HEAT INERTIA IN INTENSIFICATION REGIME

A.A. AGASIYEV, Ch.G. AKHUNDOV, M.Z. MAMMEDOV, V.G. SHARBATOV, J.G. JABBAROV

Baku State University

Az-1148, Z. Halilov str., 23, Baku, Azerbaijan

The temperature inertial profile formed in the medium heated in intensification regime has been considered. It is seen that intensification regime development leads to the freezing of different additional effects which "work" in real situations.

We many times consider under the essential difference of systems existing in the nature from them which are formed by human. The stability relatively external influences, self-refreshment, possibility to self-complication, growth, development, functioning declining, even at relatively small change of external influences or errors in control are character for first ones. Therefore, one can borrow the experience of structure construction accumulated by nature and use in our activity, i.e. one can clarify the laws of structure construction and ordering appearance. Here we do accent on principles of structure construction, its appearance, development and self-complication, but not on control processes and exchange of information.

Classic mathematical physics (i.e. the science about investigation of physics mathematical models) is connected with linear equations. Formally these equations have unknown quantities only in first degree. In reality they describe the processes carrying out simultaneously at different external influences. The changes stay quantitative ones and new qualities don't appear with intensity increase. The field of application of linear equations is unusually wide. It includes the classic and quantum mechanics, electrodynamics and wave theory.

However, we very often contact with phenomena where the more intensive external influences lead to qualitatively new system behavior. Here we need the non-linear mathematic models their analysis is more complex task but it is necessary at solution of many tasks. This leads to formation of wide front of non-linear phenomenon investigations, attempts to form the common approaches useable to many systems [1].

The heat conduction processes play the big role in our life: in nature phenomena, technique and everyday life. Nowadays the heat conduction theory the results of which are always compared with practices, experiment, is the one of more wide and studied departments of physics and mathematics.

The history of development of heat conduction theory shows the power of mathematic natural science the main content of which is the development and use of mathematic methods for solving of problems of physics, chemistry, biology and etc.

Let's consider which role the methods of mathematics and informatics play at study of new physical effect which is heat inertia. In the investigation of this effect the computational experiment, which helps to reveal the qualitative phenomena picture and form the new conceptions, plays the fundamental role. The one of important conclusions in heat conduction process character conformed to known thermodynamics principle is that any temperature heterogeneities are realigned with the course of time.

The heat inertia means the process which is opposite to (paradoxical) of heat conduction one. Indeed, the heat doesn't distribute during some time at the increase of energy contribution to medium but concentrates and thermal action on medium is localized on its concrete region.

The effect entity of heat inertia is relatively simple one. It is well known that heat velocity from substance hot parts to colder ones is defined by temperature space distribution (profile) in substance. There are such "dished", "sloping" distributions at which the heat stays too long in initial region during some times.

The temperature inertial profiles can be formed if medium is heated in intensification regime. The regimes when the some character values tend to infinity at approximation to final time are so called. In spite of intensification regime external singularity they are in physical processes.

Thus, heat inertia is inner property of heat-conducting medium and influence intensification regimes on medium, "reveal" this property.

The question of practical use of heat inertia effect requires the verification of application conditions of considered model and taking into consideration the complicated factors. So, on the example of relatively simple nonlinear task, the results of heat inertia effect theory are presented. The self-simulating solutions and solution comparing theory are used at its investigation. The comparing theories reflect the process stability to different disturbances [2].

The real medium description with help of given models isn't always possible. In principle, it is necessary to take into consideration the gas-dynamic motion, energy obtaining and loss because of different physical effects.

In many cases the intensification regime leads to "freezing" of different additional effects and moreover, the studied regularities which "work" in real situations totally reveal and can be useful ones.

