HEAT AND MASS TRANSFER IN POWER PLANTS AND ENERGY SAVING PROBLEMS

V.P. ALEKSANDRENKOV, V.M. POI.YAEV

ON THE PROBLEM OF THE EFFICIENCY OF HEAT EXCHANGE APPARATUSES AND DEVICES WITH FORCED HEAT TRANSFER

Moscow State Technical University, Moscow, Russia

A technique of estimating the efficiency of heat exchanging apparatuses is suggested that makes it possible to make an objective and rapid comparison of the available and newly proposed means of enhancing heat transfer, as well as to select the most promising of them already at the initial stage of the design of a heat exchanging apparatus or device.

V.A. ALEXEEV, I.P. OSIPOVA

MATHEMATICAL MODELING OF PROCESSES OF HEAT TRANSFER IN PHASE-TRANSITION HEAT-STORAGE ARRANGEMENTS OF COMPLICATED SHAPE WITH ENERGY SOURCES

Moscow Scientific-Research Institute of Precise Devices, Moscow, Russia

A model of heat-storage arrangement with phase-transition material is suggested. Its mathematical description and algorithms for solution are given. The arrangement consists of a box with discretive sources of energy and phase-changing material inside. The solution obtained can be used for solving practical problems connected with the security of heat regime in transient working apparatus, and also for the design of energy-guard constructions.

D.V. ANTONOVICH, A.A. KOVALEV, YU.V. YUFEREV

PROSPECTS OF DEVELOPMENT OF DIESEL POWER STATIONS WITH ACTIVE WASTE-HEAT RECOVERY BOILERS WITH THE FLUIDIZED BED

Military Engineering Construction Institute, St. Petersburg, Russia

A schematic of an experimental diesel thermal electric station with an active "fluidized-bed" waste-heat boiler is given. The calculation results on fuel consumption in the case of simultaneous and separate operation of a 315 kW diesel-generator and an active 200 kW waste-heat boiler connected by a gas-air pipeline are given.

V.A. BABUK, V.A. VASILYEV, S.L. LOBOV, O.YA. ROMANOV

HEAT EXCHANGE IN CONDENSED PHASE COMBUSTION PRODUCTS DEPOSITION IN CHAMBERS

Baltic State Technical University, St. Petersburg, Russia

On the basis of the condensed phase combustion product (CPCP) evolution model a model of heat exchange caused by deposition of CPC on the chamber elements was developed. The influence of the CPCP evolution process, geometrical parameters of the chamber and of combustion conditions on the heat exchange intensity is shown.

V.I. BARANENKO, V.P. KRAVCHENKO, V.E. TURKIN, S.P. KHMARYUK

INFLUENCE OF THERMOHYDRAULIC AND HEAT AND MASS TRANSFER PROCESSES ON RELIABILITY POWER-ENGINEERING EQUIPMENT OF HPP AND APP

Odessa State Polytechnical University, Odessa, Ukraine

Contribution of the failure of different elements in the equipment of HPP, SOPP and APP with WWER-440 and WWER-1000 to the reduction in the electric energy output is shown. Operation of high pressure heaters (HPH) and of the pipelines of thermal equipment of HPP, SDPP and APP are examined and the causes of their failure are discussed.

G.A. BERDAUEVA, A.M. BRENER, V.G. GOLUBEV

INFLUENCE OF VISCOSITY-TEMPERATURE DEPENDENCE ON DISTRIBUTION OF LIQUID FLOWS IN A BEAM OF COOLED TUBES

Kazakh Chemicotechnological Institute, Shymkent, Kazakhstan

As a result of the theoretical analysis and numerical experiment it is shown that the nonmonotonous nature of the "consumption-pressure drop" characteristic of a cooled pipeline determined by the temperature dependence of the fluid viscosity can lead to the violation of the uniform distribution of flows in a bundle of tubes. The conditions were determined under which the flow loses stability and the radistribution of flows in the tubes begins. A criterion for estimating the decrease in the efficiency of heat transfer in a bundle of parallel cooled tubes on redistribution of flows due to the above-described effect is suggested. A procedure for calculating a tubular heat exchanger is also proposed that takes into account a possible violation of the uniform distribution and the ways of the remedy are indicated.

B.V. BERG*, S. BATMUNKH

SOLAR COLLECTOR HEAT LOSSES DUE TO THE CONVECTIVE TRANSFER IN THE GAPS UNDER THE TRANSPARENT COVER

**Ural State Technical University, Ekaterinburg, Russia; * * Mongolia*

The peculiarities of the design of a solar water heater for the conditions of the Middle Ural and Mongolian climate are discussed. Analysis shows that the greater part of the solar collector heat losses are due to convective heat transfer from the heating panel to the external transparent cover and then outward to the environment. The method of the decrease of these losses due to the reduction of convective transfer by partitions set up between the transparent cover and the heating panel is described.

E.A. BOLTENKO

CRITICAL HEAT FLUX IN STEAM GENERATING CHANNELS WITH SWIRLED AND TRANSIT FLOWS

Physics and Power Engineering Institute, Obninsk, Russia

The paper presents the results of investigations of the effect of flow swirl and the combined effect of swirled and transit flows on the critical heat flux (CHF) in steam generating channels of annular type. Using swirled and transit flows allows the heat removal rate and CHF on the convex heat transfer surface to be enhanced considerably. It is established that the CHF on convex and concave heat transfer surfaces is dependent on the swirled- to-transit flows ratio.

Within the wide range of the swirled-to-transit flows ratio variation, the CHF on heat transfer surfaces are significantly in excess of those for channels without augmentators.

E.G. BRATUTA, T.I. YAROSHENKO, V.M. VOROBYOV

CONTACT HEAT AND MASS TRANSFER IN A NUCLEAR POWER STATION REACTOR SPRAY COOLER

Kharkov State Polytechnical University, Kharkov, Ukraine

A mathematical model of recycle water cooling for atomic power-station ultimate heat sink is developed. The model takes into account multisize drop composition of spray cones and a special organized effect of carrying away air. The results of a numerical experiment indicate that up- and down-spray cone part separated by a vertical screen leads to an increase in water cooling.

A.I. BRAZGOVKA, S.A. LEVCHENKO, I.A. MIKOV, V.I. SAPTSIN, A.N. FILONENKO

INSTRUMENTAL CONTROL (COMPUTER THERMOGRAPHY) OF CONSTRUCTIONS

A.V. Luikov Institute of Heat and Mass Transfer, Minsk, Belarus

Results of experimental investigations of heat losses in buildings are presented. The method of computer thermography was used for measurements of temperature distribution. The method of measurements is described. The heat losses in all of the tested buildings are much in excess (1.3-2.0 times) of the standard ones.

YU.M. BRODOV, A.YU. RYABCHIKOV, K.E. ARONSON, M.A. NIERKNSTEIN

ELABORATION OF POWER-SAVING MEASURES AT POWER PLANTS BY MEANS OF HEAT AND MASS TRANSFER ENHANCEMENT IN STEAM TURBINE HEAT EXCHANGERS

Ural State Technical University, Ekaterinburg, Russia

The work presents justification and description of various heat transfer enhancement methods resulting in power saving at heat power plants. For turbine units with the capacity of up to 500 MW the loss of efficiency is estimated which is caused by heat and mass transfer rate decrease in heat exchangers. The effect of the application of profile tubes in condensers, low stage feedwater heaters, hot water heaters and oil coolers is evaluated. The advantages and drawbacks of various design methods for heat exchangers are compared. Heat exchanger operation control methods are also suggested along with other measures for heat exchanger operation improvement tested at heat power plants.

