SOME ADVANCES IN THE SCIENCE OF HEAT AND MASS EXCHANGE IN BELORUSSIA*

On Jan. 1, 1979, the Belorussian people and the entire Soviet Nation mark the 60th anniversary of the creation of the Belorussian Soviet Socialist Republic and the Communist Party of Belorussia. And the half-century jubilee of the Academy of Sciences of the Belorussian SSR coincides with this memorable date.

Before the Great October Socialist Revolution Belorussia was a backward province of tsarist Russia. The Belorussian people were under a double burden — political and national. Now Belorussia, an equal among all the other republics of the Soviet Union, has a comprehensive development of the socialist economy, science, and culture. The scientists of the Republic make a worthy contribution to the development of Soviet science — to mathematics, physics, chemistry, technical sciences, including the science of heat and mass exchange, and others.

Let us recall some of the landmarks in the development of the science of heat and mass exchange in Belorussia. Heat and mass exchange is an especially "interdisciplinary" science, important for many branches of industry and new technology. Historically the development of research on heat and mass exchange in the Republic has proceeded on the basis of the expansion and deepening of thermoenergetic research connected with industrial thermal technology, with drying processes in particular.

Before the Great Patriotic War investigations of processes of heat and mass exchange were conducted at the Institute of Industry of the Belorussian SSR (drying of various materials) and the Belorussian Polytechnic Institute (steam turbines, internal-combustion engines, regenerative air heating for hot-water heaters, comparison of the operation of various types of heat exchangers).

In subsequent years the principal theoretical and experimental investigations of processes of heat and mass exchange were concentrated in the Academy of Sciences of the Belorussian SSR, where the Power Engineering Branch of the Peat Institute was first created (1946), followed by the independent Energy Sector, responsible directly to Presidium of the Academy of Sciences of the Belorussian SSR (1947) and then transferred to the Institute of Power Engineering (1952).

The creation of new engineering and technology and successes in the development of the sciences of heat exchange and mass exchange, especially the thermodynamics of irreversible processes, in the 60's created the objective prerequisites for the branching off of a new scientific field — the study of the process of interrelationship of the energy and mass transfer of matter — in the sum total of knowledge about heat and mass transfer. Since A. V. Lykov came to lead the Institute of Power Engineering, Academy of Sciences of the Belorussian SSR, the finer thermophysical investigations of heat and mass exchange in their interdisciplinary aspect, using the fruitful idea of the interrelationship of the processes of heat and mass transfer, have begun to develop rapidly.

The new scientific trend determined the name of the Institute — in 1963 the Institute of Power Engineering was renamed the Institute of Heat and Mass Exchange (IHME), Academy of Sciences of the Belorussian SSR. In these years the program of the Institute was rapidly being formed and an experimental base created, and the main directions of the scientific research took shape: Transfer processes in capillary-porous solids, during phase and chemical transitions, and under steady and nonsteady conditions, heat and mass exchange in disperse and rheologically complicated systems, the investigation of the thermophysical properties of matter, and the mathematical theory of heat and mass transfer.

The Institute has become the chief organization in the country for the study of fundamental and applied problems and the utilization of phenomena of heat and mass transfer in different media for the purpose of creat-

* The cycle of work carried out in Belorussia on the 60th Anniversary of the Great October Socialist Revolution has already been illuminated in our journal (Inzh.-Fiz. Zh., 33, No. 5, 1977; the article "Some results of the development of the science of heat and mass exchange in the USSR"), so that only brief additions are made in the present article.

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ing the theoretical bases for the development, perfection, and practical employment of highly efficient technological processes.

Research on gasdynamic processes and phenomena of heat and mass exchange in laser-active media have recently been undergoing intensive development at the IHME. The principles of the method of selective thermal pumping, which provides a considerable increase in the efficiency of gasdynamic lasers, have been developed.

The International Center of Academies of Socialist Countries for Increasing the Qualification of Scientific Personnel on the Problem "Heat and Mass Exchange" operates at the IHME, Academy of Sciences of the Belorussian SSR (AS BSSR). At the Institute there are also editors from the Soviet Union for the international journal Heat and Mass Transfer, published in London since 1960 by Pergamon Press, and editors from the USSR for the journal Heat Transfer — Soviet Research, published in the USA since 1969.

Five All-Union conferences on heat and mass exchange with the participation of many foreign scientists have already met in Minsk. From 1960 to the present 92 monographs have been published by scientists of the Institute of Heat and Mass Exchange, Academy of Sciences of the Belorussian SSR, alone.

Investigations in the field of thermophysics and processes of heat and mass transfer developed rapidly in the 60s at other institutes of the AS BSSR and universities and scientific-research institutes of the republic besides the IHME AS BSSR: The Institute of Nuclear Power Engineering (INPE), the Institute of Mechanics of Metal—Polymer Systems (IMMS), the Institute of Peat, the Central Scientific-Research Institute for the Comprehensive Utilization of Water Resources (CSRICUWR) of the Ministry of Land Reclamation and Water Management of the USSR, the Belorussian Institute of Railroad Transport Engineers, a branch of the G. M. Krzhizhanovskii Power-Engineering Institute, and the Technological and Polytechnic Institutes.

