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# FEATURES OF THE BEHAVIOR OF GAS-LIQUID MIXTURE TUBES

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**Abstract**- Experimental theoretical studies carried out recently with gas-containing liquids have shown that under pre-transition conditions (in pressures exceeding the saturation pressure, but close to it), the rheological systems are largely determined by the presence of "micro nuclei"- the smallest gas bubbles, the cooperative action of which manifests itself when approaching the saturation pressure [1]. When solving many practical problems, it becomes necessary to study the wave propagation taking into account the influence of the interaction between the liquid and the wall of the deformable pipe. In this case, a system consisting of a deformed body, liquid and gas is obtained; therefore, the study should be carried out taking into account interaction forces between the deformed body, liquid and gas. Mechanical properties of deformable system in modern technological processes and living organisms, as a rule, depend on the result of the interaction with the liquid covered the environment. For this reason, the hydrodynamics of the displacement of coatings along with liquid is one of the most pressing issues. In this case, the force of interaction is usually significantly dependent on the system of deformation. Therefore, when determining the force of impact of the fluid to the system, there is a need to explore the system in its own deformation.

**Keywords:** Viscous-Elastic Tube, Viscous Fluid, Waves, Dispersion Equation.

## 1. INTRODUCTION

It is known that the effects of non-conductivity substantially complicate the research and are most fully manifested when considering waves arising from the impact of shock and vibration loads [1]. These are liquids with bubbles. Knowledge of the regularities of the processes occurring in such continuous environ is one of the great importance for the creation of scientific bases for mathematical analysis.

Let's explore pulse displacement of liquid slurry bubble in the thin-walled cylindrical surface orthotropic elastic tube with radius $R$ and the thickness $h$. We accept that two-phase liquid flow conditions aren't excited and the fluid carrier being drip. A small drop in pressure created by fluid flow in the pipes with small thickness creates waves that are axis symmetrical and not axis symmetrical as in separate coatings. That is why the form of peculiar oscillations and frequency of the "cover-liquid dynamic system should be determined.

Based on the methods of the whole mechanics of bubble fluid flow, we'll give mathematical assumptions necessary to facilitate a solution to the problem of bubble environment [3]:

- in each elementary macro volume, the bubbles exist in the form of spherical inclusions of the identical radius r0, and the volume concentration of bubbles is minor (the mixture is mono-disperse), and the value r0 is significantly smaller than the distinctive dimensions of the problem;
- direct interaction and clashes of bubbles with one another can be ignored;
- the developments of coalescence (coagulation), crushing and the establishment of new particles are neglect;
- the velocities of the bubbles and the carrier phase are the same;
- bubbles have a neutral buoyancy. Don't settle and don't emerge;
- the viscosity of the carrier phase is much greater than the viscosity of the gas bubbles (for example, the viscosity of water is 10 times that of air) and therefore the viscosity of the mixture is practically independent of the volume content of the bubbles.

The flow issues of the two-phase fluid in the deforming substantially-elastic coatings are the broadly developed areas of hydrodynamics at this moment. But substantial elasticity of some materials and the compression of two-phase fluid have been less learned. The foundation of this has been laid in the fundamental works of L. Eyler, I. Gromeka, N.E. Jukovski., the importance, features of such issues are considered to be one of the widely used areas of hydrodynamics.

But the main concern about the feature of the relationship between the rheological properties of the liquid and the coating material was not sufficiently studied. The article examines the dependence of the density, pressure, displacement amplitudes of the different fluids on the unit volume of bubbles. In this case the calculations were made at 0.01-0.1 of the quantity of $\alpha_{20}$. Let's note that different values of $x$ parameter have been considered in the process of these calculations and it has been determined that, the change of this parameter doesn't practically affect the amplitudes. The dependence of amplitude of density on the amount of bubbles and the carrier liquid density has been investigated, and it has been known that the amount of bubbles significantly affect the amplitude of density.