B.I. BROUNSHTEIN, B.M. LASKIN, G.E. MALYSHEVA, V.V. SHCHEGOLEV

MACROKINETICS OF ABSORPTION PROCESSES OF FLUE GASES CLEANING FROM NITROGEN OXIDES

Russian Scientific Center "Applied Chemistry," St. Petershurg, Russia

The macrokinetics of the absorption of nitrogen oxide by water and $(NH_2)2CO$ solution was studied. For this purpose the "single bubble" plant and the laboratory plant with regular packing

were used. Oxidation degree varied from 0 to 1 at a temperature from 20 to 80°C. The Sherwood number was calculated by measured values of the degree of recovery in the "single bubble" experiments. Experiments showed that increasing the temperature led to a considerable increase in the absorption rate. The maximum increase of the rate of NO sorption by carbamide solution, in comparison with water absorption, was observed for a—0.5 through the $(NH_2)2CO$ solution absorption of NO.

V.V. BLIDRIK

EFFECTIVE PLATE-MATRIX HEAT EXCHANGERS

Joint-Stock Company "Kriogenmash", Moscow, Russia

The description, test results and main advantages are presented for a radically new plate-matrix heat exchanger (PMHE): the author has received the Patent PCT for the design and fabrication of this heat exchanger. PMHE makes it possible to replace successfully the existing various types of heat exchange apparatuses (plate-fin, coiled, shell-tube, matrix heat exchangers, radiators, etc.) with the overall volume from 0.5 liter up to 10 m^3 and the working pressure of up to 10 MPa as an example.

V.F. BURNASHEV, YA.E. YORBEKOV, B.KH. KHUZHAYOROV

NUMERICAL INVESTIGATION OF THERMO- AND HYDRODYNAMICS OF THE OIL BED UNDER THE INFLUENCE OF THERMAL AGENTS

Complex Scientific Institute for Regional Problems, Samarkand, Uzbekistan

In the work the oil recovery problem is solved on the basis of unsteady, nonisothermal, multicomponent model of filtration. The model of nonisothermal forcing out of oil in beds by taking account of the evaporation and condensation of oil and water is constructed. On the basis of the method of "large particles", a method for solving the above-mentioned problem was developed. The ousting abilities of warm water, gas and water stream, and the influence of heat losses and inhomogeneity of beds on the behavior of filtration were compared. It is shown that a water stream has the highest efficiency.

O.G. BURDO, S.G. TERZIEV, S.N. PERETYAKA

HEAT AND MASS TRANSFER IN HEAT RECOVERY FOR VAPOR-DUST-GAS REFUSE OF FOOD TECHNOLOGY

Odessa State Academy of Industrial Technologies, Odessa, Ukraine

The paper presents the results of investigation of heat and mass transfer of a drying agent laden with food dust (sugar, dry milk, coffee, starch, etc.) in heat-pipe heat utilizers. The high heat transfer coefficient can be achieved without ribbing the heat pipe, surface by using flat pipes with in-line type bundles. For heat pipes with individual integral-spiral finning the results are presented on the processes of entrapping dust, partial condensation of damp steam from a gas flow and product dissolution and washing away from the heat pipe surface. The results of the experimental investigation and practical applications are analyzed.

CHAEJAE-OU*, G.M. VASIUEV, V.A. VASETSKY, A.S. PETRAN**

HF.AT AND MASS TRANSFER IN PURIFICATION OF EXHAUST GASES OF ENERGETIC DEVICES BY PULSE STREAMER DISCHARGE

** Korea; **A.V. Luikov Institute of Heat and Mass Transfer, Academy of Sciences of Belarus, Minsk, Belarus*

The problems of heat and mass transfer in the. process of purification of diesel engine exhaust gases are investigated. Experimental results on NOx decomposition in the nonequilibrium plasma of a pulse streamer discharge are presented. A combined method for diesel engine exhaust treatment is suggested for simultaneous elimination of NOx and soot.

N.N. DAVIDENKO, A.I. KALYUTIK, YU.E. KARYAKIN

ELABORATION OF ME'JHODS AND MEANS FOR VACUUM DEFECT DIAGNOSTICS IN THE UPPER BLOCK EQUIPMENT OF THE WER- 1000 REACTOR AND IN A VACUUM VOLUME

St. Petersburg State Technical University, St. Petersburg, Russia

Description of the methods and means for vacuum defect diagnostics is given in application to the WER-1000 reactor equipment. The methods include specially constructed devices that use helium as a gas-indicator and numerical simulation of two-dimensional laminar natural convection in enclosures of arbitrary crosssection.

A.A. DEKTEREV, L.P. KAMENSHCHIKOV, A.M. KOVALEVSKY, YU.A. ZHURAVLEV, V.I. BYKOV

MODELING OF THREE-DIMENSIONAL AERODYNAMICS AND COMPLEX HEAT TRANSFER IN HIGH-TEMPERATURE INSTALLATIONS

Siberian Thermal Engineering Institute, Krasnoyarsk, Russia

A mathematical model of the processes of turbulent aerodynamics, heat exchange and burning taking place in high-temperature installations is presented. To account for the aerodynamics and motion of gas components I In model uses a method of a control volume. The description of radiation h based on a semistochastic method of beams, the modeling of the motion "I particles is based on the Lagrangian approach. Examples of modeling flows and heat exchange in the furnace chamber of a water-heating boiler and in the burner for reburning of electrolyzer gases are demonstrated.

N. DIKY, N. KOLOSKOVA, V. SHKLYAR, V. DUBROVSKAYA

HEAT AND MASS TRANSFER IN THE MIXER-TYPE CONDENSER OF A GAS-STEAM TURBINE PLANT WITH THE NEC-PROCESS

Kiev Polytechnical Institute, Kiev, Ukraine

Experimental results are presented on heat and mass transfer during condensation of gas-steam mixtures in contact apparatus with porous packings. The developed surface of phase contact together with a decreased thickness of the liquid film flowing down the channel wall due to adhesive force, increase the phase contact time and intensity of heat and mass transfer process in the equipment. Dependences of heat and mass exchanger coefficient on the velocity

of the gas-steam mixture, geometric characteristics of packings and a noncondensed gas in the mixture are shown.

YU.P. DOBRYANSKY

AN AUTONOMOUS HEAT TRANSFER AGAINST THE GRAVITY

Institute, of Technical Thermophysics of the National Academy of Sciences of Ukraine, Kiev, Ukraine

The possibility of transferring heat against gravity forces by using the difference in the pressures of the heat carrier saturated vapors in the warm and cold branches of a partially filled circulation loop is considered. The device operates cyclically and autonomously. Glass models with water as a heat carrier at an atmospheric pressure were tested in laboratory conditions at the temperatures of 28 and 75°C.

E.D. DOMASHEV, V.V. TREPUTNEV, A.A. KRIVESHKO, A.G. CHERNYAKOV

HEAT TRANSFER AND LOSS OF TRANSVERSE PIPE BUNCHES WITH PETAL RIBBING IN AN AIR FLOW

Institute of Technical Thermophysics of the National Academy of Sciences of Ukraine, Kiev, Ukraine

Correlations are obtained that describe the dependence of the convective (with the eliminated thermal resistance of a fin) heat transfer coefficient of a row of tubes in the depth of the bundle and of the aerodynamic drag coefficient of one row of a multirow bundle on the geometric characteristics of the finning and bundle.

