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The Theoretical and Experimental Study of the Behavior of the Mercury Drop, Fixed on the Glass Bottom of Vessel with Fluid, Under the Acceleration of Gravity Change

M. Shoikhedbrod*

Abstract

At present time, accumulated theoretical material of the studies of the equilibrium forms of the gas bubbles or mercury drops, fixed on the surface of solid material in the fluid or on the glass bottom of vessel with fluid, under the acceleration of gravity change, was carried out either on the basis of geometric similarity laws that greatly simplify the essence of physical processes, or on the basis of theoretical qualitative estimates of the existing hydrostatic equations of fluid equilibrium, taking into account a decrease of the acceleration of gravity, without carrying out a numerical solution of these equations. The theoretical and experimental study of the behavior of gas bubbles, fixed on the surface of solid material in the fluid, under the acceleration of gravity change was carried out by Shoikhedbrod with great computer accuracy and experimentally confirmed during flight tests aboard of the IL-76K flying laboratory. The paper presents the application of previously obtained results for modeling of the behavior of a drop of mercury, fixed on the glass bottom of vessel with fluid, under the acceleration of gravity change. The conducted computer modeling of the behavior of a drop of mercury, fixed on the glass bottom of vessel with fluid, under the acceleration of gravity decrease, experimentally proved during the process of the carried out tests aboard of the flying laboratory (FL) IL-76K, showed the practical use of the developed computer model both for the simulation of the behavior of real gas bubbles and mercury drops in the fluid in one vessel of the wide range of Bond numbers (β) in the chemically-technological processes occurring in the main control systems of the operability of automatic spacecraft, in real conditions of microgravity.

Keywords: The gas bubble, The mercury drop, The surface of solid material, The decrease of the acceleration of gravity, The law of the mass conservation.

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INTRODUCTION

At present time, accumulated theoretical material of the studies of the equilibrium forms of the gas bubbles, fixed on the surface of solid material in the fluid, or mercury drops, fixed on the glass bottom of vessel with fluid, under the acceleration of gravity change, was conducted either on the basis of the geometric laws that greatly simplify the essence of physical processes, or on the basis of theoretical qualitative estimates of the existing hydrostatic equations of fluid equilibrium, taking into account a decrease of the acceleration of gravity, without carrying out a numerical solution of these equations [1-7].

Therefore, for the precise numerical analysis of the gas bubble or mercury drops of wide area of values of Bond numbers (β), fixed on the surface of solid material or fixed on the glass bottom of vessel with fluid, under the acceleration of gravity change, was set the task of constructing of the computer physical model of the behavior of mercury drop in this case and the development of the algorithm of the numerical calculation of this model.

The theoretical and experimental study of the behavior of gas bubbles, fixed on the surface of solid material in the fluid, under the acceleration of gravity change was carried out by Shoikhedbrod in [8] with great computer accuracy and experimentally confirmed during flight tests aboard of the IL-76K flying laboratory.

The paper presents the application of these previously obtained results for modeling of the behavior of a drop of mercury, fixed on the glass bottom of vessel with fluid, under the acceleration of gravity change.

The conducted computer modeling of the behavior of a drop of mercury, fixed on the glass bottom of vessel with fluid, under the acceleration of gravity decrease, experimentally proved during the process of the carried out tests aboard of the flying laboratory (FL) IL-76K, showed the practical use of the developed computer model both for the simulation of the behavior of real gas bubbles and mercury drops in the fluid in one vessel of the wide range of Bond numbers (β) in the chemically-technological processes, which take place in the main control systems of the operability of automatic spacecraft, in real conditions of microgravity.

MATERIALS

The experimental study of the behavior of gas bubble and mercury drop in one vessel in the variable gravity was conducted on the fly lab aircraft IL-76K.

The decrease of the acceleration of gravity on the fly lab aircraft IL–76K was created by the motion it across the special parabolic trajectory (parabola of Kepler, whose form was close to the flight trajectory of stone at angle to the horizon).

Being located on the specific height, aircraft gained speed and dived at small angle to the horizon, and then it was stable and passed on the rise path. At that moment, when launch (on the “the hill”) only began (overload in this case reached about *2 units*) the engines of aircraft either were turned off or they worked with the thrust, sufficient only for overcoming aerodynamic friction of the ambient atmosphere.

The flight continued by the inertia, aircraft rose upward and, reached of the peak of height, began to move downward.

The duration of the state of close to the weightlessness in this case was *22-25 seconds*.

A change of the acceleration of gravity in the dependence on the time is represented on the Figure 1.

The registration of the amount of overloads that appear on the board IL–76K on the time, was produced on the equipment of the type MSRP and obtained during the process of the flights the values of the overloads were processed on the M-6000 computer.

For the study of the behavior of the gas bubbles, fixed on the surface of solid material and mercury drops on the glass bottom of vessel with fluid, the cylindrical vessels from the glass, whose bottom was made from materials with different degree of hydrophobic (glass, teflon, copper, dural, ebonite), were used.

Sizes of the vessels: internal diameter is-*40 mm*, height-*100 mm*, weight-*100 g*.

