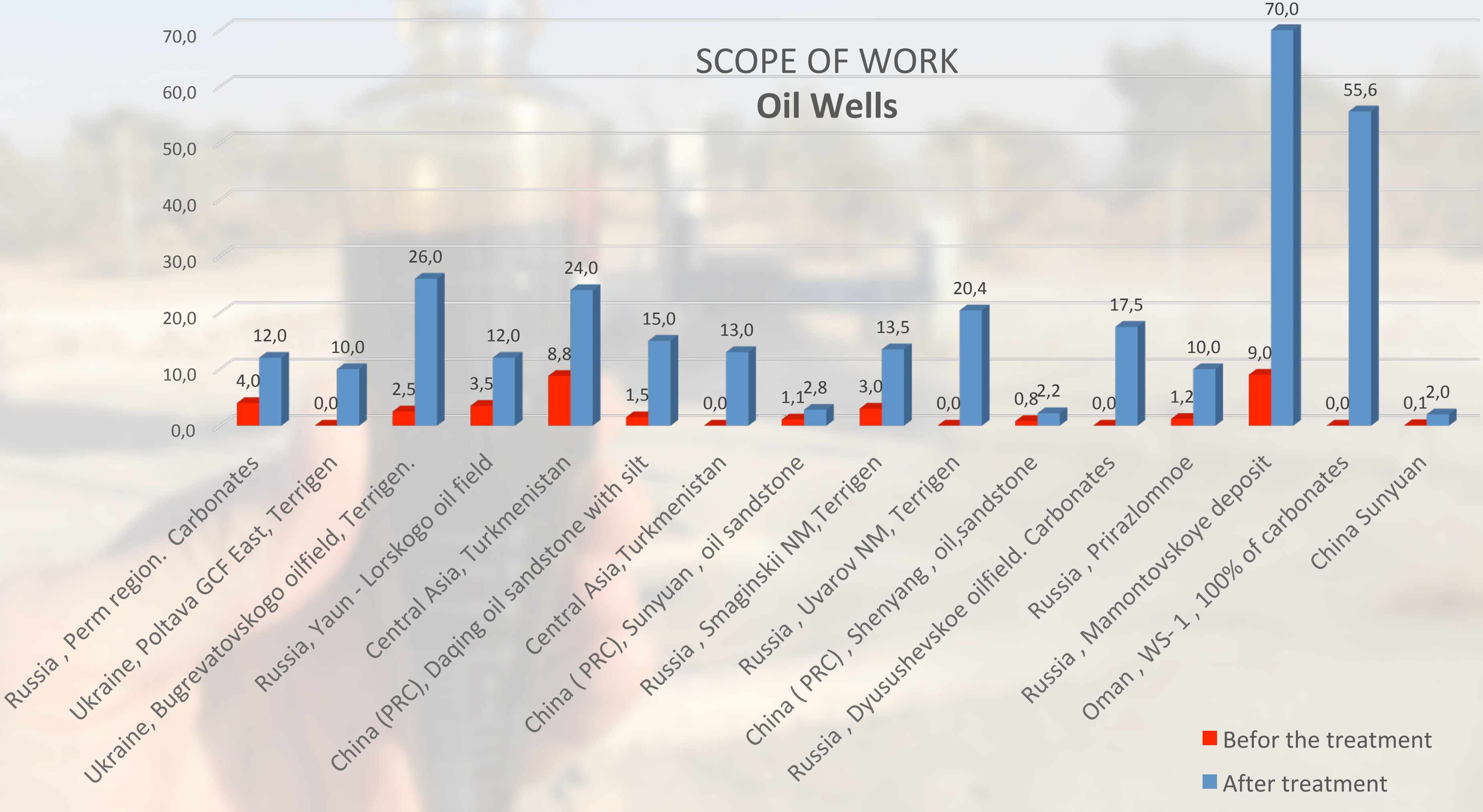

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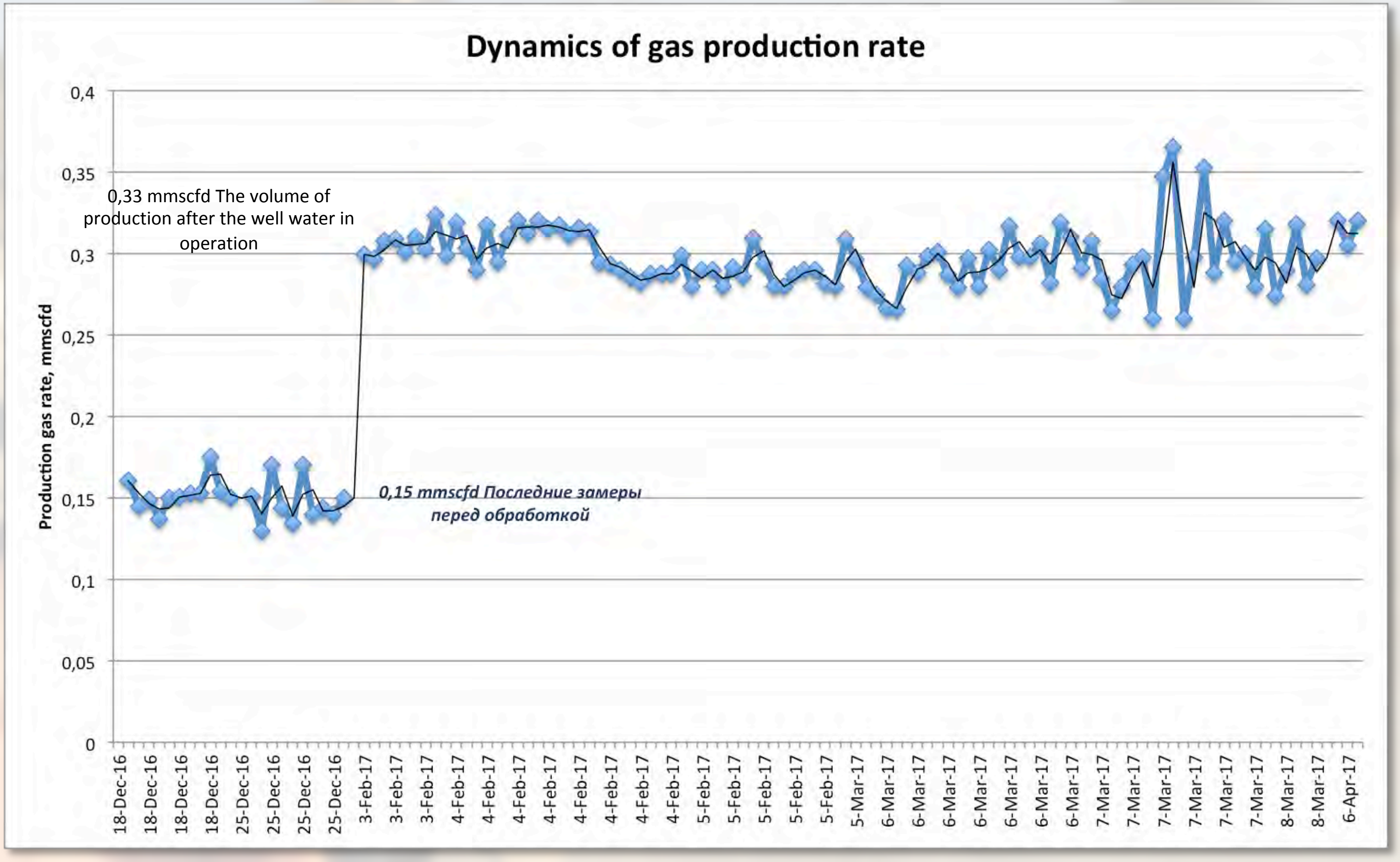
DIAGRAM

Examples of work carried out according to the TBC method

Dynamics of hydrocarbon production after application of a thermo-bar chemical effect on the productive horizon.



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HSE

- Worldwide track records prove no negative environmental effects;
- No damages or accidents;
- All Chemicals are non-hazardous, eco-friendly and can be applied with bare hands.
- Chemistry meets the requirements of the international standard MSDS, ISSO 29001: 2010