G.A.DREITSER

STATE OF THE ART IN INVESTIGATIONS IN HEAT TRANSFER ENHANCEMENT IN CHANNELS AND PROSPECTS IN CREATING COMPACT HEAT EXCHANGERS

Moscow State Aviation Institute (Technical University), Moscow, Russia

An analysis of the latest achievements in heat transfer enhancement in tubular heat exchangers is presented. The possibilities of heat transfer enhancement by means of artificial flow turbulization for single-phase heat carriers, for the surfaces with spherical pits, for bundles with finned tubes with cross flow, for boiling and condensation are shown. It is demonstrated that heat-transfer tubes with regularly spaced annular grooves and diaphragms that were developed at MAI, satisfy the requirements imposed on highly effective heat transfer surfaces.

E.P. DYBAN, A.I. MAZUR, G.A. MAZUR

UNSTEADY HEAT TRANSFER IN CONTROLLED COOLING OF A CYLINDRICAL BODY

Institute of Technical Thermophysics of the National Academy of Sciences of Ukraine, Kiev, Ukraine

Results of experimental study of heat exchange between a steel disk heated to 450°C and impact water-air jet possessing almost uniform density of the surface irrigation are presented. A correlation was used for numerical calculation of the regulation characteristics of water injector

ensuring uniform velocity of cooling of the inner surface of a bilayer cylinder. A pattern of practical implementation of the controlled process of cooling is described.

V.B. DZENZEROVSKY, V.B. VESELOVSKY, V.L. LYASHENKO

THERMAL TRANSPORT VEHICLE CRYOMODULE DESIGN

Institute of Transport Systems and Technologies of the National Academy of Sciences of Ukraine, Dnepropetrovsk, Ukraine

Thermal mathematical models for different-type supports and current leading bars of superconducting cryogenic modules of transport vehicles with magnetic suspender are presented. The solutions of nonstationary heat exchange problems are obtained using approximate analytical methods based on Laplace integral transform, successive interval and small parameter methods. The results of temperature field parametric studies for the current leading bars and support as well as the comparison with known numerical solutions and experimental data are given.

B.V. DZYUBENKO, G.A. DREITSER

HEAT TRANSFER AND HYDRODYNAMICS IN CHANNELS OF POWER PLANTS

Moscow State Aviation Institute (Technical University), Moscow, Russia

The generalization of the results of investigation of heat transfer, hydraulic resistance and interchannel mixing of heat carrier in a channel with induced turbulence of flow by its twisting and by roll burnishing of transversal grooves outside tubes is fulfilled. The effectiveness of studying heat transfer surface is estimated. It is revealed that for every region of Reynolds number variation it is possible to find a heat transfer surface that has the greatest thermohydraulic efficiency. The turbulent swirling flow structure analysis allowed to explain the mechanism of heat transfer augmentation.

V.P. ELCHINOV, V.A. KIRPIKOV, V.YU. SEMENOV

INTENSIFICATION OF HEAT TRANSFER IN OIL COOLERS

Academy of Chemical Machine. Building, Moscow, Russia

Heat transfer was studied experimentally in oil coolers with plate-fin surfaces. Plate-fin surfaces with fins parallel to a stream of oil increased heat transfer 2-2.5 times and increased the hydraulic resistance by a factor 1.5- 2.7. Plate-fin surfaces with fin perpendicular to the stream of oil gave a 8- 10-fold increase in heat transfer and 80-100-fold increase in hydraulic resistance.

M. FLEBIG, H.-W. HAHNE

SELF-SUSTAINED OSCILLATIONS; VORTICES AND HEAT TRANSFER IN PERIODIC CHANNELS WITH WING-TYPE VORTEX GENERATORS

Institut Thermo @ Fluid Dynamik Ruhr Universitat, Bochum, Germany

The flow and temperature field in a channel with periodic fins in the form of rectangular winglets at 45 angle of attack and a longitudinal pitch between 2.5H and 7.5H have been investigated numerically. The conservation equations are solved by a finite volume method with collocated variables in Cartesian coordinates. The winglets generate longitudinal vortices along

their side edges and transverse vortices along their leading and trailing edges. The vortices destabilize the flow. With increasing longitudinal pitch the flow character alternates from a periodic to aperiodic one. The Nusselt number becomes a maximum for a longitudinal pitch independent of the Reynolds number. Flow losses arc more than an order of magnitude smaller for flow with swirl than for an equivalent turbulent plane channel flow with the same heat transfer.

B.KH. GAITOV, L.E. KOPELEVICH, V.YA. PISMENNYI

AN ACCOUNT OF NONSTATIONARY HEAT EXCHANGE IN ASYNCHRONOUS GENERATORS WITH VARIABLE PARAMETERS

Kuban State Technological University, Krasnodar, Russia

Specific features of the calculation of the nonstationary two-dimensional temperature field of an asynchronous generator with variable parameters (AGVP) are considered with account for the throughflow of a liquid cooling agent.

D. GAJIC, D. PANTOVIC

HEAT TRANSFER AND PRESSURE LOSS OF COMPACT HEAT EXCHANGERS BASED ON INDIVIDUALLY FINNED FLAT MULTICHANNEL PROFILES

Institute " Kirilo Savic", Belgrade, Yugoslavia

Compact heat exchangers with cut fins belong to a new generation of highly efficient heat exchangers. Mostly they are produced from individual finned multichannel profiles made of aliminum or its alloys. In this work the analysis of experimental results of thermodynamic and flow measurements on the air side of prototype of radiators for motor vehicles, constructed according to the technology developed at the Belarusian Polytechnical Academy in Minsk, is carried out. The analysis includes the testing of radiator prototypes in laboratories at the Belarusian Polytechnical Academy in Minsk and Institute for Nuclear Sciences-Vinca in Beograd. By applying the most recent empirical formulas and numerical analysis methods, the authors of this work have defined the formulas and diagrams shown in the figures, for calculation of heat transfer coefficient and pressure loss on the air side of the radiator. Finally, comparative analysis of thermal and flow characteristics of radiators based on individually finned flat multichannel aluminum profiles and classical radiators of brass tubes with copper lamellas has shown an increased efficiency of aluminum radiators.

P.M. GAVRILOV

HEAT MASS TRANSFER AND SELF-PROTECTION OF NUCLEAR POWER PLANTS

Siberian Chemical Plant, Seversk, Russia

It is shown that the knowledge of the specific features of the effect of heat and mass transfer in a reactor on its properties and interrelations makes it possible to improve the design of the active zone in such a way that the physical processes themselves ensure its safe operation.

L.E. GNEVANOVA, B.P. ZHILKIN, I.A. ZYSKIN, V.M. KOSTOMAROV, G.A. KOSTROMSKOI, S.S. SKACHKOVA

SOME CHARACTERISTICS OF MIXING OF SWIRLING GAS JETS WITH A CROSS FLOW

"Uralmash" Joint-Stock Company, Ekaterinburg, Russia

The configuration and internal structure of single swirling gas jets and their systems when mixed with a cross flow were studied by the shadow method. The schematic jet patterns were established. It is found that combining the jets into a system causes deep changes in the flow pattern. The laboratory results were verified on a high-temperature industrial test facility. The studies were performed by the temperature method accompanied by measurements of the velocity vector field. The flow pattern is shown. Empirical equations outlining the jet configuration are presented.

A.I. GORIN, A.M. MOISEEV

TEMPERATURE FIELDS REPRODUCTION IN STRUCTURE ELEMENTS OF ENERGETIC INSTALLATIONS WITH POWERFUL VOLUME HEAT GENERATION

Scientific-Research Institute of Thermal Processes, Moscow, Russia

Temperature fields in structure elements of perspective power systems appearing at volumetric heat generation rates exceeding $10^4 KW/m^3$ are reproduced by gas cooling of preheated items under controlled conditions of the regular thermal mode. Theoretical substantiation of the method and results of experimental verification on carbide ceramic fuel elements are reported.