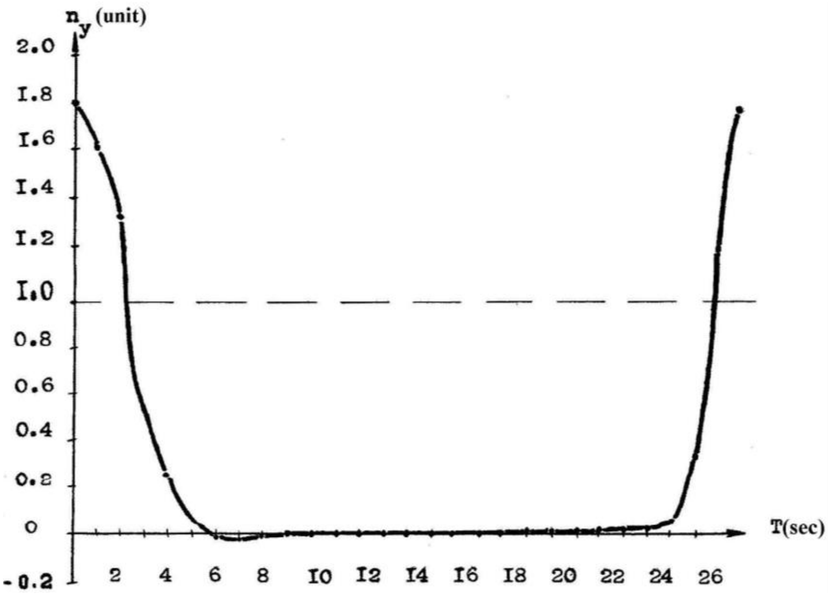

Figure 1. Change of the acceleration of gravity in the dependence on the time on the board of the fly lab IL-76K.

METHOD

Model Formulation.

1. The behavior of the mercury drop on the glass bottom of vessel with water is considered in the isothermal, isobaric conditions.
2. The water is considered incompressible, i.e., $d\rho_w/dt = 0$ and, therefore, according to the law of the mass conservation, the volume of mercury drop is the constant.
3. The behavior of mercury drop in a water is considered under the action of the forces of the gravity and of the surface tension: external forces are absent.
4. The contact wettability angle of the mercury drop on the glass bottom of vessels under of the acceleration of gravity change does not change.
5. A change of the acceleration of gravity leads to a change of the form of mercury drop in a water.

In the present model, the influence of a change of the acceleration of gravity on the form of mercury drop is considered as follows.

With a change of the acceleration of gravity g, a change of the parameter $\beta = \rho g b^2/\sigma$ occurs, under changed value of which, is determined the value of one of the coordinates (X or Z) of the profile of the form of mercury drop, which corresponds to the new value of the acceleration of gravity.

Here, $\rho = \rho_m - \rho_w$ presents the difference of densities of mercury and water; g-acceleration of the force of gravity; σ-mercury surface tension; b–normalization factor; Z-vertical coordinate points of the mercury drop on the glass bottom of vessel with water.

Further, same as in [8], in accordance with the law of the mass conservation, the calculation of another coordinate of the profile of the form of mercury drop is produced, thus, that the values of the volumes of mercury drop that correspond to the previous value of the acceleration of gravity and new, coincided.

The proposed model permits to study laws, governing of the change of profile, of the common surface energy of the mercury drop and resultant force, which retains it on the surface of glass bottom of vessel with water under the acceleration of gravity change.

The developed early model permitted to perform not only the calculations of the coordinates of the profile, total surface square, volume of the mercury drop, fixed on the surface of glass of bottom of vessel with water, and the forces, which act on it for any value of the acceleration of gravity, or graphically to build these profiles and to simulate them on the screen of computer.

On Figure 2, for comparison, graphically are illustrated obtained in [8] the profiles of gas bubble with $\beta > 0$, the coefficient of the surface tension on the border of the section of the phases water-air of *70 Dyne/cm*, the contact angle $\theta = 1.6053$ *radian* and by volume *2.05* cm^3, fixed on the surface of the solid material, taken by them under $g = 980\ cm/sec^2$ (1), $g = 196\ cm/sec^2$ (2) and $g = 1764\ cm/sec^2$ (3).

On Figure 3 graphically are illustrated the profiles of mercury drop ($\beta > 0$) with the coefficient of the surface tension *478 Dyne/cm*, the contact angle $\theta = 2.2741$ *radian* and by volume *1.12* cm^3, fixed on the surface of the glass of the bottom of vessel with water, taken by them under $g = 980\ cm/sec^2$ (1), $g = 196\ cm/sec^2$ (2) and $g = 1764\ cm/sec^2$ (3).

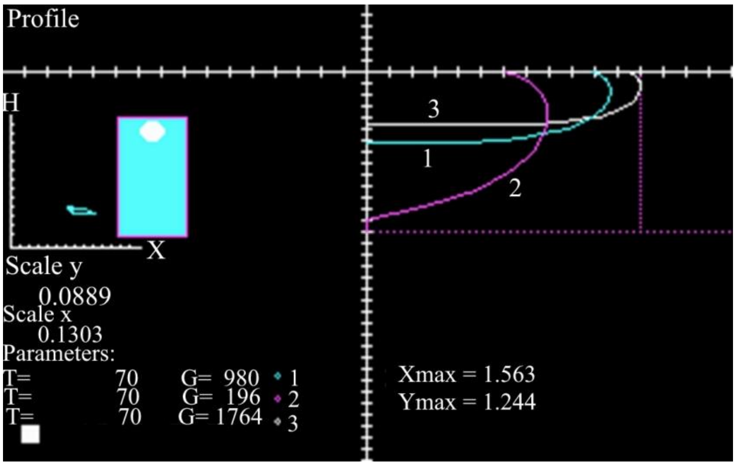

Figure 2. The computer program graphically illustrates the profiles of the forms of air bubble, constructed after the conducted computer modeling, fixed on the surfaces of the solid material, with $\beta > 0$, the coefficient of the surface tension on the border of the section of the phases water–air *70 Dyne/cm*, the contact angle $\theta = 1.6053$ *radian* (or *92°*) and by volume *2.05* cm^3, taken by them under: (1)-$g = 980\ cm/sec^2$; (2)-$g = 196\ cm/sec^2$; (3)-$g = 1764\ cm/sec^2$.

