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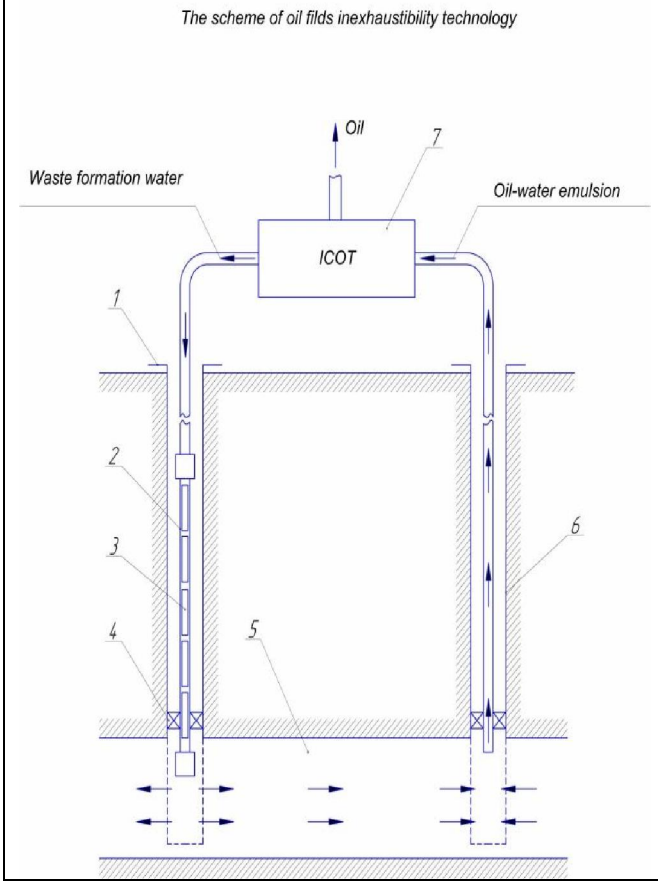
Method of recoverable oil increasing (MROI) due to activation of natural nanocatalysts in oil-field waters using a flow chemical reactor (FCR) on the bottom-well

Appointment:

Increasing in oil and gas recovery of flooded fields due to activation of natural nanocatalysts in oil-field waters and production of synthetic gas by a cassette flow chemical reactor (FCR) at the bottom of injection wells.

Schematic diagram of MROI with FCR using



On the scheme:

1. Injection well;
2. Suspension of FCP (force-compressor pipe);
3. A cassette FCR (flow chemical reactor - hydrodynamic plasmatron);
4. Packer ;
5. Oil reservoir*;
6. Flow string;
7. Installation for complex oil treatment on a deposit.

*Oil reservoir - basic (natural) catalytic chemical reactor with advanced metaphase boundaries at high static pressure, sufficient temperature and energy effect on a layer of Earth's electric and magnetic field.

Introduction.

At present the priority direction of oil stock addition in the world oil industry is development and commercial application of modern integrated methods of recoverable oil increasing (MROI) which are capable to provide a synergistic effect in development of new and producing oil fields.

In this connection, prospects of an increasing share of hard-to-extract reserves in Russia are connected with termogaz MROI.

World experience testifies that demand for modern MROI is growing; their increase potential of recoverable reserves is impressive. The cost of oil production with using of modern MROI in process of their development and improvement decreases and becomes quite comparable to the cost of oil produced by traditional methods.

One of the most similar methods of recoverable oil increasing is the method of thermogaz effect (TGE).

TGE was proposed for the first time in 1971 in "VNIIneft". The method is based on the injection of air into the reservoir and its transformation into effective displacing agents due to the low-temperature intraformational oxidation processes.

As a result of low-temperature oxidation reactions directly in the reservoir a highly efficient gas agent containing nitrogen, carbon dioxide and natural gas liquids is produced. The high efficiency is achieved due to the implementation of a full or partial miscible displacement.

Advantages of the method – using of low-cost agent, substantial increase in oil recovery **(under actual projects the increase in oil recovery up to 60% or more is fixed):**

- injection of air and its transformation into effective displacing agents (carbon dioxide, light hydrocarbons) due to intraformational oxidation and thermodynamic processes;
- using of the natural energy of formation - high reservoir temperature (above 60-70° C) for spontaneous initiation of intraformational oxidation process and formation of high-displacing agent;
- active spontaneous oxidation processes can take place at lower temperatures, as the real layers contain catalysts (CuO, MnO2, Cr2O3, NiO, CoO, etc.);
- Fast initiation of active intraformational oxidation process is one of the most important consequences of reservoir energy using. The intensity of oxidation reactions increases quickly enough with growing of temperature and pressure.

