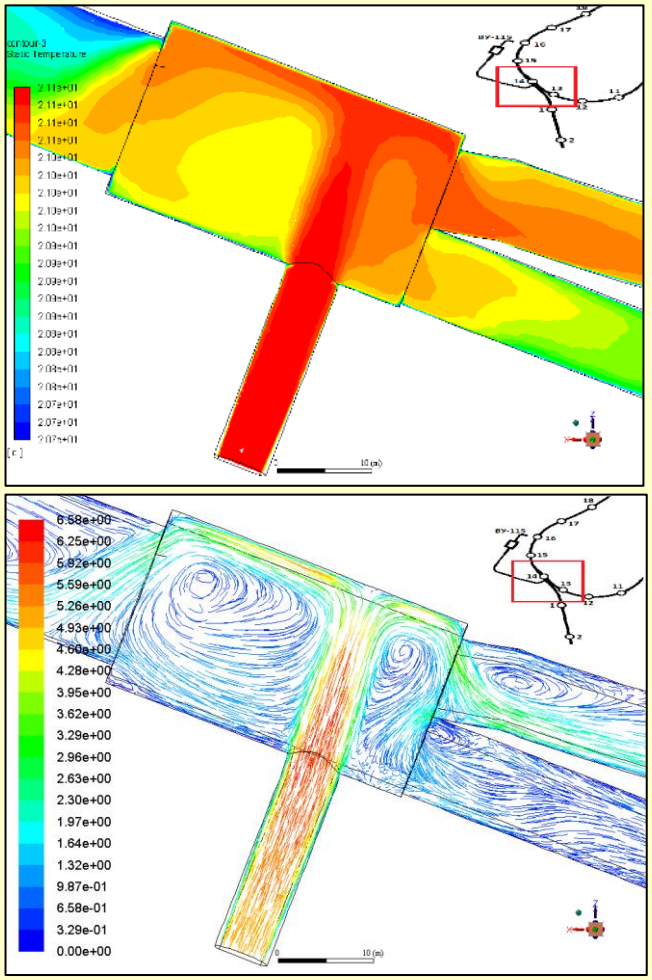
FUNDAMENTAL RESEARCH

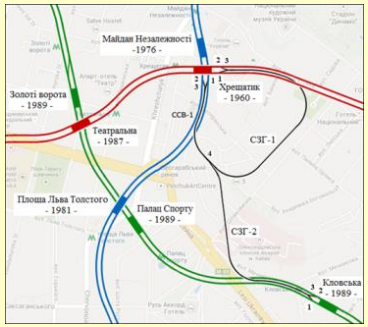
RESEARCH OF MICROCLIMATE SUBWAY

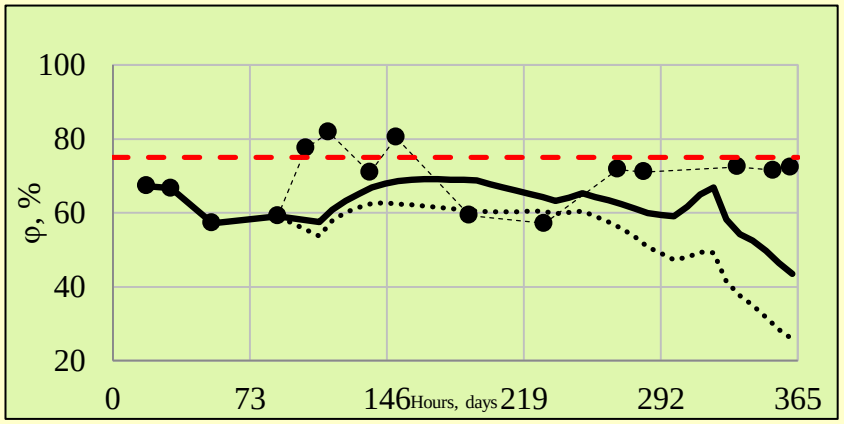
On the basis of the experimental-calculation method, with the help of the created computer non-stationary three-dimensional model of the tunnels, ways of providing the normative level air relative humidity of the Kyiv metro tunnels are analyzed.



Practical result:

An optimized schedule of operation of the tunnel ventilation system is suggested, which leads to a decrease in the average relative humidity of tunnel air below 75%.





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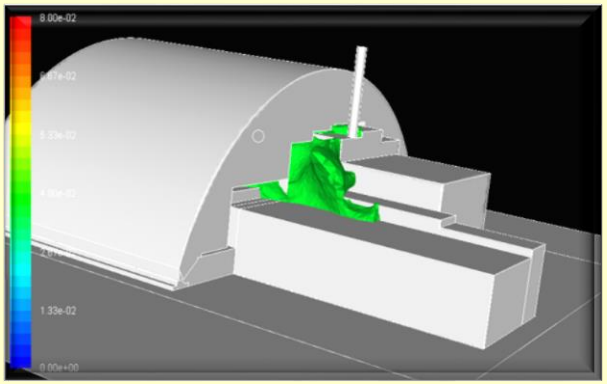
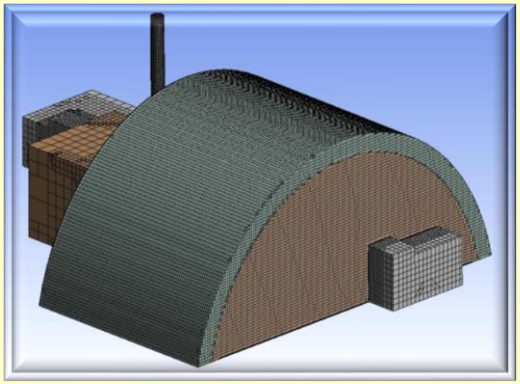
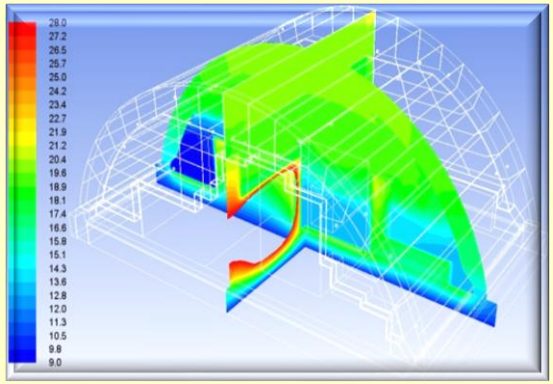
COMPUTER ANALYSIS AND PREDICRION OF THE THERMOGASDYNAMIC AND RADIATION CONDITION OF THE SHELTER OBJECT AND THE NEW SAFE CONFINEMENT OF THE CHERNOBYL NUCLEAR POWER PLANT

With the help of the created computer non-stationary three-dimensional model of thermogasdynamic processes, the thermal, humid and radiation condition of the Shelter object and the New Safe Confinement was analyzed. Defined distribution of radioactive aerosols inside and outside (in the environment) during the periods of its commissioning (near 1 year) and long-term operation (more than 100 years).

Implementation: Chornobyl NPP.







Practical result:

Recommendations for checking the NSC ventilation system under various possible climatic conditions and failures of ventilation equipment based on the results obtained with the help of the created CFD model have been developed.

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FUNDAMENTAL RESEARCH IN THE FIELD OF THERMOPHYSICS OF NUCLEAR POWER PLANTS

South Ukrainian NPP

Appointment:

Based on the renormalization group approach, a turbulence model has been developed that allows predicting thermophysical processes in the heat exchange equipment of nuclear power plants.

Advantages:

The proposed method allows to build models of turbulence without the use of empirical information.

Using:

1. Calculations of non-stationary modes for power units of the South Ukrainian NPP are performed.
2. Calculations necessary for substantiation of safety of power units with reactors of the IV generation (IAEA) are carried out:
   - high-temperature gas reactors;
   - supercritical pressure reactors.

Avramenko A.A., Kuznetsov A.V. Renormalization group model of macroscopic turbulence in porous media // Transport in Porous Media. - 2006. - vol. 63. - P. 175 - 193.

Avramenko A.A., Basok B.I., Dmitrenko N.P., Kovetskaya M.M., Tyrinov A.I., Davydenko B.V. Renormalization group analysis of turbulence. - Kiev: Publishing House IET of NAS of Ukraine, 2013. - 300 p.