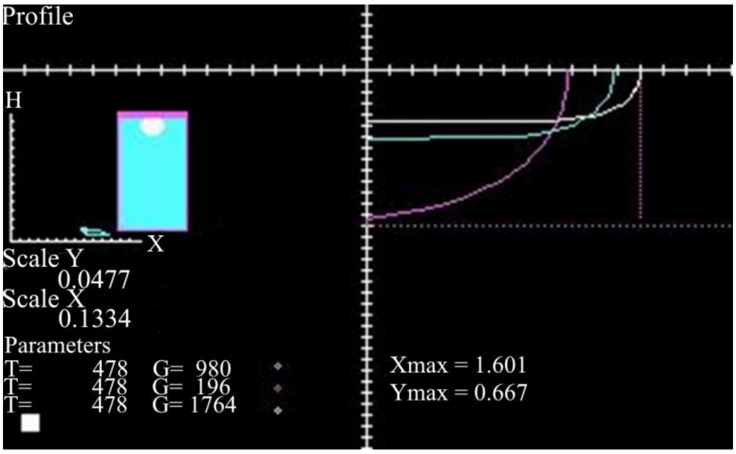

Figure 3. The computer program graphically illustrates the profiles of the forms of mercury drop, fixed on the surfaces of the glass bottom of vessel with water, with $\beta > 0$, the coefficient of the surface tension *478 Dyne/cm*, the contact angle $\theta = 2.2741$ *radian* (or *131°*) and by volume *1.116* cm^3, taken by them under: (1)-$g = 980\ cm/sec^2$; (2)-$g = 196\ cm/sec^2$; (3)-$g = 1764\ cm/sec^2$.

Figures 2 and 3 clearly show, that for the bubbles-above water surface air in the vessel and for mercury drop, fixed on the glass bottom of the vessel with water (parameter *β > 0*), the laws, governing the behavior of their form with a change of the acceleration of gravity consist of the following: with the acceleration of gravity decrease the height of bubble or mercury drop is increased and perimeter of their fastening on the surface of the solid material or on the glass of vessel bottom is decreased: the gas bubble or mercury drop "is assembled" (Figure 2, point 2 and Figure 3, point 2) on the surface of solid material or on the glass of vessel bottom.

With the acceleration of gravity increase, the height of bubble or of mercury drop decrease and the perimeter of their fastening on the surface of the solid material or on the glass bottom of vessel increase occur: gas bubble or mercury drop "flattens" on the surface of solid material or on the vessel glass bottom (Figure 2, point 3 and Figure 3, point 3).

On Figure 4, for comparison, the frames of the work of the developed computer program, obtained in [8], modeling the theoretically calculated profiles of the form of air bubble, with volume $2.05\ cm^3$, and its behavior with the acceleration of gravity decrease from $g = 980\ cm/sec^2$ to $g = 0$ (or with a change of the aircraft overload from $n = 1$ *un.* to $n = 0$) are demonstrated.

On Figure 5 the frames of the behavior of mercury drop in a water with volume $1.12\ cm^3$, under the acceleration of gravity decrease from *n = 1 un.* ($g = 980\ cm/sec^2$) *(a)* to *n = 0.8 un. (b)*, *n = 0.6 un. (c)* and *n = 02 un.* ($g = 196\ cm/sec^2$) *(d)* are demonstrated.

Figure 6 demonstrates the theoretically calculated profiles of mercury drop in a water with the volume $1.12\ cm^3$, the coefficient of surface tension *478 Dyne/cm* and the contact angle $\theta = 2.2741$ *radian*, taken by

