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**SPECIFICS OF INFLUENCE OF THE CHEMICAL COMPOSITION OF
ABSTRACT OBJECT'S PRESENCE ZONE ON ACCURACY OF
DETERMINATION OF SURFACE'S COORDINATES**

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Introduction. An important problem in ensuring the accuracy of measuring the microhardness of a material is the determination of the coordinates of detail's surface investigated. In this case, the occurrence of chemical compounds in the space between the indenter of the measuring device and the surface being investigated can be observed. Actual technological processes, in particular using control and measuring operations, for example, when measuring the microhardness parameter of detail's material, are accompanied by the formation of a chemical presence zone (CPZ) that occurs in the near-surface space of detail. The chemical composition and form of distribution of such a zone of presence has its own characteristics and affects the accuracy of the measurement process. Consequently, we have complex cases that are very precursor to the technology of production.

Modeling the shape of the chemical zone of the presence of a technological object. In the real situation, we obtain non-steady concentric circles of concentration, and closed curves of irregular shape. Moreover, they have a well-defined wave character. Since our task is to determine the distribution of the chemical, the following parameters of the chemical zone of presence are important: first, it is the accuracy of determining the geometry at the boundary of the power of the zone, and for this CZP is considered as a separate abstract entity with its pandanous zone and presence zone; secondly, the accuracy of the geometry of the CKD contour and, as a result, its durability; Thirdly, the propagation of matter in space is influenced by the accompanying processes. The paper presents the models of CWP that take into account the shape of the space of the zone.

Conclusions. Consequently, we must conclude that the chemical zone of the presence of an abstract object can be formed in three main ways: the neutral distribution of matter in a medium without chemical interaction, but with the presence of collision mechanics of atoms and molecules; active proliferation due to chemical reactions with the formation of new chemical compounds; distribution of the secondary chemical presence zone, which is the product of interaction with the environment of the primary substance.

Keywords: chemical zone of presence; abstract nature; form; microhardness; detail.

Introduction

An important problem in ensuring the accuracy of measuring the microhardness of a material is the determination of the coordinates of individual sections of the investigated surface of the part. Similar measurements are made by precision measuring instruments in conditions not only laboratory but also real production. In this case, the occurrence of chemical compounds in the space between the indenter of the measuring device and the surface being investigated can be observed.

Consequently, in the space a chemical presence zone (CPZ) of the abstract entity (AE) is formed in the space [1, 2]. The nature of the distribution of this chemical zone, its geometrical parameters and the heterogeneity of the chemical composition affects the accuracy of the measurement in accordance with the dimensions of the tip of the indenter and the local area

of the surface. In this case, the research tool that provides information about the composition of substances in the space that is in the near-surface zone of AE. Among all types of zones of presence, the chemical zone is somewhat aloof while having very good information properties. The main information property of CPZ is that it is so informing its environment about its chemical composition, but also as a consequence of possible internal constructions. In addition, in contrast to other presence zone, the chemical presence zone requires that the objects in the near-surface and surrounding space be reconciled with which they AE will be able to co-exist. In the opposite case there are actions aimed at the destruction of aggressive properties to a stable state. For example, oxygen and hydrogen have the ability to coexist only in the state of water and their derivatives.

Despite the rather active study of the properties of CPZ, which occurs in different types of combinations of AE [3, 4, 5, 6, 7], the problem of influence of the chemical composition heterogeneity of the zone's space when measuring the microhardness of the material is relevant. So, we have complicated cases that are very precursor to the production technology [8].

Problem's statement

If we have any compound of chemical elements that diffuse from the AE's surface, then it is extremely difficult to determine the boundary of the presence zone if we focus on all the components of the mixture together. That is, to determine the zone size, we have the possibility of one of them, using the distribution theorem [7]. In this case, we have the opportunity to determine CPZ size, even with a large amount of substances in the mixture. The only condition in this case should be that the decomposing or subliming chemical should have origin from AE. For example, a couple of water above water, a pair of iodine over iodine, a pair of mercury over mercury, without taking into account all the other components present. However, our task to determine the CPZ size is greatly facilitated, because we are guided by some one component. In the second case, if we have any one chemical substance, then the determination of CPZ is reduced to a similar solution as in the previous case.

So, according to the information properties, the first place is law of TONTOR [7], that is $T(T)$, if there is CPZ and when $\bar{T}(\bar{T})$ it is not. Thus, assuming the function $\chi(t)$ as a chemical reaction, we have the opportunity to write the next dependence

$$\left. \begin{aligned} T(T)\chi(t) &= \Xi\chi(t) \\ \bar{T}(\bar{T})\chi(t) &= 0 \end{aligned} \right\}, \quad (1)$$

where $0 < \Xi < 1$ is a function of the translation of CPZ.

At present, such a function in many cases has a description of diffusion processes with corresponding thermodynamics. As the most complicated example, the anomalies of the concentration of a chemical compound in AE' mass can be considered here. For a simple example, the zone of spread of smell around AE can be considered [6]. These are gases such as S_2 , SO_2 , NH_4 , H_2S , NO_2 , etc. A large number of chemical elements, their compounds and varieties a large number of chemical compounds with specific properties are generated. As a result, the process of chemical symbiosis can take place quite long before the process of balancing is completed.