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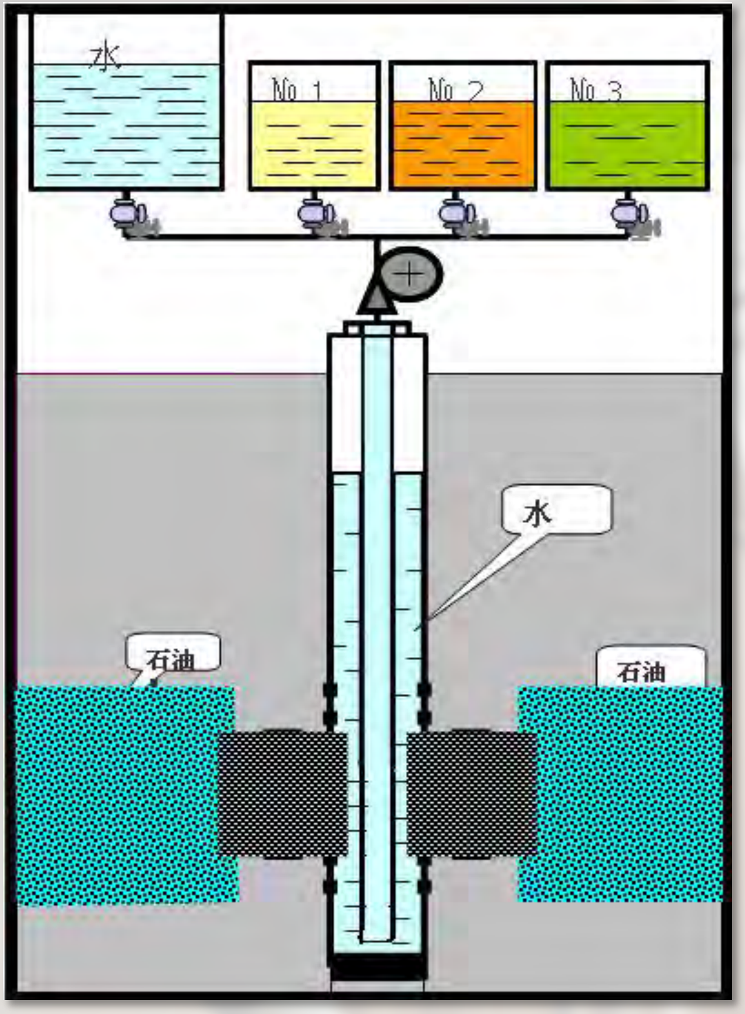
THERMO-BARO CHEMICAL IMPACT



STAGE 1

- Kill the well by technical water
- RIH Coiled Tubing to the bottom hole
- Pump in Mixture No.1 keeping the annular space open.

