Die Berechnung wurde für zwei Varianten durchgeführt:

1. Die Einführung des Benzols in den ersten Rohrstummel und des Katalysators in den zweiten;
2. Die Einführung des Katalysators in den ersten Rohrstummel und des Benzols in den zweiten.

Aus der Abb. 1 ist es sichtbar, dass die erste Variante bevorzugter ist, da die Konzentrationsdispersion in diesem Fall am wenigsten während der ganzen Berechnung ist und sie schon in 0,26 Sek. konstant wird. Für die zweite Variante wird die Dispersionsbedeutung nur in 0,87 Sek. konstant.

Anhand gefundener Ergebnisse werden die Empfehlungen zur Rekonstruktion der industriellen Alkylierungsanlagen mittels der Optimierung von Reagenzabgabe in den Apparat erarbeitet.

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CHOOSING OF OPTIMUM TECHNOLOGY OF DEVELOPMENT FIELD C PK LAYERS, CONTAINING HIGH-VISCOSITY OIL WITH BOTTOM WATER AND GAS CAP

Y.S. Berezovskiy, P.Y. Gusev
Scientific adviser professor S.M. Slobodyan
National Research Tomsk Polytechnic University, Tomsk, Russia

At present the problem of development of layers with hardly removable oil is more and more actual. The purpose of this work is the analysis of world experience of development of high viscosity reservoir to choice group of methods, which may be perspective for development of high-viscosity oil field, which contain gas cap and bottom water.

From fields-analog (Russkoe, Van-eganskoe, Severo-komsomolskoe, Viking kinsella Wainwright B) group of methods are chosen (Fig. 1).

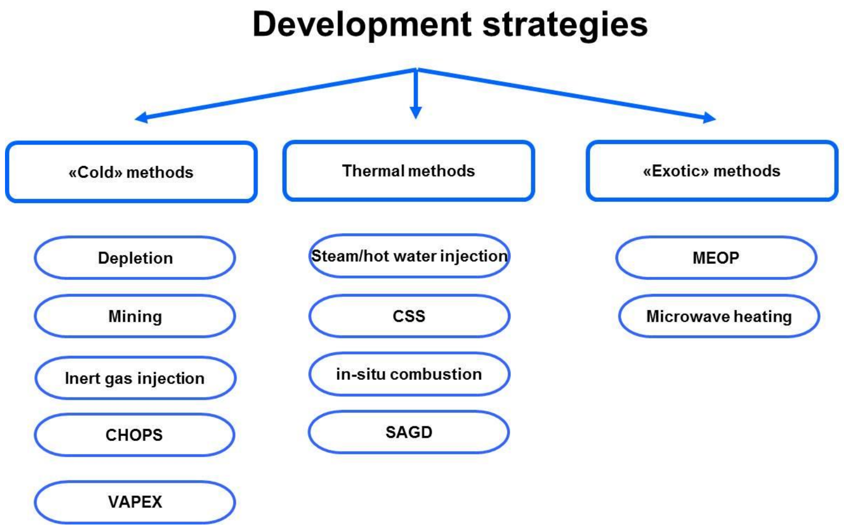

Fig. 1. The most suitable technology

After analytical screening three methods are chosen: Vapor Extraction Process – VAPEX, Steam assisted gravity drainage (SAGD), Microwave heating. [2], [3]

Vapor Extraction Process – VAPEX

For these methods two horizontal wells are drilled (one over another,). In upper well solvent are injected, oil viscosity are reduced and oil drain in lower well (solvent is light gas or special fluids, that reduced viscosity). Vapex is cheaper than thermal method, tolerant to bottom water and gas cap and allow achieving high final recovery efficiency. Despite some disadvantages (low oil production rate, need oil refining) it can be potentially efficient for this field.

Steam assisted gravity drainage (SAGD)

This method includes drilling two horizontal wells one over another (as VAPEX). During few month steam is injected in both wells (next only in upper), steam due-to less density flow up, oil flow down (oil viscosity reduced due-to thermal contact), steam chamber is created. Then it achieved top of reservoir, it extends sideway.

This method have problems in inhomogeneous reservoir, however it may be reduced by using JAGD technology: drilling J-shape well to connect separated layers (in inhomogeneous reservoir). In addition JAGD technology reduces effect of steam condensation of bottom water.

For thin reservoir with bottom water and gas cap combination of JAGD and VAPEX technology may be more attractive. [5]

Microwave heating

High-frequency electromagnetic heating of near-wellbore zone reduce oil viscosity in near wellbore zone (until 10 meters) (Fig. 2) [4]

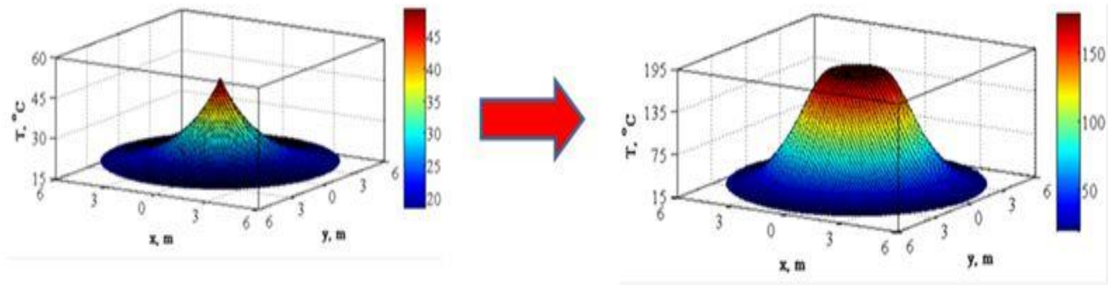

Fig. 2. Effect of solvent injection

Microbial enhanced Oil Recovery has advantages:

- No thermal losses
- Applicable in field with bottom water and gas cap
- Deep invasion

And despite some disadvantages (low effect without solvent injection, substandard equipment, lack of laboratory researches), it can be effective in this field and will be analyzed in next section. [1]

Calculations

For economic calculation synthetic geological and simulation model was created of 500 by 500 by 40 m in size about quantity of cells - 25 000. Microwave expenditures (Table 1).