In the event that a reaction occurs in the middle of AE, it has the property of propagation in all directions and stops only in the presence of some obstacle (the law of aggression) [7]. The surface of AE is the barrier that determines the external CPZ. In this case, the surface having a finite thickness forms its own presence zone. Since the surface covers the entire mass of AE, it is exposed to a powerful external load. Therefore, AE produces such a surface which

has the stability not only of physical loads, but also of chemical ones. In this case, there is a chemical reaction between the external environment and the substance of AE.

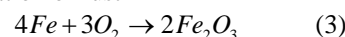
Thus, the limits of CPZ determine the concentration of matter. According to the physical principles, the theory of ideal gases distinguishes between weight and molar concentration. In the case of a liquid, only the concentration of electrolytes is considered and the concentration of solids is not determined [9]. Since the principles of determining the concentration in all cases are the same, then we will be guided by gas substances. A simple example of the distribution of CKD on a half-plane of a material in the production conditions of the application of any detail is consider. In this case, the process goes in three directions.

First, it is the worst corrosive process that occurs deep into the surface of AE. In this case, the front edge of the corrosive surface moving deep into the medium is not stable and not determined in coordinate by the error value $[S]_1$. In this case, an approximate description of the depth (radius) of the process can be obtained as

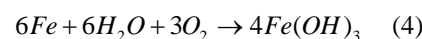
$$r = 2 \sqrt{\frac{Dt \ln \frac{M}{8\aleph(\pi Dt)^2 [S]_1}}{3}}, \quad (2)$$

where M - mass concentration, \aleph - density, D - diffusion gradient.

In addition, it is necessary to take into account the motion's velocity front of the chemical reaction, depending on the supply of the corresponding chemical components to the front $[S]_1$. For example, ordinary oxidation processes were left in the oxygen environment and the formation of rust



and at the next stage, for access to water formed iron hydroxide



That is, the first layer 1 consists of that which feeds the layer 2, which, securing oxygen, nourishes the layer 1 (Fig. 1).

Corrosion of aluminum, for example, has a slightly different character. Moreover, if the aluminum oxide is mainly concentrated in the layer 1, then its hydroxide concentrates in the second layer 2 (Fig. 1 a, b), 3 – AE, 4 – environment's zone, 5 – detail's surface.

That is, to register the boundaries of CPZ it is necessary to perform at least three technological operations: to determine the substance, determine the volume, determine the concentration. The diffusion processes have a great influence on the formation of CPZ. At present, the process of diffusion means the establishment of the same concentration. The consequence of diffusion is the alignment of the chemical potential within a mass [2, 9, 10]. The foregoing statement is valid for imaginary situations when we have a limited volume within which there is CPZ.

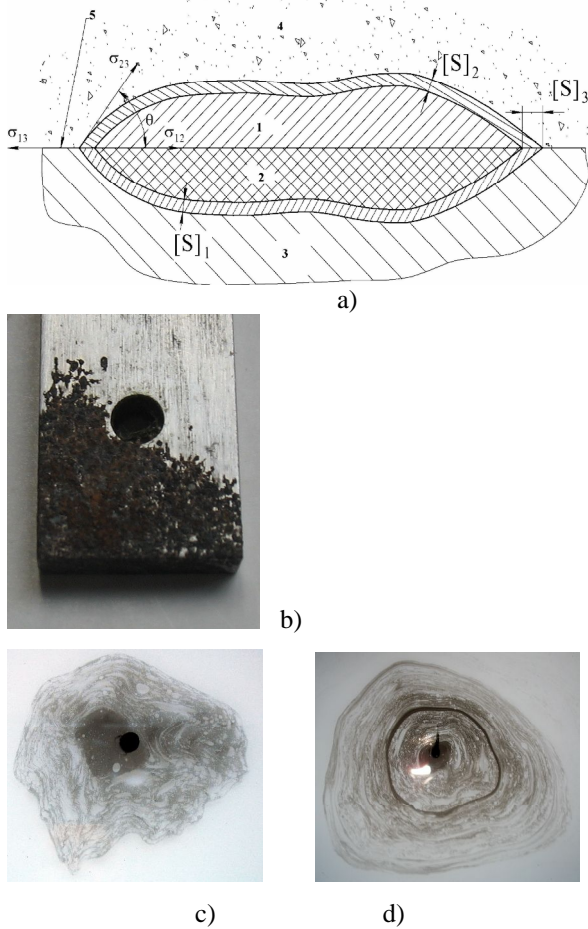


Fig.1 Distribution of chemical ZP: a) general principle of the corrosion process; b) corrosion process on the steel surface of detail; c) process of spreading paint in fresh water; d) process of propagation of paint in water at a salt concentration (0.5% NaCl)

Thus, as seen from Fig. 1, the distribution of chemicals in CPZ is a diffusion process that depends on the properties of both the substance and the environment.

Therefore, it is necessary to consider a model for determining the distribution of chemicals in space when controlling details.

Modeling of the chemical presence zone shape of an abstract object at control and measurement processes

At first sight extension substance has a linear character and the movement there is normal to the outer front of the substance wave. However, this is not always the true, it is enough to look at the real situation in the drawing (Fig. 1). That is, ideal concentric circles are impossible even in a series of ideal conditions. All these phenomena have the appropriate to the physical and mathematical description [11, 12].

So, if we have a diffusion process $U(x,t)$, which is the magnitude of the molecules concentration in the

coordinate x at time t , then the process can be written down by the diffusion equation:

$$\frac{\partial}{\partial x} \left(D \frac{\partial U}{\partial x} \right) = C \frac{\partial U}{\partial t}, \tag{5}$$

where C - layer coefficient.

