МЕТОДИ ТА ЗАСОБИ ҐЕНЕРУВАННЯ, ІНДИКАЦІЇ ТА ВИЗНАЧЕННЯ ПАРАМЕТРІВ ФІЗИЧНИХ ПОЛІВ ТЕХНІЧНИХ І БІОЛОГІЧНИХ ОБ’ЄКТІВ

TECHNOLOGICALLY SITUATIONAL VARIATIONS TO SOLVE THE MAIN TASK OF GAS-HYDRODYNAMIC RESEARCH OF GAS WELLS

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The publication discusses various approaches that can be used to find the level of inflow according to the results of well research in regimes depending on the research technology. By this time, the task of determining them is a very urgent and difficult one. The indicated direction of its solution. It has significant advantages over the direction of traditional methods and technology.
Key words: flow equation coefficients, research technology, gas-hydrodynamic research.

RELEVANCE OF WORK. As is known, the main purpose of gas-hydrodynamic well research is to obtain an informative base for calculating the physical indicators characterizing the well-reservoir-fluid system in order to be able to evaluate the productive capabilities of the studied object. Moreover, the main indicators that are determined in this case are the coefficients of linear and inertial resistance, the flow equation, that is, the flow equation. That is, ultimately it is necessary to determine the equation of the inflow. The coefficient of linear resistance directly characterizes the coefficient of productivity and gas-like formation, and the coefficient of inertial resistance characterizes the coefficient of macro scale.

MATERIALS AND RESULTS OF RESEARCH. As a rule, the filtration resistance coefficients and the equation of product inflow to the bottom of the well are determined by the results of well testing using steady-state sampling methods or by modifications to this method with long-term stabilization of bottom-hole pressure and flow rate. The duration of testing gas wells by the steady-state production method in 5-8 modes, depending on the reservoir properties of the formations, ranges from several hours to several days. Methodological research for such a short period compared with the duration of the entire field development process is justified, because during this time some parameters of the formation and the properties of the liquids and gases saturating it practically do not change. Therefore, the filtration resistance coefficients A and B, which are the main parameters, need to be determined during the study, and which are determined by the test results characterizing the state of the reservoir and reservoir fluid at the time of the well study. During the development of the field, the following changes: the state of the bottom-hole zone, the physicochemical properties of the gas or gas-condensate mixture, the gas-water contact position, condensate formation and subsequent evaporation of the condensate in the formation, etc.

A change for one of the reasons for one or more of the above parameters can change the coefficients A and B, which are determined by the actual data of the study. Most often, the filtration resistance coefficients change as a result of changes in the physical properties of the gas μ and coefficient Z, as well as permeability k from pressure.

If we use well production data for a relatively short period of field development (such an assumption is unacceptable for underground gas storage (UGS)), then a slight change in reservoir pressure will practically not affect the values, μ, Z and k. The reservoir pressure changes by several atmospheres during the year, while the development process lasts an average of 20-30 years.

One of the main conditions for the use of operating data is the complete stabilization of pressure and flow rate. This means that the radius of the well-drained zones at different times and in different modes should be almost the same. The method of using operational data for determining the coefficients of filtration resistance allows the possibility of changing the reservoir and bottomhole pressures and gas flow rate over time.

With the standard method of researching wells using the steady-state production method and processing the results, the reservoir pressure P_{res} is assumed to be constant for all modes. It is believed that during the study of the well, the reservoir pressure does not change. Only the pressure at the bottom P_{bot} is changed, and therefore the gas flow rate by changing the diaphragm or changing the bore of the adjustable nozzle. Moreover, the obtained dependence between the established values of bottomhole pressure and flow rate makes it possible to determine the coefficients of filtration resistance.

Therefore, in order to use operational data that accumulate over a relatively long time, it is necessary to prove the possibility of using a variable value of reservoir pressure. From the two-term formula for gas inflows, $\frac{P_{res}{}^2(t_i) - P_{bot}{}^2(t_i)}{2P_{atm}} = AQ(t_i) + BQ^2(t_i)$ it can be seen that for constant values of the coefficients A and B for each time t_i there corresponds its own reservoir pressure $P_{res}(t_i)$. That is, there are two ways to use operational data.

1. A certain mode is established at the well, and it has been working on the mode for a relatively long time. During this time, reservoir pressure P_{res}, bottomhole pressure P_{bos} and flow rate Q change. By fixing $P_{res}(t_i)$, $P_{bot}(t_i)$ and $Q(t_i)$, and at different times, and using several values of these quantities, the binomials determine the coefficients A and B for the gas inflow formula.

2. Over a long time, the well changes in reservoir pressure $P_{res}(t_i)$. At the same time, the operating mode is changed at the well, that is, there is a natural decrease in reservoir pressure and a forced change in the operating mode. These data are also used to determine the coefficients A i B.

The validity of the above conditions for determining the filtration resistance coefficients A and B was once tested under industrial conditions and experimentally on reservoir models [1].

Comparing the values of the coefficients A i B, determined according to the operation data and the results of the study, respectively, a conclusion is drawn on the acceptable convergence of the coefficients determined by various methods. Analysis of the results of determining the coefficients A i B showed that:

- to use this method, collector stability is required;
- the quality of certain coefficients substantially depends on the reliability of the operation data;
- when processing data, it is necessary to take into account the change in the physical properties of the gas μ and Z the pressure;
- with significant changes in the parameters of the reservoir during the development of the use of operational data for determining the coefficients of filtering resistances should not be carried out.

Therefore, when applying the two-term law of resistance when interpreting the results of well research, it becomes necessary to determine the values of the filtration resistance coefficients from the results of gas well research. With the traditional method of researching gas wells in several modes, graphical and analytical methods for their determination are proposed. Currently, they are widely used in the practice of studying gas and gas condensate wells in Ukraine and in many countries of the world.