In 2007 ÷ 2011 a great volume of bench research and development works on a test borehole on activation of natural formation (salt) water on the oil fields of RT was performed by a number of research teams of the Republic of Tatarstan. The purpose of this research was intensification of oxidation processes by effecting upon natural (formation) catalysts in the flow chemical and electrochemical reactors.

During researches the scientific basis of processes occurring in FCR, technical and technological parameters of flow chemical reactors, conditions of their application in the wells have been developed.

Principle of operation of the cassette flow chemical reactor (FCR)

While pumping the formation water containing natural (Fe_2O_3 CuO, MnO_2, Cr_2O_3, NiO, CoO, etc.), the energy processes of catalysts activation is occurring. The catalysts release free H_2 from formation (salt) water and combine it into metal-hydride compound (MeH), and also metal-carbon compounds (MeC) are formed. As a result a colloidal solution is formed (three-phase fluid: liquid, gas and solid phase), representing a chemical accumulator – nanoreactor of hydrogen and hydrocarbon gases.

Type of the chemical reaction in FCR - mechanochemical reactions occuring in a double electric layer on the surface of catalysts.

While processing water-cut oil and water containing highly mineralized formation waters under the influence of natural and being generated metal-carbon catalysts the intensive non-equilibrium processes occur on the surface of the nanoparticles, where the electric field can reach $10^8 \div 10^{11}$ v/m, which can lead to lots of various chain reactions of hydrocarbon synthesis, plasma-catalytic processes of substances synthesis.

In the presented technology of recoverable oil and gas increasing the FCR is a primary bottom-hole reactor and the reservoir - a secondary natural chemical reactor with its own energy: electric and magnetic fields of the earth, seismic waves effecting upon a reservoir as on a flow piezoelectric generator - chemical reactor with highly developed surface, in which reactions at high static pressure and sufficient temperature take place.

FCR simultaneously functions as a bottom-hole heat-generator that defines the given technology as a method of heat-water-gas influence on a layer.

The synthesis gas is a mixture of gases, the main components of which are CO and H_2, depending on the method of producing the ratio CO: H_2 ranging from 1:1 up to 1:3. The term "synthesis gas" is historically associated with the synthesis of Fischer-Tropsch. Currently, synthesis

gas is produced by conversion of natural gas or petroleum products (from light petroleum to oil leavings) and coal gasification.

The concept "synthetic gas" under this project means a mixture of synthetically generated hydrocarbon gases with a large percentage of carbon dioxide.

For generation of synthetic gas water-oil emulsion is used (formation saline water containing 60 - 80 mg of oil per 1 ton of formation water).

To split water into hydrogen and oxygen with minimal power input using the energy of chemical bonds in a molecule of water a cassette flow chemical reactor (FCR) is installed into suspension of pump-compressor pipe.

Released oxygen is bonded by oil carbon, forming carbon dioxide. Any oil is primarily a source of carbon.