Equation (5) takes the form for linear diffusion and constant coefficients:

$$U_t = a^2 U_{xx},$$

where $a^2 = D/C$ is a coefficient of thermal conductivity.

So, if the process of diffusion of unstable gas, the speed of which is proportional to the concentration, get the equation:

$$U_t = a^2 \Delta U + \beta U \quad (\beta > 0), \quad (\beta < 0).$$

The motion of molecules can cause a chain reaction in this case, when particles of substance, reacting with the environment, begin to multiply.

At $\beta = 0$, we have pure diffusion. In the case $\beta < 0$, if a diffusion occurs with disintegration, this means that reduction of concentration occurs faster than pure diffusion ($\beta = 0$). In the case of $\beta > 0$ there is a diffusion of particles duplicating, that is a chain reaction. The value β is the characteristic of substance, (duplicating coefficient), while how λ_1 is the characteristic of the shape and size of the plot.

So, if we have a plot for value β , which given, and $\lambda_1 = \beta/a^2$, then it is necessary to introduce the concept of critical size. Thus, for the case of a one-dimensional problem, we have an infinite layer ($0 \leq x \leq l$) at the:

$$\lambda_n = \left(\frac{\pi n}{l} \right)^2 \text{ and } \lambda_1 = \frac{\pi^2}{l^2}, \tag{6}$$

at the same time, the critical value of the layer l_{kp} , from which the lavalhe concentration increase process, is defined as

$$l_{kp} = \frac{\pi a}{\sqrt{\beta}} \approx \frac{3,14a}{\sqrt{\beta}} \quad (\beta > 0). \tag{7}$$

For an infinite cylinder, the smallest value λ corresponds to the personal function, which has a radial symmetry and is equal to:

$$\lambda_1^{(0)} = \left(\frac{2,4048}{r_0} \right)^2.$$

Hence the critical diameter

$$d_{kp} \approx \frac{4,80a}{\sqrt{\beta}}.$$

For a sphere, the smallest value corresponds to a personal function that has spherical symmetry

$$\lambda_1 = \left(\frac{\pi}{R} \right)^2.$$

Hence the critical diameter d_{kp} :

$$d_{kp} = \frac{2\pi a}{\sqrt{\beta}} \approx \frac{6,28a}{\sqrt{\beta}}.$$

So, we examined the physics and mathematics base for the distribution of chemical substances in space. We are interested in the size of the presence of a chemical substance in the space around the source of leakage. This process creates a cloud of gas or dust. Such a cloud has initial dimensions that we can imagine as a three-dimensional function $C(x, y, z, t)$ time dependent. The process of propagation of the chemical cloud can be regarded as the process of diffusion of substance from an instantaneous dotted source of mass M in an unlimited space. Such a diffusion process has no molecular and turbulent character, which has some effective coefficient D . This cloud is gradually absorbed, until it disappears altogether. In addition, it occurs, gradually starting from the periphery, where the substance merges with the environment. Under these conditions, if we assume that the source and the cloud are related their own geometric centers, the concentration function can be written as

$$C(x, y, z, t) = M \left(\frac{1}{2\sqrt{\pi Dt}} \right)^3 \cdot e^{-\frac{x^2+y^2+z^2}{4Dt}} \quad (8)$$

at $D = a^2$.

On its own the cloud is a chemical presence zone of source. That is, in the general case, we need to determine the size of the presence zone of the object as such. In this case, the orientation is on the equation (1). So, we need to determine the size of the object (cloud) around the source. To do this, must be considered the physical and chemical properties of this object. The first property of such an object (cloud) is the ability to propagate in the surrounding space. Such environment may be a vacuum, a plasma, a gas, a liquid, or a solid [7, 13]. In all cases, we have a situation of diffusion or the spread of penetration of one substance into another, that is environment. Relying on the physical or chemical properties of the substance, you can determine the coordinates of the diffusion front. Moreover, if a certain physical or chemical property is significantly different from the environment, this does not mean that it is possible to determine the coordinates of the front diffusion without problems. So, if we measure the parameters of the microhardness of the material, then such a cloud containing chemicals from the air gap, as well as those that isolate the surface of the material of the control object, has a significant impact on the accuracy of the measurement. In most situations, chemicals are colorless, such as air consisting of nitrogen, oxygen and inert gases. All gases, of which the air is composed - colorless, therefore, it is not necessary to build on this principle registration devices for the concentration of nitrogen, oxygen or argon. It is necessary to rely on the chemical properties of these gases. Summing up, we have the opportunity to state the fact that when measuring, we must focus on the phantom property of

a substance, which should stand out sharply on the background of the environment. Moreover, the measuring instruments or systems must be very sensitive to this property, denote this phantom property as Φ . In this case, the power of the property in the selected area can be defined as

$$\Phi = \Phi_0 e^{-\alpha l},$$

where Φ_0 is the primary power of the diffusion source, $\alpha = \alpha_0 C$ - scattering and absorption coefficient, proportional to gas concentration ($\alpha_0 = const$), C - concentration of substance in the thickness, l - layer thickness. So, if we have two layers with different layers of thickness l_1 , l_2 and different concentrations of substance C_1 , C_2 then:

$$\Phi = \Phi_0 e^{-\alpha_0 C_1 l_1} \cdot e^{-\alpha_0 C_2 l_2} = \Phi_0 e^{-\alpha_0 (C_1 l_1 + C_2 l_2)}. \quad (9)$$

There is a condition for this:

$$\left. \begin{array}{l} l_2 - l_1 \geq [S] \\ C_2 - C_1 \geq [S] \end{array} \right\}.$$

Therefore, it is clearly from Clauzius law (6) that the change of property occurs on the principle:

$$\Phi = \Phi_0 e^{-\alpha_0 \int C dl}. \quad (10)$$

Thus, determining of limit of chemical propagation will be determined the ratio as Φ/Φ_0 , dependent on value $\int C dl$.