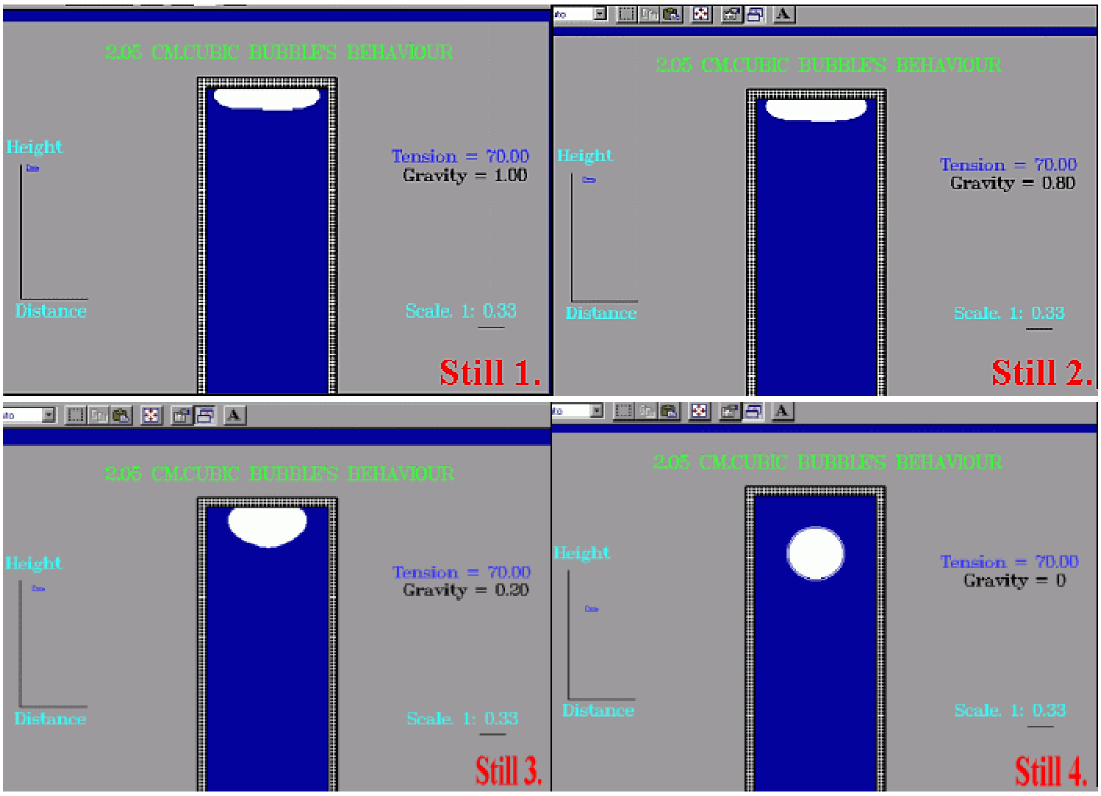

Figure 4. The frames of the demonstration of the work of the developed computer program, which simulates the profiles of the form of the air bubble with the volume $2.05\ cm^3$ and its behavior with the decrease of the acceleration of gravity from $g = 980\ cm/sec^2$ (or $n = 1$ *un.*) to $g = 0$. Scale 1:0.33

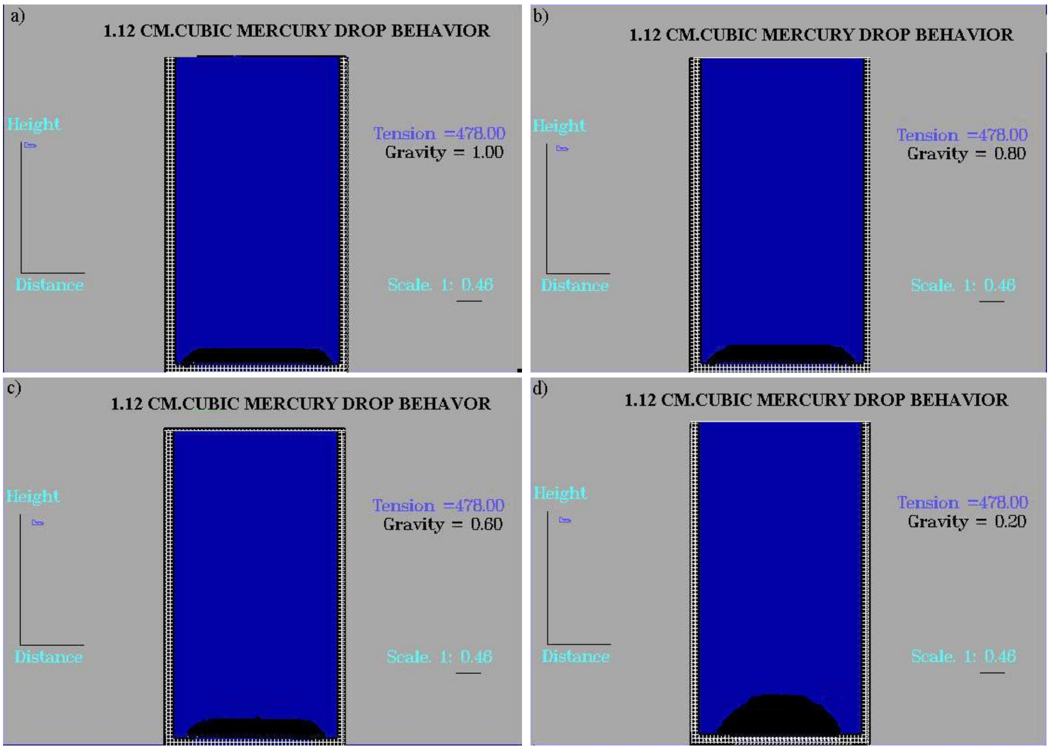

Figure 5. The frames of the demonstration of the work of the developed computer program, which simulates the profiles of the form of the mercury drop with the volume *1.12* cm^3 and its behavior with the acceleration of gravity decrease from *n = 1 un. (980* cm/sec^2*) (a)* to *n = 0.8 un. (b)*, *n = 0.6 un. (c)* and *n = 0.2 un (196* cm/sec^2*) (d)*, Scale 1:0.46.