The main direction in the activity of the INPE AS BSSR is the development, together with a number of organizations, of questions connected with the solution of the most important problem in the national economy of the nation — the problem of the fuel—energy balance on the basis of the development of nuclear energy. The Institute has advanced the idea of using a fundamentally new heat-transfer agent in atomic power plants (APP) — a dissociating gas — supporting this idea with a combination of theoretical and experimental research. The work of the INPE shows that dissociating nitrogen tetroxide is one of the promising heat-transfer agents for APP, especially those with fast-neutron reactors.

The main results of the scientific, experimental-construction, and production activity of the Institute of Nuclear Power Engineering have been the perfection of installation and repair work on the test-industrial experimental installation Vikhr'-2 having a flame heater with a thermal power of 5000 kW.

The Institute of Mechanics of Metal—Polymer Systems, AS BSSR, is developing the scientific principles for the creation of composite materials based on polymers, metals, silicates, and wood, and it conducts research in the field of the nature and mechanism of friction and wear of composite materials, the mechanism of the interaction of the main components of composite systems with an external medium, and optimization of the technological and prediction of the operational properties of articles and coatings made of new materials.

A complex of investigations on the influence of the structural state of polymer materials on the thermophysical properties of composite systems has been carried out at the IMMS, AS BSSR. The influence of the thermophysical and surface properties of metals on the processes of structure formation in boundary layers upon contact between a polymer melt and a solid surface was studied. The phenomenon of the dissolving of metals by polymer melts was discovered. New procedures have been developed for modifying the surface properties of metals and polymers to obtain stable adhesive bonding of the components.

Investigations of processes of fluidization of disperse materials with their subsequent cooling at metal surfaces and the thermal formation of metal—polymer compounds have made it possible to develop principles for optimizing the technological parameters for the deposit of polymer coatings with allowance for the specifics of the interaction between polymers and metals.

Investigations of processes of heat and mass transfer in peat and its rheological properties are being conducted at the Institute of Peat, AS BSSR.

The nature and mechanism of the transfer of heat and moisture in peat, its thermophysical and structural characteristics needed for the development of efficient ways of preparing peat blocks for exploitation, the control of peat dehydration processes, and the obtainment of high-quality production are investigated on the basis of modern concepts about heat and mass transfer in capillary-porous systems. Processes of

structure formation and heat and mass transfer in the radiative—convective mode of drying of natural peat and peat modified by additions of surface-active substances and polyelectrolytes are being studied, which allows one to control processes of moisture transfer and the quality of products based on peat.

The problems of the national economy being solved by the CSRICUWR, connected with the development of methods for improving the filtration properties of heavy soils and grounds and of methods for predicting their properties in salinization and leaching processes, particularly when using mineralized water for irrigation, have required the performance of a number of scientific investigations involving the study of the adsorption and filtration properties of complicated disperse systems, consisting mainly of rock-forming clay minerals. This work is now being performed using IR-spectroscopic, x-ray-structural, electron-microscopic, and gas-chromatographic methods for the analysis of disperse systems.

The results obtained provide new information on the structure of bound water and the structure of disperse media in the surface layers of a solid phase and explain the mechanism (nature) of the permeability of finely disperse systems modified by exchange cations and water-soluble polymers during the filtration of liquids.

Research in the field of the development of the theory of interrelated processes of transfer of energy, momentum, and mass in rheologically complex media of the type of metal—polymer composites and thick lubricating filler materials, to increase the productivity, durability, reliability, and efficiency of components and details of machines and mechanisms with a simultaneous decrease in the metal content and cost of the articles, have been conducted in the last few years in the Scientific-Research Laboratory of Applied Physics Problems in the Department of Physics (SRL APP) of the Belorussian Institute of Railroad Transport Engineers (Gomel).

Research on the drying of grain and of food and vitamin preparations for the agricultural economy, for which a far-reaching development program was outlined by the July (1978) Plenum of the Central Committee of the Communist Party of the Soviet Union, is developing successfully in the jubilee year at the A. V. Lykov Institute of Heat and Mass Exchange, AS BSSR.

In the jubilee year, as always, the scientists of Belorussia who are specialists in the field of heat and mass exchange consider it their honorable duty to participate actively in the solution of the urgent problems formulated by the Communist Party.

SPATIAL—TEMPORAL PULSATIONS OF AN ARC PLASMA PINCH IN A PLASMATRON CHANNEL

V. D. Shimanovich, G. P. Lizunkov,
O. I. Yas'ko, N. F. Aleshin,
and A. F. Bublievskii

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The results of an investigation of the pulsation characteristics of the arc column in a plasmatron, based on a statistical analysis of emission traces, are presented.

The study of processes taking place in a plasmatron channel and the calculation of the electric-heater characteristics are impossible without knowledge of the parameters of the hottest zone of the plasmatron — the arc pinch. Plasma diagnostics in the channel is usually hindered by pulsations of the pinch in time and space, which requires an experiment with time resolution [1]. Spectroscopic methods of determining the parameters of a nonsteady arc plasma from the time-integral emission are described in [2-6]. The normal distribution law of transverse displacements of the pinch, required for the realization of this procedure, was established by the authors for a limited range of the working parameters, and it is generally postulated for the brightness pulsations of the pinch emission [6]. The present report is devoted to the further development of the methods of plasma diagnostics for electric heaters.

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