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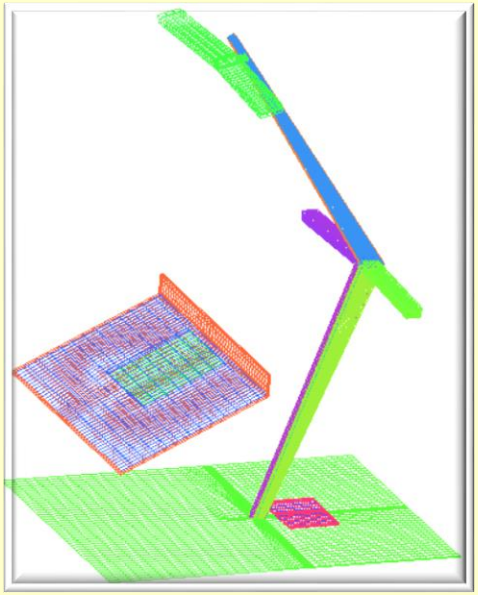
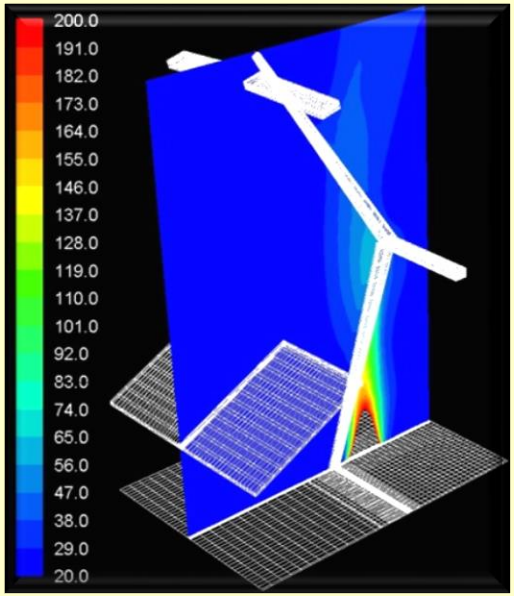
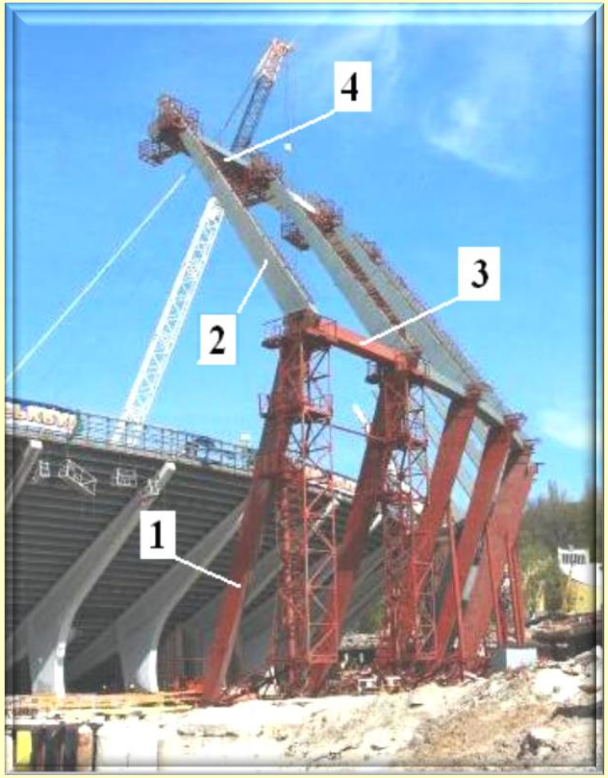
ANALYSIS OF HEAT AND MASS TRANSFER PROCESSES IN BUILDING OBJECTS AND CONSTRUCTIONS UNDER NORMAL AND EXTREME CONDITIONS

With the help of developed three-dimensional CFD-models, the fire resistance of bearing structures of stands and canopies of Ukraine's stadiums is estimated. The calculated temperature fields are defined, local, maximum and average temperatures along the cross sections of metal constructions are determined to assess their fire resistance.







Implementation:

The fire resistance of bearing metal structures was determined over the stands of the "Olympic" stadium (Kyiv).

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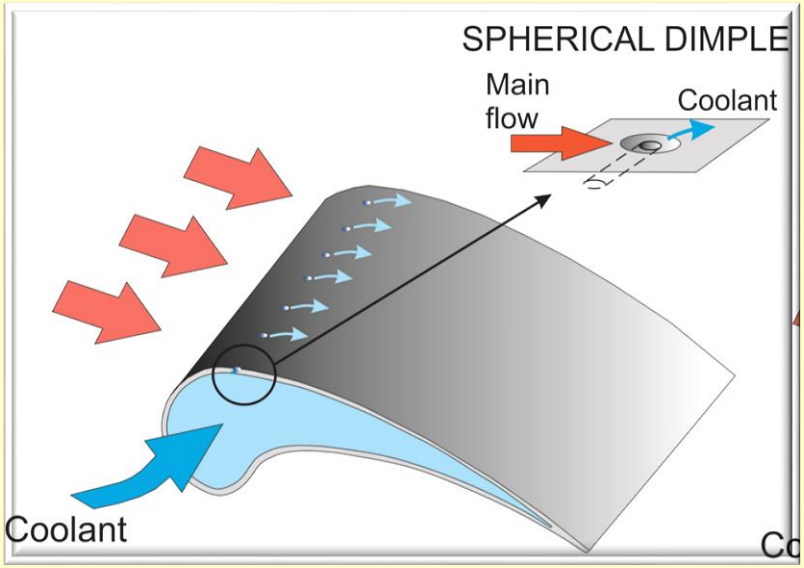
PERSPECTIVE SCHEMES OF FILM COOLING OF BLADES OF HIGH PERFORMANCE GAS TURBINES



Appointment:

Film cooling of nozzle and working blades of high-temperature gas turbines.

Advantages:

Reduction of flow separation, minimization of negative influence of vortex structures and improvement of cross distribution of the cooler due to its giving in system of depths of a different configuration on a surface of a blade of the gas turbine.

Efficiency:

- ✓ increase in the film cooling efficiency 1.5…2.5 times as large in comparison with traditional schemes of holes without dimples;
- ✓ decrease in the coolant mass flow rate for 10…15%.

Basic technical characteristics

The ratio of depth to diameter hole depressions	**0,5…1**
The ratio of the diameter of the depth to the diameter of the hole	**2…3**
Geometric shape of recesses	**Spherical, cylindrical, triangular, trench**

Patent of Ukraine for invention: №113452.

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THERMAL HYDRAULIC INSTABILITY OF THE HEAT FLOW IN THE ELEMENTS OF HEAT ENERGY EQUIPMENT

Appointment:

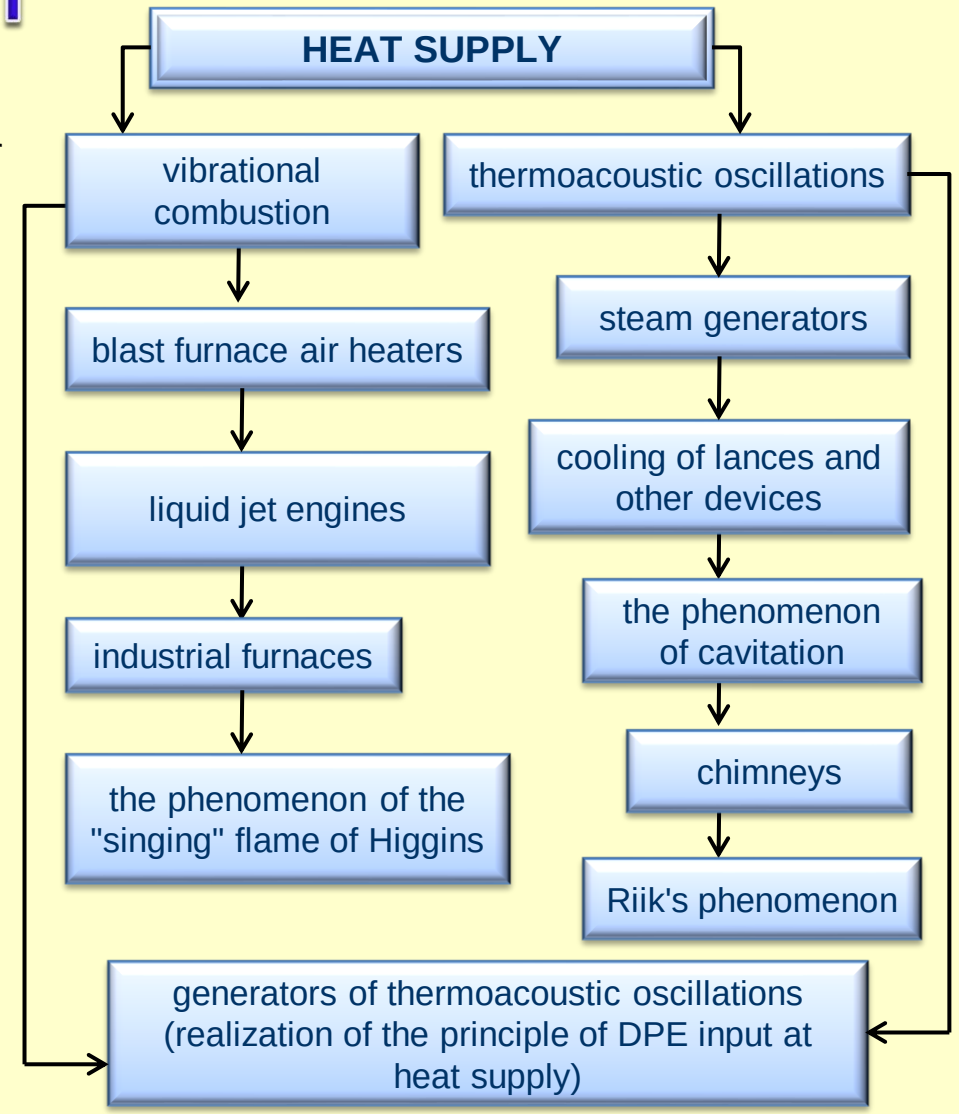
Analytically calculate the instability of the coolant flow in the elements of thermal power equipment (shown in the block diagram), which is due to the influence of: temperature dependence of thermal conductivity and flow viscosity; time of fuel combustion delay; liquefaction on combustion processes. The modeling is based on a basic system of conservation equations in balanced integral form using a tensile stress tensor and a thermal energy dissipation tensor.

Advantages:

Application of the proposed model to power equipment: Riike pipes; pipeline models; blade supercharger; combustion chambers; steam generator; gas boiler; liquid jet engine.

Application:

Proposed methods of controlling self-oscillations, technical measures and devices to avoid the negative effect of fluctuations in the flow or reduce their amplitude to an acceptable level.