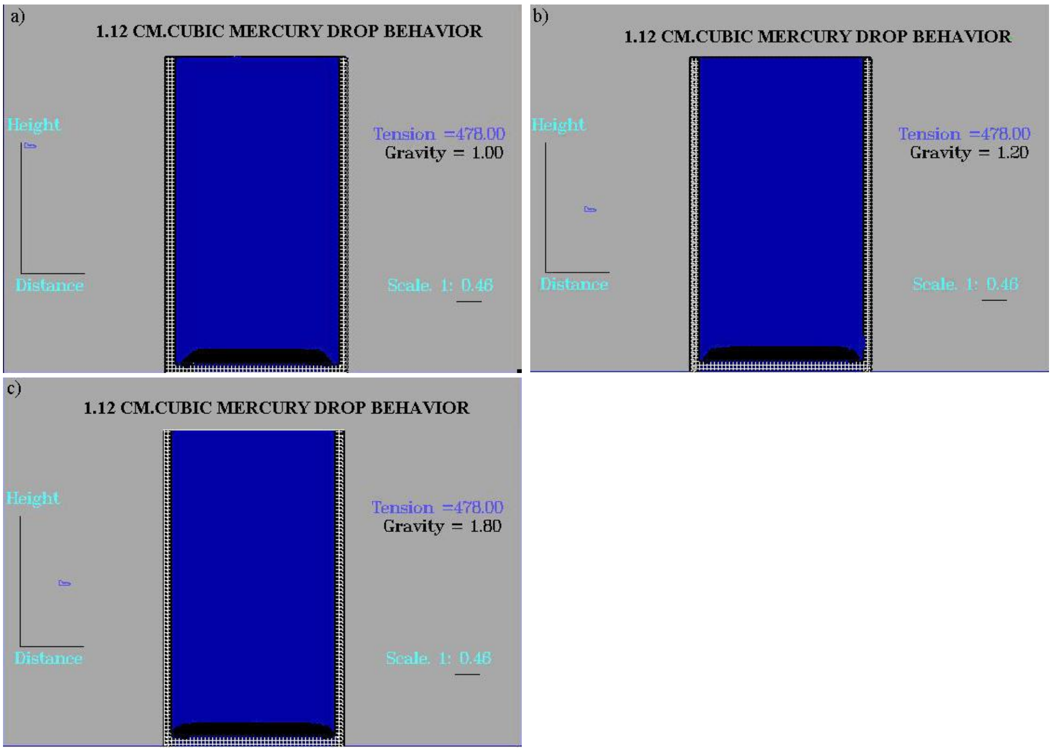

Figure 6. Profiles of the forms of mercury drop in water, acquired by them, with the acceleration of gravity increase from *n = 1 un. (980* cm/sec^2*) (a)* to *n = 1.2 un. (b)*, *n = 1.8 un. (g = I764* cm/sec^2*) (c)*. Scale 1: 0.46 them under the acceleration of the gravity increase from *n = 1 un. (980* cm/sec^2*) (a)* to *n = 1.2 un. (b)*, *n = 1.8 un. (g = I764* cm/sec^2*) (c)*.

It is necessary to note, that increase of the square change of the fastening of gas bubble or mercury drop in this case, is considerably more than the square change of its side change.

The numerical analysis of the obtained profiles of gas bubbles or mercury drops showed that with the acceleration of gravity decrease, the square of the fastening of air bubble on the surface of solid material or mercury drop on the glass bottom of vessel with water change decreases, and the side surface square change increases.

The produced calculations of changes of the side surface square of air bubble or mercury drop, of square of their fastening on the surface of solid material or on the glass bottom of vessel with water, subsequently, were used for calculation of the change of the common surface energy of the bubble or mercury drop, which appears with the acceleration of gravity decrease.

The calculation of the common surface energy change of the air bubble or mercury drop, fixed on the surface of the solid material or on the glass bottom of the vessel with the water, which appears with the acceleration of gravity decrease, was produced in accordance with the conclusions, obtained in the work [7] by the formula:

$$\Delta E = \sigma_{12}\,[\Delta Ss.s. + (Cos\theta)\cdot\Delta S']\qquad(1)$$

where $\Delta S_{s.s}$-side surface square change, ΔS side surface square change; θ-contact wettability angle.

As a result, it was established, that with the decrease of the acceleration of gravity, the release of the surface energy of air bubble or mercury drop occurs and its value is the greater, the less the smaller value it reaches *g*.

The obtained in [8] results of the numerical calculation of an increase of the common surface energy change of the air bubble, fixed on the surface of solid material, with the volume of $2.05\ cm^3$, by contact angle $\theta = 1.6053$ *radian* and by the coefficient of the surface tension on the border of the section of the phases water air of $\sigma_{12} = 70$ *Dyne/cm* with a change of the acceleration of gravity from $g = 980\ cm/sec^2$ to $g = 196\ cm/sec^2$ showed that the release of the general surface energy of air bubble occurs and its value composes $\Delta E = 276.4283$ *Erg*.

The results of the numerical calculation of an increase of the common surface energy change of the mercury drop, fixed on the glass bottom of vessel with water, with the volume of $1.12\ cm^3$, by contact angle $\theta = 2.2741$ *radian* and by the coefficient of the surface tension of $\sigma = 478$ *Dyne/cm* with a change of the acceleration of gravity from $g = 980\ cm/sec^2$ to $g = 196\ cm/sec^2$ showed that the release of the general surface energy of gas bubble occurs and its value composes $\Delta E = 257.4866$ *Erg*.

If the volume of a mercury drop will be $2.05\ cm^3$, then the calculations showed that the release of the general surface energy of mercury drop composes $\Delta E = 471.2924$ *Erg*.

The freed under the acceleration of gravity decrease from $g = 980\ cm/sec^2$ to $g = 196\ cm/sec^2$, the common surface energy change of air bubble or mercury drop passes into the kinetic energy of motion of gas bubble or mercury drop, when its value exceeds the value of the resultant force, which retains air bubble on the surface of solid material or mercury drop on the glass bottom of vessel with water.

If the value of the freed common surface energy change of air bubble or mercury drop less or is equal to the value of the resultant force, which retains air bubble on the surface of solid material or mercury drop on the solid base layer, then in this case, the freed common surface energy change of air bubble either mercury drop passes into the vibrational energy of air bubble or mercury drop near the equilibrium level, which slowly reduces because of the friction of the gas bubble or mercury drop in a water.

