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OPTOELECTRONIC HUMIDITY MEASUREMENT METHOD

Abstract: In the article, the optoelectronic method for measuring humidity is based on a mutual change in the flow of infrared (IR) radiation incident on the analyzed wet material and after interaction with it.

Keywords: humidity, optoelectronic, infrared light, transparent, full return.

Introduction

The opoelectronic method of moisture measurement is based on the interaction of infrared (IQ) radiation flux in the states falling on and after interacting with the wet material being analyzed.

The main role in this is played by the absorption of IR-radiation of certain wavelengths in moisture, that is, in the IQ-spectra of water. Water has a number of absorption spectra at a wavelength of 0.8-6.1 μm, and these spectra are selectable (0.94; 1.91 and h.k.).

Materials and methods:

This includes empirical methods such as modeling, fact-finding, experiment, description and observation, as well as theoretical methods such as logical and historical methods, abstraction, deduction, induction, synthesis and analysis, as well as methods of heuristic strategies. The research materials are: scientific facts, the results of previous observations, surveys, experiments and tests; means of idealization and rationalization of the scientific approach.

In optoelectronic moisture meters, precipitation diodes (iodine) are selected for these wavelengths. The absorption and return of light propagated from iodine in moisture by interacting with the material is recorded in radiation receivers (NQQ).

In this case, the passage of IR radiation through two different environments obeys the Buger-Lamberg-Ber law, that is

$$\Phi_{\lambda} = \Phi_{0\lambda e} - \left[\sum_{i=1}^{n} \left(\varepsilon_i(\nu) C_i + \alpha_p \right) d \right] \quad (1)$$

where: Fλ is the flow of light passing through a medium in the direction of a given wave length λ; $F_{0\lambda}$ is the flow of light falling from a wavelength to an environment in the direction of a given wave length λ; $\varepsilon_i(\nu)$ is the coefficient of attention to absorption in the i – component of a wave length λ; α_r is the concentration of a component in percent λ (%); d-medium thickness.

If $F_{0\lambda}$; α_r; d; $\varepsilon_i(\nu)$ (permanent) that are beneficially, Fλ (through radiation monoxromatik) S_i, we can find that the wet environment.

Fot In this case it will be possible to selectively measure and base wavelengths according to the basic scheme of the optoelectronic moisture meter (figure 9,7), that is, the flow of radiations $F_{0\lambda}$ va $F_{0\lambda 2}$. With these currents, it will be possible to irradiate the material, record the flow of returning or passing light using NQQ, convert them to photoelectric silnal, process the photoelectric signal, and determine the percentage of moisture proportional to the signal quantity.

Photoelectric signal processing is carried out as follows. The signal coming out of the nqq is transmitted to the amplifier and a signal of the desired amplitude is obtained. These signals are mathematically processed as measurement and base signals.

If the environment being analyzed is the same for both (beam and beam) currents $\sum_{i=1}^{n} \left(\varepsilon_i(\nu) C_i + \alpha_p \right) K_1$, then we will be able to assume that for the beam, we will take that for th e beam current of the meter is both rotating and absorbing $\sum_{i=1}^{n}(\varepsilon_i(v)C_i+\alpha_p)K_1+K_2$.

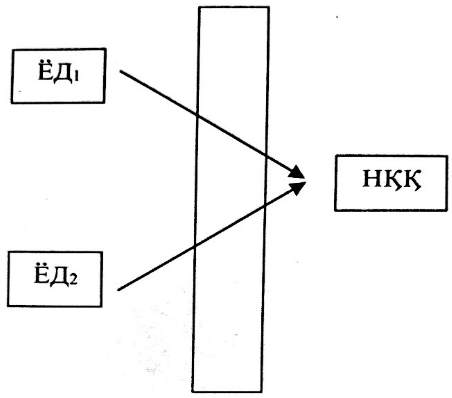

Figure 1. Scheme for determining moisture in an optoelectronic way: BFD (ЁД$_1$) – base fat diode (λ=0,7 mkm), MFD (ЁД$_2$) – measurement fat diode (0,94 mkm),KE (M)– controlled environmen, RR (НҚҚ) – radiation receivers

Results and discussion:

Then when the controlled medium $F_{0\lambda}$ is illuminated at the arc - base and $F_{0\lambda 2}$ is illuminated at 2 – measure wavelengths, the currents of light passing through the medium are as follows:

$$\Phi_{\lambda 1}=\Phi_{0\lambda 1}\cdot e^{-kd}; \quad \Phi_{\lambda 2}=\Phi_{0\lambda 2}\cdot e^{-(k1+k2)d}. \qquad (2)$$

If we equalize the initial light currents ($\Phi_{0\lambda 1}=\Phi_{0\lambda 2}$),, then (with both currents falling to one RR), where: resistor resistance J_{F1}, b·J_{F2} , connected in series with R_N – RR, B is the photoelectric current of J_{F1}, b·J_{F2} the base and shaft sewer. Photo electric current with its own light current J_F=UγFα for the fact that it is connected in the cell F $U_1=R_nJ_{\Phi 1};U_2=R_nJ_{\Phi 2}$.

(3)

$$J_{\Phi 1}=CU^{\gamma}\left(\Phi_{0\lambda 1}\cdot e^{-kd}\right)^{\alpha};$$

$$J_{\Phi 2}=CU^{\gamma}\left(\Phi_{0\lambda 1}e^{-(k1+k2)d}\right)^{\alpha} \qquad (4)$$

where: constant quotient is γ string and γ string is a non - quotient; C is a quotient.