V.V. IVANOV, I.L. DUNIN, N.V. BUKAROV

HEAT REGIMES OF UNDERGROUNDCHANNEL-TYPE HEAT PIPELINES

Rostov Engineering-Construction Institute, Rostov, Russia

A physical model for the description and analysis of heat transfer processes in the zone of laying underground channel-type heat conductors is presented. The calculations of heat losses and surface temperatures of the ground are made. An opportunity for applying heat-vision technique to control the state of the underground heat conductors is shown.

A.A. KASATKIN, I.I. SOLODKII, A.P. PUKHOV, V.S. SHVEDOV, V.G. TIKHONOV, A.A. TRETYAK

DEVELOPMENT OF SOLID FUEL VORTEX-TYPE GASIFIER TO OBTAIN AND INJECT HOT REDUCING GAS INTO BLAST FURNACE (BF)

Institute of Ferrous Metallurgy, Dnepropetrovsk, Ukraine

This problem of the replacement of a scarce coke by the low-grade coal gasification products can be solved using a gasifier to be set in BF tuyere units. Some pulverized tuyere reactor-gasifier constructions have been developed to realize the new technology. Some tuyere gasifier designs were tried under laboratory and actual BF conditions and an optimal design has been selected for BF operations. A great expected economical effect of the new technology is shown.

V.T. KAZAZYAN, V.M. POLYUKHOVICH

HYDRAULIC RESISTANCE AND HEAT EXCHANGE IN THIN ANNULAR FILLINGS OF SPHERES

Institute of the Problems of Power Engineering, Minsk, Belarus

The results of experimental investigations of hydraulic resistance and heat exchange of sphere fillings in annular channels at the channel width-sphere diameter ratio κ = 1.05-3 are presented. The ranges of κ were determined where the hydraulic resistance coefficient decreases by a factor of 1.5-3. For all annular fillings the heat transfer from spheres does not depend on κ parameter and the location of the sphere with respect to the wall of the channel. The dependencies for the calculation of the hydraulic resistance coefficient and heat transfer of annular fillings were obtained.

M.L. KONOVALOV, V.V. BELOBORODOV

INDUCTION LIQUID HEATING (CONJUGATE HEAT TRANSFER PROBLEM)

Krasnoyarsk Commercial Institute, Krasnoyarsk, Russia

Based on the analysis of the conditions occurring in induction heating of fluids it is found that heat transfer is conjugated. The concept of the Bryun longitudinal criterion as the conjugation criterion of induction heating of a fluid is introduced. The problem of induction heating of a fluid (a conjugate heat transfer problem) is formulated and solved analytically. The results of theoretical investigations were used to calculate and design an induction heater of fat for deodorizing installations.

G.V. KONYUKHOV, A.I .PETROV

THERMAL AND HYDRAULIC CHARACTERISTICS OF HEAT EXCHANGERS FOR SPACE ENERGETICS

Scientific-Research Institute of Thermal Processes, Moscow, Russia

The results of experimental investigations of thermal and hydraulic characteristics of heat-exchanger surfaces, used for the construction of the running paths of heat exchangers, and manufactured heat exchangers on the basis of profiled sheets with special form stampings, are presented. A comparative analysis of thermal-and-hydraulic characteristics of individual plates and manufactured heat exchangers shows a distinct difference between these characteristics, mainly, in hydraulic properties. It is associated with the peculiarities of fluid supply and removal to the running paths of heat exchangers.

A.S. KORSUN*, S.G. VITRUK*, M.S. SOKOI.OVA*, P.A. USHAKOV**

VERIFICATION OF THE THEHYCO-3DT SOFTWARE PACKAGE

* *Moscow Engineering-Physical Institute, Moscow, Russia; ** Physical Power Engineering Institute, Obninsk, Russia*

A thermohydrodynamic software package "THEHYCO-3DT' is discussed worked out within the scope of the neutron-physical thermohydrodynamic software package "SKETCH" at the Moscow Engineering Physical Institute at the Chairs "Thermal Physics" and "Physics Nuclear Power Engineering Installations" for simulating three-dimensional nonstationary neutron-

thermal-physical processes in the active zone of promising nuclear power engineering installations.

P.G. KRUKOVSKY, E.S. KARTAVOVA

SIMULATION OF HEAT AND MASS TRANSFER PROCESSES IN COMPONENTS OF POWER PLANTS FOR PREDICTION OF HIGH- TEMPERATURE GAS CORROSION

Institute of Technical Thermophysics of the National Academy of Sciences of Ukraine, Kiev, Ukraine

The model of high temperature gas corrosion is proposed. The model is based on a detailed account for the thermal data of the components, diffusional redistribution of alloying elements and oxidant in the surface layer of the material of the blade and of the processes of corrosion formation.

A.I. KUROCHKIN, G.A. RYABOV

INVESTIGATION OF HEAT TRANSFER TO WALL SCREENS FOR THE AERODYNAMIC MODEL OF CFB BOILER

Russian Thermal Engineering Scientific-Research Institute, Moscow, Russia

One of the main problems in designing CFB boilers is to determine the heat flux to the tube walls. Control of the heat flux can be done mainly by means of changing conduction heat transfer. Influence of gas velocity, average solid concentration and the size of particles can be studied on an aerodynamical test rig that models the furnaces circuit CFB boiler. For the explanation of the results of research, it is important to study local mass flux near the walls. The data obtained are used for working out a method of heat transfer calculation in the furnaces of CFB boilers.

V.I. KUZNETSOV, V.V. MAKAROV, A.B. YAKOVLEV

HEAT AND MASS EXCHANGE IN A COUNTERCURRENT VORTEX TUBE WITH ADDITIONAL FLOW

Omsk State Technical University, Omsk, Russia

Up to now it was assumed that an additional supply of gas flow to a backward flow vortex tube makes all the additional flow escape through a diaphragm and that in the course of its motion from the hot terminal to the diaphragm power exchange occurred between axial and peripheral gas layers. The results of the present study show that an additional gas flow passes to a larger radius and escapes to the atmosphere through the hot end orifice. There is no heat and mass exchange between the primary and additional flows. Thereby the additional flow plays the part of a gas orifice.

V.I. KUZNETSOV, V.V. MAKAROV, A.B. YAKOVLEV

THE INFLUENCE OF A STREAM PART VORTEX ON THE HEAT AND MASS EXCHANGE AND THE GAS FLOW RATE IN EXHAUST CHANNEL OF POWER PLANTS

Omsk State Technical University, Omsk, Russia

The possibility of vortex device application on the basis of the Rani vortex tube for increasing flow in the exhaust path of a power plant is considered and the results of experimental investigation of the device with a tangential supply of a part of flow with the aim of its twisting are given.

D.P. LAOSHVILI, B.M. CHUNASHVIU

INFLUENCE OF PRINCIPAL PARAMETERS OF THE ENERGY SYSTEM ON THE THERMAL REGIMES OF ELECTRIC POWER STATIONS

Georgian Technical University, Tbilisi, Georgia

The results of investigation of electrodynamic processes that directly influence thermal regimes of thermal electric power stations are presented. A mathematical model is constructed that takes into account all the features of the Republican Energy System. On the basis of studying the model on an electronic computer the nature and parametres of the dynamic processes occurring in the thermal electric part of thermal stations are determined. It is found that the power indices of the thermal part of the thermal electric power station depend directly on transient processes caused by the change in the load of the system.

V. MAKAREVICIUS, R. MAKAREVICTIIS

TRANSFER IN WORKING SPACE HEAT EXCHANGERS OF A REGENERATIVE HEAT PUMP

Lithuanian Power Engineering Institute, Kaunas, Lithuania

Results of experimental investigation of transfer in heat exchangers of the working cylinders of a heat pump operating on the Stirling reverse thermodynamic cycle are presented. As working fluids, inert gases mixed with changeable phase gaseous components were used. The kinetics of the heat transfer process were also investigated. Experimental data were generalized by dimensionless relations.