If we accept the value $[S]$ as error of sensitivity of a measuring device, which registers the front of the distribution, then we have three cases respectively.

In the first case, we have a relation:

$$\frac{\Phi_0 - \Phi}{\Phi_0} < [S] \text{ or } \frac{\Phi}{\Phi_0} > 1 - [S],$$

thus, the front zone is not registered.

In the second case with:

$$\frac{\Phi_0 - \Phi}{\Phi_0} > 1 - [S] \text{ or } \frac{\Phi}{\Phi_0} < [S],$$

the device provides uncertain information.

In the third case:

$$[S] < \frac{\Phi}{\Phi_0} < 1 - [S],$$

the device only partially registers the presence zone, and because it has an uncertain character within the limits $[S]$, since the degree of registration of the quantity Φ is dependent on the ratio:

$$\frac{\Phi}{\Phi_0} = e^{-\alpha_0 \int C dl}. \quad (11)$$

If we consider the projection of the cross sections of zone on the plane (x, y) then we will get the projection of concentration zones as in the figure (Fig. 1), which, although not cross-sections, nevertheless give a complete picture of this process.

To determine the geometry of these sections, we define

$$\int C dl = \int_{-\infty}^{\infty} C(x, y, z, t) dz = M \left(\frac{1}{2\sqrt{\pi Dt}} \right)^3 \cdot \int_{-\infty}^{\infty} e^{-\frac{x^2+y^2+z^2}{4Dt}} dz =$$

$$= M \left(\frac{1}{2\sqrt{\pi Dt}} \right)^2 e^{-\frac{x^2+y^2}{4Dt}}. \quad (12)$$

Thus, if the amount of matter in the section is small, that is:

$$\int C dl < \frac{[S]}{\alpha_0}, \text{ then } \frac{\Phi}{\Phi_0} > 1 - [S],$$

then such a region corresponds to the absence of a substance. By a large amount of substance:

$$\int C dl > \frac{\Delta}{\alpha_0}, \text{ then } \frac{\Phi}{\Phi_0} < e^{-\Delta} = [S], \quad (13)$$

that is for an appropriate choice $\Delta = \ln \frac{1}{[S]}$ the region has a powerful property.

That $[S] \leq \int C dl < \frac{\Delta}{\alpha_0}$ is provided, we have:

$$\alpha_0 \int C dl = [S] \text{ or } \alpha_0 M \left(\frac{1}{2\sqrt{\pi Dt}} \right)^2 e^{-\frac{R^2}{4Dt}} = [S], \quad (14)$$

where $R^2 = x^2 + y^2$ defines the boundary of the presence zone, by which it becomes unregistered.

Consequently, as a result, the radius of the chemical zone of presence in equation (14) will be:

$$R = 2 \sqrt{-Dt \ln \frac{[S] 4\pi Dt}{M \alpha_0}}. \quad (15)$$

This dependence is reflected in Fig. 2.

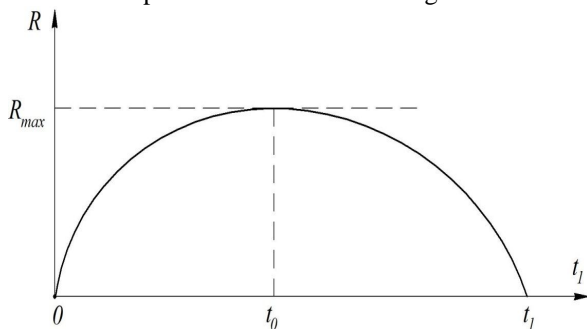


Fig.2 The value of changing the radius by time

For small values of t , the presence zone radius is small, but increases with t at:

$$t = t_0 = \frac{\alpha_0 M}{4\pi e D [S]},$$

the value of radius reaches the maximum value:

$$R_{max} = 2\sqrt{Dt_0} = \sqrt{\frac{\alpha_0 M}{\pi e [S]}}. \quad (16)$$

At $t > t_0$ the radius of the presence zone ρ decreases and for magnitude:

$$t_1 = \frac{M \alpha_0}{4\pi D [S]},$$

is zero, which corresponds to the disappearance of the presence zone.