Resolving the problem of transference of two-phase flows, we must pay attention that such a medium differs from other two-phase media in that the heat capacity of the transporter phase $\rho_1 c_1$ considerably exceeds the heat capacity of the scattered phase $\rho_2 c_2$ due to the prevailing mass content of the transporter phase per unit volume [2]: $\rho_1 c_1 >> \rho_2 c_2 \left(c_1 \sim c_2,\, \rho_1/\rho_2 >> 1\right)$
where, $\rho_1$ and $\rho_2$ accordingly, the density of the liquid and gas. Therefore, the fluid is a thermostat and has a constant temperature $T_1 = \text{const}$. Within the framework of these features, it is of theoretical and practical interest to character the flow of a two-phase bubbly liquid in cylindrical tubes. The urgency of this task is also determined by the fact that in engineering practice (medicine, transport and storage of oil and gas, aviation, etc.) there are widespread structures, elements whose components have cavities or compartments containing liquid, which in turn never homogeneous, and contains small additives of un-dissolved gas.

## 2. MATHEMATICAL MODEL OF THE FLUID

A small gas double bubble - ambient combination can be shown as fairly significant sample of the relaxation surroundings. Practical and theoretical investigations show that, while determination the problem of the flow of two-phase liquid we should take into account that such kind of environments differ from other two-phase environments by the fact that the heat capacity of the moving phase is much higher than the heat capacity of the dispersion phase, the mass of the moving phase exceeds it in the volume unit.

We receive the following ratios from rheological equation of a two-phase environment and average of the flow cross-section along the continuity equation and Navier-Stokes linearized assumptions of viscous fluid [3]:

$$\frac{2}{R}\frac{\partial w}{\partial t} + \frac{\partial u}{\partial x} + \frac{1}{\rho_0}\frac{\partial \rho}{\partial t} = 0$$

$$\rho_0 \frac{\partial u}{\partial t} + \frac{\partial p}{\partial x} + \mu \frac{\partial^2 u}{\partial x^2} = 0$$

$$\rho_0 \frac{\partial u}{\partial t} + \frac{\partial p}{\partial x} + \mu \frac{\partial^2 u}{\partial x^2} = 0$$

where, $u$ is the velocity of the mixture, $w$ is radial displacement of the tube wall, according to $\rho_0$, $\rho$ are the density of the fluid and the mixture, $\mu$ and $\xi$ are dynamic viscosity of the fluid and the volume ratios, and $a$ is the rate of spread of sound in a two-phase.

we can basically write for quantity $a^2$ and $\rho$ [1]:

$$a^2 = \frac{1}{\alpha_{20}\left(1-\alpha_{20}\right)} \cdot \left(\frac{\rho_{10}}{\rho_{10} - \rho_{20}}\right)^2 \cdot \frac{p}{\rho_{10}}$$

$$\rho = \left(1-\alpha_{20}\right) \cdot \rho_{10} + \alpha_{20} \cdot \rho_{20}$$

where, $\alpha_{20}$ is the amount of volume bubbles, according to $\rho_{10}$ and $\rho_{20}$ are the carrier phase (liquid) and the gas density. Zero index shows rates appropriate to the parameters of the system in the form of balance. $p(x,t)$ is hydrodynamic pressure of the two-phase environment. The index 0 below indicates the value of the parameter in the balanced condition. In the linear formulation it has to be considered that, instead of the current volume concentration $\alpha_2$, an equilibrium one is used $\alpha_{20}$, and this method a priori implies the existence of bubbles ($\alpha_{20} \neq 0$)

The radius of the bubbles in known experiments varies in the range 0.2-2 mm, and their volume content $\alpha_{20}$ is determined by lifting the column of liquid in the range 0.01-0.1. Let's take into account that the gas density is smaller than the density of liquid phase: $\rho_{20} << \rho_{10}$. It will allow you to replace above statements of the velocity of spread of sound and density of two-phase environment with the more sufficient accuracy statements in the two-phase environment,

$$a^2 = \frac{1}{\alpha_{20}\left(1-\alpha_{20}\right)} \cdot \frac{p}{\rho_{10}}$$

$$\rho = \left(1-\alpha_{20}\right) \cdot \rho_{10}$$

A system consisting of a liquid, gaseous, and solid phases is modeled as an isotropic, homogeneous, infinite cylindrical shell.

It is assumed that the movement of the gas-liquid medium and the pipe is axisymmetric, and the movement of the pipe occurs only in the radial direction. Then the movement of the pipe $u$ walls will depend only on the radial coordinate $r$ and time $t$. In this case, the equation of motion of the pipe will look like [3], [4]:

$$\frac{u}{R^2} = \frac{1-v^2}{E}\left(-\rho_T \frac{\partial^2 u}{\partial t^2} + \frac{p}{h}\right) \tag{1}$$

where, $\rho_T$ is the density of the pipe material, $v$ is the Poisson's ratio, $E$ is the Young's modulus, $R$ is the radius and $h$ is the thickness of the pipe, $p$ is the pressure of the gas-liquid medium.