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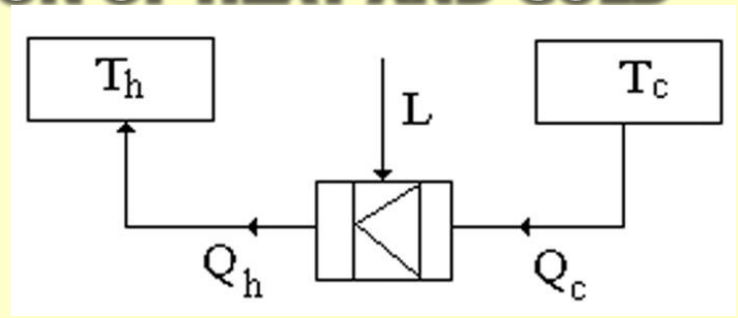
DISTRIBUTION OF ENERGY COSTS IN COMBINED PRODUCTION OF HEAT AND COLD (CPHC)

Appointment:

Application of the method of division of costs for heat and cold production using the obtained dependences for the purpose of technical and economic calculations for comparison of HVAC and alternative heat and cold supply options, as well as modeling of CPHC systems.



Basic patterns:

- ✓ Based on the thermodynamic analysis of combined heat and cold production and based on the first and second laws of thermodynamics, the exact distribution of drive energy costs for heat and cold in CPHC systems is obtained;
- ✓ Exergy losses of combined heat and cold production are divided in proportion to the specific exergy (exergetic temperature function) of products.

Basic calculation dependencies

$$L_c = E_c + D\frac{\tau_c}{\tau_c + \tau_h} \qquad L_h = E_h + D\frac{\tau_h}{\tau_c + \tau_h}$$

$$\eta_{ex}^{h} = 1 - \frac{T_c}{T_a}(1 - \eta_{ex}) \qquad \eta_{ex}^{c} = 1 - \frac{T_h}{T_a}(1 - \eta_{ex})$$

Advantages of application:

- ✓ The exergetic method overestimates the cost of primary energy for heat production and underestimates - for the production of cold the more, the lower the exergetic efficiency of cogeneration;
- ✓ In contrast to the exergetic method, exergetic efficiency of KVTH is different, and exergetic efficiency of receiving heat is always higher, and cold - lower than the total exergetic efficiency;
- ✓ On a practical example of calculation it is established that the maximum differences of the offered method from exergetic are estimated at 24%.

Articles:

Dubovsky S.V., Tverdokhlib A.S. Thermodynamic analysis of combined heat and cold production systems / S.V. Dubovsky, O.S. Tverdokhlib// Problems of general energy. - 2014. –№ 2 (37). - P. 46–51.

Dubovskaya C.V., Tverdokhlib A.S. Division of energy costs in the combined production of heat and cold / S.V. Dubovskoy, A.S. Tverdokhlib// Energy technologies and resource saving. - 2014. –№ 1. - P. 24–30.

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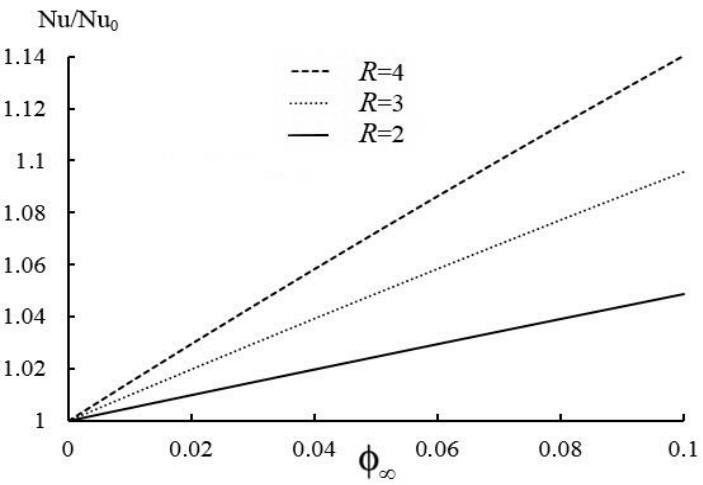
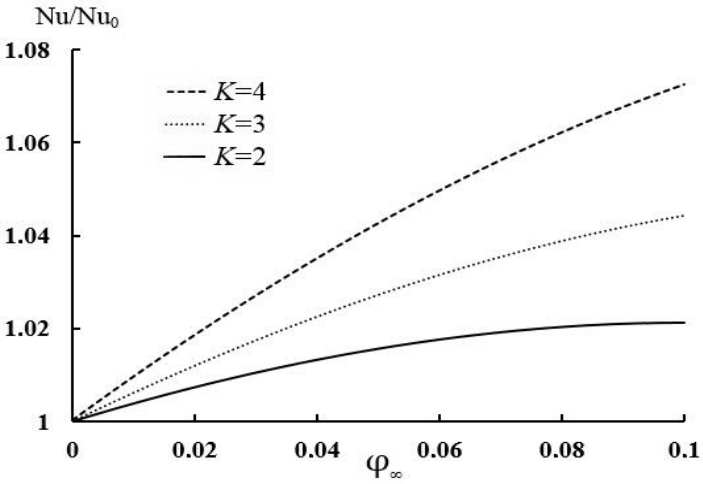
THEORETICAL FUNDAMENTALS OF PROCESSES IN NANOLIQUIDS

Dependence of the relative heat transfer coefficient on the concentration of nanoparticles





Appointment

Theoretical bases of hydrodynamics, heat exchange and instability of nanofluids flow are developed.
This allows you to assess the possibilities use of nanofluids in many industries, namely:

- ✓ refrigeration equipment;
- ✓ microelectronics;
- ✓ thermal and nuclear energy;
- ✓ metallurgy;
- ✓ biotechnology;
- ✓ food Industry;
- ✓ medicine.

Advantages :

The development makes it possible at the design stage to evaluate the efficiency of the use of nanofluids to intensify heat transfer during cooling of high-temperature objects.

Research materials are published in many leading world publications that are part of the world's main scientometric database ISI.

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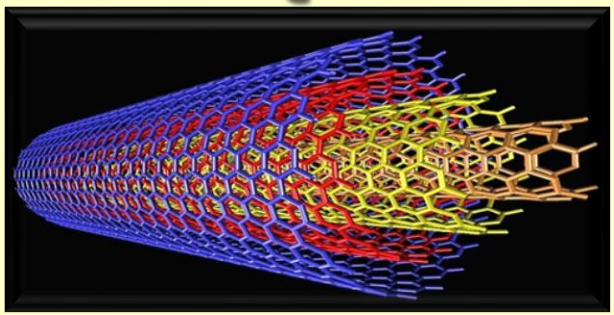
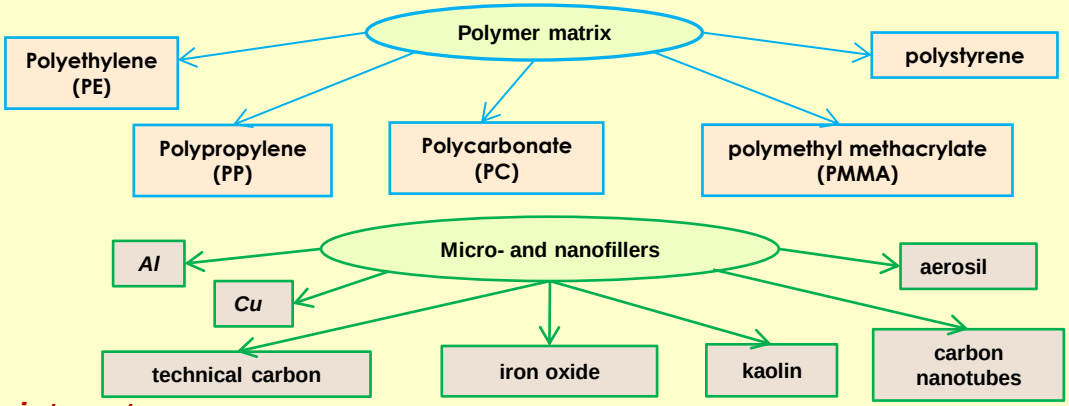
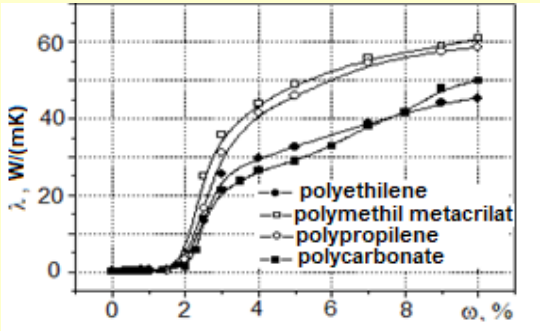
POLYMERIC MICRO- AND NANOCOMPOSITES FOR ELEMENTS OF HEAT AND POWER EQUIPMENT





Dependence of thermal conductivity of composites on the mass fraction of carbon nanotubes



Appointment:

Improving the durability and reliability of heat exchange surfaces of elements of heat and power plants and pipelines of various energy systems.

Advantages:

- ✓ high level of thermal insulation properties;
- ✓ improved mechanical performance;
- ✓ increased corrosion resistance.

Efficiency:

- ✓ reduction of heat losses in heat lines for various purposes;
- ✓ increase in the life of the heat and power equipment.