Investigating the process of increasing the presence zone, one can determine the coefficient of turbulent diffusion D in a free atmosphere, using expressions for t_1 and t_0 . Consequently, all the above applies only to the imaginary situations of diffusion processes based on these theoretical theses. In the real situation, we obtain non-steady concentric circles of concentration, and closed curves of irregular shape. In the real situation, we obtain non-steady concentric circles of concentration, namely closed curves of irregular shape. Moreover, they have a well-defined wave character. Since our task is to determine the contour (area) of chemical propagation. Since our task is to determine the contour (area) of chemical propagation, then it is necessary to pay attention to the following parameters of the chemical zone of presence. Firstly, it is the accuracy of determining the geometry at the boundary of the zone power. For this purpose, CPZ must be considered as a separate AE with its own pandan zone and its occurrence zone. Secondly, determining the accuracy of the geometry of CPZ contour and as a consequence its durability. Thirdly, the influence of the accompanying processes on the propagation of matter in space. Consequently, by equation (16), we have the opportunity to determine R_{max} value, nevertheless, this expression is too idealized and different from the real situation. In equation (9), the change in properties occurs in the thickness of the chemical layer. But a similar situation occurs when the distance from the center of the coordinates changes. Thus, values of l_1 and l_2 can be taken as a centrifugal distance, and equation (9) retains its validity in our mathematical intelligence. As a consequence, in equation (9) we accept the concentration of matter as constant value, that is $C_1 = C_2$ on which responsive system of precision measurement. In this case, we get the following dependencies:

$$\Phi_{max} = \Phi_0 e^{-\alpha_0 C R_{max}}$$

and

$$\Phi_{min} = \Phi_0 e^{-\alpha_0 C R_{min}} \quad (17)$$

In order to register a zone of presence, it is necessary that the difference between Φ_{max} and Φ_{min} was not less than as $[S]$, that is:

$$[S] = |\Phi_{max} - \Phi_{min}| = e^{-\alpha_0 C} \Phi_0 (e^{R_{min}} - e^{R_{max}}), \quad (18)$$

this is reflected in Fig. 3.

Consequently, the physical property Φ of the abstract entity loses its power under the exponential law (17). Unlike the previous task, we observe the concentration according to the distance. It is very well seen that it is possible to define the boundary coordinate only approximately, because it is in the range from $R_0 + R_{min}$ to $R_0 + R_{max}$, where R_0 is the radius of the abstract object with mass M .

Thus, if we move in the direction of the object's surface, then the sensitive element will register the coordinate $R_0 + R_{min} - [S]$.

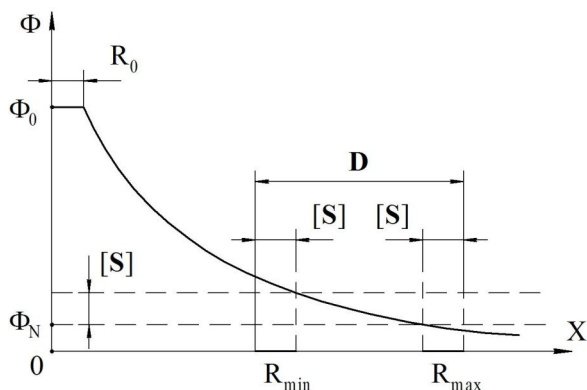


Fig. 3. Boundary zone of CPZ

In addition, the value of R_{\min} is known only to the accuracy of $[S]$. A similar movement is performed in the opposite direction until CPZ disappears in the environment, that is, the property takes the value of mass Φ_N as an object of control. As a result, we get the coordinate $R_0 + R_{\max} + [S]$. It is impossible to make measurements in such a way as to determine radii such as $R_0 + R_{\min} = R_0 + R_{\max}$, because an environment of the function of the CPZ radius is formed

$$\lim(R_{\max} - R_{\min}) > [S],$$

that is the definition of the radius is not better than $[S]$.

In this situation, the duality effect of the boundary of CPZ occurs (Fig. 3), which is denoted by \mathbf{D} . The duality is a vector value, that is, if the function of the property is scalar, then:

$$\text{grad}\Phi = \mathbf{D}_\Phi. \quad (19)$$

Since any property is related to the chemical properties of CPZ, then the concentration as such (8) also has its duality within the zone, that is:

$$\text{grad}C(x, y, z, t) = \mathbf{D}_C. \quad (20)$$

Concentration as a property of CPZ is associated with general properties and, as a consequence, their gradients coincide. Any device that registers any parameter responds to the gradient of the abstract property. In the opposite case, it is simply impossible to determine the size of CPZ, in addition, movement is absolutely necessary to determine the boundary of CPZ.

If we consider the surface of the level of properties, it is quite easy to understand that there is a rather large difference between the imaginary and the real zone of CPZ. The imaginary is always the correct geometry, moreover, it tries to reach the shape of the disk, the half-sphere, and the sphere as the most perfect geometric shapes. Fig. 4 shows the total zone behind the surface of the level. .

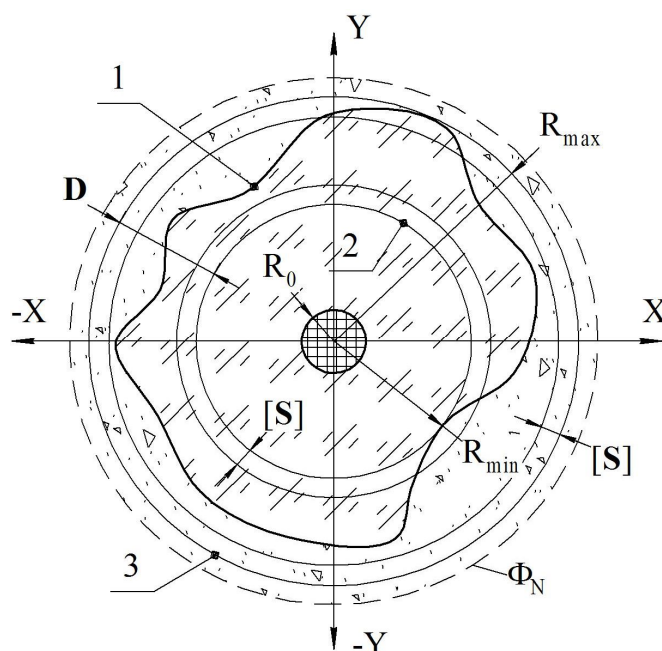


Fig. 4. CPZ scheme: 1 - real CPZ, which is registered by the devices, 2 - surface of the maximum concentration level, 3 - surface of the minimum concentration, Φ_N - concentration is lower than the general background.

