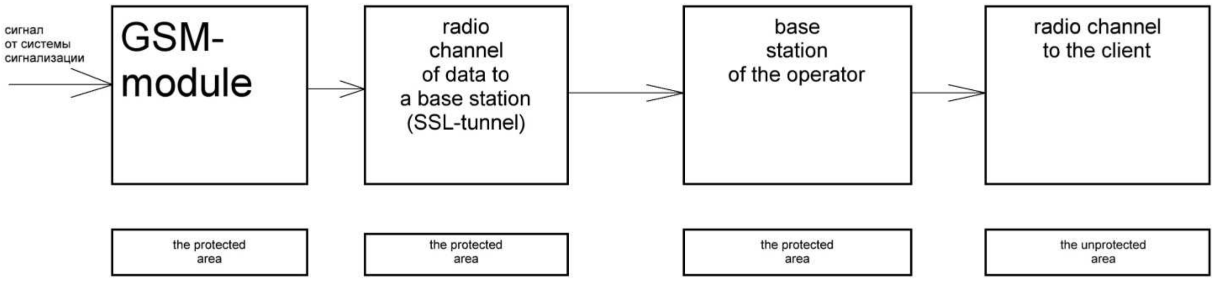

SSL-encryption

Only the communication channel from the base station to the client remains unprotected. SSL-encryption can be used in this channel, but it is necessary to contact your service provider to connect this option [4].

One of the very flexible functions of GSM-module is the management of the whole security system for GSM-channel. In this case, a bidirectional channel for transmitting and receiving information is formed.

GSM-modules J2ME are considered to be promising, using a powerful embedded platform designed for mobile devices, and security systems. Their advantages are as follows: high level of security and protection system in accordance with X.509 certificates; built-in debugging tools; high stability and absence of reboots; built-in perceptual difficulties code [4].

To realize such a platform the best solution is to use a portable PC devices - specialized mini-computers with high computing performance.

Conclusions:

– there are problems with the definition of the offender of the protected object because of their clothes materials, which absorb heat, or because of an extremely small distance from the motion sensor;

– complete protection of information transmission channels is currently not provided - the channel most vulnerable to unauthorized access are the ones from the base station to the customer; the use of SSL-encryption may allow to significantly reduce the likelihood of cracking;

– security systems should be placed in protective shields to ensure their sustainability to electromagnetic fields;

– the use of combined sensor increases the probability of intruder detection;

– perimeter systems consisting of multiple receivers and transmitters of infrared radiation allow quality control of large areas.

Further development of security systems is associated with remote access and management, the enhancement of functionality through improved algorithms for processing data from the sensors, the use of computing resources in the sensors ("smart sensors").

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ULTRASONIC FLAW DETECTION

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In this article the echo-method of ultrasonic flaw detection is considered. It describes the main reasons that contribute to the appearance of defects and gives practical recommendations for their detection and measurement of conventional size of defect.

During operation the rails arranged in a track are exposed to mechanical shock by the rolling wheel pairs, as well as climatic influences, which cause their wear and, consequently, the formation of internal defects. These defects are very dangerous for the safety of trains, transportation of passengers and cargo. Thus, the problem of early detection and removal of such defects is of great importance.

In general, there are three main reasons contributing to the appearance of such defects. The first reason is a manufacturing defect, which shows itself in the form of flakes (very fine cracks), air bubbles and various types of non-metallic inclusions, resulting from violations of methods of casting, welding and hardening rails. The second reason contributing to the development of defects is poor maintenance of a railway track. So, in case of rail sagging, horizontal or vertical steps in the place of joints and other irregularities of a railway track, the rails are subjected to intense dynamic impact of carriage wheel pairs. The consequence is an intensive development of defects. The third reason is defects of carriage wheel pairs, which have a mechanical influence on the rails. It should be noted that when the temperature decreases, brittleness of the metal increases that is also a cause of accelerated development (growth) of defects.