Characteristics of a type series of polymer micro- and nanocomposites for heat transfer surfaces

T_{max}, K	λ, W/mK	Polymer type	Filler type	Filler fraction, %	T_{max}, K	λ, W/mK	Polymer type	Filler type	Filler fraction, %	T_{max}, K	λ, W/mK	Polymer type	Filler type	Filler fraction, %
390	20	ПЕ	Al	4,3	425	20	PP	Al	3,3	470	20	PC	CNT	2,9
	30	PMMA	CNT	2,8		30	PP	CNT	3,1		30	PC	CNT	5,2
	40	PMMA	CNT	3,5		40	PP	CNT	3,9		40	PC	CNT	7,5
	50	PMMA	CNT	5,3		50	PP	CNT	6,0		50	PC	CNT	10,0
	60	PMMA	CNT	9,5		55	PP	CNT	7,5					

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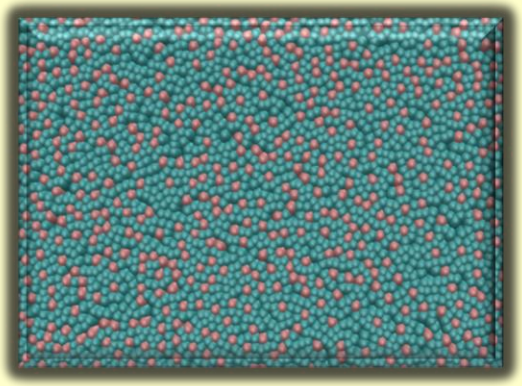
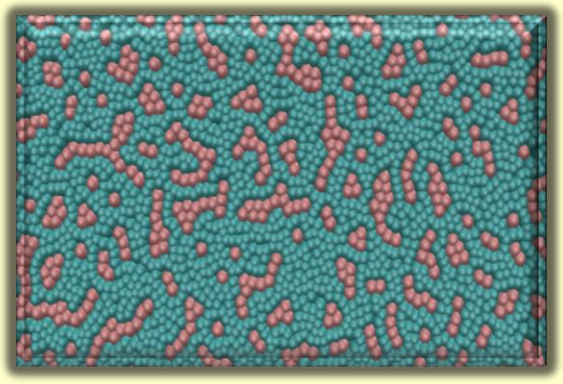
COMBINED MATHEMATICAL MODEL OF MOLECULAR DYNAMICS AND DYNAMICS OF DISSIPATIVE PARTICLES

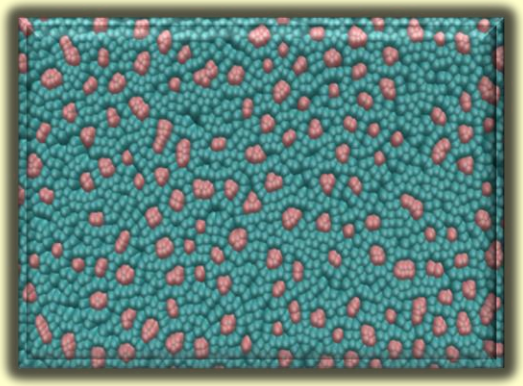
Spherical micelles



Rod-shaped micelles



Globular structure



$$m_i \frac{d^2 r_i}{dt^2} = F_{ij}(r),\ i = 1,2,\ldots, N,$$

Appointment:

The combined model allows modeling of colloidal nanostructure of hydrophobic and hydrophilic nature.

$$F_{ij} = \begin{cases} \pi\ \omega_1 - \gamma_{ij} m_i \omega_2 (\mathbf{v}_{ij} \cdot \mathbf{e}_{ij}) + \dfrac{\delta_{ij}\theta_{ij}}{\sqrt{\Delta t}}\omega_1, \\ \dfrac{24\varepsilon_{ij}}{r_{ij}}\left[\left(\dfrac{\sigma_{ij}}{r_{ij}}\right)^6 - 2\left(\dfrac{\sigma_{ij}}{r_{ij}}\right)^{12}\right], \end{cases}$$

Advantages:

The use of modeling makes it possible to significantly reduce experimental research in the development of equipment for biotechnology and food industry.

Dolinsky A. A., Avramenko A. A., Tyrinov A. I., Grabova T. L. Study of the Dynamics of Formation of Spatial Nanostructures // Nanoplasmonics, Nano-Optics, Nanocomposites, and Surface Studies. Selected Proceedings of the Second FP7 Conference and the Third International Summer School Nanotechnology:
From Fundamental Research to Innovations, August 23-30, 2014, Yaremche-Lviv, Ukraine. – 2015. - Volume 167. – P. 223 – 232.

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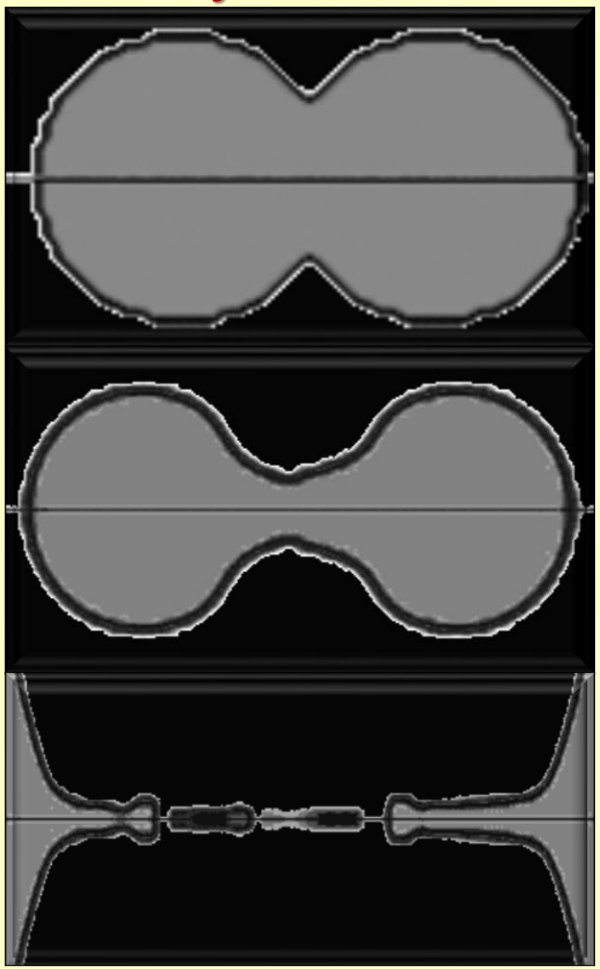
MATHEMATICAL MODELING OF BIOLOGICAL PROCESSES

Appointment

Mathematical methods allow modeling processes in biotechnology, food industry, medicine.

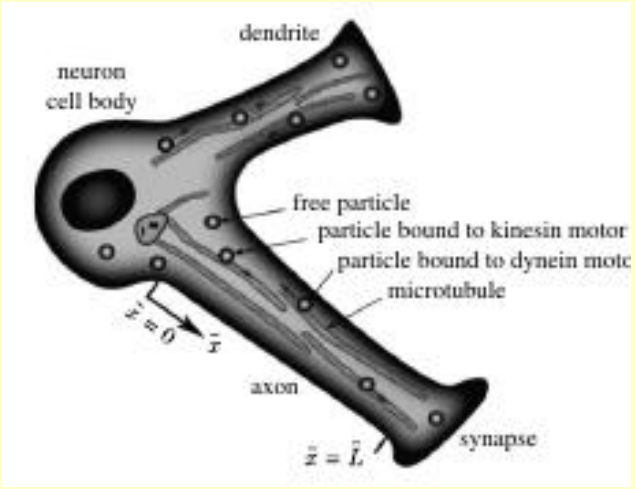
Cytokinesis



Advantages:

The use of modeling makes it possible to predict processes in biological objects and technological processes in equipment for biotechnology and food industry. Also, these methods are used to predict the development of neuro-degenerative diseases such as Alzheimer's disease, Huntington's disease, Down syndrome, as well as the development of the mammalian embryo.

Axon transport



Research materials are published in many leading world publications that are part of the world's main scientometric database ISI.

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THERMOPHYSICAL SIMULATION OF VIBRATION COMBUSTION IN THE FIREPLACE OF A HEATING BOILER (example of implementation of the proposed method of calculation of autocolution parameters)

Appointment:

A general method for calculating the parameters of both the transient mode and constant self-oscillations (frequencies and amplitudes) of pressure and coolant flow in typical installations with heat sources, in particular in boilers, has been developed. The general unified thermophysical model for calculation of parameters of longitudinal self-oscillations of the heat carrier in potentially unstable elements of the heat power equipment is created.

Advantages:

The problem of determining the causes, mechanisms and consequences of thermo- and hydro (aero) dynamic and other types of instability of the coolant flow is solved.

Application:

The analysis of this model (the basic system of equations of which is given below) in each separately considered boiler unit allowed to create schemes of its reconstructions in which the mode of vibrational combustion is completely neutralized or methods of control of amplitude of fluctuations are offered.