The calculation of the resultant force, which retains the mercury drop on the surface of solid material, in the computer program was produced by the following formula:

$$\Delta F = F1 + F2 + F3 = 2\pi a\sigma\, Sin\theta - \rho_w\, gV - \pi\sigma a^2\, (1/R1 + 1/R2) \quad (2)$$

The obtained in [8] the results of the numerical calculation of the resultant force, which retains the above surface of water air bubble on the surface of the solid material, with the volume of $2.05\ cm^3$, by the contact angle $\theta = 1.6053$ *radian* and by the coefficient of the surface tension on the border of the section of the phases water-air $\sigma_{12} = 70$ *Dyne/cm* at the acceleration of gravity $g = 196\ cm/sec^2$, show that its value composes $\Delta F = 267.6038$ *Dyne*.

The results of the numerical calculation of the resultant force, which retains the mercury drop on the glass bottom of vessel with water, with the volume of $1.12\ cm^3$, by the contact angle $\theta = 2.2741$ *radian* and by the coefficient of the surface tension $\sigma = 478$ *Dyne/cm* at the acceleration of gravity $g = 196\ cm/sec^2$, show that its value composes $\Delta F = -7{,}590.408$ *Dyne*.

Sign "-" in the value of the resulting force means the direction of the action of this force on a drop of mercury from the glass bottom of a vessel with water to the surface of water.

In the developed computer program [8] was introduced estimation of the retention of the air bubble on the surface of solid material or mercury drop on the solid base layer or forward movement of the air bubble or mercury drop on the basis, what has been said previously, i.e., on the ratio of the freed common surface energy change and the resultant force, which retains air bubble on the surface of solid material or mercury drop on the solid base layer.

In the case of forward movement of air bubble or mercury drop in the computer program, the distance, on which will move air bubble or the mercury drop, was calculated as follows:

The kinetic energy of motion of air bubble or mercury drop can be presented in the following form:

$$\frac{mv^2}{2} = \Delta E - (\Delta F\, \Delta X_1) \quad (3)$$

Here, v-the speed of the motion of air bubble or mercury drop of the liquid; m-the mass of air bubble or mercury drop; ΔE-freed common surface energy; ΔF-the resultant force, which retains gas bubble on the surface of solid material or mercury drop on the solid base layer; $\Delta X_1 = 1cm$.

If v to represent as $(\Delta X/\Delta t)$ and to count $\Delta t = 1\ sec$, then v in (3) can be represented as ΔX-distance on which will move gas bubble or the mercury drop in a water for *1second*.

The mass of air bubble can be recorded as $m = \rho_w\, gVol$, where ρ_w-is density of water; $g = 980\ cm/sec^2$-the acceleration of gravity and Vol-the volume of air bubble or mercury drop.

Substituting the expressed values in (3) and taking into account that $\Delta X_1 = 1\ cm$, we will obtain the following equation:

$$(\rho_w\, gVol)/2\, (\Delta X)^2 = \Delta E - \Delta F \quad (4)$$

Solving equation (4) relative to ΔX, we will obtain the formula for the determination of distance, on which will move the air bubble:

$$\Delta X = \frac{\sqrt{2(\Delta E - \Delta F)}}{\rho g Vol} \quad (5)$$

The conducted by the computer program calculations [8] showed that for the air bubble, fixed on the surface of solid material, with the volume of $2.05\ cm^3$, by the contact angle $\theta = 1.6053$ *radian* and by the coefficient of the surface tension on the border of the section of the phases of the water-air σ_{12}

= 70 Dyne/cm, under a change of the acceleration of gravity from $g = 980\ cm/sec^2$ to $g = 196\ cm/sec^2$ is freed $\Delta E = 276.4283\ Erg$, and the resultant force, which retains above water's air bubble on the surface of solid material at $g = 196\ cm/sec^2$, composes $\Delta F = 267.6038\ Dyne$.

Consequently, we have a condition, when $\Delta E > \Delta F$, and, therefore, above water's air bubble with the volume of $2.05\ cm^3$, with the contact angle $\theta = 1.6053$ *radian* and by the coefficient of the surface tension on the border of the section of the phases water-air $\sigma_{12} = 70\ Dyne/cm$ under a change of the acceleration of gravity from $g = 980\ cm/sec^2$ to $g = 196\ cm/sec^2$ will be detach from the solid surface and move down in the water in the direction to the bottom.

The numerical calculations of the computer program, conducted based on formula (5) permitted to calculate the distance, on which air bubble will move and this distance is equal $\Delta X = 2.933\ cm$.

The conducted by the computer program calculations showed that for the mercury drop, fixed on the surface of glass bottom of vessel with water, with the volume of $2.05\ cm^3$, by the contact angle of $\theta = 2.2741$ *radian* and by the coefficient of the surface tension $\sigma = 478\ Dyne/cm$, under the acceleration of gravity change from $g = 980\ cm/sec^2$ to $g = 196\ cm/sec^2$ is freed $\Delta E = 471.2924\ Erg$, and the resultant force, which retains mercury drop on the glass bottom of vessel with water at $g = 196\ cm/sec^2$, composes $\Delta F = -7590.408\ Din$.

Consequently, we have a condition, when $\Delta E > \Delta F$, and, therefore, mercury drop with the volume of $2.05\ cm^3$, with the contact angle $\theta = 2.2741$ *radian* and by the coefficient of the surface tension $\sigma = 478\ Dyne/cm$ under the acceleration of gravity decrease from $g = 980\ cm/sec^2$ to $g = 196\ cm/sec^2$ will be detach from the glass bottom of vessel with water and move up in the water in the direction to the water surface.

