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THE ANALYSIS OF THE CONDITION OF WATER INSULATING WORKS ON FAMENNIAN SUBLEVEL WELLS AND ZAVOLZHYE SUPRAHORIZON WITH USE OF STATISTICAL TOOLS

The question of the analysis of a condition of water insulating works on the layers of a Famennian sublevel and Zavolzhye suprahorizon is considered in the article. The method of main a components (for grouping) and the regression analysis were used for a forecast of works productivity of additional oil production and duration of effect from influence. Models are received and recommendations are made.

Keywords: analysis, water insulating works, dependence, grouping, components, factors

Necessity of the qualitative analysis of a condition of works on water inflow restriction is an integral part at the subsequent forecasts of again offered objects under influence. Dfam and Dzav layers, in which homogeneous groups of wells are allocated, are considered in work. Analyzed layers, after allocation of homogeneous sets of wells, were divided into 8 groups of objects.

Geological-physical properties of analyzed objects (80 wells of layers of Dfam and Dzav of the Southern Tatar arch fields, on which water insulating works were carried out) change largely (an analyzed sample consisted of 3120 values) therefore for the purpose of finding the optimum number of parameters classification by six options including from 39 to 7 parameters (table 1) is carried out.

A certain characteristic of classification offered options can be received, considering the share of dispersion [1,2] explained by several main components (drawing 1). Therefore, at any classification option it is possible to be limited by considering five – seven main components, characterizing not less than 65 % of parameters variability (on the average 86 %) [3].

Each of groups in the corresponding main component axes possesses own area of values (drawing 2-3), separated from others [4]. At the imaging on the plane the arrangement of some objects can coincide in one coordinates, however their consideration in others allows to draw a conclusion on well belonging to one or different groups. The presented distribution of our groups in coordinate axes of the first and the second main components at the first and sixth options of classification testifies that the arrangement of some objects can coincide in one coordinates though their consideration in others allows to draw a conclusion on their accessory to one or different groups. In coordinates of PC1-PC2 of group 1 and

Table 1.

Classification of objects by the geological-physical characteristic of a layer by main components methods.

Parameters, unit of measure	Option					
	1	2	3	4	5	6
qo	+	+	+	+	-	+
ql	+	+	+	+	-	+
B	+	+	+	+	-	+
q'o	-	+	-	+	-	-
q'l	-	+	-	+	-	-
q'w	-	+	-	+	-	-
qini	-	+	-	+	-	-
qmax	-	+	-	+	-	-
q''	-	+	-	+	-	-
Qo	+	+	-	+	-	-
Ql	+	+	-	+	-	-
Qw	+	+	-	+	-	-
Tl	-	+	-	+	-	-
Te	+	+	-	+	-	-
T'	-	+	-	+	-	-
L	+	+		-	+	-
pl	+	+	+	-	+	-
pin	-	+	-	-	-	-
Vp	+	+	+	-	-	-
t	+	+	-	-	-	-
ko	+	+	+	-	-	+
m	+	+	-	-	-	+
kp	+	+	-	-	-	+
ρ	+	+	-	-	-	-
opr	-	+	-	-	-	+
pkv	-	+	-	-	-	+
ko	+	+	+	-	-	+
hper	+	+	-	-	+	-
hg	+	+	+	-	+	-
nop	+	+	+	-	+	-
nopm	-	+	-	-	+	-
qh	-	+	-	-	+	-
nc	-	+	-	-	-	-
se	+	+	-	-	-	-
sm	-	+	-	-	-	-
s	-	+	-	-	-	-
N	-	+	-	-	-	+
d	-	+	-	-	-	-
on	-	+	-	-	-	-

2 are separately located relatively each other at the first option of classification, and at the sixth option their areas are imposed at each other.