Since only one RR is applied, if U is being supplied from the voltage, then

$$U_1 = A\left(\Phi_{0\lambda 1} \cdot e^{-kd}\right) \cdot \alpha; \qquad U_2 = A\left[\Phi_{0\lambda 1}\left(\cdot e^{-(k1+k2)d^{\alpha}}\right]\right., \quad (5)$$

where: A=SUαRn.

The ratio of signals to obtain a signal proportional to humidity:

$$\frac{U_1}{U_2} = \frac{(\Phi_{0\lambda_1} e^{-K_1 d})^{\alpha}}{[(\Phi_{0\lambda_2} e^{-(K_1+K_2)^d}]^{\alpha}} \qquad (6)$$

logorifmable, i.e. $\ln U_1 - \ln U_2 = K_2 d\alpha$. (7)

Remembering that the resulting signal is not linear, that the base light current is also absorbed in moisture even if it is small, it is known that some inaccuracies in the measurement arise.

To eliminate these inaccuracies, i.e. increase accuracy, a full internal return distortion (FIRD) effect is applied.

This effect is based on the fact that the optical density of light propagates from a larger (n_1) medium and the optical density shifts to a smaller, controlled (n_2) medium. Consider the case when a Hemisphere lens is taken as a FIRD element (figure 9.8). $\Phi_{0\lambda 1}$ light currents fall under the tip of a tube from an environment with a larger optical density to an environment with a smaller optical density.

If we take into account that the reduction of the coefficient R is exactly proportional to the absorption of light in the medium being analyzed, then the larger the absorption, the greater the distortion of the full return effect. Also, if this absorption is carried out in an environment with a certain humidity, the amount of relapse violation, which is fraught with a change in humidity, also changes.

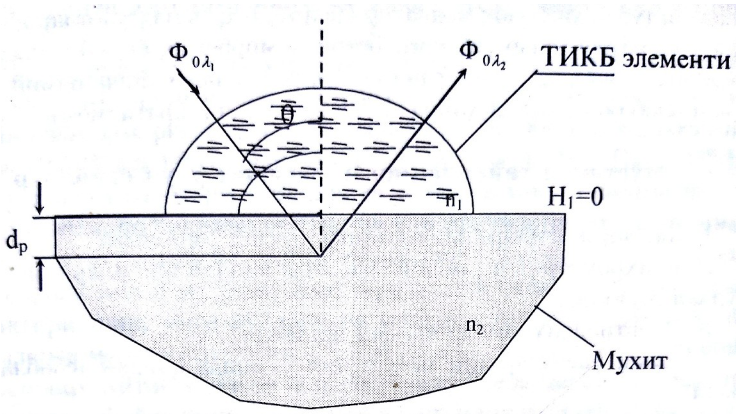

Figure 2. Scheme of application of full internal return distortion (FIRD) effect when measuring humidity optoelectronic:

If the flow of light ($\Phi_{0\lambda 1}$) is penetrating into the environment being examined in some (d_r) quantity, then the attitude in the flock is appropriate:

$$d_p \frac{\lambda_1}{2\pi\left(\sin_2 \theta - n_{21}\right)^{\frac{1}{2}}} \qquad (8)$$

If the angle of incidence is equal to or greater than the critical angle of $q_k = \alpha rc \sin \frac{n_2}{n_1}$ of the input, then it is called the full internal return (FIR) effect. If the complex breaking pointer of a less dense medium consists of $n=n_2 - i\chi_2$ of the moment 2, then absorption is observed in the medium, and the full internal return is broken.

Where the return coefficient is

$$R = \frac{J_\lambda}{J_{0\lambda}} \qquad (9)$$

will be smaller than one unit.

Conclusion:

This method is widely used and developed in the enterprises of our country, including various liquid substances (oil, petroleum products, cottonseed oil, etc.) by scientists from the Fergana Polytechnic Institute.k.) and materials (cement, concrete, reinforced concrete, wood products, cotton, gauze, sawdust, etc.k.) as well as scientific research in the direction of systematic automatic measurement of soil moisture in La'lmi, cultivated fields, the tradition of creating express Measuring Instruments continues.

References:

1. Tojiyev R.J., Yusupov A.R.. Metrologiya, standartlashtirish va sifat nazorati. O`quv qo`llanma. Farg`ona.: FarPI,«Texnika» noshirlik bo`limi. 2003-328 bet.
2. Tojiyev, R.J., Yusupov, A.R., Rajabova, N.R. Qurilishda metrologiya, standartlash va sertifikatlashtirish [Matn]: darslik / R.J. Tojiyev, A.R. Yusupov, N.R. Rajabova. – Toshkent: «Yosh avlod matbaa», 2022. – 464 b.
3. Raximov N.R., Saidaxmedov Sh.M., Xaydarov I.M., Yuldashev A.A.. Opticheskiye metodq opredeleniya soderjaniya vodq v nefteproduktax. «Neft va gaz» jurnali. 2001. 1-son, 24-25 b. 370
4. Raximovn N.R., Saidaxmedov Sh.M., Tojiyev R.J., Xatamov S.O.. Razrabotka priborov dlya ekspresnogo kontrolya za posledovatelg`noy perekachkoy nefti. «Neft va gaz» jurnali. 2001. 3-son, 41-42 b.
5. Muxitdinov M.M., Musayev E.S.. Opticheskiye metodq kontrolya vlajnosti. M.: Energoatomizdat, 1986 – 372 str.