Table 1

Microwave expenditures

Expenditures	Cost, mln rub
HF-generator: AKIP-3201A/8	7,0
Additional equipment	6,0
Equipment replacement (every 5 years)	10,2
Electrical OPEX	1/10 from production

From Table 2 it is visible that microwave horizontal case has maximum FOE and NPV value and only it has positive. economics. Hence this results seems perspective, however it may be very optimistic – some uncertainties (oil composition, laboratory researches, more precision estimation of viscosity reduction, more corrected simulation – when the necessary information will be available on hand – this method may be analyzed by changing flow equation in PROPS section, from PVTi model) and problems (technical – horizontal well has high length, equipment breakage, properties of rock, compatibility of solvent) may reduce effect.

Thus, this technique can be applied, however after carrying out necessary researches, more correct modeling, and also after pilot tests as it has the highest risks.

Table 2

Results of model calculation

Parametr	Base horizontal	SAGD	Microwave horizontal
Total oil produced	25,1	29,6	42,9
FOE	0,040	0,048	0,069
NPV	-5	-280	54

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COMPARISON BETWEEN MATHEMATICAL MODELS USED FOR CALCULATIONS OF DIESEL FUEL FRACTIONS CETANE INDEXES

I.A. Bogdanov, A.A. Altynov
Scientific advisor assistant teacher M.V. Kirgina
National Research Tomsk Polytechnic University, Tomsk, Russia

Nowadays, the main purpose of the Russian Federation energy policy is to use natural resources more efficient for sustainable economic growth, for improvement of the life quality of the population and strengthening foreign economic positions.

Diesel fuel is ranked third after oil and gas in the structure of Russian exports. According to the Energy strategy in Russia, until the 2030 year production volumes of diesel fuel should be more than 110 million tons per year [1]. However, despite the annual increase in the consumption of diesel fuel, the most industrialized countries devote increased attention to the quality of diesel fuels and supports efforts to reduce emissions.

Thus, improvement the quality of produced diesel fuels is an important task nowadays. Basic properties of diesel fuels produced in Russia are governed by three basic standards: USS 305-82, USS R 52368-2005 and Technical Regulations of the Customs Union "Requirements for automobile and aviation gasoline, diesel and marine fuel, jet fuel and heating oil". The most stringently controlled key indicators for diesel fuels are: cetane number, flash point, density, kinematic viscosity and low temperature properties (cloud point, cold filter plugging point, pour point), and others.

Experimental determination of cetane index is a multi-step and time-consuming process, as it requires certain skills, special equipment, as well as time and money. That is why the development of new methods and take the most accurate one for cetane index determination is a crucial task [2].

During the study, on the basis of the experimental data obtained from the operation units at the petroleum refinery in Western Siberia, cetane indexes for diesel fuels components were calculated. The calculation was carried out based on the international standard ISO 4264, in which the calculations of cetane index are described by the following formula:

$$\begin{gathered} CI = 45.2 + 0.0892 \cdot T_{10N} + (0.131 + 0.901B) \cdot T_{50N} + \\ +(0.0523 - 0.42B) \cdot T_{90N} + [0.00049 \cdot (T_{10N}^2 - T_{90N}^2)] + 107B + 60B^2; \\ T_{10N} = T_{10\%} - 215;\ T_{50N} = T_{50\%} - 260;\ T_{90N} = T_{90\%} - 310; \\ B = [\exp(-0.0035 \cdot D_N)] - 1;\ D_N = D - 850. \end{gathered} \tag{1}$$

CI – cetane index, points; $T_{10\%}$, $T_{50\%}$, $T_{90\%}$ – boiling point of 10%, 50%, 90% fraction, ºC; *D* – fraction density at 15 ºC, kg/cm^3.

Also, calculations were carried out according to the method presented in the USS 27768-88:

$$CI = 454.74 - 1641.416 \cdot \rho_4^{15} + 774.74 \cdot (\rho_4^{15})^2 - 0.554 \cdot t + 97.803 \cdot (\lg t)^2 \tag{2}$$

ρ_4^{15} – fraction density at 15ºC, kg/cm^3; *t* –boiling point of 50% fraction, ºC.

The calculation results of cetane index according to the ISO 4264 (CI_{ISO}), and USS 27768-88 (CI_{USS}) are presented in Table; the calculation results were compared with the experimentally determined cetane index (CI_{EX}).

Table

Comparison between the experimental and calculated cetane index for diesel fuel fractions

No.	$T_{10\%}$	$T_{50\%}$	$T_{90\%}$	Density at 15 ºC	CI_{EX}	CI_{ISO}	CI_{USS}	Δ_{ISO}	Δ_{USS}
	ºC			kg/cm^3					
Straight-run diesel fraction “Winter”									
1	200	234	275	827	46.8	46.795	46.506	0.005	0.294
2	197	235	279	830.6	45.5	45.532	45.525	0.032	0.025
3	205	238	287	832.7	46.3	46.291	45.680	0.008	0.619
average error								***0.015***	***0.313***
Straight-run diesel fraction “Summer”									
1	277	320	356	866.5	54.1	54.078	50.655	0.022	3.445