The numerical calculations of the computer program, conducted based on formula (5) permitted to calculate the distance, on which mercury drop will move to the water surface and this distance is equal

$\Delta X = 12.328\ cm$, i.e., the rate at which a mercury drop reaches the surface of the water is almost 4 times higher than the rate at which the air bubble, formed from the above water surface air in the vessel, reaches the bottom of the vessel.

For experimental confirmation of the developed computer model of behavior of the air bubbles and mercury drops in the variable gravitational field was developed and prepared for experiments the research facility "RF" Figure 7.

The construction of the "RF" included the filming processes on the 16 mm film using the movie camera of the type of 16 SP.

The speed of filming composed 24 frames per second.

The research facility "RF" consisted of: the electrical power unit, instrument package, remote control panel.

For the study of the behavior of the gas bubbles and mercury drops, fixed on the surface of solid material or on the glass bottom of vessel with water, the cylindrical vessels from the glass, whose bottom was made from materials with different degree of hydrophobic (glass, teflon, copper, dural, ebonite), were used.

Sizes of the vessels: internal diameter is-*40 mm*, height-*100 mm*, weight-*100 g*.

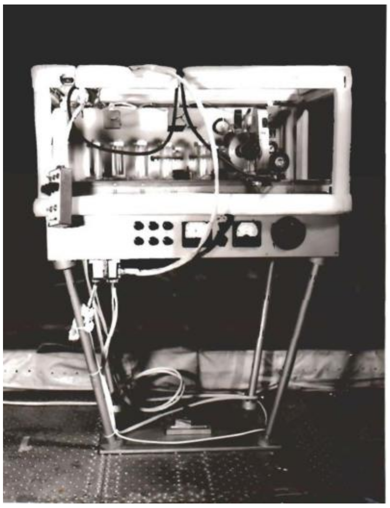

Figure 7. Developed research facility “RF”.

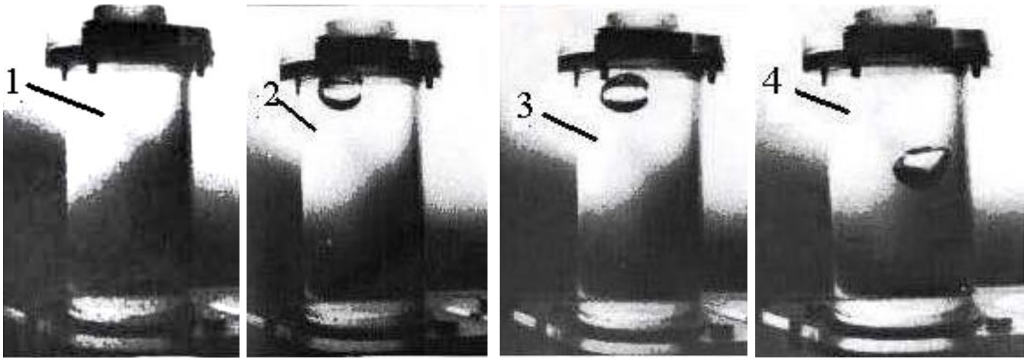

Figure 8. The frames of filming of the profiles of the form of air bubble with volume *2.05 cm/sec*^{3} and its behavior with the acceleration of gravity decrease from $g = 980$ *cm/sec*^{2} (or *1 un.*) to $g = 0$, during of aircraft’s flight tests on board the flying laboratory IL 76-K. *1.-*$g = 980$ *cm/sec*^{2} *(1 un.)*; *2.–*$g = 196$ *cm/sec*^{2} *(0.2 un.)*; *3* и *4-*$g = 0$.

RESULTS

For experimental confirmation of the developed computer model of behavior of the air bubbles, mercury drops in the variable gravitational field, the experiments were conducted on the fly lab aircraft IL–76K, on the instrument package of research facility “RV” in the state of “free floating” [9].

During the experiments, conducted aboard of the fly lab IL 76-K, theoretically obtained profiles of air bubble with volume *2.05 cm/sec*^{3} and it simulated behavior with the acceleration of gravity decrease from $g = 980$ *cm/sec*^{2} (or *1un.*) to $g = 0$ were proved.

Figure 8, [8] demonstrates frames of filming of the profiles of the form of air bubble with volume 2.05 *cm/sec*^{3} and its behavior with the acceleration of gravity decrease from $g = 980$ *cm/sec*^{2} (or 1 *un.*) to $g = 0$.

During the experiments, conducted aboard of the fly lab IL 76-K, theoretically obtained profiles air bubble and mercury drop with volume *2.05 cm/sec*^{3} and their simulated behavior in one vessel under the acceleration of gravity decrease from $g = 980$ *cm/sec*^{2} (or *1 un.*) to $g = 0$ were proved.

Figure 9 demonstrates frames of filming of the profiles of the form of air bubble and mercury drop with volume *2.05 cm/sec*^{3} and their behavior in one vessel under the acceleration of gravity decrease from $g = 980$ *cm/sec*^{2} (or *1un.*) to $g = 0$.