S.A. MAKAROV, YU.V. CHOVNYUK, N.R. MAKAROVA, E.V. CHOVNYUK

EFFECT OF NONLINEAR WAVE PACKAGES ON HEAT TRANSFER PROCESSES IN TWO-PHASE FLOWS IN A PIPE

Kiev State Technical University of Construction and Architecture, Kiev, Ukraine

The results of numerical and analytical investigations of the specific features in the propagation of nonlinear waves in gas—liquid systems of bubble structure with я gas content varying in the direction of wave propagation are presented. The governing parameters such as the heat transfer and hydraulic resistance coefficients are determined. Investigations of the effect of the gas content inhomogeneity on the structure of nonlinear stationary waves of the type of "quasisolitons" and "shock waves" showed that the enhancement of waves is possible when certain restrictions on the degree of inhomogeneity are fulfilled. With account for nonlinear formations in gas— and vapor—liquid mixtures the Nusselt and Reynolds numbers should be determined using the heat transfer coefficient of the fluid for various regimes of vapor—liquid flow.

V.A. MALYARENKO, A.V. YEGOROV

MATHEMATICAL MODEL FOR HEAT AND MASS EXCHANGE IN HEAT AND NUCLEAR PLANT SPRAY COOLING PONDS

Kharkov State Academy of Municipal Facilities, Kharkov, Ukraine

The results of investigation of the heat and mass-exchanger performance of heat and nuclear plant spray cooling pond (SCP) modules that can be used for design, exploitation and modernization of power and industrial coolers are presented. New dimensionless thermal efficiency indices for single centrifugal tangent nozzle (ITEN) and isolated module (ITEM) are suggested on the basis of a mathematical model of heat and mass exchange between polydisperse ensemble of droplets and air. Formulas are given for calculating the temperature of water cooled in a module along the determined air direction. Analytical equations of ITEN and ITEM dependence on construction and airohydrothermal SCP characteristics are obtained as a result of parametric investigation of formulas and data analysis of long-term field observations at a number of power plant SCPs.

V.P. MARKOSOVA, B.A. TROSHENKIN, A.S. POSHTUK, V.A. GROMOV

REGULARITIES IN PROCESSES OF UNDERGROUND BURNING OF COAL

Institute of the Problems of Machine Building of the National Academy of Sciences of Ukraine, Kharkov, Ukraine

A physical model of the process of coal burning in mines is developed that makes it possible to estimate the thermal efficiency of the underground heat generator. The model is constructed on the basis of the assumption about the determining role of heat and mass transfer in the process of burning.

R. MERTZ, M. GROLL

FLOW BOILING HEAT TRANSFER IN NARROW CHANNELS

Institut fur Kernenergetik und Energiesysteme Universitat Stuttgart, Germany

In the framework of the JOULE 2 research and development project on compact heat exchangers of the Commission of the European Communities experiments were carried out at IKE with the aim to investigate the heat transfer characteristics and the boiling phenomena of heat exchanger surface with narrow channels. The experiments with vertical planar heat exchanger surfaces were carried out in the flow boiling mode. The specimens were copper plates with rectangular narrow channels, 1, 2 or 3 mm wide with aspect ratios of up to 3 and an industrial prototype. The test rig allows visual observations of the boiling phenomena. Water and R141b were used as working fluids. The experiments were carried out under saturation conditions at pressures of 1 and 2 bar. Mass fluxes from 50 kg/m^{2}sec to 700 kg/m^{2}sec were employed, and the heal input varied up to 9 kW.

S.YU. MESNYANKIN

CALCULATION AND CONTROL OF CONTACT CONDUCTIVITY IN CONSTRUCT ELEMENTS OF POWER SYSTEMS

Moscow State Aviation Institute (Technical University), Moscow, Russia

Systematization of the well-known data on contact heat exchange is carried out, and classification of the versions of thermal contacts is offered. Results on generalized research of the existing analytical dependences for the most widespread types of units and connections are given, and the limits of applicability and the range of materials are established, for which the ratios considered are valid. On the basis of model representations of the thermal contact of solid bodies, a more exact dependence for contact heat exchange is given, the calculation by which is compared with the known experimental data.

O.O. MILMAN, V.A. FYODOUOV

AIR-CONDENSING PLANTS IN POWER ENGINEERING. DEVELOPMENTS, PROSPECTS AND PROBLEMS

"Kaluga Turbine Plant" joint-Stock Company NPVP "Turbocon", Kaluga, Russia

The design and study results for air-condensing plants are given, their hydrothermal and lifetime characteristics are obtained, the prospects of their use in Russia and the CIS countries (L.C. and M.C. plants for acid areas) and the problems of the effect of environment factors in North regions are determined.

O.O. MILMAN, A.A. PINDRUS

HEAT TRANSFER INTENSIFICATION IN DIFFUSERS BY USING OF PROFILED SURFACES

Kaluga State Pedagogical University, Kaluga, Russia

The results of investigation of heat transfer intensification by using longitudinal profiling of diffuser wall are presented. The traditional smooth surfaces were replaced by the surfaces with longitudinal rectangular and triangular grooves. Higher turbulence and whirl formation make it possible to intensify heat transfer while preserving high flow stability in the diffuser regions.

O.V. MITROFANOVA, A.S. KORSUN

CALCULATIONS OF HEAT TRANSFER IN ANNULAR CHANNELS WITH SWIRLING DEVICES

Moscow State Engineering Physical Institute, Moscow, Russia

A procedure and a computing program are developed that give the possibility to perform comparison of the thermal efficiency of channels with swirling spirals and to select their optimal geometry. The results of calculations are compared with experimental data.

YU.L. MUROMTSEV, V.I. LYASHKOV, L.P. ORLOVA

ENERGY-SAVING HEATING OF BODIES

Tambov State Technical University, Tambov, Russia

The results of investigations of the optimal energy saving control by heating processes are presented. A nontraditional approach to the solution of the problems of heating is suggested involving analysis and synthesis of optimal control on a multitude of the functioning states. Optimal control can be implemented by simple microprocessor devices (MPD). Conceptual approaches to the design of optimal controlling programs for MPD are determined. The

application of the results is demonstrated on an example of the solution of the problem of optimal heating of water. Experiments showed that the use of optimal control can ensure a 20-28% decrease in energy expenditures on water heating to boiling compared to heating at a constant value of controlling effect.

A.V. NIKITIN, V.A. LIOPO, V.I. LAVRUSHKO

COMPUTER-AIDED DESIGN OF HEAT AND MASS TRANSFER EQUIPMENT

Grodno State University, Grodno, Belarus

The program of calculation of optimal technological parameters of heat exchangers, refrigerators, evaporators, condensers is developed. The program ensures the selection of the model of heat and mass transfer, thermal and hydraulic calculations, automated determination of the physical parameters of working media, control of the agreement between the original and predicted parameters, full automatization of calculations, display of the results of calculation on a screen, their printing and storage. The medium is MS DOS IBM PCAT. The data base contain information on 512 substances. It is taken into account that the working bodies can be multicomponent.

G. ODNOROZHENKO

INVESTIGATION OF HEAT MASS TRANSFER IN RECTANGULAR CHANNELS UNDER IJIGH HEAT LOADS

Institute of Technical Thermophysics of the National Academy of Sciences of Ukraine, Kiev, Ukraine

The initial results of comparative experimental investigations of heat and mass transfer processes in channels of rectangular profile with heat supply to one wall are given. The investigations are carried out in smooth, ribbed and finned channels and in a channel with a permeable porous insert. Empirical relations are obtained that can be used for calculating heat transfer in the above-indicated channels with supply of high-density heat fluxes.

