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RESEARCH PERFORMANCE FREQUENCY-MODULATED SIGNALS IN ANISOTROPIC ENVIRONMENT WITH THE AID OF MATLAB SOFTWARE

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Relevance of consideration in this paper tasks is to improve the existing methods of electromagnetic geological exploration and development of new methods of search and identification of oil and gas fields on the basis of frequency - modulated (FM) signals. Using the software Matlab analyzes the frequency components of the surface impedance of the medium over hydrocarbon deposits (HD) when changing the FM, a variation of which extends the functionality of the components depending on the resistance of the modulation modes and to improve the information content of the developed methods to search for HD.

In this paper we have determined values of the components of the surface impedance of an anisotropic medium plasma-type, which was selected as the hydrocarbon deposit. The propagation of electromagnetic wave pools in FM mode - signals. The analysis is conducted in the impedance-frequency range of sounding signals. Various modes of application FM modulation. The results of interaction of FM signals with the environment over HD can be used for the development of radio-engineering signals (RES) search of oil and gas and improve the performance of high-quality exploration.

The solution of problems of interaction of electromagnetic waves (EMW) and hydrocarbon deposits (HD), located on the background of a heterogeneous and polyphase environment due to the view of complex physical processes of hydrocarbon deposits, the conditions of their occurrence. Until recently, the electrodynamic description overlying heterogeneity was reduced to its representation in the form of "body with finite conductivity, immersed in a medium with a loss."

Currently, there are several physical models of hydrocarbon deposits, taking into account the migration of hydrocarbons to the environment over the deposits to the surface of the Earth. In this case, the influence of electromagnetic signals on such formation can be described as one - resonance and multiresonance reacting [1–3].

In modern electrical prospecting tendency to search for new methods associated with the complexity of techniques and technologies in pursuit of reducing the time of certification of the test surface and improve the quality of performance indicators [4]. The greater number of the proposed methods have theoretical justification, sometimes contrary to the canons of radio physics. All this requires a careful analysis of the physical processes taking place over the deposits of hydrocarbons, specifying its electrodynamic model to study the interaction of electromagnetic wave with deposits.

The aim of this work is the development of electromagnetic methods of prospecting of anisotropic plasma-type environments (ASPT) based on the test characteristics of the surface impedance of the media in the mode of frequency-modulated (FM) signals.

Interaction with computers ASPT. Studies on the subject are presented in [5]. However, features of interaction of electromagnetic wave with Hydrocarbon deposits (HD) in this mode effects require further analysis.

Researched hydrocarbon deposit can be represented in the form of an anisotropic inhomogeneity on the road communication [6].

In general, the spatial orientation of the external normal to the interface and the wave vector $\vec{k}$ is arbitrary (see Figure 1), and the interaction of electromagnetic wave with a local patch on the road propagation of radio waves (PRW) can be represented as the mode of oblique incidence of a plane wave with vertical polarization on the boundless surface with anisotropic impedance (in approximation of heterogeneity large characteristic dimensions compared with the wavelength of the probe signal) [2].

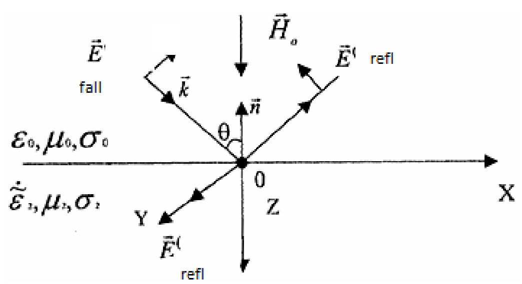

Fig. 1. The geometry of the problem for the electromagnetic wave with vertical polarization fields