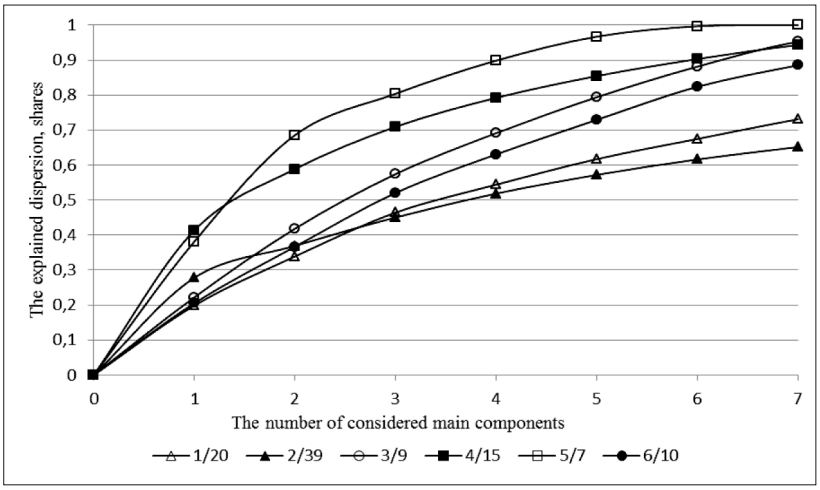
From the results of the analysis follows that from 39 main components 67,47 % are the share of the first seven for Dfam and Dzav layers of parameters general dispersion (drawing 4). It turns out, that at allocation of rather homogeneous objects groups it is quite enough to consider them in the space of these components. Any of seven main components has substantial character, gives in to semantic interpretation, reflecting this or that property characterizing operational characteristics, deposit conditions, physical-chemical and capacitor-filtrational properties of layers and fluids sating them, current state of development of these objects.

The first component reflects generally operational characteristics on wells and capacitor-filtrational characteristics. The second component - a factor causing punched characteristics and conditions of reservoir deposit. The third component reflects layer thickness properties and punching and the parameters reflecting values of pressure. In the fourth main component the contribution is brought by special factors of heterogeneity and types of the punchers opening wells taking into account age and diameter of openings, also such operational characteristic, as factor of the relation of the maximum output to an average on oil, and also frequency rate of carrying out acid processings here enters. The fifth component includes conditions of layer deposit and operational characteristics. The sixth component reflects primary conditions of sampling, acid processings and the parameters reflecting layer thickness properties. The seventh component includes physical and chemical properties of sating fluids, capacitor and filtrational characteristics, technological parameters and type of the puncher, which carried out layer opening.

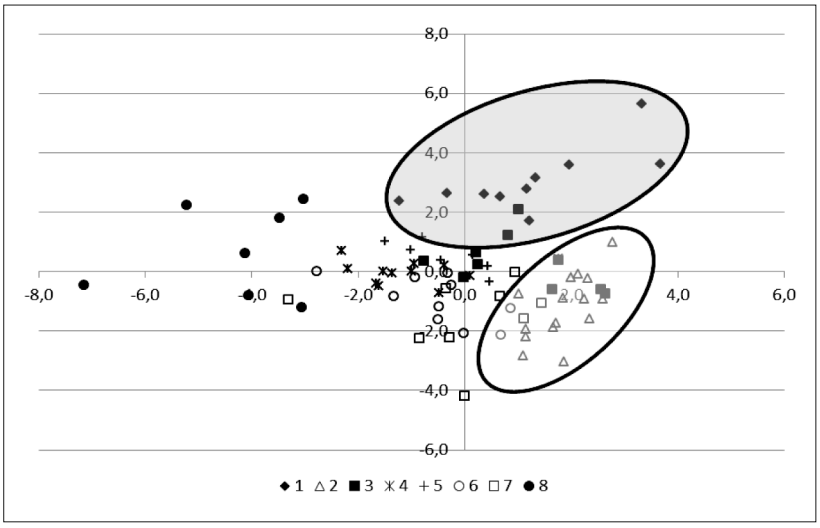
The parameters influencing the main share of dispersion are specified in table 2, entering in each of seven components.

It is necessary to emphasize that the share of the sixth and seventh components come the smallest values of paraeters general dispersion - 4,23 % and 4,02 %.