S.D. PANIN, I.M. FADIN

COMPREHENSIVE DIAGNOSTICS OF HEAT AND MASS TRANSFER PROCESSES IN TURNING AND SUNK NOZZLES OF ROCKET ENGINES

Moscow State Technical University, Moscow, Russia

The experimental values of the Stanton numbers on the part of the nozzle sunk into the channel of the charge coincide with the Stanton numbers calculated by the boundary layer theory when nonisothermal and external turbulence and special character of boundary layer are taken into account. The investigation of radiative heat transfer showed that in combustion products of mixed fuels containing c-phases 0.3 ... 0.36, the emissivity is equal to 0.69 ... 0.76; beginning from 30 mm the thickness of radiative layer does not influence heat transfer. Behind the angular point of the nozzle with a cylindrical throat the fields of heat transfer intensification are found, resulting from the interaction of condensation jump with boundary layer and production of longitudinal vortical structures.

V.P. PARFENOV

INVESTIGATION AND OPTIMIZATION OF HEAT EXCHANGE PROCESSES IN MULTISECTION GAS COOLERS

Omsk State Technical University, Omsk, Russia

The paper describes the main results of theoretical and experimental study of heat exchange processes in multisection gas coolers with various coolants. Influence of many different factors on efficient heat exchange processes is analyzed. Advantages of the gas coolers are shown. The general approach to optimization of multisection gas coolers is also described.

E.N. PISMENNYI

METHODS OF EFFICIENCY ENHANCEMENT OF HEAT EXCHANGE SURFACES WITH TRANSVERSELY FINNED TUBES

Kiev Polytechmcal Institute, Kiev, Ukraine

New types of heat exchangers containing transversely finned tube bundles with enhanced heat transfer characteristics are described. Physical causes of heat transfer intensification are considered.

V.V. POKOTILOV, A.D. SHALAK, S.A. MAKARHVICH

HEAT EXCHANGE IN GE1.IOSYSTEM WITH NATURAL AND PUMP LIQUID CIRCULATION

Belarusian State Polytechnical Academy, Minsk, Belarus

Experimental investigation of heat exchange in flat solar collectors was carried out. A new heat exchange analysis method based on the similarity theory is proposed. Two determining dimensionless complexes were defined to characterize heat exchange in geliosystems with natural and pump circulation of heat carrier, respectively. It is proposed that test results for each type of a geliocollector be presented not as a single expression, but as two dimensionless expressions depending on the liquid circulation type. Such an approach gives the possibility to perform heat and hydraulic calculations more effectively for any type of geliosystem with flat collector.

B.G. POKUSAEV, A.N. TCHEREPANOV, E.A. TAIROV, D.A. KAZENIN, A.K. NEKRASOV

MODELING OF PROCESSES AT DRASTIC INCREASE OF HEAT OUTPUT IN AN ASSEMBLY OF FUEL ELEMENTS

Moscow State Academy of Chemical Machine Building, Moscow, Russia

A statement of the problem, as well as experimental and numerical results of modeling nonstationary thermophysical processes for an assembly of generating heat units of a nuclear reactor due to drastic heat output are considered. Computer simulation of conjugated three-dimensional problem of nonstationary heating of the unit and adjacent layer of a coolant is carried out taking account of the real constructive geometry of the unit. The thermohydraulic processes at explosive boiling are investigated experimentally on an annular channel model. The dynamics of the vapor cavity onset and condensation and the formation of shock waves of large

amplitude were investigated theoretically using the cavity evolution model on the basis of mass and energy balance equations and of strong discontinuity conditions.

V.M. POLYAEV, D.V. MAKAROV

MODELING OF A 3D FLOW AND HEAT TRANSFER IN CROSSING CHANNELS

Moscow State Technical University, Moscow, Russia

A special kind of heat exchangers composed of crossing channels are used in industry and aerospace vehicles. The paper presents some details of 3D numerical simulation of flow and heat transfer in a typical mixing cell of this kind of rectangular crossing channel. Initial and boundary conditions are are described. Specially adapted (for 3D flows) lit Prandtl turbulence model was used. It is shown that the main features of this complex flow with mixing and detachments of fluid were revealed in numerical calculation. Particularly, velocity distribution near the channel wall is in a good agreement with experimental data.

YU.S. POSTOLNIK, YU.M. ORUK

HIGH-SPEED TWO-WAY HEATING OF POWER PIPELINES UNDER LIMITATIONS IMPOSED ON THE CONTROL AND TEMPERATURE STRESSES

Dneprodzerzhinsk State Technical University, Dneprodzerzhinsk, Ukraine

The problem of the two-sided heating of power pipelines under limitations of the heating media temperatures and temperature stresses is solved. The admissible stresses are given by nonlinear temperature functions. The technique of successive boundary modes is adopted as an organizer-technique, and the technique of equivalent sources is taken for solving the problem of thermal conductivity with nonclassic boundary conditions.

V.A. PRONIN*, M.I. CARVAJAL**

INCREASE IN COMPACTNESS AND ENERGY EFFICIENCY OF CONVECTIVE CROSS-FINNED HEAT TRANSFER SURFACES

** Moscow Power Engineering Institute, Moscow, Russia; ** Mexico*

The results of the estimation of the power efficiency of tubular bundles with inclined screw transverse fins in cross flow are presented. For dense staggered bundles the increase in compactness with inclination of fins is accompanied by the increase in the energy efficiency. The data on heat transfer and aerodynamic drag are obtained at $Re_{\alpha}=(10\text{-}60)*10^3$ for bundles of finned tubes with d=42, h=0.015, t=0.007, δ=0.0015 m at the inclination angle of fins from the vertical to the tube surface $\varphi°=30$.

A.M. PYLAEV, I.V. STANKEVICH

ANALYTICAL METHOD OF CALCULATION OF LONGITUDINAL HEAT CIRCULATIONS AND COORDINATE-TEMPERATURE DEPENDENCE OF HEAT EMISSION IN SURFACE HEAT EXCHANGERS (SHE)

Moscow State Technical University, Moscow, Russia

The problem is considered applying the solutions of the integral energy equation for the functional characteristic of heat transfer and heat conduction equation derived on the assumption of lumped-linear change in the wall temperature of the SHE portion over its thickness. An analytical solution of the problem in the form of an infinite Macloren-type series is obtained and substantiated with the separation of the main portion that determines temperatures at the boundaries of the portion and revealed by solving the final linear algebraic system. Specific results are presented.

b.s. repic, lj.L. jovanovic, a.v. Saljnikov, m. pmartinovic, a.b. Gajger

ANALYSIS OF FURNACE ABSORPTION RATES OF POWER BOILERS

Institute of Nuclear Sciences "Vinca", Beograd, Yugoslavia

Analyzed in the paper are the results obtained by measuring heat absorption distribution in boiler furnaces at several thermal power plants. Analyses were performed for boilers of the following powers: 110, 125, 210, 300, and 310 MW, of different origin and construction, all of them burning pulverized coal, with tangential and opposite wall firing. Analyses encompassed the following considerations: analysis of furnace heat absorption rate profiles over the height of a furnace for several heat power values, analysis of average and maximum accumulated heat absorption values over the depth of chosen representative furnace levels. Analyses have shown that heat absorption distribution depends on the following influences: type of firing (tangential, opposite wall), type of burner placement (one, two or more levels) and number and placement of mills in operation.