On the inner surface of the shell, the condition of equality of radial velocities of the two-phase medium $v_r$ and the pipe wall is taken:

$$v_r\big|_{r=R} = \frac{\partial u}{\partial t} \tag{2}$$

If the volume content of bubbles in a unit volume of the mixture $\alpha_2 \sim 1\%$ (a very interesting case from the practical point of view), then the stable bubble structure of the medium is realized and the latter can be considered as a kind of homogeneous "bubbly liquid" [5].

A characteristic feature of such a liquid is a high average density $\rho = \alpha_1 \rho_1^0 + \alpha_2 \rho_2^0 \approx \alpha_1 \rho_1^0 \approx \rho_1^0$ and $\left(\alpha_1 + \alpha_2\right)$ slightly different from the density of the carrier phase in force $\rho_2 << \rho_1^0$, $\alpha_2 << 1$.
where, the subscripts 1 and 2 refer respectively to the parameters of the liquid and gas phase. In this case, the compaction of the mixture actually happens only due to the compression of its gas constituent, the liquid phase is practically not compressed.

We use the generally accepted assumption about the manifestation of viscosity only in the processes of interfacial interaction and the manifestation in the macroscopic processes of momentum transfer.

We also assume that the average mass temperature of the mixture is constant. Under these assumptions, the linearized equations of continuity and motion are written in the form:

$$\frac{\partial \rho}{\partial t}+\frac{\rho_0}{r}\frac{\partial (r v_r)}{\partial r}+\rho_0\frac{\partial v_x}{\partial x}=0 \tag{3}$$

$$\frac{\partial v_x}{\partial t}=-\frac{1}{\rho_0}\frac{\partial p}{\partial x} \tag{4}$$

where, the index 0 below refers to the unperturbed state.

Let us average the Equation (3) over the pipe section.

Bearing in mind that, $\langle A\rangle=\dfrac{\int_0^R 2\pi r A dr}{\pi R^2}$, then we get

$$\frac{2}{R}v_r\big|_{r=R}=\frac{\partial v_x}{\partial x}+\frac{1}{\rho_0}\frac{\partial \rho}{\partial t}=0 \tag{5}$$

## 3. THE RESOLVING EQUATION

Let's solve the system of equations for the hydrodynamic pressure $p(x,t)$:

$$\left[\frac{2R\cdot(1-v_1v_2)}{hE_2}a^2-\frac{1}{\rho_0}\right]\frac{\partial^2 p}{\partial t^2}+\frac{2\xi R(1-v_1v_2)}{\rho_0 hE_2}\frac{\partial^3 p}{\partial t^3}+$$
$$+\left[-\frac{2\mu R(1-v_1v_2)}{\rho_0 hE_2}a^2-\frac{\mu-\xi}{\rho_0^2}\right]\frac{\partial^3 p}{\partial x^2\partial t}-$$
$$-\frac{2R\mu\xi(1-v_1v_2)}{\rho_0^2 hE_2}\frac{\partial^4 p}{\partial x^2\partial t^2}-\frac{a^2}{\rho_0}\frac{\partial^2 p}{\partial x^2}=0$$

As a result of simple mathematical conversions, we get partial differential equation from the fourth content for hydrodynamic pressure in the system.

$$\left[\frac{a^2}{c_0^2}-1\right]\frac{\partial^2 p}{\partial t^2}+\frac{\xi}{c_0^2\rho_0}\frac{\partial^3 p}{\partial t^3}+\left[-\frac{\mu a^2}{c_0^2\rho_0}+\frac{\mu-\xi}{\rho_0}\right]\frac{\partial^3 p}{\partial x^2\partial t}-$$
$$-\frac{\xi\mu}{c_0^2\rho_0^2}\frac{\partial^4 p}{\partial x^2\partial t^2}-a^2\frac{\partial^2 p}{\partial x^2}=0$$

where, $c_0^2=\dfrac{hE_2}{2R(1-v_1v_2)\rho_0}$

Let's seek a solution in the form of variables in the equation,

$$p(x,t)=y(x)\exp(i\omega t)$$

In this case the mathematical solution of the issue for the spatial coordinate brings to the calculation of usual partial differential equation.

