PROBLEMS OF USE OF GEOMETRICAL METHODS IN RESEARCHES OF ALTERNATIVE POWER ENGINEERING

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Summary. **The review of constituents of process of heat exchange is executed from positions of determination of geometrical character of distribution of values of physical sizes in space. Paid attention perspective of introductions of developments of the applied geometry in industry of alternative energy. Examples of the use of algorithms and programs of computer graphics are made in engineering practice of determination of the temperature fields.**

Keywords**: a geometrical design, alternative energy, process of heat exchange, crooked lines and surfaces, distribution of the temperature field.**

Formulation of the problem. The modern state of production capacities requires development of the effective and flexible going near the decision of tasks of alternative (in a greater degree - sunny) energy. Therefore many tasks must be accompanied by not only exact physical and mathematical models but also corresponding geometrical and graphic information. This information is characterized foremost evidentness, that allows both on quality and on quantitative levels to nose after the change of those or other parameters.

Analysis of the recent researches. Traditional development of industrial production, receipt and use of energy, development of transport [1], in particular motor-car [2], envisage development of NT only. Together with this in our days object of research of alternative energy [3] the systems that actively use achievement of the applied geometry and geometrical design become [4]. An optimal look was lately determined to the process of forming of geometrical models by facilities of computer graphics [5, 6].

Analysis of recent research. To conduct the analysis of problems of alternative energy, where realization of algorithms of geometrical design is expedient.

Main part. Existent tendency of exhaustion of fuel and energy resources, price advance on the production of energy and global ecological problems stimulate the necessity of introduction of alternative energykeeping technologies on the basis of environmentally clean energy sources. One of priority directions of development of alternative energy there is sunny energy. Her development goes to directions [3]:

- it is converting of sunny energy into thermal for the hot water and heating systems;

- it is converting of sunny energy into electric (foto-voltage transformers);
- it is creation on the basis of sunny energy of combined cool-heatsystems;
- it is creation on the basis of sunny energy of the systems of cooling and climatization.

Development of the systems of alternative energy assists realization of laws on an energy-savings and Kyoto (Japan, in 1997) protocol [3], sent to the decline of emission of greenhouse gases.

The balanced combination of traditional and alternative energy sources gives possibility to develop the systems of heating with the use of flat sunny collectors (rice. 1) [3], and also to create the sunny drying and evaporation process refrigeration systems and systems of conditioning.

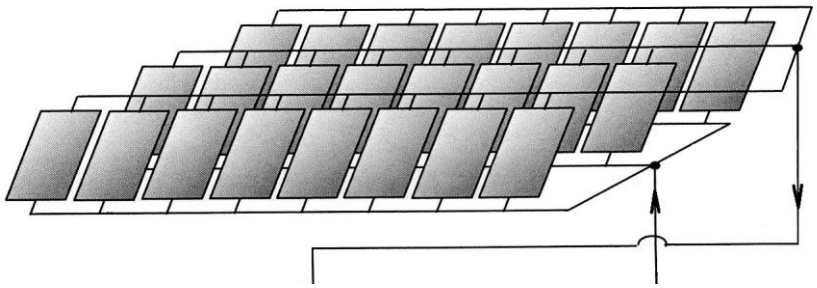


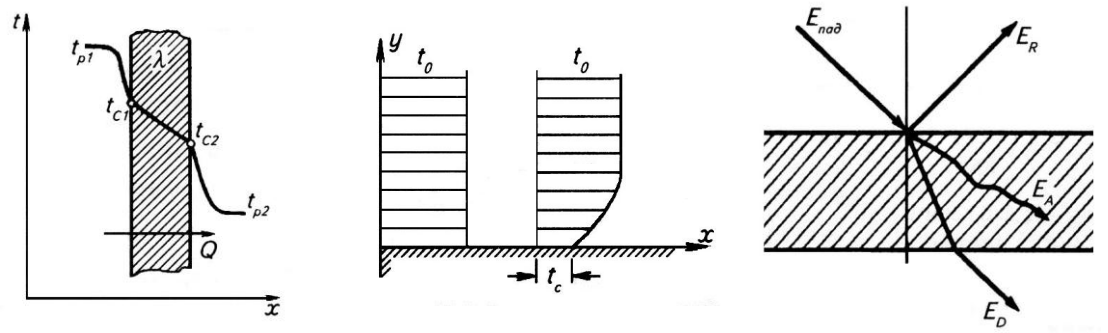
Fig. 1. Scheme of elements of the sunny system of heat and cool supply.

The process of heat exchange (to the transfer of warmth) can take place only on condition that in the different points of the system a temperature is different. In general case a temperature depends on the coordinates of x, y, z of the considered point and time τ, id est

$$t = f(x, y, z, \tau). \qquad (1)$$

If the temperature of body (systems of bodies) changes in direction of one coordinate, then the temperature field is named one-dimensional ($t = t(x)$), if along two coordinates ($t = t(x, y)$) - two-dimensional, in the direction of three coordinates ($t = t(x, y, z)$) - three-dimensional.