Let's consider the main question: the growth of Earth population. Let's growth rate of population is proportional one to product of men and women numbers. Then Earth population $N(t)$ will be:

$$dN / dt = \alpha dN_1 N_2 \qquad (1)$$

where N_1, N_2 are numbers of men and women and $0<\alpha<1$ is some proportionality coefficient. Supposing $N_1 = N_2 = \frac{N}{2}$ we rewrite (1) in the following form:

$$dN / dt = dN2 / 4 \qquad (2)$$

and integrate (2) of some moment t_0 up to t moment;

$$\frac{4}{2}\left(-\frac{1}{N(t)}+\frac{1}{N(t_o)}\right)=t-t_o$$

and then we obtain:

$$N(t)=\frac{4}{2}\frac{}{t_o+\frac{4}{\alpha}N^{-1}(t_o)-1}=\frac{4}{(t_f-t)} \qquad (3)$$

where $t_f=t_0+(4/2)N^{-1}(t_0)>t_0$
and according to (3) the number of Earth population will be infinite one in $t=t_f$ moment.

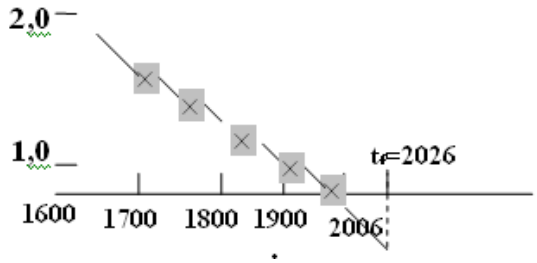

Fig.1. The growth of Earth population.

The growth dynamics of Earth population during last centuries is presented on fig.1. Beginning from XX century the statistic data are well agree with dependence (3) which direct line and "catastrophe" has taken place since November, 13, 2006.

But there are many obvious reasons limiting the Earth population. The intensification regimes, i.e. the processes when any values transform into infinity in final time $t=t_f$ (intensification time), model the strongly non-stationary rapidly growing during phenomena.

Such processes are called the "explosion" ones.

In real situation there are always reasons limiting the intensification regime and process "doesn't' lead" to infinity. However, the new unusual properties of intensificating processes can reveal long before "switching" of limiting effects.

The smoothing process of gas bubbles in liquids serves as quite real example of intensification regime.

If bubble disequilibrium condition takes place then liquid pressure strongly increases and interface gas-liquid begins to collapse to its center. The intensification regime takes place (for example, liquid pressure near bubble surface changes by $\sim(t_f-t)^{-6.5}$ law where t_f is bursting time).

The intensification of this case is caused by cumulative effect.

The boundary surface decreases proportionally to square of bubble radius although energy specific parameters (pressure, density, energy) characterizing the process increase indefinitely.

Really the pressure growth is limited by compressibility of liquid, viscosity and heat conduction processes, gas back pressure in bubbles.

Moreover the pressure in water near air bubble growths up to some hundreds atmospheres that leads to formation of strong shock waves distributing in liquid.

The surface damage of turbine fins and screws (cavitation) moving in water is explained by this mechanism. According to modern conceptions, the diamonds form as a result of gas bubble collapsing in melted rocks.

[1] *A.A. Samarskii, N.V. Dmitrinko, S.P. Kurdumov, A.P. Mikhaylov*. Rep.ASSSR, 1975, vol.233, №6, pp. 1344-1347.

[2] *V.A.Galaktionov, S.P.Kurdyumov, A.P.Mikhayulov, A.A.Samarskii*. Dif. Equations, 1981, vol.17, №10, pp.1826-1841.

A.A. Ağasıyev, Ç.Q. Axundov, M.Z. Məmmədov, V.X. Şərbətov, C.Q. Cabbarov

KƏSKİNLƏŞMƏ REJİMLƏRİNDƏ İSTİLİYİN ƏTALƏTİ

Kəskin qızma rejimlərində mühitdə yaranan temperaturun inersiyasına baxılmışdır. Göstərilmişdir ki, real situasiyalarda kəskin qızma rejimlərinin inkişafı əlavə müxtəlif donma effektlərinin yaranmasına gətirib çıxarır.

А.А. Агасиев, Ч.Г. Ахундов, М.З. Мамедов, В.Г. Шарбатов, Дж.Г. Джаббаров

ИНЕРЦИЯ ТЕПЛА В РЕЖИМЕ ОБОСТРЕНИЯ

Рассмотрен инерционный профиль температуры созданный в среде нагретой в режиме с обострением. Показано, что развитие режима с обострением приводит к замораживанию различных дополнительных эффектов, которые « работают » в реальных ситуациях.

Received: 29.05.09