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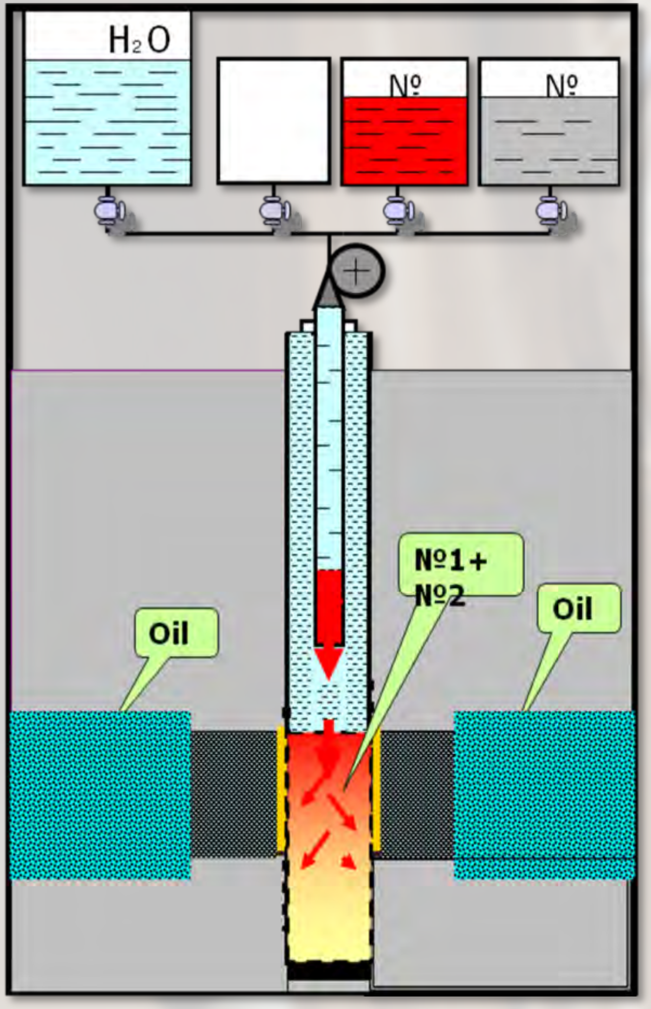
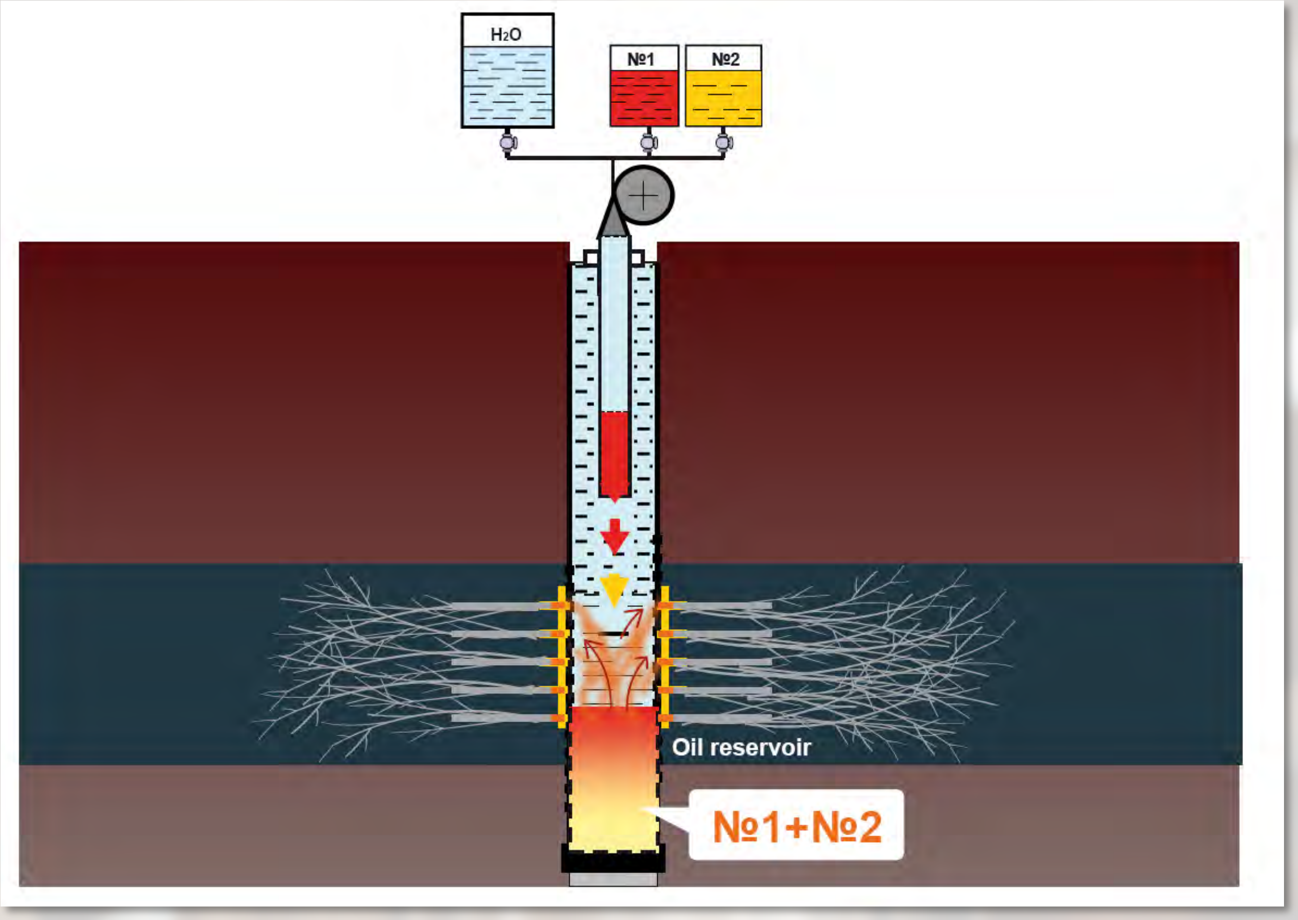


STAGE 2

- POOH Coiled tubing on 20 m above the uppermost holes of the perforated zone.
- Pump in Mixture No.2, (hydro-reactive compositions (HRC) and combustible oxidizing mixtures (COM) in a flushing solution) till its spilling from the tubing;
- Reaction starts & temperature in the production string rises up to 300 degrees Celsius.
- Pressure within the hole remains hydrostatic .