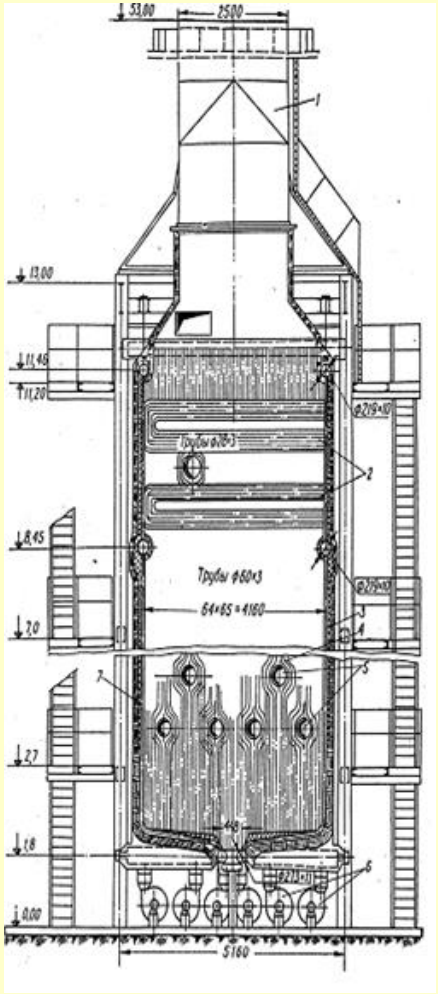
Patent: №68534. Blast furnace air heater combustion chamber. Publ. 26.03.2012 Bull. № 6.

$$\begin{cases} L_a \dfrac{dG}{dt} = F^{\Sigma}(G) - P, \\ C_a \dfrac{dP}{dt} = G(t-\tau) - \varphi(P), \end{cases} \quad G = \varphi(P)$$

- inversion of the throttle characteristic $P = h_{th}(G)$,

$L_a = \ell/S$, $C_a = V/c^2$ – **acoustic parameters of the combustion chamber**

$$F^{\Sigma}(G) = H_{\text{подачи}}(G) + A - h_{\text{тр}}(G) - h_{\text{т}}(G), \quad A = g\ell(\rho_0 - \rho_t), \quad h_{\text{т}}(G) = \frac{G^2}{2\rho S^2}\left[1 - \left(\frac{T}{T_0}\right)^2\right], \quad G_{\text{дыма}} = G = \rho v S$$



Water heating boiler PTVM-50-1
1 - metal pipe; 2 - convective packages;
3 - rear screen; 4 - side screen;
5 - gas-oil burners; 6 - blast fans; 7 - front screen

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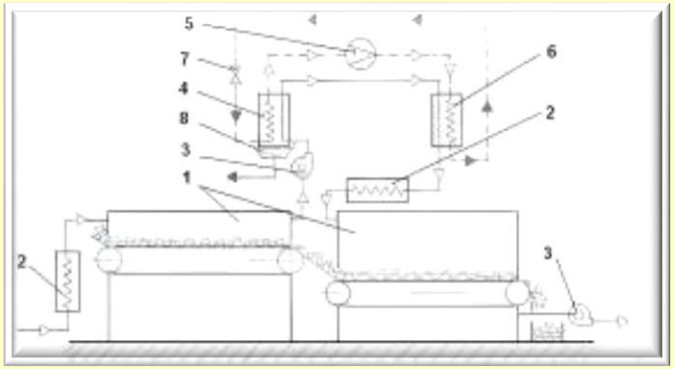
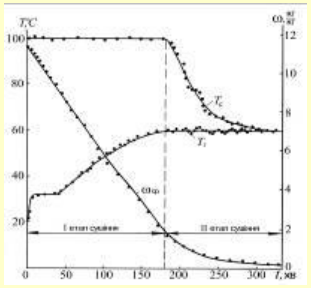
SOFTWARE COMPLEXES FOR CALCULATION OF PROCESSES OF ADSORPTION AND DRYING OF POROUS SYSTEMS IN APPARATUS OF PERIODIC AND CONTINUOUS ACTION

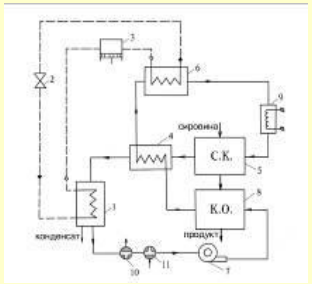


Created on the basis of developed mathematical models and numerical methods for calculating the dynamics of heat and mass transfer and phase transformations during drying and humidification of various porous materials for a wide range of process conditions.

Appointment:

Determination of temperature fields, volume concentrations and partial pressures of liquid, vapor and air phases in the body depending on the initial parameters of the contact medium, geometric characteristics of the porous body and adsorber or drying chamber to improve existing and create new energy-intensive technologies and equipment.



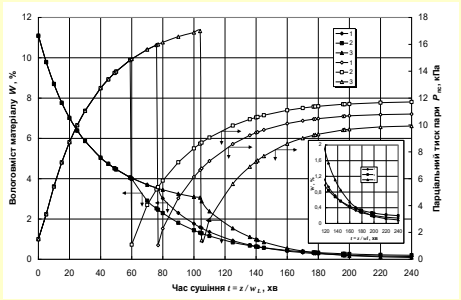


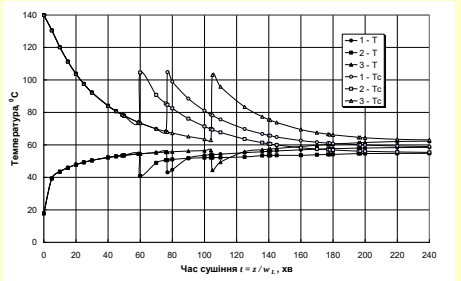
Advantages:

Speed of obtaining results in a wide range of variation of parameters and selection of optimal parameters for efficient process in terms of energy and resource conservation.

Practical application:

New methods of drying thermolabile materials for dryers of periodic and continuous action are developed, which provide change in time of temperature and moisture content of drying agent and are carried out in two stages (***Patents for invention:*** № 2003043816, 109241) and proposed drying units (***Patent*** № 3618).





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NOISE DIAGNOSTICS OF HEAT ENERGY OBJECTS

Theoretical results:

- ✓ developed methods of mathematical and non-Gaussian computer simulation noise signals that occur during operation heat power equipment;
- ✓ probabilistic properties are investigated characteristics of noise signals and created methods of their statistical processing;
- ✓ the expediency of use as informative parameters of cumulants noise signals.

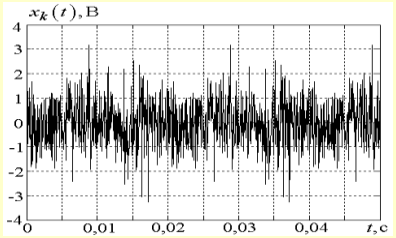
Models of noise signals

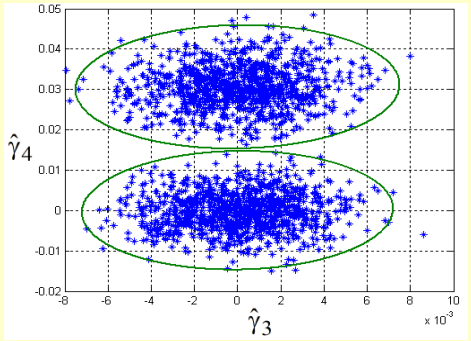
$$\xi(t) = \sum_{k=1}^{\nu_t} h\left(t, t_k, \boldsymbol{\eta}_k\right) \qquad \xi(t) = \int_{-\infty}^{\infty} h(t,\tau)\, d\eta(\tau)$$

Cumulant noise signals

$$\kappa_s\left[\xi(t)\right] = \kappa_s \int_{-\infty}^{\infty} h^s(t,\tau)\, d\tau$$

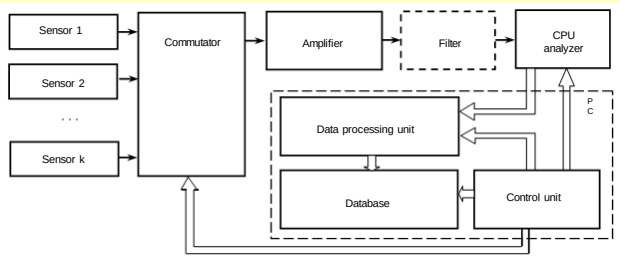
Cumulative method of distinguishing noise signals





$$\rho\left(\xi_1, \xi_2\right) = \sum_{s=1}^{m} \left| \kappa_s\left[\xi_1\right] - \kappa_s\left[\xi_2\right] \right|$$

Mobile system for collecting, registering and processing noise signals



Practical results:

- ✓ developed a mobile computerized system for acoustic noise diagnostics of elements of heat power equipment;
- ✓ created detection methods and algorithms acoustic signal of fluid leakage on the base cumulative analysis and their experimental study;
- ✓ it has been experimentally established that the cumulative method of liquid leakage detection and preliminary bandpass filtering of acoustic signals in the frequency range 5… 10 kHz increases the signal-to-noise ratio by more than 15 times for all distances, and the pipeline control zone by approximately 10 m.

Patents of Ukraine: № 74457, № 88789, № 112139.

