WELL-INFORM INCREASING OF THE RADAR PENETRATION BY HIGH BROAD-BAND RADIO PULSES WITH THE ACCOUNT OF THE UNDER SURFACE MEDIUM MODELING AT THE REAL CLIMATIC FACTORS INFLUENCE

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Abstract. *The problems of the electrodynamic parameter space-temporary sharing in the capillary-porous media at real climatic and weather factors influence are considered. It is shown, that these distributions have non-stationary character. A technique of finding of such distributions under the external and internal factors action is resulted. It come to a conclusion, that when deciding a direct electrodynamic problem for ultra-wideband signals in capillary-porous media it is necessary to take into account the non-uniform character of the distribution their electrodynamic parameters, stipulated by the influence of the moisture and temperatures.*

At development of the broadband sensing data interpretation methods the problem of identical interaction description of electromagnetic waves with sensing media, characterized by efficient complex dielectric permeability (ε) is one of the most urgent. It is connected with sensing mountain sorts, ground-soils, building materials etc. represents itself the complex dielectric heterogeneous media with capillary-porous structure. In the dry condition they are lumpy dielectrics but in the humid condition they are half-conduct media. In real natural conditions these media constantly contact with varying temperature field and water in various modular condition. Herewith the water is a variable component and defines the dielectric property of such media [1].

When deciding the problems of radiowave diagnostics of condition and properties of such capillary-porous media it is necessary to take into account the space-temporary distribution into electrical characteristics, such as the complex dielectric permeability (ε) and electrical conductivity (σ). These parameters are complex functions of moisture, temperature, kind and structure of media, and interacting with media the electromagnetic field frequency. In real conditions the moisture (W), temperature (T) in such media are changed in the area and time under various external and internal factors. The problem of determination of space distribution dynamic of the moisture, temperature and dielectric characteristics in capillary-porous media under influence of the various external factors considered in [2] in detail. Based on model representations of the flowing theory, which assumes a power-mode character of the capillary-porous material dielectric parameters dependence from the volume contents of the component with large generalized conductivity, the electrical model is designed by authors. This electrical model has satisfactory describe the moisture and temperature dependencies of complex dielectric permeability, as well as electrical conductivity of capillary-porous media with regular distributed volume moisture within band $(10^2 - 10^{10})$ Hz [3,4].

Used in given working the dependencies of electrodynamic parameters of capillary-porous systems from moisture, temperatures and electromagnetic field frequencies has a kind [2]:

$$\varepsilon_{1см}(\omega) = \varepsilon_{1вода}(\omega)\cdot(W - W_{c1})^{t1} + \varepsilon_{1сух}(\omega), \quad (1)$$

$$\varepsilon_{2см}(\omega) = \varepsilon_{2вода}(\omega)\cdot(W - W_{c2})^{t2} + \varepsilon_{2сух}(\omega) + \sigma/\omega, \quad (2)$$

$$tg\delta_{см} = \varepsilon_{2см}/\varepsilon_{1см}, \quad (3)$$

where $\varepsilon_{1см}(\omega)$, $\varepsilon_{1вода}(\omega)$, $\varepsilon_{1сух}(\omega)$are dielectric permeability of a mix, water and dry material on the frequency ω accordingly; $\varepsilon_{2см}(\omega)$, $\varepsilon_{2вода}(\omega)$, $\varepsilon_{2сух}(\omega)$ are factors of dielectric losses for a mix, water and dry material accordingly; σ is the ohm end-to-end conductivity on the direct current; W is relative volumetric moisture; W_{c1} , W_{c2} are thresholds flowing;; t_1, t_2 are the degree factors.

For samples with uniform sharing of the water volumetric concentration, provided that the time of sample endurance at temperature measurement reasonably large, moisture can be write:

$$W = W_0 \exp(-\alpha \cdot \Delta T), \quad (4)$$

where $\Delta T = (T_0 - T)$ is temperature in K degrees, α is a coefficient for different materials on the completion of phase transitions.

In accordance with available experimental data for dry media it is possible to neglect of the dielectric parameters frequency dependency. For determination of the humid media frequency dependencies $\varepsilon_{1вода}(\omega)$ and $\varepsilon_{2вода}(\omega)$ the Debit formulas were used. Included in these formulas a relaxation time, static and high frequency dielectric permeability either as $\sigma_{вода}$ water in (3) depends from temperature and salting soil dissolve. The defining these

0-7803-5172-X/99/$10.00 © 1999 IEEE.

dependencies empirical formulas are taken from [5].

Changes of spatial sharing of the main electrical parameters($\varepsilon_{1см}(\omega)$, $tg\delta_{см}$) of capillary-porous media is determined by the various factors, where temperature T and moisture W are the most importance. In real conditions the temperature and moisture inside material depends from changing of external temperature, quantity of the precipitation dropped out and other climatic influences.

For a finding of the W and T space-temporary distribution the capillary-porous media were submitted in a kind of the hard framework and pores, forming the mutual penetrate structures [6]. The parameters describing the thermo-moisture processes in similar media, essentially depend not only from as material, but also from T and W. It results that the problem of finding of distributions $T(z,t)$ and $W(z,t)$ on the depth z for a given moment of time t is reduced to the decision of the nonlinear differential equation system of thermo-conductivity and diffusion with boundary conditions on surfaces, simulating by various climatic effects [2]. Founding thereby the space-temporary distribution T and W are used by us for the determination of sharing the electrodynamic parameters in the lumpy on characteristics capillary-porous media. The dependencies $\varepsilon_{1см}$, $tg\delta_{см}$ inside each layer from T and W are defined on formulas (1-3).

Рис.1 Распределение влажности

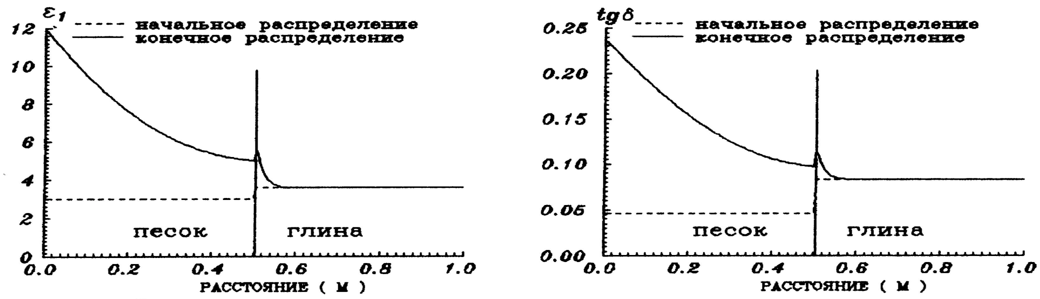

Рис.2 Распределение диэлектрических параметров в системе

CONCLUSIONS. Theoretical and experimental researches of the sub-shallow medium electrodynamic parameter and influence them on the results of the underground penetration radar problems decision permits to make the following conclusions and to schedule the further ways of the ultra-wideband penetration system development.

1. The electrodynamic parameter space-temporary sharing in capillary-porous media at the influence of real climatic and weather factors have a non-stationary character, are defined from dependencies of the specified parameters on moisture and temperature, which finding from the thermo-moisture equations decision for each area of the researched object, by means of the flowing theory formulas, with the account of the frequency-temperature relaxation of the free water dielectric characteristics, the dielectric permeability dispersions in the low frequency band and other processes, stipulated by influence of moisture, temperatures, salting, density, etc.

2. Deciding of direct electrodynamic problem for ultra-wideband signals in capillary-porous media it is necessary to take into account the character of lumpy distribution their electrodynamic parameters, stipulate by the influence of moisture and temperatures.

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