$$y''(x)+\delta^2 y(x)=0$$

where, $\delta$ is complex number in the equation marked with the following expression.

$$\delta^2=\frac{\left(\frac{a^2}{c_0^2}-1\right)\omega^2+i\frac{\xi}{c_0^2\rho_0}\omega^3}{-\frac{\xi\mu}{c_0^2\rho_0^2}\omega^2+a^2+i\left(\frac{\mu a^2}{c_0^2\rho_0}-\frac{\mu-\xi}{\rho_0}\right)\omega}$$

The solution of the equation is as follows:

$$y=Ae^{-i\delta x}+Be^{i\delta x}$$

where, $A$ and $B$ constants in the integration of complex ratio case, their ratios are determined by the border terms of issue. As oscillations of the system are placed in $x$=0 created by the piston displacement and $y$ is limited function,

$$\begin{cases}\text{when } x=0,\ y=y_0\\ x\to\infty,\ y\to 0\end{cases}$$

We will get the next step to determine pressure:

$$p(0,t)=p_0\exp(i\omega t),\ p(\infty,t)=0$$

Considering these conditions, in the expression of the solution of the equation,

$$p(x,t)=p_0\exp[i(\omega t-\delta x)]$$

We can find displacements through the use of pressure expression:

$$w=\frac{R^2(1-v_1v_2)}{hE_2}p_0\exp[i(\omega t-\delta x)]$$

A similar procedure is determined for the expression of the velocity of the mixture.

$$u(x,t)=\upsilon(x)\exp(i\omega t)$$

We will have the following computation taking into account the expression rate of the mixture in (2),

$$\upsilon''(x)+ik\upsilon(x)=i\frac{\delta p_0}{\mu}\exp(-i\delta x)$$

Let's separate sought-after $v(x)$ function into the real and complex parts,

$$\upsilon(x)=\upsilon_1(x)+i\upsilon_2(x)$$

The following solution is received for the waves spread only in the right direction of ox axis: [4]

$$u(x,t)=\left\{\frac{p_0}{k\mu}(\delta_0\cos(\delta_0 x)-\delta_1\sin(\delta_0 x))-\right.$$
$$-\frac{E}{kL}\left(-2\delta_0\delta_1\cos(\delta_0 x+\alpha)+(\delta_1^2-\delta_0^2)\sin(\delta_0 x+\alpha)\right)+$$
$$\left.+\frac{E}{L}i\sin(\delta_0 x+\alpha)\right\}\cdot\exp(i\omega t-\delta_1 x)$$

where the following expressions have been pointed out by $E$ and $L$.

$$E=\sqrt{D^2+C^2}\quad L=\sqrt{M^2+N^2}$$

where,

$$D=\frac{p_0}{\mu}\left(\delta_1^2\delta_0+2\delta_1^2\delta_0-\delta_0^3-k\delta_1\right)$$

$$C=\frac{p_0}{\mu}\left(2\delta_0^2\delta_1+\delta_0^2\delta_1-\delta_1^3-k\delta_0\right)$$

$$M=4\delta_1\delta_0^3-4\delta_0\delta_1^3$$

$$N=\delta_0^4-6\delta_0^2\delta_1^2+\delta_1^4+k^2$$

$$\alpha=\arctan\frac{D}{C}$$

Note that, complex number $\delta$, is shown like $\delta = \delta_0 - i\,\delta_1$

$$\delta_0 = \sqrt{\frac{1}{2m}\left(\sqrt{m_1^2 + m_2^2} + m_1\right)}$$

$$\delta_1 = \sqrt{\frac{1}{2m}\left(\sqrt{m_1^2 + m_2^2} - m_1\right)}$$

where,

$$m = \left(\frac{\xi\mu}{c_0^2\rho_0^2}\omega^2 + a^2\right)^2 + \left(\frac{\mu a^2}{c_0^2\rho_0} - \frac{\mu+\xi}{\rho_0}\right)^2 \omega^2$$

$$m_1 = \left(\frac{a^2}{c_0^2} - 1\right)\cdot\left(\frac{\xi\mu}{c_0^2\rho_0^2}\omega^2 + a^2\right)\cdot\omega^2 - $$
$$-\frac{\xi}{c_0^2\rho_0}\omega^4\cdot\left(\frac{\mu a^2}{c_0^2\rho_0} - \frac{\mu+\xi}{\rho_0}\right)$$

$$m_2 = \frac{\xi}{c_0^2\rho_0}\omega^3\cdot\left(\frac{\xi\mu}{c_0^2\rho_0^2}\omega^2 + a^2\right) +$$
$$+\left(\frac{a^2}{c_0^2} - 1\right)\cdot\left(\frac{\mu a^2}{c_0^2\rho_0} - \frac{\mu+\xi}{\rho_0}\right)\cdot\omega^3$$