Impedance boundary condition is given by:

$$E_x = -Z_0(\dot{Z}_{11}H_x - \dot{Z}_{12}H_y),$$
$$E_y = -Z_0(\dot{Z}_{21}H_x - \dot{Z}_{22}H_y),$$
$$\dot{Z}_{11} = \dot{Z}_{22} = -\frac{1}{j2\sqrt{\dot{\varepsilon}_R\dot{\varepsilon}_L}}(\sqrt{\dot{\varepsilon}_R} - \sqrt{\dot{\varepsilon}_L}), \qquad (1)$$
$$\dot{Z}_{11} = \dot{Z}_{21} = \frac{1}{2\sqrt{\dot{\varepsilon}_R\dot{\varepsilon}_L}}(\sqrt{\dot{\varepsilon}_R} + \sqrt{\dot{\varepsilon}_L}),$$

where $E_{x,y}, H_{x,y}$ – the projection of the incident and reflected waves on the respective coordinate axes;

Z_0 – the characteristic impedance of the medium surrounding the anisotropic heterogeneity.

Using the software Matlab analysis the frequency components of the surface impedance of the medium over HD when changing the FM, a variation of which extends the functionality of the components depending on the resistance of the modulation modes and to improve the information content of the developed methods to search for HD.

Studied the frequency dependence of impedance boundary conditions on the interval from 105 Hz to 10^{10} Hz, examined the effect of frequency modulation index and modulating frequency characteristics of the surface impedance.

The calculation of the surface impedance components (1) was based on the experimental data on the deposits of hydrocarbons: the dielectric constant of the host rocks $\varepsilon_r = 10$, specific electrical conductivity

$\delta_r = 0.03\frac{S}{m}$; Effective collision frequency: the electron $U_B = 10^9 s^{-1}$ and ion-ion $U_i = 0.5 \cdot 10^7 s^{-1}$ [5].

Figures 2 and 3 shows the frequency dependence of component Z_{11}. To isolate the hydrocarbon deposits on the part of the impedance Z_{11} can recommend the following frequencies: $1{,}15\cdot10^8$ Hz and $1{,}45\cdot10^8$ Hz (when B = 0.5).

For the frequency modulation index = 1 in the input impedance at different frequencies $9{,}8\cdot10^7$ Hz and $1{,}2\cdot10^8$ Hz. By increasing the modulation index to B = 10 is shifted to the left Z_{11} extreme points. At a frequency of $9{,}8\cdot10^7$ Hz module is 0.2, and the frequency of $1{,}2\cdot10^8$ Hz unit is 0.25.

FM index increase leads to the fact that the extremum points at frequencies $0.54\cdot10^6$ Hz and $0.98\cdot10^7$ Hz differ insignificantly compared with smaller frequency modulation index. To isolate the hydrocarbon deposits on the part of the impedance | Z_{11} | we can recommend the following frequencies $1{,}1\cdot10^6$ Hz and $1{,}38\cdot10^8$ Hz (when B = 15). For the frequency modulation index B = 25 to frequencies 0,50·10 Hz and $0{,}94\cdot10^7$ Hz for frequency modulation in the index = 50, a shift extreme points | Z_{11} | left.

At a frequency of $0{,}96\cdot10^7$ Hz module is 0.22, and the frequency of $0{,}48\cdot10^6$ Hz module is 0.175. FM index increase leads to the fact that the extremum points at frequencies $0.94\cdot10^7$ Hz and $0.90\cdot10^7$ Hz differ insignificantly compared with smaller frequency modulation index.

Figures 4 and 5 shows the frequency dependence of component Z_{12}.