H.V. RIFERT, YU. SHAVRIN, I.I LIEV

INVESTIGATION OF FORCED CONVECTIVE HEAT EXCHANGE IN FLAT-OVAL CHANNELS WITH PROFILED SURFACES

National Technical University of the Ukraine "Kiev Polytechnical Institute", Kiev, Ukraine

The results of an experimental investigation of heat transfer and hydrodynamics of an incompressible fluid flow in slit channels with transverse knurling of the surface are presented. The shaping of the surface made it possible to obtain a 1.3-2.7-fold enhancement in heat transfer compared to a smooth channel. It is shown that the symmetric or nonsymmetric character of the knurling of the channel walls does not influence heat transfer inside the channel. Relations for calculating heat transfer in a knurled channel are given.

G.A. RYABOV, V.A. MOLCHANOV, A.F. KHITININ

INVESTIGATION OF THE PROCESSES OF MIXING OF SECONDARY AIR WITH HIGHLY DUSTY FLOW IN THE CFB BOILER PERFORMANCE

All-Russian Thermal Engineering Scientific-Research Institute, Moscow, Russia

Results of experimental investigation of secondary air-dust flow mixing conditions are presented. Experiments were performed on a cold model of CFB boiler with the help of measuring temperature profile over the cross section and height. On the basis of the data obtained a method of calculation of secondary air ports were made. The method was used for designing a CFB boiler with steam capacity of 500 t/h for antracite calm firing.

G.A. RYABOV, O.M. FOLOMEEV

INVESTIGATION OF MASS EXCHANGE AND HYDRODYNAMICS FOR THE CFB BOILER MODEL

ALL-Russian Thermal Engineering Scientific-Research Institute, Moscow, Russia

Processes of mass-exchange and hydrodynamics in the furnaces of CFB boilers determine the conditions of combustion, heat transfer and $S0_2$-$N0_X$ reductions. These processes were studied on a cold model of a CFB boiler with the cross-section of 0.4 x 0.4 m and height = 7 m. New data on the profile of the average concentration of solids, carry-over of particles vs gas velocity, bed inventory and sizes and densities of particles were obtained. The local specific flow of particles was determined by means of sampling. The data obtained were used for designing the calculating models of the hydrodynamics of furnace circuits.

S.S. RYZHKOV

JET HEAT AND MASS TRANSFER DEVICES FOR GAS TURBINE VENTING SYSTEMS

Ukrainian State Marine Technical University, Nikolaev, Ukraine

The investigation results on the creation of the gas turbine jet oil separators for a venting system are presented. A new physical and mathematical model for flow along the plate over the initial part of the jet and a system of jets is suggested. On the basis of this model developed a scheme of complex intensification of heat and mass transfer of aerosols during the jet flow along nonisothermal plate is developed. Heat and mass transfer of oil drops in a hot gas jet is studied. The investigation of the trapping of vapors due to their condensation on coagulating surfaces was made. Net-type and hydrodynamic-type coagulators were developed. The results of the investigation are realized in oil-catching devices. Twelve patents are obtained.

S.S. RYZHKOV, A.S. RYZHKOV, V.V. STARIY

HEAT AND MASS TRANSFER INSTALLATION FOR COMPREHENSIVE PURIFICATION OF OIL-CONTAINING WATER AND EXHAUST GASES

Ukrainian State Marine Technical University, Nikolaev, Ukraine

Investigation results on the development of an evaporating installation for complex cleaning oily water and exhaust gas are presented. Working processes in the Venturi tube channel were investigated and a design method is offered. Computer-aided design of the evaporation of oily water drops was made. A rational technology was developed. It is relized on an experimental installation. Novelty of the construction is confirmed by a patent. The installation was tested aboard a floating crane with a diesel engine power plant.

O.V. SEMENOVICH

INVESTIGATION OF HEAT AND MASS TRANSFER IN THE ELEMENTS OF THE CORE OF A WATER-COOLED REACTOR

Institute of Power Engineering Problems, Academy of Sciences of Belarus, Sosny, Minsk, Belarus

The results of investigations of heat and mass transfer processes, as well as hydrodynamics in fuel assemblies of water-cooled nuclear reactors under unsteady operating conditions, including transient and emergency ones, are presented. Mathematical models for the hydrodynamics and heat and mass transfer in fuel assemblies, which are longitudinal bundles of cylindrical fuel rods, are considered.. The models presented are based on a subchannel approximation, in the framework of which the space filled with a coolant is considered as a system of interconnected channels.

A.M. SHAMSUTDINOV, A.F. MAKHOTKIN, R.N. HUZIACHMETOVA

HEAT ENERGY COMBINATION AND ANALYSIS OF TECHNOLOGICAL EJECTION AND ACIDS CONCENTRATION PROCESSES

Kazan Chemicotechnological Institute, Kazan, Russia

The questions of the construction of an apparatus, mathematical stimulation of vortex flows and analysis of heat-energy combined technology as considered. It is shown that the stability of gaseous and gas liquid flows pends on the geometry of vortex design and that the stability parameters the ratio of the rotation coefficient to the hudrodynamic decrease of the cross-section area coefficient. The full usage of heat-energy designed for the purification of gases from nitric oxides, utilization of valuable products from sanitary gases and ecological safety of the atmosphere became possible due to the introduction of a combined heat-energy system.

V.I. SHARAPOV, M.A. KRYLOVA

INCREASE IN THE MASS TRANSFER AND POWER EFFICIENCY OF HEAT AND MASS TRANSFER APPARATUS OF WATER TREATMENT PLANTS FOR POWER STATION

Ulyanovsk State Technical University, Ulyanovsk, Russia

The results of an experimental investigation of decarbonators and vacuum deaerators used for anticorrosion treatment of water for a heat-supply system are presented. The experimental results were approximated by mathematical models of heat and mass transfer apparatus. The model made it possible to develop new technologies of anticorrosion water treatment. After the use of the new technologies the heat-supply systems may be classified as virtually noncorrosive. The new technologies save up to 14000 tons of equivalent coal annually per each 1000 m-'/h of water treatment plant capacity.

A.V. SHARKOV, V.A. KORABLEV, P.S. BRUSNITSIN, S.E. PARAKHUDA

THERMAL STABILIZATION OF SOLID-STATE LASERS

St. Petersburg State Institute of Precise Mechanics and Optics, St. Petersburg, Russia

The thermal and mathematical models of the cooling system of solid-state lasers are described. Heat transfer in the cooling system channels is investigated. The procedure of numerical design and complex of programs for modeling the thermal conditions of laser schemes blocks are developed.

E.N. SHEVCHUK, V.L. YURCHUK, V.V. PROKOPOV

SIMULATION OF HEAT TRANSFER PROCESSES IN METAL HYDRIDE STORAGE BOTTLE FOR A SOLAR POWER RIG

Institute of Technical Thermophysics of the National Academy of Ukraine, Kiev, Ukraine

The paper presents the results of numerical simulation of the process of unsteady hydrogen sorption in a magnesium hydride-storage bottle for solar thermochemical power rig, whose jacket is a heat pipe with potassium as heat carrier.

SHOU GUANG YAO

ANALYSIS OF THERMODYNAMIC ENERGY PERFORMANCE FOR A FLOW AND HEAT TRANSFER PROCESS IN A TUBE

Department of Power Engineering East China Shipbuilding Institute, China

Based on the thermodynamic principle, the paper analyzes the thermodynamic energy performance of air flow in a tube at subenvironmental temperature. The dimensionless exergy loss rate equations, that show quantitatively the irreversibility of heat transfer and fluid flow in the process, are derived. The changes in the Reynolds number, temperature in the tube and irreversible exergy losses are discussed. It is shown that in the process involving a gas flow, the tradeoff which exists between the irreversibility due to pressure losses and that due to heat transfer over a finite temperature difference can be used to minimize the total process irreversibility, and as the operating temperature decreases the optimum Reynolds number of the gas flow must increase, the corresponding minimum value of irreversibility increases, but the optimum balance between the two components of irreversibility remains constant. The results obtained can be used as reference of engineering for air flow in a tube for subenvironmental temperature design.