Consider the case when the radial inertia of the liquid phase is not significant during bubble pulsations, and the difference between the phase pressures is balanced by viscous forces in the liquid. Such situations are realized when the bubbles are small and the liquid is viscous. For the case of an incompressible liquid phase, the equation of state of such a gas-liquid medium was obtained in [6], [7]:

$$p = \frac{\alpha_{20} p_0 \rho_{10}^0}{\rho_{10}^0 - \rho}\cdot\frac{\rho}{\rho_0} + \zeta\frac{1}{\rho_0}\frac{\partial\rho}{\partial t}$$
$$\zeta = \frac{4\mu_1(1-\alpha_{20})}{3\alpha_{20}} \approx \frac{1}{3\alpha_{20}}\mu_1 \qquad (6)$$

where, respectively, the pressure $p$ and density of the gas-liquid medium $\rho$, $\alpha_{20}$ is the volume content of bubbles in a unit volume of the mixture $(\alpha_{20}\sim 0,01-0,1)$, $\mu_1$ is the dynamic viscosity of the liquid (for water $\mu_1 = 10^{-3}$ Pa.sec $= 10^{-3}$ N.sec/m$^2$), $\rho_{10}^0$ is the true density of the liquid (for water at atmospheric pressure $\rho_{10}^0 = 1000$ kg/m$^3$). The subscript "0" refers to the value of the parameters at $t = 0$.

The linearized expression [8] for pressure (6) has the form:

$$p = \frac{\alpha_{20} p_0 \rho_{10}^0}{\rho_{10}^0 - \rho}\cdot\frac{\rho}{\rho_0} + \zeta\frac{1}{\rho_0}\frac{\partial\rho}{\partial t} \qquad (7)$$

Due to the fact that viscosity of water is approximately 60 times greater than air's, it practically doesn't depend on the volume content of bubbles in the mixture. $(\alpha_{20}\sim 0.01-0.1)$

Thus, the complete system of equations [9] takes the form:

$$\frac{u}{R^2} = \frac{1-v^2}{E}\left(-\rho_T\frac{\partial^2 u}{\partial t^2} + \frac{p}{h}\right)$$
$$\frac{\partial v_x}{\partial t} = -\frac{1}{\rho_0}\frac{\partial p}{\partial x}$$
$$\frac{2}{R} = \frac{\partial u}{\partial t} + \frac{\partial v_x}{\partial x} + \frac{1}{\rho_0}\frac{\partial p}{\partial t} \qquad (8)$$
$$p = \frac{p_0}{\rho_0}\frac{1}{\alpha_{20}}\rho + \zeta\frac{1}{\rho_0}\frac{\partial\rho}{\partial t}$$

The system of Equations (8) is closed and can be helpful to study the development of small perturbations in a shell include a gas liquid medium. Further we will use the following dimensionless variables and parameters:

$$U = u/R$$
$$P = p/p_0$$
$$V = v_x/v_0$$
$$v_0 = R/t_0$$
$$z = x/R\,\tau = t/t_0 \qquad (9)$$
$$t_0 = R\sqrt{\rho_T/E}$$
$$\alpha = p_0 R/hE$$
$$\beta = p_0\rho_T/\rho_0 E$$
$$Q = \rho/\rho_0$$
$$M = \zeta/p_0 t_0$$

Then the system of equations in a dimensionless form takes the form:

$$U = (1-v^2)\left(-\frac{\partial^2 U}{\partial\tau^2} + \alpha P\right)$$
$$\frac{\partial V}{\partial\tau} = -\beta\frac{\partial P}{\partial z}$$
$$\frac{\partial Q}{\partial\tau} + \frac{\partial V}{\partial z} + 2\frac{\partial U}{\partial\tau} = 0 \qquad (10)$$
$$P = \frac{1}{\alpha_{20}}Q + M\frac{\partial Q}{\partial\tau}$$