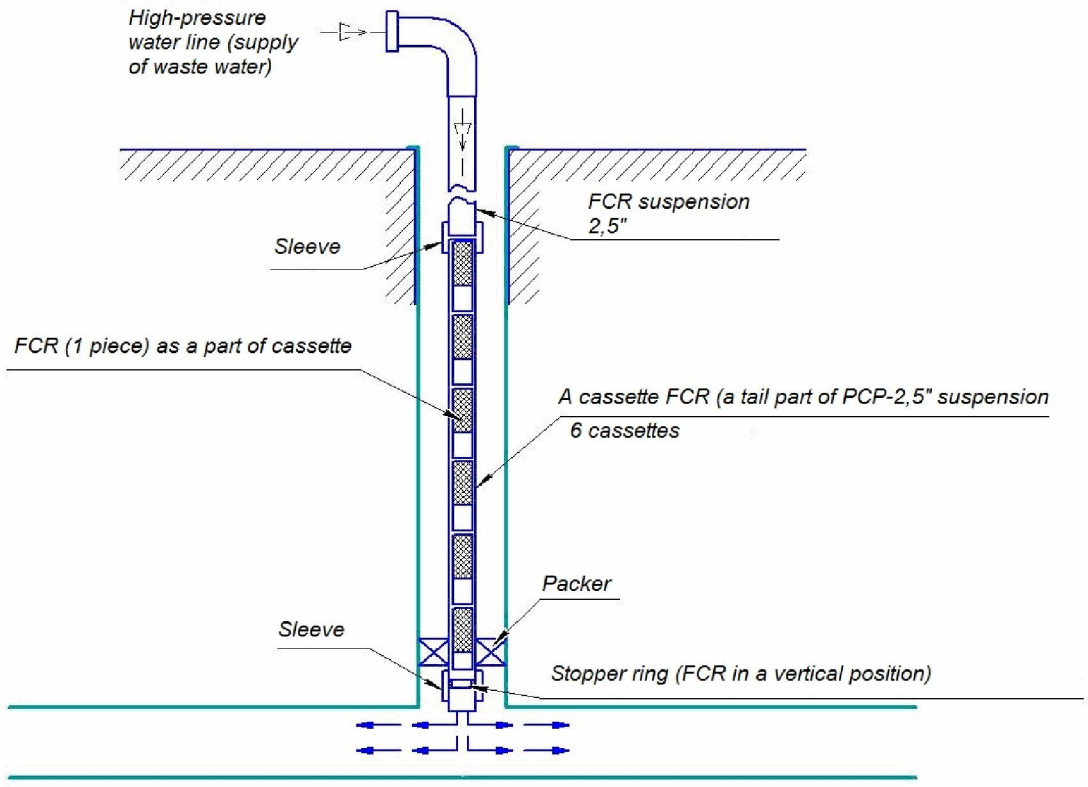
Released hydrogen is a part of generated hydrocarbon gases. The reaction product - a synthetic gas (similar to petroleum gas with a large percentage of carbon dioxide).

Technology essence:

Based on the initial geological and geophysical data the scheme of water injection into the oil reservoir (location of injection and production wells), operating practices and injecting conditions, control methods of recoverable oil and gas.

In injection wells **into the suspension of a pump-compressor pipe a cassette flow chemical reactor (FCR) is built in, Fig. 1, Enclosure 1**.

Technological scheme of a cassette FCR using at the bottom of the injection well



Note: 1. FCR (60 pcs.) and stopper ring (4 pcs.) are produced and supplied by "EcoEnergoMash" Co Ltd.
2. The works on the well are carried out by WWO brigade.

Main directions of FCR use

1. FCR is used to increase recoverable oil and gas, especially at the late stage of development of oil and gas deposits, of highly watered oil, high-viscous and heavy oil. **In prospect the suggested technology for the oil industry will allow to reanimate old unprofitable watered oil fields.**
2. Generation of hydrogen in underground saline formation waters (such layers are available in all countries at different depth underground) for using in an autonomous heat and power engineering, as well as as fuel on transport;
3. Production of carbohydrate fuel (CHF) from waste gas of heating boilers for pollution-free carbon closed-cycle;
4. Production of synthesis gas from carbohydrate fuel directly in the boiler furnace;
5. Recycling carbon dioxide from any source with subsequent production of synthetic liquid fuels (SLF);
6. Production of petroleum products from crude oil by hydrogenation process (increasing the yield of light oil products);
7. Extraction of precious and rare-earth metals from waste water of chemical plants, underground formation water, with further increase in weight and transmutation of extracted metals;
8. MOST IMPORTANT! **Production of synthetic oil in underground reservoirs of salt water due to use of earth energy** (similar layers are available everywhere at depth of 800 meters and more, that defines technical and technological possibility of organisation of highly profitable production of synthetic oil in any country).

Offer on cooperation

To all interested oil companies we offer cooperation in joint production of flow chemical reactors (FCR) for implementation of the technology of heat-water-gas influence on a layer.

Advantages in comparison with competitors:

Competitors on the offered technology are not known because of exclusive world novelty of the development.

Assembly and installation of the cassette flow chemical reactor (FCR) into pump-compressor pipe (PCP) for lowering as a tail part of a suspension on a bottom of injection well

Photo 1. A stopper ring for fixing 15 FCR in vertical position inside PCP

Photo 2. Filling the stopper ring into the sleeve of PCP

Photo 3. Filling the FCR (in number of 15 pieces) into PCP 2,5" (1 generated cassette)

Photo 4. The moment of the cassette FCR lowering into the injection well as a part of PCP suspension