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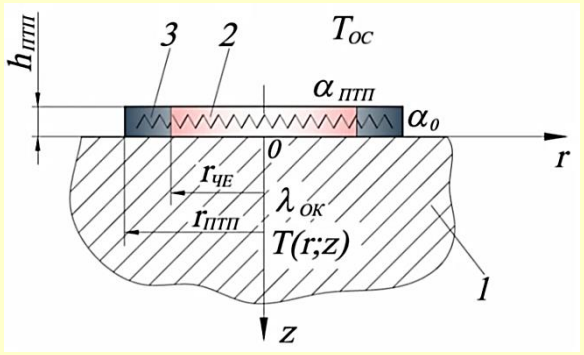
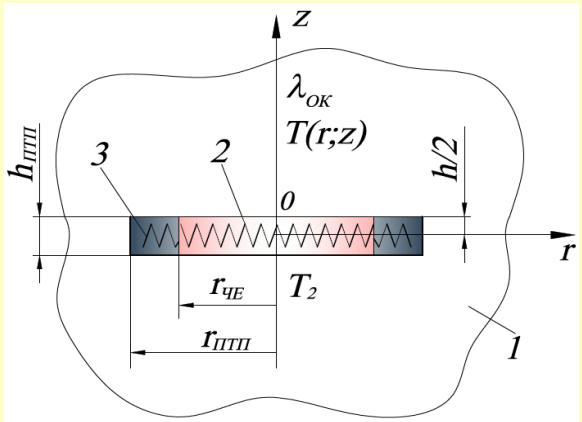
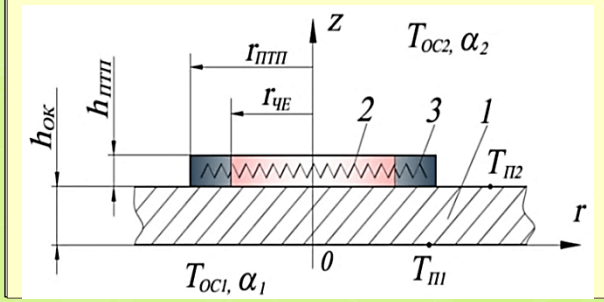
CORRECTION OF METHODICAL ERRORS OF HEAT FLOW DENSITY MEASUREMENTS







Methodical errors of heat flux density measurements

$$\delta^q(Bi_{0,r}, \frac{R_{\alpha,ОК}}{R_{\alpha,ПТП}+R_{ПТП}}, \rho_{чЕ}) = \frac{q_B}{q_0} - 1 =$$

$$= (\frac{R_{\alpha,ОК}}{R_{\alpha,ПТП}+R_{ПТП}} - 1) \cdot (1 + Bi_{0,r} \cdot \frac{R_{\alpha,ОК}}{R_{\alpha,ПТП}+R_{ПТП}} \cdot \varphi(\rho_{чЕ}, Bi_{0,r}))$$

$$\varphi(\rho_{чЕ}, Bi_{0,r}) = \int_0^\infty \frac{J_1(x)\cdot J_1(x\cdot\rho_{чЕ})}{x(x+Bi_{0,r})}dx \Big/ \int_0^\infty \frac{J_1(x)\cdot J_1(x\cdot\rho_{чЕ})}{x+Bi_{0,r}}dx$$

Theoretical result:

- ✓ the influence on the value of methodical error of heat flux density measurements on control objects of different types of ratio of thermophysical characteristics and geometrical parameters of heat flow sensor and control object is investigated, namely: heat exchange coefficients, thermal conductivity coefficients, thermal resistance and linear dimensions;
- ✓ it is established that the reduction of methodological error is achieved by aligning the thermophysical characteristics of the sensor and the object of control, as well as the introduction of a protection zone in the design of the sensor and increasing its width.

Practical meaning:

Recommendations for the choice of thermophysical characteristics and geometric dimensions of thermal sensors taking into account the conditions of their application were developed, which allowed to reduce the methodological error of heat flux density measurements by 5 times.

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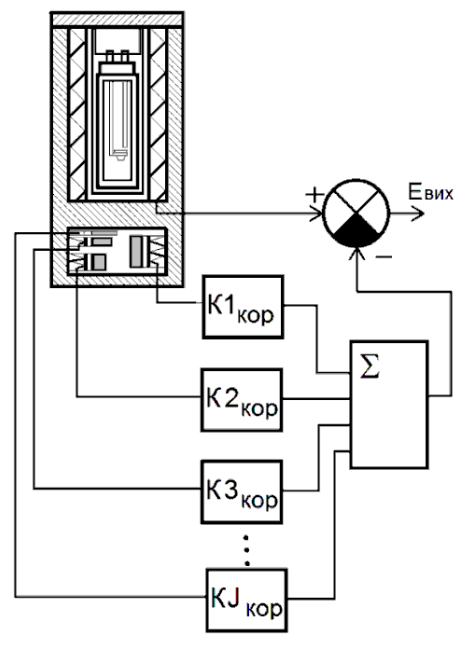
METHOD OF MULTI-REFERENCE QUASIDIFERENTIAL CALORIMETRY

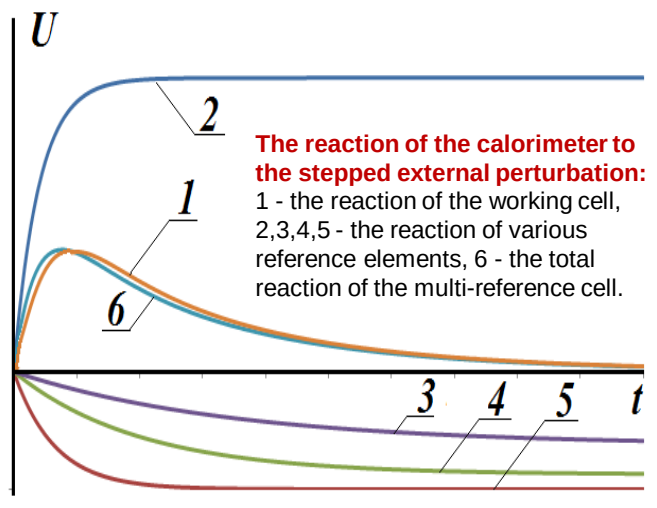
Transfer function of the working cell of the heat flow calorimeter

$$K_{кс}(s) = \frac{a_n \cdot s^n + a_{n-1} \cdot s^{n-1} + \cdots + a_1 \cdot s + 1}{b_m \cdot s^m + b_{m-1} \cdot s^{m-1} + \cdots + b_1 \cdot s + 1} =$$

$$= \frac{G_1}{\tau_1 \cdot s + 1} + \frac{G_2}{\tau_2 \cdot s + 1} + \cdots + \frac{G_m}{\tau_m \cdot s + 1}$$

$$m > n$$





The reaction of the calorimeter to the stepped external perturbation:
1 - the reaction of the working cell, 2,3,4,5 - the reaction of various reference elements, 6 - the total reaction of the multi-reference cell.

Features of the method:

Consist in replacing a full-scale reference cell in a differential calorimeter with a multi-reference cell with first-order inertial elements, the time constants of which correspond to the roots of the denominator of the transfer function of the working cell. The inertial elements are included in the parallel correction circuits to compensate for the reaction to external perturbations.

Practical result:

The size of the reference cell is reduced by 5… 10 times, which improves the mass and size characteristics of the device while maintaining the advantages of the differential measurement method.

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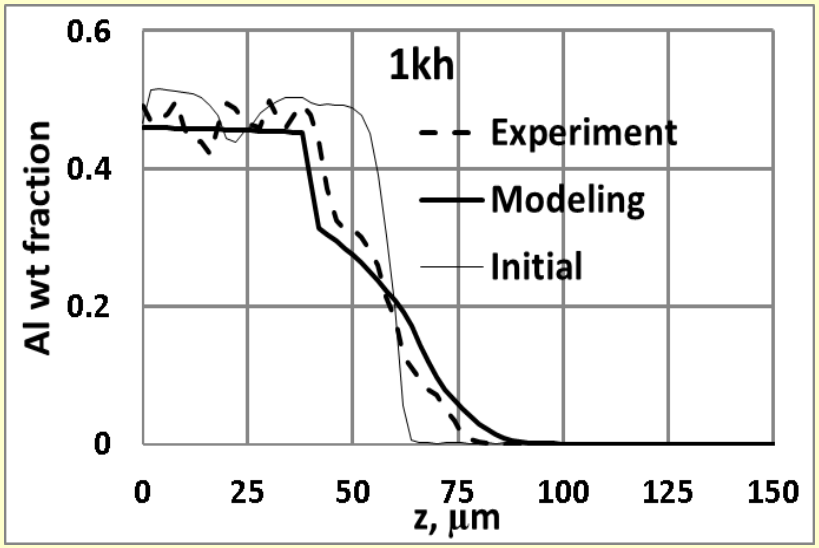
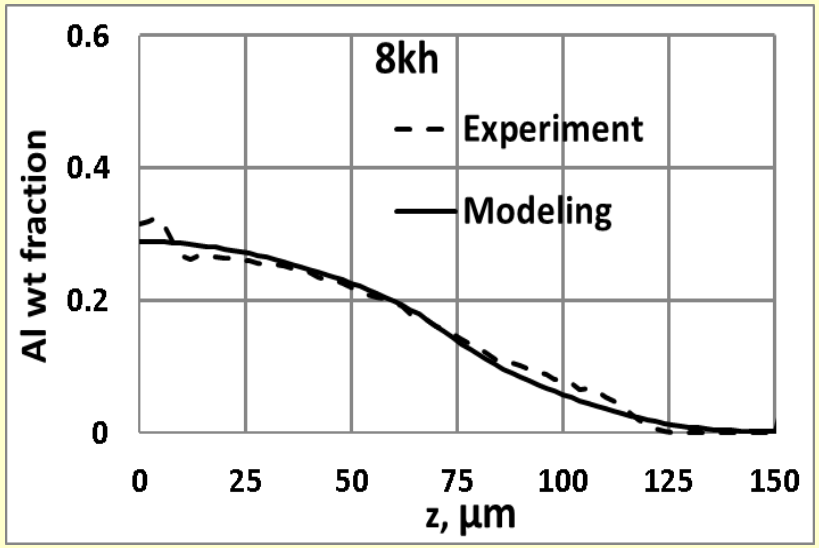
ANALYSIS OF HEAT AND MASS TRANSFER PROCESSES AND LIFE TIME PREDICTION FOR PROTECTED COATINGS OF HIGH-TEMPERATURE PARTS OF HEAT POWER PLANTS EQUIPMENT WORKING OVER UNDECRITIC PARAMETERS OF STEAM





Determination of the resource of protective coatings of the new power plants blades turbines of on supercritical parameters of steam on the basis of long-term prediction of mass-exchange processes in the "part-coating" system is carried out with the help of created refined mathematical models of heat-mass transfer processes and special computer programs on their basis.