Considering all the nuances regarding the determination of filtration resistance coefficients, the inflow equation, which are indicated above, and which relate to the quality of research for obtaining high-quality initial data, it seems most interesting from the point of view of time, money and improving the quality of the initial data the option of determining the filtration resistance coefficients the inflow equation according to the data obtained due to the high-quality unified research regime [2, 3], which would contain open the well for working on mode and the subsequent closing of the well for recording pressure recovery curve.

Such research methods also make it possible to determine the linear and inertial resistance coefficients of the inflow equation. Traditional graphical and analytical methods for finding these coefficients in the case of modern research methods are becoming unsuitable. To solve one inflow equation with two unknowns, which describes the process of reservoir fluid filtration, a method was applied that consists not in creating another equation for determining the inflow equation, but a method based on the use of two techniques at once that are used to process the same curve - pressure recovery curve. This method is not graphical - the coefficients are calculated analytically. There are certain advantages to this, since the subjective factor is eliminated when constructing the indicator curve, as is usually done. The indicator curve, in this case, is not built at all, although in principle this is possible. But it is no longer necessary.

In this case, if a productive gas or gas condensate well is highly depleted, then the pressure recovery curve (PRC) is processed using the Yu.P. Borisov method [3]. If the well is medium production, then the method of E. B. Chekalyuk and I. A. Charny [2] and is also processed the inflow curve of not only PRC.

Various approaches to finding the coefficients were discussed in more detail in [4], and the possibilities of calculating the coefficients A and B are not exhausted by this.

It should be noted that the theoretical foundations underlying the new methods of well research are so effective that they are several times greater than the results obtained using traditional methods.

No less significant is the fact that, based on the data obtained during the study, it is possible to achieve a preliminary calculation of the initial gas reserves in the studied productive gas facility [6], which is developed at the level of the Ukrainian patent and is based on the use of a relatively small amount of initial data.

CONCLUSIONS. Based on the multivariance of technical and technological situations in the study of gas and gas condensate wells, we can recommend the same multivariate approach to the research process itself, choosing a method that is rationally involved and methods of interpreting the obtained factual data that fully reveal the informative spectrum of data to determine the productive characteristics of the studied object and to decide its further use in the energy sector.

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ANALYSIS OF CLUSTERIZATION METHODS FOR GROUPING OF THE FRAGMENTS OF ETCH PITS ON THE IMAGE OF SEMICONDUCTOR WAFER

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Article is devoted analysis of clusterization methods and density methods in particular for grouping on the plates of semiconductor wafers. It is set that right, the use of algorithms DBSCAN, OPTICS and DENCLUE have described features of the search does not reflect the specificity of compact groups of related fragments. To solve the problem of groups of fragments dislocation etch pits of semiconductor wafer requires a special method.

Key words: dislocation, etch pit, clusterization, density methods.

АНАЛІЗ МЕТОДІВ КЛАСТЕРИЗАЦІЇ ДЛЯ ГРУПУВАННЯ ФРАГМЕНТІВ ЯМОК ТРАВЛЕННЯ НА ЗОБРАЖЕННІ ПЛАСТИНИ НАПІВПРОВІДНИКА

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Аналізується використання методів кластеризації групування фрагментів дислокацій на пластині напівпровідника. Можуть використовуватися різні методи кластеризаці з метою групування, але оптимальними являють плотностні. Встановлено, що використання алгоритмів DBSCAN, OPTICS і DENCLUE не відображають специфіку компактних груп фрагментів цифрового зображення пластини напівпровідника.

Ключові слова: дислокація, ямка травления, кластеризація, плотностні методи.

RELEVANCE OF STUDIES. Features display of dislocations in the semiconductor wafers in the surface of the resulting raster images do not give sufficient quality in the course of processing and mapping faces dislocations figures especially in the case adjacent circuits etch pits on the binarized image of the semiconductor wafer. To avoid ambiguity of the definition of the contour lines dislocation, it is necessary to separate the adjacent contour lines on a background of other fragments.

MATERIAL AND RESULTS OF RESEARCH. Novadays developed a large number of different clustering algorithms and their modifications. Generalized clustering algorithm consist of stage describe as follow:

1. A certain data format.
2. Selection of an affinity measure.
3. Selection of the clustering algorithm.
4. Implementation of the algorithm.
5. Presentation of the results of the algorithm.
6. Interpretation of the clustering results.

The specifics and unpredictability of some clustering algorithms work in the conditions of the underlined fragments of binary circuits adjacent etch pits, requires an algorithm for determining fragments of compact groups having a minimum number of customizable options to work with the smallest predicted number of calculation operations.

Applying to the wafer of the semiconductor, the maximum distance to the fragments of a single etch pits groups defined as the biggest distance between the points coordinates centers of mass of fragments etch pits polygon dislocation of the contour. Thus, minimum number of adjustable parameters may include a parameter of the maximum distance between the centers of mass of fragments grouped in the etching of pits.

Cluster analysis finding similarities between data according to the characteristics found in the data and grouping similar data objects into clusters.

Most partitioning methods cluster objects based on the distance between objects. Such methods can find only spherical-shaped clusters and encounter difficulty in discovering clusters of arbitrary shapes.

Other clustering methods have been developed based on the notion of density. Their general idea is to continue growing a given cluster as long as the density (number of objects or data points) in the “neighborhood” exceeds some threshold.

Density-based methods can divide a set of objects into multiple exclusive clusters, or a hierarchy of clusters.

Typically, density-based methods consider exclusive clusters only, and do not consider fuzzy clusters. Moreover, density-based methods can be extended from full space to subspace clustering.