Processes of heat exchange [7], including heat-conducting (fig. 2, a), often have the expressed non-stationary character. Transients are described by equalizations differentially, that characterizes flowing of the phenomenon in time and space.



а) *б)* *в)*

Fig. 2. Distribution of thermal stream at: *а* is heat transfers (Q is a stream of warmth; t_p, t_c are temperatures of liquid and wall); *б* – convective heat exchange (t_0 is a temperature of stream of liquid); *в* - effulgent heat exchange (E is energy of radiation).

In rectangular coordinates differential equalization of heat-conducting is written down so [7]:

$$\frac{\partial t}{\partial \tau} = a(\frac{\partial^2 t}{\partial x^2} + \frac{\partial^2 t}{\partial y^2} + \frac{\partial^2 t}{\partial z^2}) + \frac{q_v}{c\rho}, \qquad (2)$$

where $a = \frac{\lambda}{c\rho}$ – coefficient of diffusivity; λ – heat-conducting; c - heat capacity ; ρ – closeness of liquid; q_v – bulk density internal sources of heat.

A coefficient of diffusivity is the physical parameter of substance and characterizes speed of change of temperature.

In a convective heat exchange (fig. 2, б) the process of transfer of heat contacts with the transfer of environment. Equalization of motion for a incompressible liquid (p = const) in projections on wasp of cartesian coordinates is written down in a form [7]:

$$\rho\frac{Dw_x}{d\tau} = \rho g_x - \frac{dp}{dx} + \mu(\frac{d^2 w_x}{dx^2} + \frac{d^2 w_x}{dy^2} + \frac{d^2 w_x}{dz^2});$$

$$\rho\frac{Dw_y}{d\tau} = \rho g_y - \frac{dp}{dy} + \mu(\frac{d^2 w_y}{dx^2} + \frac{d^2 w_y}{dy^2} + \frac{d^2 w_y}{dz^2}); \qquad (3)$$

$$\rho\frac{Dw_z}{d\tau} = \rho g_z - \frac{dp}{dz} + \mu(\frac{d^2 w_z}{dx^2} + \frac{d^2 w_z}{dy^2} + \frac{d^2 w_z}{dz^2}),$$

where w_x, w_y, w_z – components of speed are in direction of coordinates of x, y, z; $\frac{D}{d\tau}$ – substance derivative; g_x, g_y, g_z – projection accelerating external mass forces on the axis x, y, z; p – pressure; μ –projections of acceleration of external mass forces are on wasp of x, y, z; p is pressure; μ it is dynamic viscidity.

Equalization (3) is named equalizations Navie-Stox, where the increase (on unit of volume) of mass, force of gravitation, force of pressure and force of friction is taken into account from viscidity.

An effulgent heat exchange (fig. 2, в) shows a soba the process of transformation of internal energy of radiative body in energy of electromagnetic vibrations. At the hit of effulgent energy on other body she is partly taken in, growing into internal energy. Feature of heat exchange to the radiations [7] consists in that a necessity falls off for the direct contact of bodies. The radiation of hertzian waves is peculiar to all bodies.

Stream of radiation from a surface 1 to the surface 2 determine after equalization [7]:

$$Q_{1-2} = \varepsilon_{\text{пр}} C_0 \varphi_{1,2} F_1 \left[(T_1/100)^4 - (T_2/100)^4 \right], \qquad (4)$$

Where $\varphi_{1,2} = \frac{1}{F_1} \iint\limits_{F_1 F_2} \frac{\cos\varphi_1 \cos\varphi_2}{\pi r^2} dF_1 dF_2$ – coefficient of irradiation; $\varepsilon_{\text{пр}}$ - resulted degree of blackness of the system of bodies; C_0 is a coefficient of radiation black body; T_1, T_2 is an absolute temperature of surfaces 1 and 2; φ_1, φ_2 are corners between streamline of radiation and normals to the surfaces 1 and 2; F_1, F_2 are areas of surfaces 1 and 2; r is distance between the areas of surfaces.

During description of constituents of process of heat exchange thermal streams are estimated, for what it is necessary to know distribution of temperature in space or for to the surfaces of bodies. The applied tasks usually contact with description of surfaces and crooked lines, that in geometrical terms interpret the real space and character of distribution in him of physical sizes (temperature, pressure, pressure, rate of movement of substance and others like that). During introductions of results of geometrical design as methodologies of calculation, algorithms and programs it will be to co-ordinate numeral calculations with engineering data. Examples are realizable introductions in relation to the calculations of hydrodynamic building [6,8], heat suppliers for the production of glass [9,10], sources of light [8,11].