Practical result:

Possibility to predict and evaluate the warranty period of steam turbine blades.

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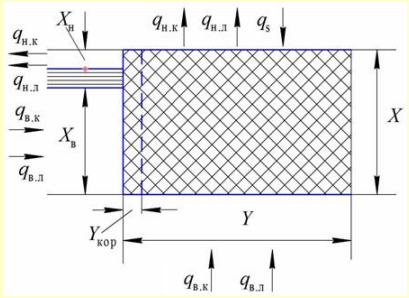
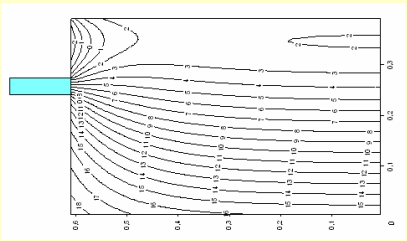
THERMOPHYSICAL BASES OF INCREASE OF BUILDINGS ENERGY EFFICIENCY

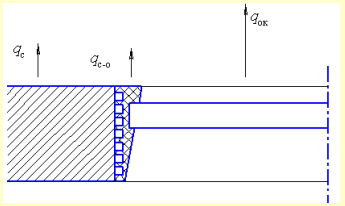
INFLUENCE OF THE WINDOW OPENING ON THE HEAT TRANSFER THROUGH THE FENCES



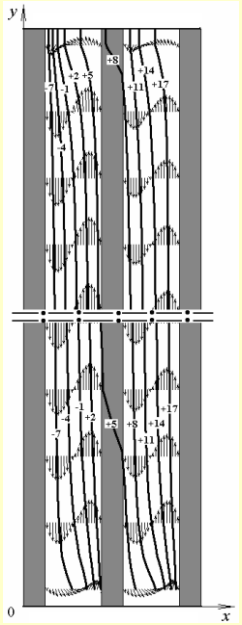
TEMPERATURE DISTRIBUTION ON THE THICKNESS OF WALLS FROM CLOSING WINDOWS IN WINTER



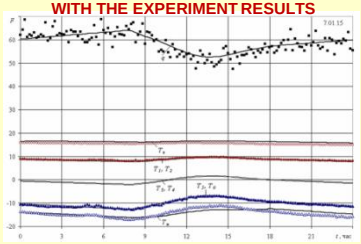
APPLICATION RIBBED WINDOW BOX TO REDUCE HEAT LOSSES



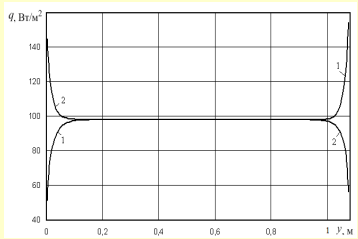
VELOCITY AND TEMPERATURE FIELDS IN THE DOUBLE-GLASS



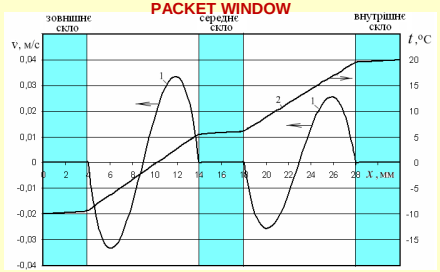
COMPARISON OF CALCULATION RESULTS WITH THE EXPERIMENT RESULTS



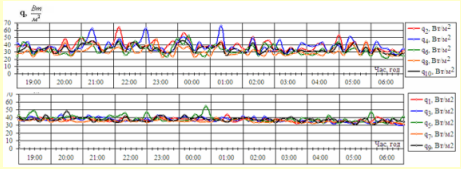
HEAT FLOW DENSITY DISTRIBUTION OVER THE SURFACE OF THE PACKET WINDOW



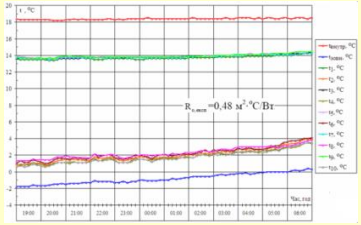
SPEED (1) AND TEMPERATURE (2) DISTRIBUTIONS ON THE THICKNESS OF THE DOUBLE-GLASS PACKET WINDOW



CHANGES OVER TIME OF HEAT FLOW DENSITIES OF EXTERNAL (TOP GRAPH) AND INTERNAL SURFACES OF THE DOUBLE-GLASS PACKET WINDOW IN WINTER SEASON



CHANGES OVER TIME OF HEAT FLOW DENSITIES OF EXTERNAL AND INTERNAL SURFACES OF THE DOUBLE-GLASS PACKET WINDOW IN WINTER SEASON



Appointment:

For adequate and complete both calculated and experimental determination of local and integrated heat losses through the enclosing structures of buildings, taking into account all influential factors - direct and scattered solar radiation, wind speed and direction, ambient temperature, humidity, infiltration effects. Providing recommendations for the optimal arrangement of facades with effective window constructions, including the places of their adjacency to the walls, and the installation of effective thermal insulation facades of adhesive and ventilation types.

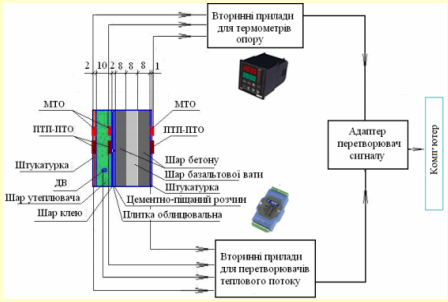
Advantages:

Definition of local zones of the increased heat losses and their prevention, establishment of optimum energy-efficient translucent designs, arrangement of warming of facades taking into account a rose and wind speed of the winter period.

Application:

For buildings of high energy efficiency; passive buildings; 0-energy buildings.

INSTALLATION SCHEME FOR HEAT MEASUREMENT ON THE SURFACES OF WINDOW CONSTRUCTION



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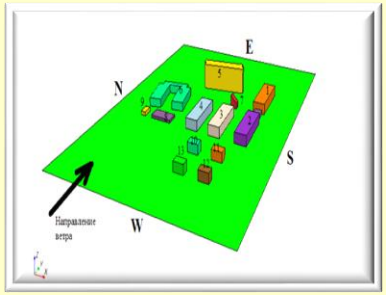
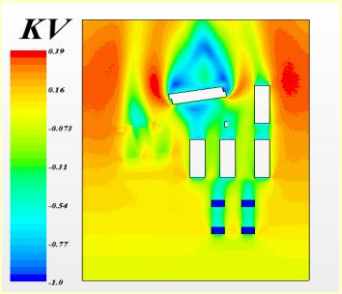
MODELING OF INTERACTION OF THE BUILDING COMPLEX WITH THE ENVIRONMENT IN THE DENSITY ZONE OF THE URBAN URBAN BUILDING

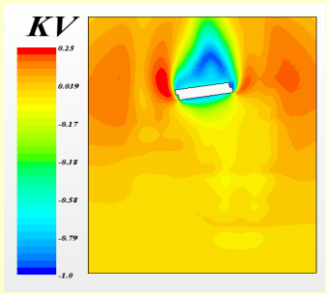
The target region - 13 sites buildings of IET NAS of Ukraine on the Bulakhovskogo str. 2

Fields of wind velocities U m/s at different heights
West wind 5 m/s at the height of Weathervane



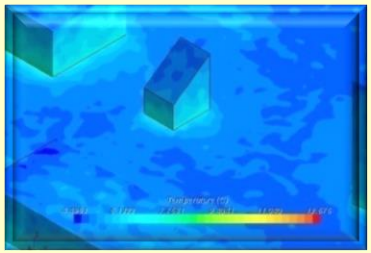


H = 10 м

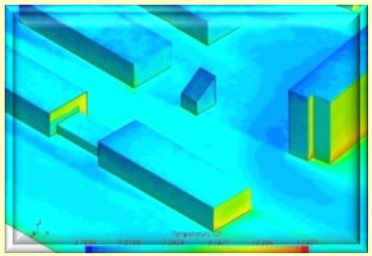


H = 20 м

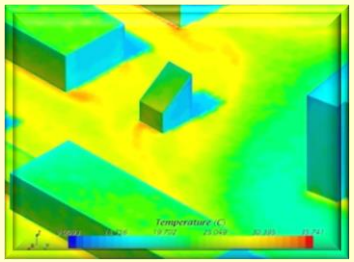
Field of temperatures



time 1:52 , night



time 6:00, sunrise



time 12: 14, day

Appointment:

- ✓ Assessment of energy potential of wind flows in the area of dense urban development for the purpose of local use of renewable wind energy;
- ✓ Radiation-convective heat exchange of buildings with the environment in the area of dense urban development, taking into account solar radiation.

Advantages:

The most realistic and complete consideration of natural conditions in the design and operation of buildings, as well as in the design and operation of equipment designed to use the renewable energy of the sun and wind.