## 4. THE OBTAINED NUMERICAL VALUES OF THE SOLUTION OF THE ISSUE.

In a numerical experiment, we consider a semi-infinite tube with a flowing two-phase liquid: glycerin, water and oil containing small additions of air bubbles, respectively. The obtained numerical results show that, depending on ratios, the determined $\delta_0$ and $\delta_1$ are composed of several spectrum. Getting physical properties of different solutions in different ratio parameters and physical processes giving rise to the viscosity of the environment is taken into account.

Comparison of the results of calculations shows that dispersion of flexible elasticity of waves transmitted with the help of the "mixture of viscous liquid surface orthotropic elastic tube" system, is dependent on the physical properties of the walls coatings and in case of hard coatings - on liquid viscosity.

Preference of elasticity of the coating in high frequencies, in the second case, wave with small frequencies applied by the hydraulic form spread of bulging waves is provided.

As shown in the figures:

1) Depending on the physical parameters of the environment, enough change is felt in the ratios of the velocity, displacement, density and the hydrodynamic pressure as size concentration of the bubbles increases in the two-phase. Thus, for lighter carrier phase, the following difference is more common;

2) the reduction occurs in the rates of pressure drop and radial displacement of the wall of the coating, starting from the growth rate of the density of the carrier phase and the fixed rate of the flow;

3) comparison with single-phase environment, the reason to hold analysis for adequate hydrodynamic view are related in advance to planned investments of the matter.

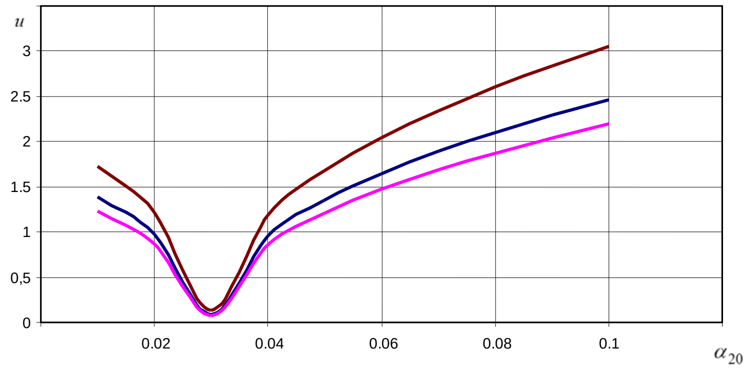


Figure 1. Depending the velocity of the two-phase liquid on the size concentration of the bubbles; 1-oil, 2-water, 3-glyserine

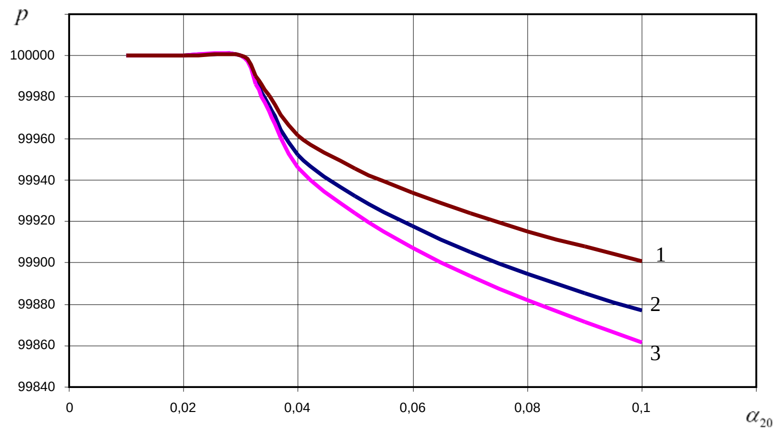


Figure 2. Depending the hydrodynamic pressure of the two-phase liquid on the size concentration of the bubbles; 1-oil, 2-water, 3-glyserine