To solve these problems, aiming at detecting defects, there have been developed a number of methods and means of non-destructive testing, which allow carrying out diagnosis of the controlled object, while maintaining its integrity and without withdrawing it from service. These methods include: acoustic, magnetic, eddy current, optical, electrical, thermal, and many others. Methods vary, but they all have one feature in common – the sensing element is usually sensors of physical quantities.

One of the most common and effective methods of control is a method of ultrasonic inspection of the rails (relates to acoustic methods) using direct and inverse piezoelectric effect occurring in the piezoelectric material. Under the influence of an applied electrical voltage of a certain frequency to the piezoelectric element, the deformation of the piezoelectric plate occurs and the ultrasonic vibrations are entered into the tested object. The ultrasonic wave reflected from the back side of the tested object and (if available) from the discontinuity (defect), returns to the piezoelectric plate and, as a result of the direct piezoelectric effect, is converted into an electrical signal. Further signal processing is performed by the electronic unit of a defect detector.

This method is called an echo method; it exhibits high sensitivity with respect to internal defects, reliability and relative ease of implementation. A fundamental prerequisite of the control using the echo method is the presence of an acoustic contact between the converter and the tested product. To ensure the acoustic contact different fluids are used. During the control of the rolling surface of the rail head water is used (at low temperatures – alcohol-containing liquid), and to control the side edge due to the rapid run-off of water there should be used technical oil which has a lower fluidity.

A second prerequisite for ensuring the accuracy of the test results is correct sensitivity setting of the converter. The sensitivity is adjusted to a standard sample so that a piezoelectric converter can detect defects of the lowest possible size and does not react to interference. Qualitative sensitivity setting of a piezoelectric converter provides precise definition of the parameters of the defect. Unjustified increase in the sensitivity of a piezoelectric converter distorts the measurement results. This phenomenon is explained by the expansion of the direction pattern of a piezoelectric converter with increasing sensitivity.

The information received by the piezoelectric converter and processed in the electronic unit of the defect detector can be provided in several forms. One form is the A-scan (amplitude and time). Analysis of the received signals in the scan of this type is informative: in addition to the conventional size of the defect it's possible, with high probability, to determine the orientation of the detected defect and the types of its reflective surface (diffuse or mirror). In addition to the A-scan, modern defect detectors also use scanning-type B and C. These scans allow you to increase the information content of ultrasonic testing. Drawing of the scanning data is produced by a series of echo signals received during the movement of the piezoelectric converter on the surface of the tested object. The main difference between the C-scan and the B-scan is a color gradation of the level of the received signal. Thus, a high level signal on a C-scan will have a warmer color than a low level signal. This feature also allows to judge with a certain degree of probability about the orientation of the defect in relation to the normal, as well as its size.

All standard and non-standard rail defects are summarized in a single classification, which is followed by the personnel involved in the implementation process of ultrasonic testing. According to this classification, the rail defect rate is determined based on its conventional size, measured during the non-destructive testing of the object. These sizes (Fig. 1) include [1]:

– conventional length ΔL;
– conventional height ΔH;
– conventional width ΔX.

As stated above, the accuracy of the test results (conventional size of defect) depends on the correct sensitivity setting of the converter, which is directly related to the direction pattern width. It should be added that the accuracy of determining the conventional size is influenced by other factors. They include:

– input angle of the converter (the higher it is, the greater the direction pattern of the piezoelectric converter and, as a consequence, conventional size of the defect);
– depth from the scanning surface to the defect (due to the divergence angle of the direction pattern);
– temperature at which test is carried out;
– etc.