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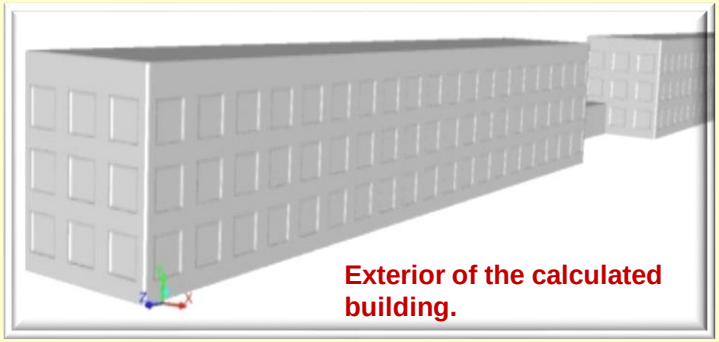
MODELING OF AERODYNAMICS AND HEAT EXCHANGE OF A BUILDING WITH WINDOW DEPRESSIONS ON THE FACADE

Appointment:

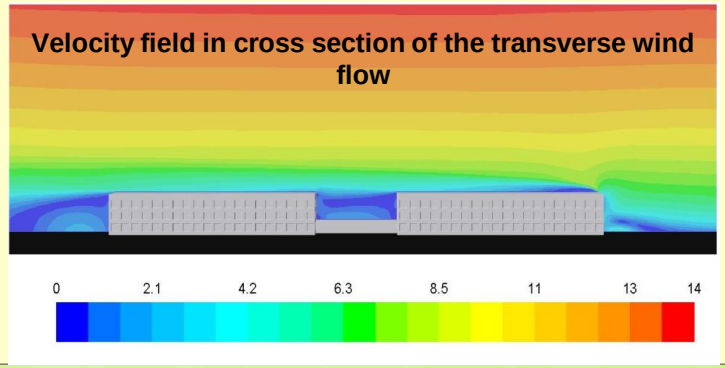
For the establishment of zones of relief enclosing structures of the building with increased heat loss and the calculation of local heat transfer coefficients depending on the influence of solar radiation; rumba and wind speed, ambient temperature; facade geometries (window recesses, protruding balconies and decorative elements, complex facade geometry, etc.).

Advantages:

In contrast to the application of the only normative value of the integrated heat transfer coefficient for all facades in the design calculations of heat losses of the building, use of the calculated local heat transfer coefficient of facades of complex geometry and development of appropriate heat loss measures and design solutions to prevent them.

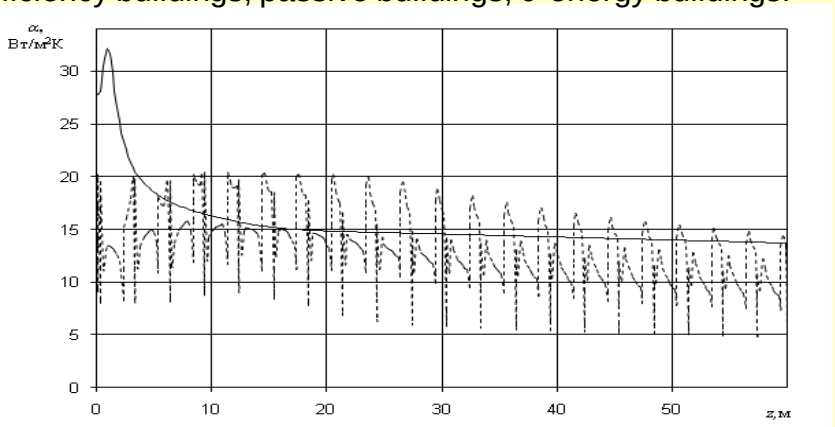


Exterior of the calculated building.



Application:

For buildings of complex geometry of facades; for high energy efficiency buildings; passive buildings; 0-energy buildings.



Distribution of heat transfer coefficients along the surface of the side wall at a height of 5 m from the ground:

——— - without window recesses; - - - - with window recesses.

The obtained values differ significantly from recommended in the DBN of Ukraine 23 W \ K · m^2.

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THERMAL PHYSICAL MODELING OF AN ENERGY EFFICIENT BUILDING EQUIPPED WITH A PASSIVE THERMAL CURTAIN FACADE AND ROOF

Protected by the patent of Ukraine № 88791

Application:

For buildings of high energy efficiency; passive buildings; 0-energy buildings.

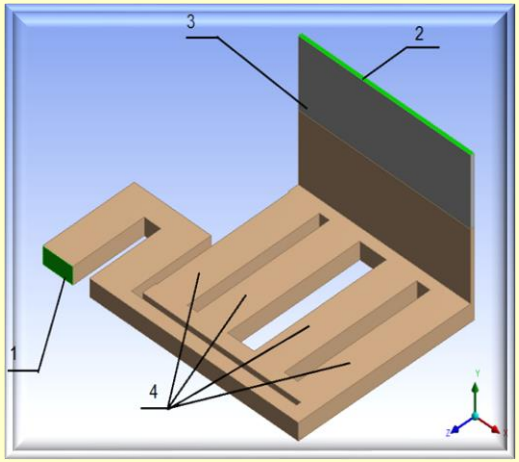
Appointment:

For passive gravitational-convective washing by external air flows of an internal air layer in multilayered warming of a facade of the energy-efficient house with the subsequent removal of this air at the highest level of a roof. The flow (and hence the temperature) of the air is regulated by the air damper of the intake. Two (southern and northern) ground heat exchangers of volume bulk type are used.

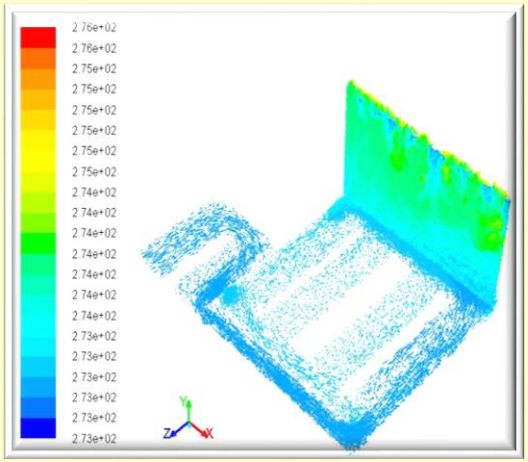
Advantages:

The passive system of thermal protection without additional energy consumption allows to use effectively natural heat of soil for actual change of temperature of climate, raising temperature of air washing the building in the winter and cooling it in the summer.

Location of the thermal curtain of the facade walls and roof.
2 - exit from the thermal curtain, 3 - interlayer space in the wall.



Calculation scheme.
1- entrance to the ground heat exchanger;
4 - multi-pass system of air boxes.



Field of velocity vectors whose color corresponds to the temperature of the heated air

Ground-to-air heat exchangers make it possible to heat the air supplied to the thermal curtain by 3-8 ^{0}C in winter and to cool it in summer, actually changing the thermal influence of the environment.

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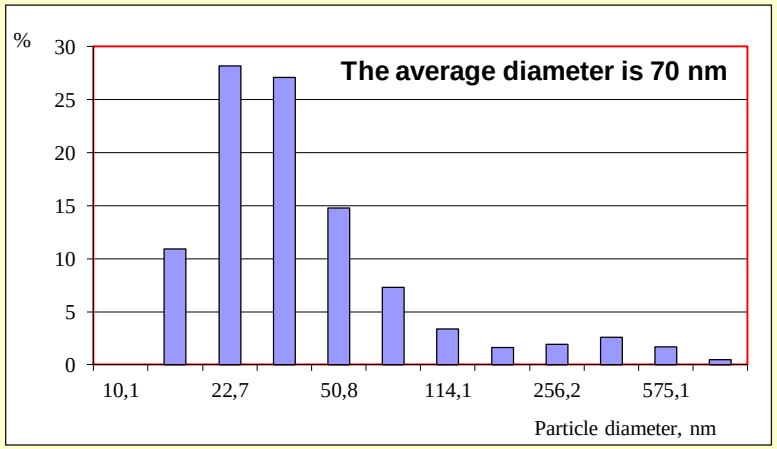
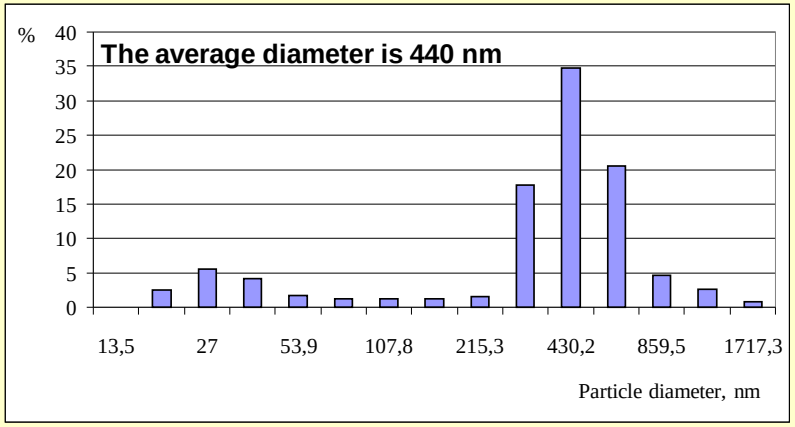
INVESTIGATION OF HEAT-MASS EXCHANGE PROCESSES IN THE CREATION OF VESICULAR PHOSPHOLIPID NANOSTRUCTURES USING THE OF THE EFFECT OF DISCRETE-PULSE ENERGY INTRODUCTION





Appointment:

Control of heat and mass transfer process of formation of stable bilayer vesicles from phospholipids 10-9-10-7 m in size and functional materials with them under the influence of discrete-pulse energy input (DIVE) effects for creation of industrial technologies.

Advantages:

- ✓ production of lipid nanostructures and functional preparations with them of high quality in industrial volumes;
- ✓ complex mechanical, hydrodynamic and hydroacoustic influence on the material;
- ✓ significant reduction of specific energy consumption compared to existing technologies;
- ✓ obtaining phospholipid nanostructures with specified high quality properties.

Practical result:

Energy efficient industrial technologies for the production of functional preparations with lipid nanostructures for targeted delivery of active substances directly to a living cell of the body for use in the medical, pharmaceutical, food industry, veterinary medicine and agriculture.0

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