THERMO-BARO CHEMICAL IMPACT

SAMPLE OF CHEMICAL REACTION IN THE BOTTOM HOLE ZONE IN THE WELL



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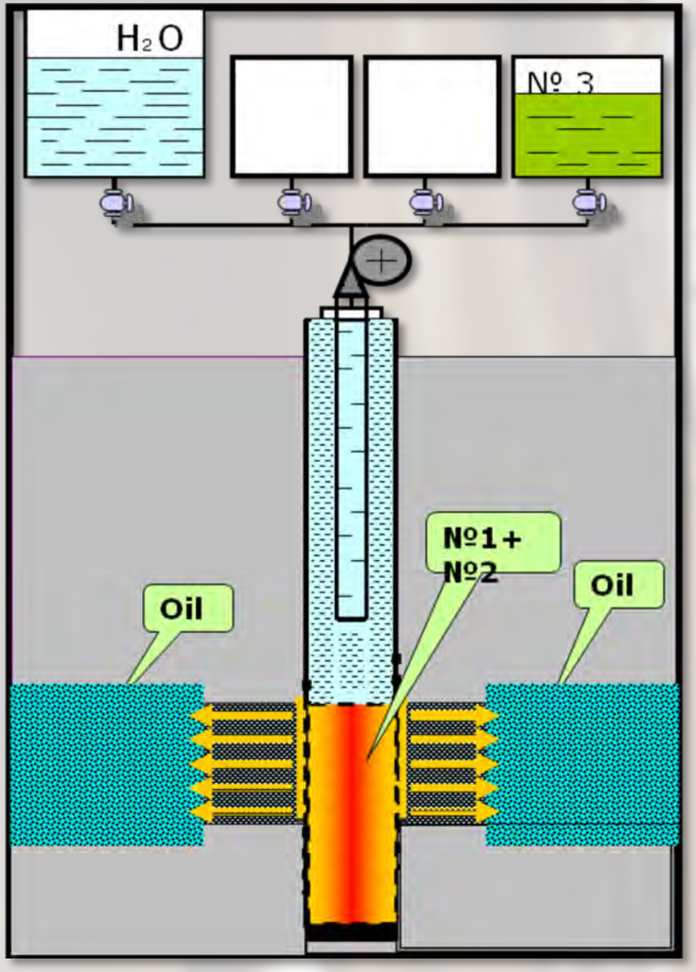
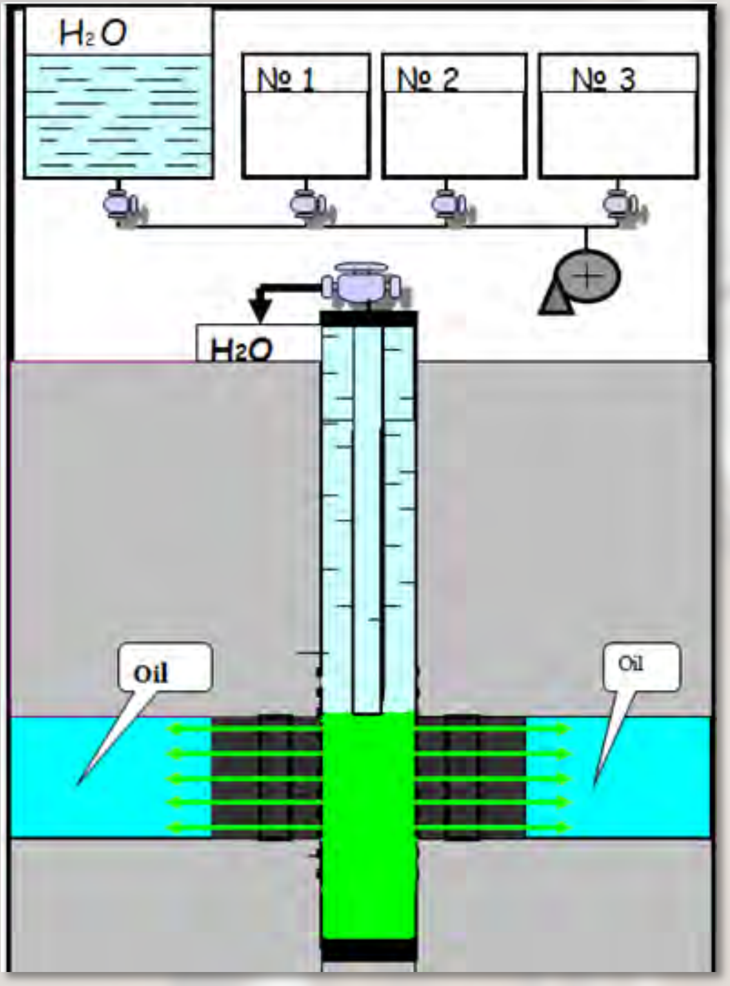


STAGE 3

- Leave the well for 12 hours (to allow time for chemical reaction and heat transfer to take place).
- Close the annular space and inject the reaction products into the subject layer. RIH the coil tubing to the uppermost holes of the perforation zone.

THERMO-BARO CHEMICAL IMPACT



STAGE 4

- RIH the Coiled tubing to the upper- most holes of the perforation zone.
- Close the annular space.
- Pump-in Mixture 3 into the formation to neutralize & remove the resultant chemical products formed

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THANK YOU FOR YOUR ATTANTION

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