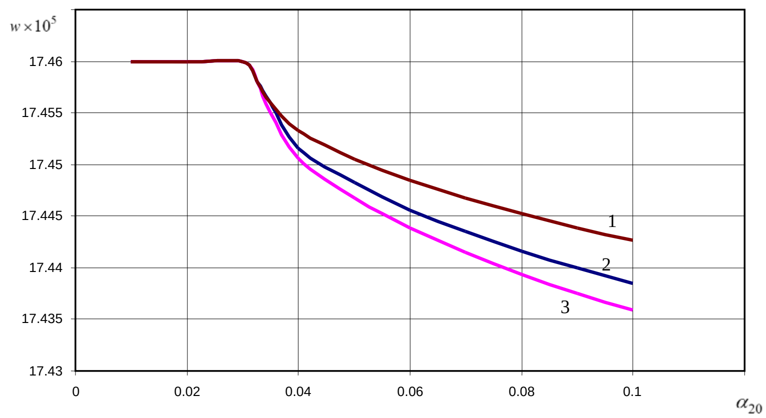


Figure 3. Depending the displacement of the two-phase liquid on the size concentration of the bubbles; 1-oil, 2-water, 3-glyserine

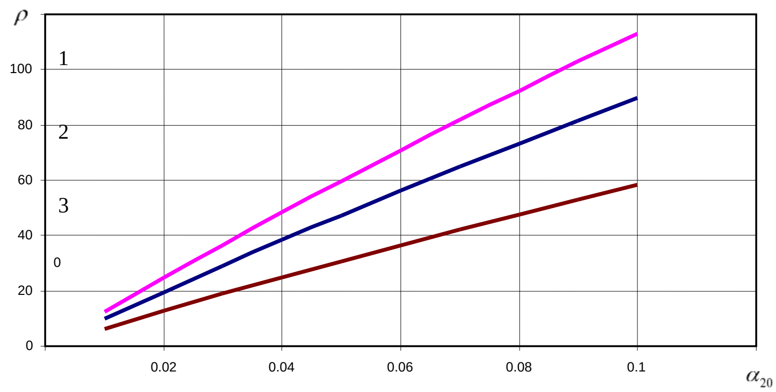


Figure 4. Depending the density of the two-phase liquid on the size concentration of the bubbles; 1-oil, 2-water, 3-glyserine

## 5. CONCLUSIONS

Consequently, according to the selected parameters and mode of system, we can come to the following conclusions:

- In addition, the amplitude of the dimensionless density increases by an order of magnitude;
- It is determined that only the viscosity lightly effects the flow pattern of the mixture and its substantiality almost doesn't affect the nature of flow of the mixture. .
- As the α value increases, the wave propagation velocity decreases significantly; the wave propagation rate decreases in the process of the two-phase fluid environment (non-squeezed linear substantial fluid and compressed gas bubble) motion in the core-elastic cylindrical pipe, the influence of the fluid substantiality on the characteristics of the movement is small;
- the amplitude of the speed flow of the mixture increases (and consequently its consumption increases);
- in the flow of two-phase substantial fluid on the deformed elastic coatings it has been determined that, the volume of gas bubbles increases depending on the concentration coefficient $\alpha_2$ in the $\delta_0$ - environment. The numerical calculations reflect in themselves the cases of their change in the coating two-phase environment at the 0.01-0.1 interval;

Concluding Remarks:

1. The result of the study revealed that, hydroelasticity of coatings with fluid should be considered as one of the topical issues of the whole environment mechanics. For this reason, while determining the effect of the liquid on the system the deformation of the system has also been taken into account. It has been shown that the physical and mechanical properties of the deformed system in modern technological processes and living beings depends on the result of the interaction with bubble fluid.
2. In the process of the problem solution on the coatings inside of which bubble fluid is transmitted the evaluation of the effects of the compaction and blend of the mixture non-stationary dynamic procedures has been held, when the cover is made of non-classic materials, the need of the selection of a more complex mathematical model and mathematical analysis of issues in 3D dimension are highlighted.
3. In this considered issue it has been shown that hypersensitivity effect of the fluid causes complications in the solution process, and there is a need to establish a scientific basis for the system's exploitation.
4. It has been shown that, the points of the dance decryption according to the coordinates are slightly dependent on the properties of the fluid mixture transported at the high points of the rigidity of the tube material and vice versa, physical properties of liquid mixture in flexible pipes (of relatively small hardness) have a great effect on the points of the decrement of the dances in accordance with the coordinates.
5. The numerical results of the article can be used in technological processes, modern rocket-space complexes, oil-gas industry, gradual study of hydrodynamic processes occurring in living organisms.

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