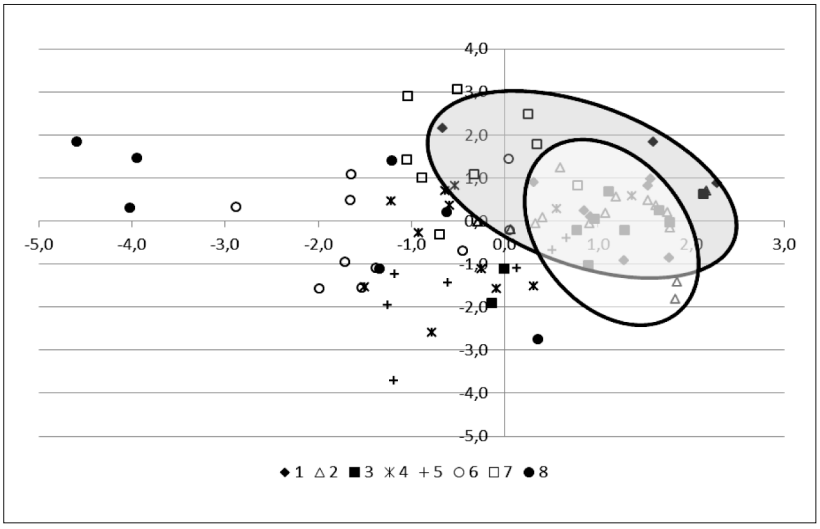
From the foregoing it is visible that every component reflects geological, technological and other features of development objects in this or that hierarchical level.



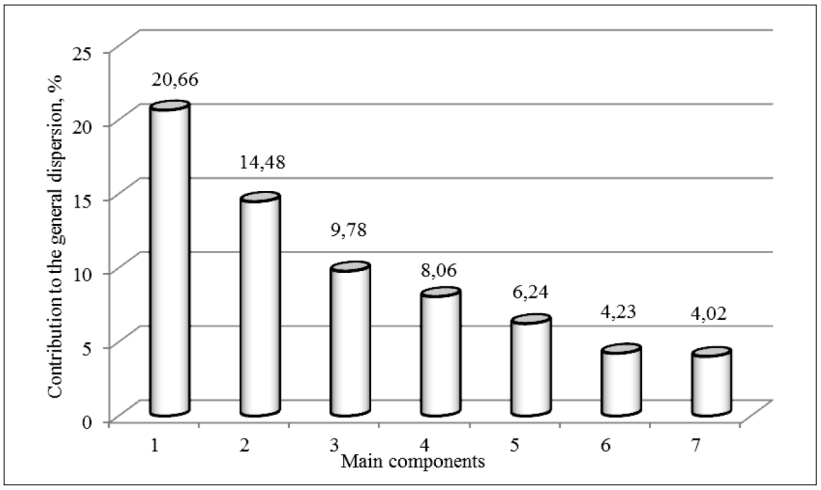
Drawing 1. Dependence of the explained share of dispersion on number included into a consideration components and geological-physical parameters (in numerator is classification option, in a denominator – number of analyzed physical parameters)



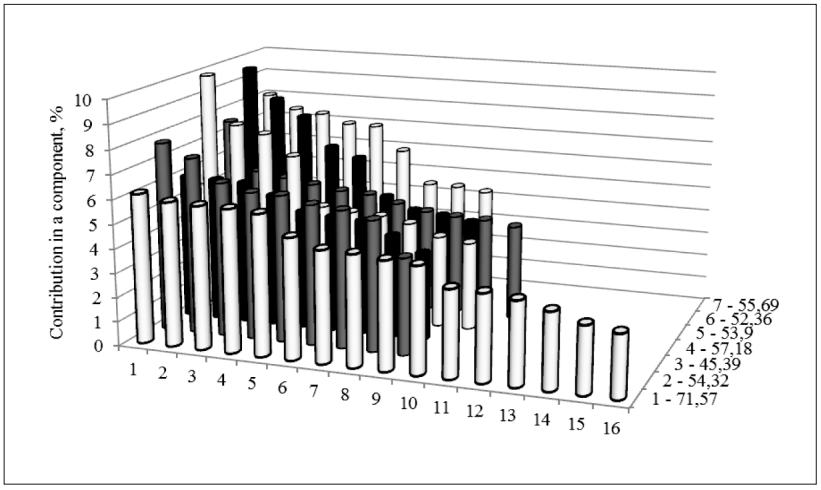
Drawing 2. Distribution of research objects in axes of PC1-PC2 main components by the first option of classification



Drawing 3. Distribution of research objects in PC1-PC2 main components axes by the sixth option of classification.



Drawing 4. the Contribution of main components into the general dispersion of parameters.



Drawing 5. the Contribution of parameters to each of the 7th component (on an axis x – number of parameters in a component, on an axis y – number components and a contribution of parameters to its dispersion).