Thus, in the real lamps [12,13] there always is an unevenness of distribution of temperature for the surfaces of retort, id est unevenness of distribution of energy of radiation. An exact decision of general equalization of balance of energy on such conditions is difficult enough and needs the special software. Therefore in engineering practice conduct close calculations in every certain case. The receipt of results is facilitated, if at the stowage of algorithms and programs to use facilities of computer graphics [8, 11].

In the classic tasks of determination of distribution of temperature in the volume of spatial body the non-stationary temperature field, in

particular, in the volume limited to the cylinder, describe a functional row [14, 15], the functions of Bessel are included in the constituents of that. At it data depend on the value of radial corner of cylindrical coordinates. In relation to determination of the stationary temperature field in a cylindrical volume, then distribution of temperature is the function of height and radius of basis of cylinder. On fig. 3 an example of realization of the program is made [9-11] for determination of the stationary field of temperatures on a rectangular area (rice. 3,a, v) and in the volume of cylinder with insulated basis (rice. 3, b, g).

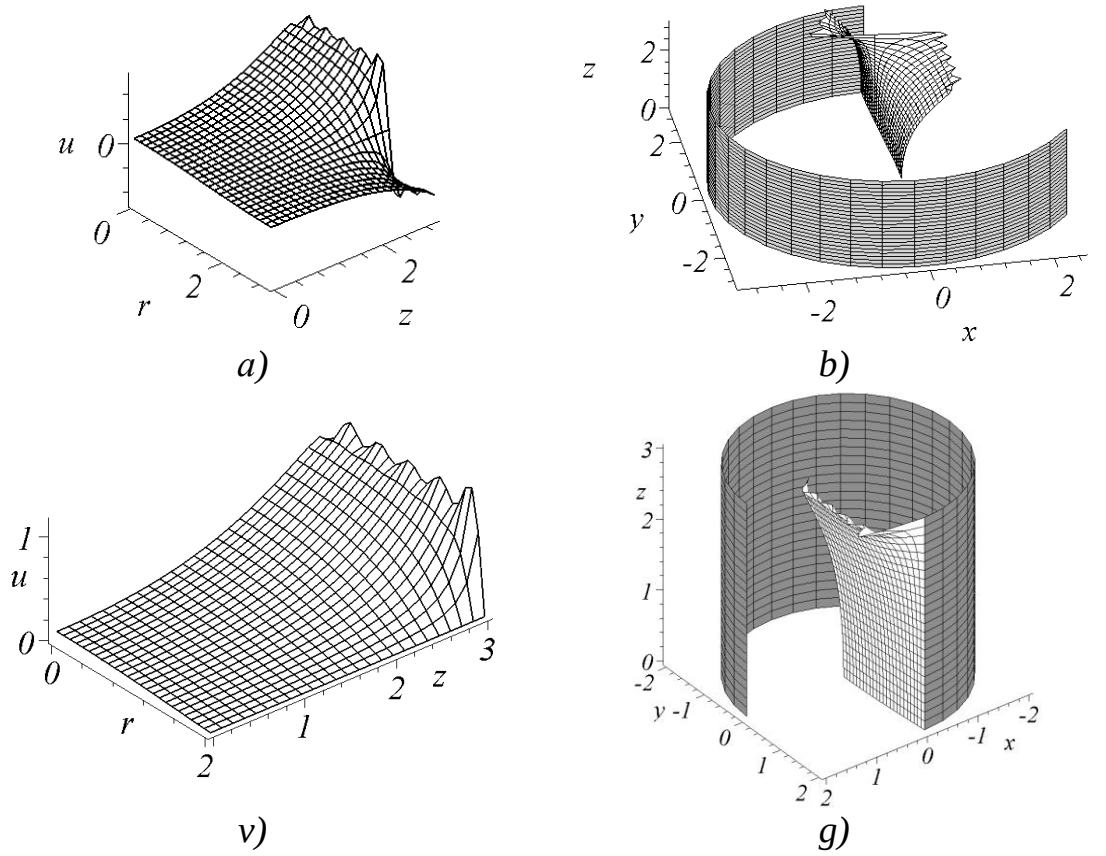


Fig. 3. Determination of the field of temperatures: *a*, b –in limits $\{0 \le r \le 3, 0 \le z \le 3\}$; v, g – in limits $\{0 \le r \le 2, 0 \le z \le 3\}$.

Due to evidentness of decisions the process of acceptance of engineering decisions was facilitated in relation to variation of geometrical parameters of the temperature fields.

Conclusions. Each of problems of alternative energy is related to the processes of booty of energy, increase of production, development of transport, guard of environment and others like that. Certain processes force to use the sign system as evident images that carry the unique informative loading. Therefore conditioning is actual for introduction of geometrical methods in research of objects of alternative energy.

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