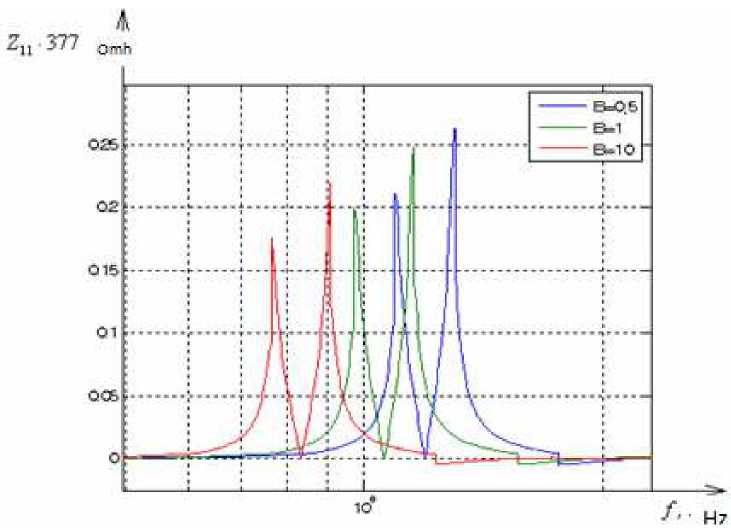

Fig. 2. Dependencies $Z_{11} = \psi(f)$:
1 - B = 0.5; 2 - for B = 1; 3 - for B = 10

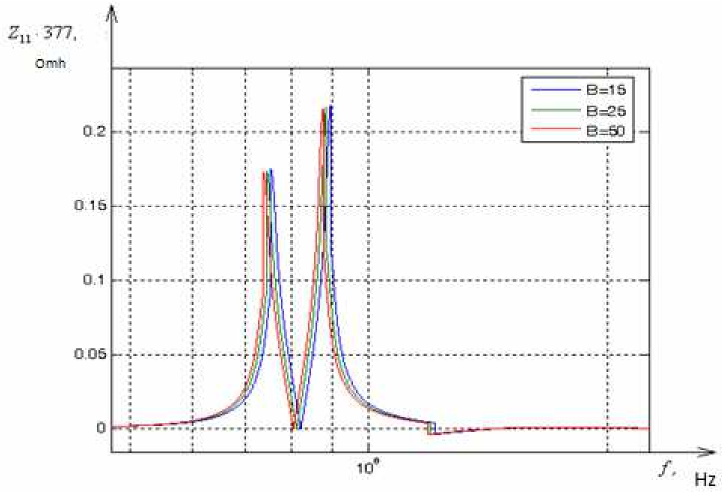

Fig. 3. Dependencies $Z_{11} = \psi(f)$:
1 - for B = 15; 2 - for B = 25; 3 - for B = 50

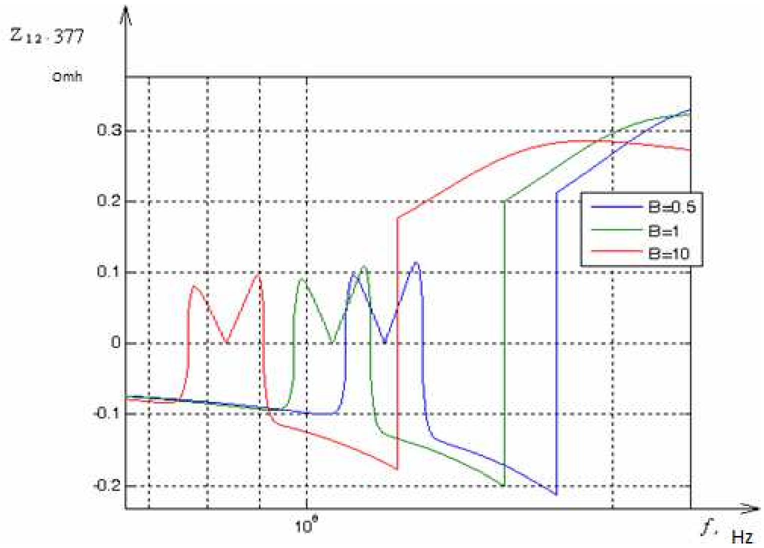

Fig. 4. Dependencies $Z_{12} = \psi(f)$:
1 - for B = 0,5; 2 - for B = 1; 3 - for B = 10