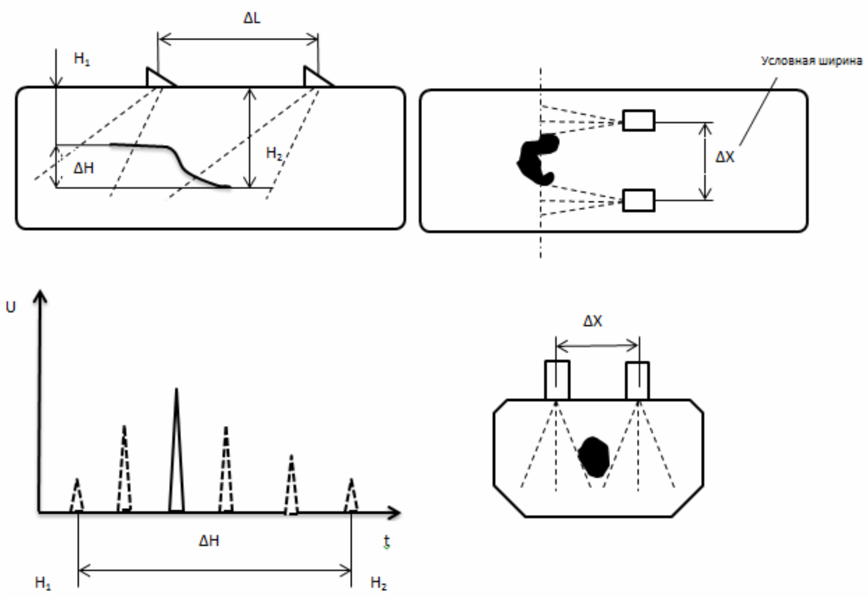
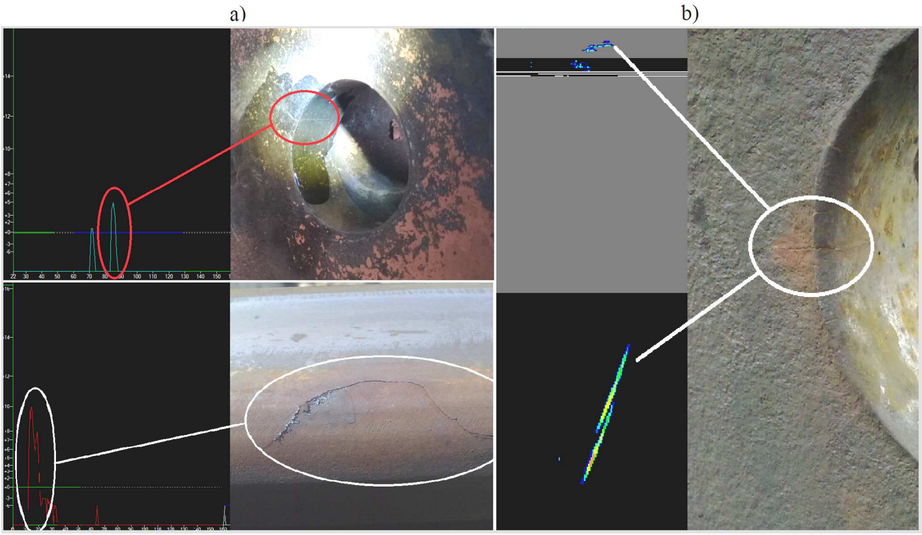


Fig. 1. Measurement principles of conventional size of defect

Real defects of rails and their representation in A- and C-scan are shown in figure 2.

a) b)



c)

Fig. 2. A-scan of crack in the bolt opening (a);
A-scan of horizontal split of the head rail (b); C-scan of crack in the bolt opening

The figures show that these defects can be detected visually. There are defects that are not visually detected. These defects are the most dangerous and are very difficult to detect. The presence of these defects is confirmed by control breaking down.

