APPLICATION of WATER-PROOFING COMPOUNDS AS a PROMISING WAY of OIL PRODUCTION ENHANCEMENT

There exists a problem at many oil fields with a significant portion of oil reserves where more than a half of fund wells are working below their potential.

Among the major negative events in the development of oil and gas industry experts note the continuing fall in oil production. The cause is man-made factor of high water saturation of bottom-hole formation zones (BHFZ). Increased water saturation near bottomhole zone reduces the permeability of oil in this zone and restricts flow of oil from the formation into the wellbore.

The proposed solution.

One of the ways to reduce water cut of oil wells and increase their productivity is a technology based on hydrophobizing(water-proofing) of borehole zone wells.

Changes in the rock wettability of bottom-hole formation zones (BHFZ) causes a change in the nature of fluid flow in the area and a change in the direction of capillary forces, so that capillary forces prevent effective water filtration and, conversely, promote oil filtration. Though there exist some theoretical contradictions in interpretation of capillary action of hydrophobized rocks in the bottom hole formation zone and in spite of criticism of the hydrophobic technology the effect of reducing water cut is a surely established fact.

So it remains a promising direction in oil industry to search efficient technologies of hydrophobization of bottom-hole formation zones, as well as water-proofing compositions.

As chemical reagents water-proofing compositions pumped-in can either weakly interact with a rock surface or form with it rather strong chemical or adsorptive bonds. Water-proofing compounds that interact chemically with the rock surface silanol groups or such that are specifically adsorbed on it for an extended period belong to the last and most important group. For this purpose nanodispersed water-proofing silicas, organosilicon compounds and other surfactants may be applied to the composition.

While operating the wells bottom-hole formation zone is exposed to water and zone of high water saturation is formed near the wells in the formation. Film of loosely bound water appears on the surface and reduces the pore volume of the formation.

When water saturation grows water permeability increases also causing oil permeability decrease because of capillary strength and loosely-bound water blockage of the bottom hole formation zone.

When water-proofing compounds are pumped in, loosely-bound water film is

destroyed, pushed out of formation zone resulting in its draining. Rehydration is not possible as far as the water-proofing agent is fixed on the rock surface.

Water saturation of hydrophobized sections decreases causing increase for oil permeability. As far as water-proofing agents are not able to change the pore structure this effect can be explained only by decrease of water saturation owing to interaction of hydrophobizator functional group with sylanol groups of rock surface with water. It results in extrusion of weakly linked water out of rock surface and enhances oil flow into the well. Therefore water-proofing of oil layers should promote an enhancement of oil production. It has been proved by results of treating wells with water-proofing compounds. After that oil flow rate has been increased while water flow has been reduced. In order to obtain significant decrease of water influx it is necessary to use plugging agents in water-bearing intervals. Or water-proofing compounds should have polyfunctional effects such as water-repelling properties and plugging effect when there is excess of water.

The task is to choose manageable physicochemical interaction of process fluids and rock mass. The main cause of complications is active hydrodynamic connection of well with openable complex permeable rocks. It defines the task as a need to combine process of opening the permeable rocks with water-proofing.

Effective waterproofing of a trunk is obtained by combination of drilling and wellbore mudding. The task can be solved by means of hydrophobic nanosized silica in drill fluids.

When hydrophobic nanosized silica is present in clay drilling mud it considerably reduces clay swelling degree and the rate of capillary suction fluid. Physicochemical properties of hydrophobic nanosized silica are shown in the table.

These are several brands of highly hydrophobic nanosized silica powders that have main following properties:

№	***Properties***	*Silica brand*				
		АМ-1-3 00	**АМС**	**МАС-200-**	**АМД-1**	**К-7-30**
1	Appearance	White powder(Б/П	Б/П	Б/П	Б/П	Б/П
2	Packed density, g/dm3	35	40-60	40-45	45-120	25-45
3	Hydrophobity, %	99	99,8	90	98	99,2
4	pH value (pH aqueous slurry)	3,6	4,5-5,0	3,6	4,0-7,0	3,6-4,3
5	Specific surface area, m2/g	Up to 300	Up to 300	Up to 300	Up to 300	Up to 300
6	Particle size, nm	5-25	5-25	5-25	5-25	5-25
7	Concentration=Si-CH3, millimole/g	0,6	К3	-	-	0,5
8	Concentration =Si-OH. millimole/g	~0,05	no	-	-	-

Water-proofing compounds are polymeric plugging materials with varying polymeric degrees of organoelement compounds with ***atkoksi- and alkoksiatkil алкоксилат*** groups meant for soil consolidation and waterproofing in wells with temperature from 10 to 120 ° C and above.

The following table shows information on polymeric plugging water-proofing compound:

Compound properties	***Value of the index***
Density, g/cm3	1,0- 1,2
Dynamic viscosity , MPa/s	1-10
The freezing point °C	-50
The volume fraction of the precipitate after dilution with water , 1:3,%	Not more than 7
Gel performance at t = 75 °C and dilution with water 1: 3, h	1,3-5

- Summary
- Application of waterproofing compositions should be considered an effective way of enhancing oil production.
- Well treatment with waterproofing agents reduces water saturation of oil-bearing zone and increases its oil permeability.
- Use of polyfunctional waterproofing compositions allows to reduce water cut as a consequence of colmatage (mudding effect) in water-saturated intervals.