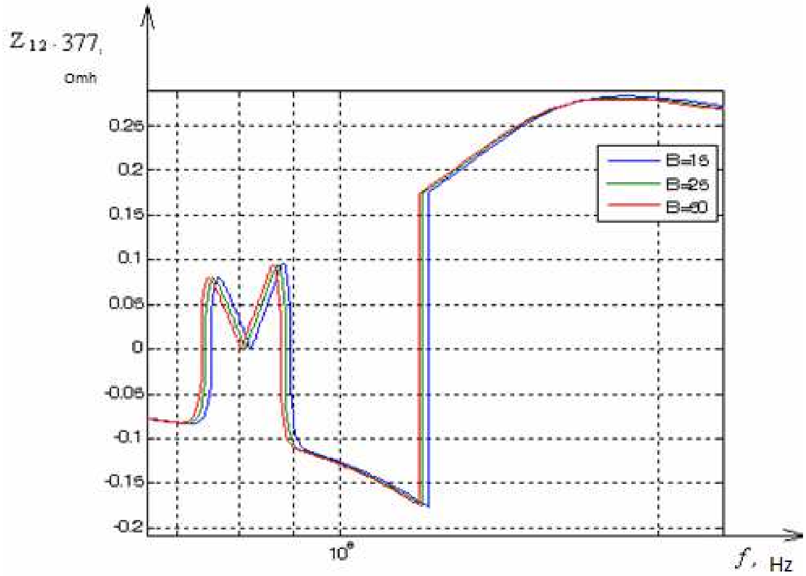

Fig. 5. Dependencies $Z_{12} = \psi(f)$:
1 - for B = 15; 2 - for B = 25; 3 - for B = 50

The value component of the surface impedance Z_{12} hardly changes in the frequency range from 10^5 Hz to 10^8 Hz. At a frequency range from 100 MHz to 180 MHz, a sharp surge to the values of 0.28-0.35. The variation in the index affects the interval of frequencies from 100 kHz to 1 GHz. Smaller index value corresponds to high values of Z_{12} and high frequencies at which an increase in the surface impedance.

The value component of the surface impedance $| Z_{12} |$ It almost does not change in the frequency range from 10^5 Hz to 10^8 Hz (at B = 15 - 50). At a frequency of 300 MHz in a sharp surge in values to 0.17. The variation in the index affects the interval of frequencies from 100 kHz to 1 GHz.

Smaller index value corresponds to high values of Z_{12} and high frequencies at which an increase in the surface impedance.

The impedance of the test plasma-type layer is a complex value. Thus, the analysis is reduced to the separate study of amplitude and phase characteristics of the surface impedance. In this paper, there is analysis of the amplitude characteristics of the surface impedance. Quantitative manifestations of these effects are determined by physical and geological properties of the oil and gas fields: chemical and mineralogical composition of layers, of structural and textural features of the skeleton, the nature of the porosity and permeability, the percentage of constituent substances, especially the mechanical properties of the skeleton, the amount of produced water in the pores, its mineralization and etc., so in the expressions (1) it is necessary to take into account the corrections for these characteristics.

In this paper we have determined the values of the components of the surface impedance ASPT, as has been selected hydrocarbon deposit. The propagation of electromagnetic wave pools in FM mode - signals. The analysis is conducted in the impedance-frequency range of sounding signals. Various modes of application FM modulation. The results of interaction of FM signals with the environment over HD can be used for the development of radio-engineering signal (RES) search of oil and gas and improve the performance of high-quality exploration.

The analysis of the surface impedance of the medium over HD, the magnitude of which can assess the performance of antennas that have a fixed position in space relative to the interface when you change the properties of the underlying surface, which makes it possible to quantify the properties of the medium without the need for an accurate calculation of changes in the electrodynamic parameters of the underlying surface. The results can be used to develop new methods of electromagnetic exploration and delineation of HD.

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OVERVIEW OF SOFTWARE FOR THE AUTOMATION OF DISTRIBUTION LOGISTICS FUNCTIONS IN RETAIL CHAINS

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The paper discusses distribution logistics systems and the results of the comparative analysis of software for logistics.

Nowadays in a competitive environment retailers with large chain store increasingly develop among retailers. For retailer of this type a significant proportion of performance mesure are related to logistics. In addition, logistics is one of the most expensive segments in the total fraction of the cost. The experience of developed