The main problem of ultrasonic defect detection is the inability to detect various-oriented defects with the help of a piezoelectric converter with one input angle. This is due to the characteristics of ultrasound reflections from defects oriented in different planes. To solve this problem piezoelectric converters with different input angles are used. The input angle is specified by a prism made of organic glass. To determine the parameters of defects, such as depth, width and height piezoelectric converters with input angles of 0, 42, 45, 50, 55, 65, 70 degrees are used. These converters provide practical identification of about 95% of the defects of the rails. Thus, the defect illustrated in Figure 3, was detected with the help of a piezoelectric converter with the input angle of 55°, but was not detected with a piezoelectric converter with the input angle of 0°. This is because the defect is oriented perpendicular to the scanning surface and an ultrasonic wave (0°) simply goes around it. Thus, the main demand during the inspection of suspicious cross sections is to check it using different converters.

At the present stage of development the main purpose of developers of defectoscopy systems and devices is a fully automated inspection process to eliminate the human factor and to increase efficiency. Software is being developed, whose main task is to analyze the signals received by the defect detector. However for reliable and trouble-free operation of this equipment and software it's necessary to observe a number of conditions that can be regarded as the shortcomings of the echo-method. The first condition is the need for permanent preservation of an acoustic contact between the piezoelectric converter and the tested surface. Contacting liquid used for the contact is the matching substance that keeps the focus of the ultrasonic wave during its introduction in the tested object. Accordingly, in its absence (or insufficient amount) the control can not be called qualitative. The second condition is the absence of contamination on the surface of the scan. In the presence of contaminants, as in the case of the acoustic contact, it is impossible to speak of a qualitative control.

Summarizing all the above, it is certain that a variety of methods and means of defectoscopy at this stage of development allows detecting almost all defects in tested objects. The choice of the method depends on the goals and tasks of the control. During rail defect detection the echo-method is widespread used due to its advantages. Work is under way to improve the methods and automation of defectoscopy process but complete elimination of human involvement in the process is quite problematic.

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CONTRIBUTION OF EXCESSES OF THE HIGHEST ORDER IN THE DIFFUSION BLURRING CONCENTRATION SPOTS

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The paper develops a new ideology of solving the equations of mathematical physics, describing the molecular nature of the phenomenon. Owing to the nature of the problem to be solved the quasi-stationary probability density of a random variable, associated with the desired function, is introduced. The diffusion in an endless tube is considered as an example. The asymptotic behavior of the probability density of the diffusing particles is obtained coordinates study its statistical moments. Their evolution in time is set by the diffusion equation (without solutions) and the associated initial condition. It is shown how the error is associated with the excesses of the distribution function if the exact solution is replaced by its asymptotic expression.

Diffusion plays an important role in many processes of chemical technology. For example, the penetration of impurities into the porous beads is a rate-limiting step in the problem of sorption dynamics. Usually the diffusion is modelled by the methods of mathematical physics, not taking into account the molecular nature of the phenomenon at the solution of the relevant partial differential equations. This article develops an alternative approach proposed in [1, 2] for solving the problems of sorption dynamics.

For simplicity we take one-dimensional case, and we write the diffusion equation in the form

$$\frac{\partial n(x,t)}{\partial t} = D\frac{\partial^2 n(x,t)}{\partial x^2}, \tag{1}$$

where $n(x,t)$ - volume concentration of impurities, t – time, x – coordinate, D – diffusion coefficient.

In the presence of the initial condition it has a unique solution (1) (see [3].), which allows to reliably predict the value $n(x,t)$ at any given time. However, despite this determinism, the coordinates of individual impurity molecules are random variables, the distribution law of which evolves over time. This allows you to enter the coordinates of the probability density of impurity particles

$$f(x,t) = n(x,t)S/N, \tag{2}$$

where N - the total number of molecules diffusing impurities in a horizontal tube with a cross-sectional area S.

Introduced instead of $n(x,t)$, a new unknown function $f(x,t)$ probabilistically describes the situation at time t each impurity molecule. Only their huge number (comparable with the number of Avogadro), in accordance with the law of large numbers, leads to a reliable forecast of evolution $n(x,t)$, which finds its formal expression in the theorem of existence and uniqueness of solutions of the Cauchy problem.