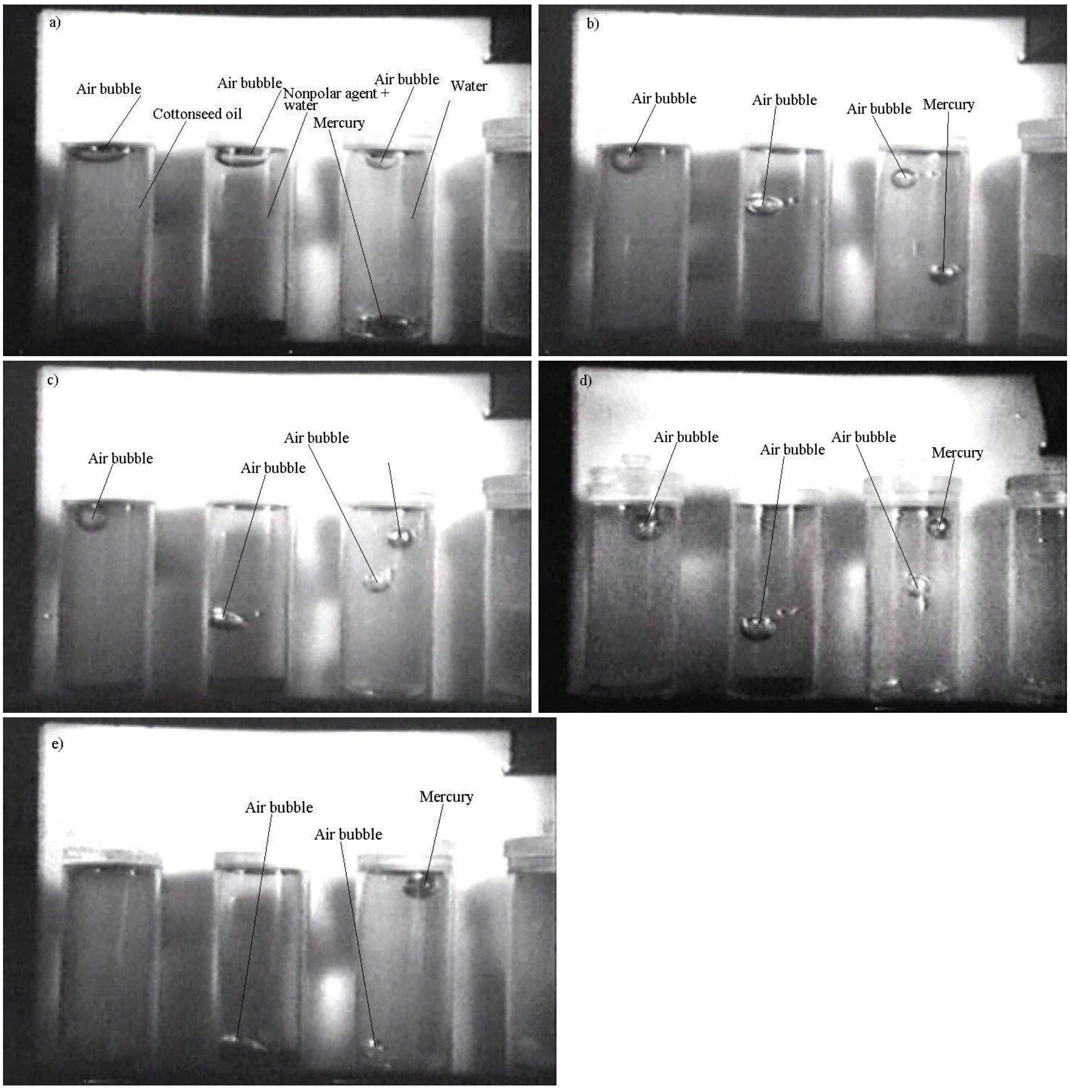

Figure 9. Frames of filming of the profiles of the form of air bubble and mercury drop with volume *2.05 cm/sec*^{3} and their behavior in one vessel under the acceleration of gravity decrease from $g = 980$ *cm/sec*^{2} (or *1un.*) to $g = 0$. (a) Acceleration of gravity-*196 cm/sek*^{2}; (b), (c), (d) and (e)-microgravityin the fluid in one vessel of the wide range of Bond numbers (*β)* in the chemically-technological processes, which take place in the main control systems of the operability of automatic spacecraft, in real conditions of microgravity.

Figure 9(a) demonstrates the profiles of the form of air bubble and mercury drop with volume *2.05cm/sec*^{3}at acceleration of gravity equal *196 cm/sec*^{2} (or *0.2 un.*), which corresponds to the theoretically obtained Figures 4 (still 3) and 5 (d).

Figures 9(b, c, d) demonstrate detachment and movement of a mercury drop from the bottom of the vessel to the surface of the water and an air bubble from the surface of the water to the bottom of the vessel under microgravity conditions.

The frames of figure 9 (c and d) clearly show that the speed of movement of a drop of mercury is much higher than the speed of movement of an air bubble in a water under microgravity conditions, which corresponds to the previously obtained calculations.

And finally, frame (e) of Figure 9 captures the location of the mercury drop at the vessel lid and the position of the air bubble at the bottom of the vessel under microgravity conditions.

Thus, the conducted computer modeling of the behavior of a drop of mercury, fixed on the glass bottom of vessel with fluid, under the acceleration of gravity decrease, experimentally proved during the process of the carried out tests aboard of the flying laboratory (FL) IL-76K, showed the practical use of the developed computer model both for the simulation of the behavior of real gas bubbles and mercury drops in the fluid in one vessel of the wide range of Bond numbers (*β)* in the chemically-technological processes, which take place in the main control systems of the operability of automatic spacecraft, in real conditions of microgravity.

CONCLUSION

The conducted computer modeling of the behavior of a drop of mercury, fixed on the glass bottom of vessel with fluid, under the acceleration of gravity decrease, experimentally proved during the process of the carried out tests aboard of the flying laboratory (FL) IL-76K, showed the practical use of the developed computer model both for the simulation of the behavior of real gas bubbles and mercury drops

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