With use of the most influencing factors the regression equations by each studied result are worked out: in addition extracted oil for all duration of effect Δqн, tons; duration of effect on time of T, months; watercutting change ΔB, % (positive, if the watercutting after processing has been decreased or on the contrary); change of production of water Δqв, t/day (taking into account the entire period of effect action); the maximum gain of an output on oil in a month, t/month. All parameters were normalized for an exception of independent factors influence on dependent. The multiple factor of correlation was used for an interrelation assessment between parameters, adequacy of the received equations of multiple linear regression was estimated by Fischer's ratio test, and the importance of factors estimates of factors of the equation by Student's test. Following models for Dfam and Dzav layers were received:

1. Additional oil production at the expense of water insulating works with application polymer of acid influence:

$$\Delta q = 0.356Qw - 0.216qo - 0.054qini + 0.294Vp - 0.145hper - 0.087port - 0.084Sm \quad (1)$$

The greatest positive influence on the additional oil production is rendered by sizes of pumped reagents volume and number of the saved-up production on water for the entire period of operation.

2. Duration of effect on time:

$$T = 0{,}305Vp - 0{,}179qo - 0{,}182Te - 0{,}041ko - 0{,}154hper - 0{,}091nopm + 0{,}06Sm \quad (2)$$

The greatest positive influence on duration of effect is rendered by size of volume of pumped reagents.

3. Change of an obvodnennost of B:

$$\Delta B = 0{,}469B - 0{,}136qo - 0{,}095Ql + 0{,}057m - 0{,}213pkv + 0{,}233nop + 0{,}011nc \quad (3)$$

The greatest positive influence on change of an obvodnennost is rendered by obvodnennost size before processing.

4. Change of production of water Δqв:

$$\Delta qw = 0{,}584ql + 0{,}174B + 0{,}092qo + 0{,}061L - \quad (4)$$

Table 2.

Distribution of parameters onto components

	1	2	3	4	5	6	7
1	Ql	s	nopm	se	q''	B	t
2	q'w	N	ql	d	B	ql	kp
3	Qo	hg	pl	on	t	T'	on
4	q'o	nc	L	ko	q'o	nopm	sm
5	qmax	nop	hper	Qw	q'w	opr	Vp
6	qh	hper	q'l	nop	L	hper	ρ
7	Qw	Tl	on	q''	pl	N	nop
8	qini	Te	pin	sm	qo	q'l	pl
9	q'l	sm	N	nopm	qh	qini	pin
10	m			nc	ko		
11	opr				qini		
12	Tl						
13	Te						
14	ko						
15	d						
16	qo						

$$0{,}072pl + 0{,}224m + 0{,}066opr$$

The greatest positive influence on change of production of water is rendered by size of production of liquid before processing.

1. The maximum gain of an output on oil in a month:

$$\Delta qmax = 0{,}169qmax - 0{,}09Qo + 0{,}222Qw + 0{,}007Tl + 0{,}094pl + 0{,}311Vp + 0{,}129kp \quad (5)$$

The greatest positive influence on the maximum gain of oil production is rendered by size of volume of pumped reagents.

The multiple factor of correlation fluctuates in limits from 54 % to 71 %. The equation is statistically significant with probability of 72-80 %.

The analysis of the received equations of multiple linear regression allowed to receive the following results:

1. A method main a component one of the most productive tools serving for a choice and justification of a complex of criteria of effective application of technology and an assessment of an informativnost of geologo-physical parameters of sheeted systems. Receiving authentic models of carrying out polymer of acid influence is possible even at reduction of the huge massif of used basic data by allocation and grouping of various parameters by this method.

2. High extent of influence of a complex of geologo-technological parameters of processed wells on size of efficiency of carried-out water insulating works with composition use on the basis of polymer and acid is revealed. The most powerful are the following factors: on all results of the carried-out influences have influence operational characteristics (in each equation is on two, these three parameters). In different degree the parameter of water insulating reagent, capacitor and filtrational properties of a layer, the characteristic of punching and acid processings influence. It is revealed that a slozhnopostroyennost of fields became the reason of that 30 % of all parameters entering into the equations, are connected with special factors of heterogeneity, tolshchinny properties and conditions of a zaleganiye of a layer

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