Figure 4 shows the situation with equations (2), when a given parameter is fixed. In the future, we must consider the processes, which occur in wave oscillations mass, in which the chemical is distributed from the object of control. Consequently, we add to

the environment a certain substance, which then infinitely distributed in space (environment) around the object. In this case, if we introduce into the environment an object that begins to diffuse in the environment, there is a spatial displacement of the

mass. As a result, such a disequilibrium of the mass causes wave processes that extend both in space and on the surface. In the simplest form, it is the pressure that affects the local concentration of matter. In general, the wave equation, which gives a description of this process, has the following solutions. It should be noted that the increase of CPZ is wavy, which is quite well observed in concrete examples (Fig. 1). So, on Fig.1.b an example of ordinary corrosion of a steel surface is given. In this case, it is necessary to pay attention to the fact that corrosion is spread by the points. In addition, the propagation front has a point character with a different density. That is, the front of corrosion has a rather indefinite outer contour of the presence zone. In such cases, the front can be detected by the points of corrosion that affect the general background. Separately located point should be considered for local corrosive formations. In this case, they should be considered as a wave process (Fig. 1,a, b) the destruction of the surface of a solid under the influence of humidity and aggressive media. The presence of corrosion on the surface leads to a change in its geometry (Fig. 1,a). Consequently, on the surface 5 of the object 3 an active zone is formed, chemical zone 2, which supports surface formation 1. In this case, the fluids are under the influence of a number of forces [13]. If the liquid is on the surface of a solid, then the equilibrium is achieved when the conditions are fulfilled:

$$\frac{W}{S} = \sigma_{23}(1 + \cos \theta), \quad (21)$$

which is called the Dupree-Jung formula [13].

In the case where the process takes place between two fluids, the following condition must be fulfilled

$$\frac{W}{S} = \sigma_{13} + \sigma_{23} - \sigma_{12}, \quad (22)$$

which is called the Dupre equation.

In the equations (21) and (22) we have the following labels: W - surface tension energy, S - effective surface area, σ_{12} - surface tension force between two fluids or liquid and solid, σ_{13} - tensile strength between fluid and medium, σ_{23} - equivalence power σ_{11} and σ_{12} , which is located at an angle θ to AE's surface.

Nevertheless, the geometric dimensions of such entities are not regulated, although they are the chemical concentrator to AE. In this way, the process of spreading CPZ for a solid surface can be explained, as in Fig. 1,b, but for CPZ in Fig. 1,c,d, it is unsatisfactory. As previously shown for CPZ is a very important time factor for which diffusion occurs until the level of chemical activity is not equal to the environment. Therefore, it is very important to consider possible processes, which in one way or another will accelerate the processes in CPZ. As can be seen from the results of the research, CPZ is trying

to increase its size until a balance is established with the external environment. In this case, the dynamics of motion has a wave character, which can be explained by several physical phenomena. These phenomena arise in almost all cases of the existence of an object of measurement almost independently of its material. Taking into account these phenomena gives the opportunity to increase the accuracy of measuring the microhardness of the material of the object.

The process of condensation or dilution of a chemical in space can be explained by the influence of any external forces that lead to the internal movement of a chemical in CPZ. First, these are ordinary chemical reactions, because of thermodynamics of absolutely neutral chemicals. Since there are no thermally neutral reactions, there is a temperature difference already in the middle of the object itself, not to mention external influence. The result of the difference in the temperature of the occurrence of convection, which aligns the temperature field and, as a consequence, accelerates the growth of CPZ. Second, aerodynamics and hydrodynamic motion, which leads to a faster expansion of CPZ. The emergence of such a movement with the possible formation of waves that affect the concentration within CPZ can create gravitational forces [14]. For example, point perturbation of the surface of a liquid leads to the appearance of ring waves, which are described by the wave equation of the following form:

$$\frac{1}{r} \frac{\partial}{\partial r} \left(r \frac{\partial U}{\partial r} \right) + \frac{\partial^2 U}{\partial z^2} = 0.$$

Solving this equation is a complex mathematical operation that gives the following result (wave amplitude):

$$a(r,t) \approx \frac{gt^2}{2^{3/2} r^3} \cos \frac{gt^2}{4r},$$

where g - acceleration of earthly gravity.

Consequently, analyzing the equation (4), we arrive at the conclusion that when the time t fixes, the profile of the liquid surface with height r forms longer waves with unlimitedly decreasing height. By fixing r , we see that the oscillations at each selected point are initially slow with a small amplitude, but over time, they accelerate unconditionally and grow by amplitude. That is, in our case, they do not have the properties of the concentration of the chemical substance and, consequently, of the concentric strips. The motion in the wave in this case occurs vertically, and therefore we simply observe the deformation of a certain layer of fluid. Consequently, if it contains a chemical, it simply moves to the top and bottom without a horizontal displacement. In such a situation, we have no conditions for creating a high concentration.

Another factor that excite the environment before the formation of wave fronts is the sound vibrations in an environment that which related to gravity. In contrast to the gravitational, the sound propagates in the near-surface layer of the liquid and practically does not affect the geometry of the surface. The peculiarity of

sound waves is that they propagate radially from the center and create pressure on any object that is in the liquid. In this case, the pressure field around the vibration ball must satisfy the Helmholtz equation [14]:

$$\Delta U + k^2 U = 0, \quad (23)$$

where $k^2 = \frac{\omega^2}{c^2}$, C - sound speed.

Equation (23) transforms into the following at:

$$\Delta p + k^2 p = 0.$$

From there we get a private solution:

$$p = \frac{A_0}{4\pi} \frac{\omega^2 \rho}{c} \frac{e^{ikr}}{ikr}.$$

At the same time, the speed of the medium at large distances is

$$V_r = \frac{1}{4\pi} \frac{\omega^2 A_0}{c^2} \frac{e^{ikr}}{ikr},$$

where $A_0 = 4\pi r_0^2 a \omega$ - a volumetric pulsation rate, r_0 - radius of sphere, C - sound speed, ω - circular frequency, ρ - liquid density.

In this case, the intensity of the sound field will be determined as (at $I = [S]$):

$$I = \frac{\omega^2 \rho}{32\pi^2 c} \frac{A_0^2}{r^2}.$$

The maximum radius of the zone will be determined as:

$$R_{\max} = \frac{\omega \rho A_0}{4\pi} \sqrt{\frac{1}{2c[S]}}.$$

In our case there is a plane problem and its solution has a slightly different form, that is, a cylindrical radiating object. In this case, the pressure will be determined as:

$$p = A_0 \sqrt{\frac{2}{\pi}} \frac{e^{i(kr - \frac{3}{4}\pi)}}{\sqrt{kr}} \cdot \cos \phi, \quad (24)$$

and radial velocity

$$V_r \approx \sqrt{\frac{2}{\pi}} \frac{A_0}{\rho_0 \omega} \frac{e^{i(kr - \frac{3}{4}\pi)}}{\sqrt{kr}} \cdot \cos \phi. \quad (25)$$

Intensity as the main power indicator will be determined as:

$$I = \frac{A_0^2}{\pi \omega \rho_0 r} \cos^2 \phi. \quad (26)$$

In this case, the radius of zone will be determined at the minimum intensity $I = [S]$ as:

$$R_{\max} = \frac{A_0^2}{\pi \omega \rho_0 [S]} \cos^2 \phi. \quad (27)$$

From the above considerations it is necessary to pay attention to the remarks to the equations concerning diffusion chain. At present, the coefficient n indicating in the rate of interaction of a chemical with the medium simultaneously indicates the mechanism of formation of the wave of a chemical substance. In this case, we have a limited amount of the reactant. As a

result, the reaction process takes place very quickly leaving the products of the reaction itself. As a result of such processes, regions of different density are formed, for example, in Fig.1b, d. This is an important problem for increasing the accuracy of determining the size of the zones that are specific to each biotechnical object [16].

Conclusions

So, in general, we must state the fact that the chemical zone of the presence of an abstract object can be formed in three main ways:

- neutral distribution of matter in an environment without chemical interaction but with the presence of collision mechanics of atoms and molecules;
- active proliferation due to chemical reactions with the formation of new chemical compounds;
- distribution of the secondary chemical presence zone, which is the product of interaction with the environment of the primary substance.

Therefore, it is quite obvious in the course of the investigation that CPZ in its form is trying to acquire a central-symmetry form. Such forms are disks, hemispheres, bullets and distorted varieties, depending on the homogeneity of surrounded the environment. However, even with such homogeneity, when the gradient of any property is zero, central symmetry is impossible for some factors. The motion of molecules occurs in all substances without exception. In addition, even in the absence of extraneous forces, in this way, the Brownian motion of molecules occurs due to thermal fluctuations. Even if we have a sufficiently large molecule, then its straightforward motion is hampered by the so-called D'Alembert's paradox, that is, it is impossible to get a collision front.

Consequently, further research will develop in the direction of determining the magnitude of the error of measurement, depending on the concentration of the layering of the chemical in the presence zone. This is especially true for the boundaries of the pandan zone, the instability of which can lead to significant errors in measuring the microhardness of the local area of the object's material.

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ОСОБЛИВОСТІ ВПЛИВУ ХІМІЧНОГО СКЛАДУ ЗОНИ ПРИСУТНОСТІ АБСТРАКТНОГО ОБ'ЄКТУ НА ТОЧНІСТЬ ВИЗНАЧЕННЯ КООРДИНАТИ ПОВЕРХНІ

Вступ. Важливою проблемою забезпечення точності вимірювання мікротвердості матеріалу є визначення координат окремих ділянок досліджуваної поверхні деталі. Подібні вимірювання здійснюються прецизійними вимірювальними приладами в умовах не тільки лабораторних, але і реальних виробничих. В цьому випадку може спостерігатися виникнення хімічних сполук в просторі між індентором вимірювального пристрою та поверхнею, яку досліджують. Реальні технологічні процеси, зокрема з використанням контрольно-вимірювальних операцій, наприклад, при вимірюваннях параметру мікротвердості матеріалу деталі, супроводжуються формуванням хімічної зони присутності (ХЗП), яка виникає у приповерхневому просторі деталі. Хімічний склад та форма розподілу такої зони присутності має власні особливості та впливає на точність процесу вимірювання. Отже, ми маємо складні випадки, які є дуже дошкульними для технології виробництва. Для отримання точності вимірів мають бути врахованими форма та вміст хімічних речовин у просторі між поверхнею деталі та індентором вимірювального пристрою, а тому моделювання форми ХЗП та відповідне врахування вирішує проблему точності визначення координати поверхні локальної ділянки деталі, що впливає на точність визначення мікротвердості деталі.

Моделювання форми хімічної зони присутності технологічного об'єкта. У реальній ситуації ми отримуємо не пристайні концентричні кола концентрації, а замкнені криві неправильної форми. Мало того, вони мають яскраво окреслений хвильовий характер. Оскільки нашою задачею є визначення контуру (площі) розповсюдження хімічної речовини, то наступні параметри хімічної зони присутності мають вагоме значення: по-перше, це точність визначення геометрії на межі потужності зони, а для цього ХЗП розглянуто як

окрему абстрактну сутність зі своєю панданною зоною та зоною присутності; по-друге, визначено точність геометрії контуру ХЗП і, як наслідок, її тривкості; по-третє, на розповсюдження речовини в просторі впливають супутні процеси. У роботі наведено створені моделі ХЗП, які враховують форму простору зони.

Висновки. Отже, за загального підсумку маємо констатувати той факт, що хімічна зона присутності абстрактного об'єкта може утворюватися у три основні способи: нейтральне розповсюдження речовини у середовищі без хімічної взаємодії, але з наявністю механіки зіткнення атомів та молекул; активне розповсюдження завдяки хімічним реакціям з утворенням нових хімічних сполук; розповсюдження вторинної хімічної зони присутності, яка є продуктом взаємодії з середовищем первинної речовини. Дослідження довели, що ХЗП за своєю формою намагається набути центральносиметричної форми. Такими формами є диски, півкулі, кулі та її спотворені різновиди залежно від однорідності оточуючого середовища.

Подальші дослідження розвиватимуться у напрямку визначення величини похибки вимірювання залежно від концентрації нашарування хімічної речовини у зони присутності. Особливо це стосується меж панданної зони, нестабільність якої може призвести до значних похибок вимірювання мікротвердості локальної ділянки матеріалу об'єкту.

Ключові слова: хімічна зона присутності; абстрактна сутність; форма; мікротвердість; деталь.

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ОСОБЕННОСТИ ВЛИЯНИЯ ХИМИЧЕСКОГО СОСТАВА ЗОНЫ ПРИСУТСТВИЯ АБСТРАКТНОГО ОБЪЕКТА НА ТОЧНОСТЬ ОПРЕДЕЛЕНИЯ КООРДИНАТ ПОВЕРХНОСТИ

Введение. Актуальной проблемой обеспечения точности измерения микротвердости материала является определение координат отдельных участков исследуемой поверхности детали. Подобные измерения осуществляются прецизионными измерительными приборами в условиях не только лабораторных, но и реальных производственных условиях. В этом случае может наблюдаться возникновение химических соединений в пространстве между индентором измерительного устройства и исследуемой поверхностью. Реальные технологические процессы, в частности с использованием контрольно-измерительных операций, например, при измерениях параметра микротвердости материала детали, сопровождаются формированием химической зоны присутствия (ХЗП), которая возникает в приповерхностном пространстве детали. Химический состав и форма распределения такой зоны присутствия имеют свои особенности и влияют на точность процесса измерения, который очень чувствителен для задач технологии производства.

Моделирование формы химической зоны присутствия технологического объекта. В реальной ситуации мы получаем не концентрические круги концентрации ХЗП, а замкнутые кривые неправильной формы с ярко очерченным волновым характером. Поскольку нашей задачей является определение контура (площади) и распространение химического вещества в этом пространстве, то следующие параметры химической зоны присутствия имеют большое значение: во-первых, это точность определения геометрии на пределе мощности зоны, а для этого ХЗП рассмотрено как отдельную абстрактную сущность со своей панданной зоной и зоной присутствия; во-вторых, определена точность геометрии ХЗП и, как следствие, прочность; в-третьих, на распространение вещества в пространстве влияют сопутствующие процессы. В работе приведены модели ХЗП, которые учитывают форму пространства зоны.

Выводы. Итак, в результате мы можем констатировать факт: химическая зона присутствия абстрактного объекта может образовываться благодаря трем основным способам: нейтральное распространение вещества в среде без химического взаимодействия, но с наличием механики столкновения атомов и молекул; активное распространение благодаря химическим реакциям с образованием новых химических соединений; распространение вторичной химической зоны присутствия, которая является продуктом взаимодействия со средой первичного вещества. Исследования доказали, что форма ХЗП пытается приобрести центрально-симметричную форму, например, такими формами являются диски, полушария, шары и ее искаженные разновидности в зависимости от однородности окружающей среды. Дальнейшие исследования будут развиваться в направлении определения величины погрешности измерения, которая зависит от концентрации наслоения химического вещества в зоне присутствия. Особенно это касается границ панданной зоны, нестабильность которой может привести к значительным погрешностям измерения микротвердости локального участка материала объекта.

Ключевые слова: химическая зона присутствия; абстрактная сущность; форма; микротвердость; деталь.

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