A.P. SKURATOV, S.V. SOBOLEV, S.D. SKURATOVA

MATHEMATICAL MODELING OF HEAT EXCHANGE IN FURNACES OF FLASH SMELTING-SMELTING VANYUKOV-TYPE

Krasnoyarsk State Academy of Nonferrous Metals and Gold, Krasnoyarsk, Russia

A mathematical model for predicting the thermal condition of flash smelting-smelting Vanyukov furnaces is developed. With the use of the predicting and multizone models a detailed analysis and optimization of the thermal operation of designed flash smelting-smelting Vanyukov furnace is conducted. The results of the analysis are used for developing the final project of the furnace.

R. SLEZAS, A. SLANCIAUSKAS

THE EFFECT OF THE BURNER EXHAUSTED AIR-GAS STREAMS MIXING RATE ON THE FORMATION ON NITROGEN OXIDES

Lithuanian Power Engineering Institute, Kaunas, Lithuania

Experiments were performed for determining the effect of the mixing rate on the emission of NO_x and on finding a way of controlling the mixing rate in industrial burners. A staged burner of a pilot construction was studied in the furnace of a steam generator. The constant fuel gas was

maintained at 400 m^3/h, and the ratio of primary and secondary air streams, the swirl of the secondary stream of air, the location and angle of fuel-gas injection were varied. The concentrations of O2, CO and NO_x were measured. When the fuel gas is injected in a primary air stream, a 50% reduction of NO_x can be achieved by varying the location, its angle and redistributing flow-rate of the air streams. For secondary flows injection of just 1/4 of the overall gas is reasonable.

A.F. SLITENKO

GAS TURBINE COOLING SYSTEMS DESIGN OPTIMIZATION

Scientific-Research Institute of Turbine-Driven Machines, Kharkov, Ukraine

To find an optimum version of the designed system of cooling a gas turbine, an effective method is developed for solving a multicriteria optimization problem in a multidimensional space of the parameters with account for functional and parametric limitations. The goal functions are determined by simultaneous calculations of the hydrodynamic characteristics of cooling systems and the temperature fields of the elements cooled. The calculation of the cooling systems are made by the method based on the theory of graphs and the calculation of the temperature fields — by the finite element method.

A.F. SLITENKO, V.B. TITOV

HEAT TRANSFER IN VANE CASCADES OF GAS TURBINES AT HIGH TURBULENCE OF THE GAS FLOW

Scientific-Research Institute of Turbine-Driven Machines, Kharkov, Ukraine

Using the methods of mathematical statistics, the processing of experimental data is made and equations for multiple regression are obtained that make it possible to rather accurately determine the local values of the degree of turbulence and coefficients of heat transfer intensification on the inlet edge, as well as the convex and concave surfaces of turbine blades. Comparison of the results of calculation by these relations with the experiment data of other authors, that were not statistically processed, showed a sufficient universality and reliability of the predicting relations obtained.

V.I. TEREKHOV, V.P. PARFENOV, I.V. BELOKRYLOV

HEAT TRANSFER INTENSIFICATION IN PLATE-FINNED DUCT DUE TO ARTIFICIAL POINT ROUGHNESS

Institute of Thermal Physics, Siberian Branch of the Russian Academy of Sciences, Russia

Heat and mass transfer as well as hydrodynamic drag of elements were studied in plate-finned duct heat exchangers with artificial lugs and holes on the inner surface. The effect of lugs-holes size and their square density on heat transfer and hydraulic parameters was investigated. The use of these structures can provide heat transfer enhancement up to 20—40% for definite regimes accompanied by the same (or lower) drag increase.

V.L. TIMOSHENKO, I.G. TOVAROVSKY, I.S. BELOTSERKOVETS, N.M. LAZUCHENKOV

NUMERICAL SIMULATION OF HEAT AND MASS EXCHANGE PROCESSES OF COAL GASIFICATION AND FERROUS MATERIAL REDUCTION IN CYCLONE-TYPE APPARATUS

Dnepropetrovsk Institute of Technical Mechanics, Dnepropetrovsk, Ukraine

The problems of mathematical simulation of the processes of low-quality coal gasification in cyclone-type apparatus for production of a hot reducing gas accompanied by simultaneous primary iron reduction in its medium are discussed. The processes of heat release, mass exchange between coal particles, gas environment and iron ore particles, as well as the processes of heat transfer from the reacting gas-particle mixture to the technological apparatus surfaces and extra heat removal from these surfaces are considered. The list of results of numerical modeling of some of the aforementioned processes is presented and the ways of their application in determining the process parameters of particular apparatus are pointed out.

V.I. TIMOSHPOLSKY, V.B. KOVALEVSKY, I.A. TRUSOVA, V.N. PAPKOVICH

THEORY AND CONTROL FUNDAMENTALS OF MATERIAL HEATING AND COOLING REGIMES

Belarusian State Polytechnical Academy, Minsk, Belarus

The results of solving problems of optimal control of metal heat treatment regimes with minimum fuel consumption in cell-type furnaces are presented. The method of asymptotic manifold optimization developed at the Belarusian State Polytechnical Academy is used as a mathematical apparatus.

V.B. VESELOVSKY

APPLICATION OF METHODS OF THE THERMAL REGIME DESIGN OF A FLYING VEHICLE FOR THE INVESTIGATION AND INTENSIFICATION OF THE TECHNOLOGICAL PROCESSES

Institute of Technical Mechanics of the National Academy of Ukraine, Dnepropetrovsk, Ukraine

The results are presented on using the methods of computation of flight-vehicle thermal condition for the investigation and intensification of such technological processes as the winding and removal of hot-rolled steel coils from the coil-holder heads: high-frequency welding of large-diameter pipes; electric arc pipe welding; investigating the processes in the blast tuyere region; warm-up and reduction of carbon containing brequettes moving in a blast furnace; thermal rock fracture; plasmachemical technology of new material synthesis.

V.B. VESELOVSKY

THERMAL CONDITIONS OF PIPELINES WITH FLOWING HEAT CARRIER UNDER THE ACTION OF FIELDS OF DIFFERENT PHYSICAL NATURE

Institute of Technical Mechanics of the National Academy of Sciences of Ukraine, Dnepropetrovsk, Ukraine

A nonstationary heat exchange in conjugate formulation in a heat carrier flowing through pipelines of complicated configuration under the action of a high-enthalpy gas flow, low

temperatures, electromagnetic fields is considered. It is supposed that the pipeline is covered with one - and multilayered thermal insulation nonuniformly in length and the heat carrier flowrate is changed by a special program. The algorithm for solving the erxternal and internal conjugate problems of heat exchange is based on the finite difference method. The results of parametric studies and the comparison with experimental data are presented.

A V.N. VIKULIN, E.U. MURUSHKINA

CONSTRUCTION DESIGN AND RESULTS OF HEAT TRANSFER AND FLOW FRICTION INVESTIGATIONS OF CONVECTIVELY COOLED PARTS OF GAS TURBINES USED IN AIRCRAFT ENGINE CONSTRUCTION AND POWER ENGINEERING

Moscow State Aviation Technological University, Moscow, Russia

The results of experimental investigations of transfer and flow friction characteristics for a high-temperature gas turbine with the use of an aviation engine are presented.

J. VILEMAS, E. USPURAS, A. KAIIATKA

ANALYSIS OF TRANSIENT THERMAL HYDRAULIC PROCESSES IN THE MAIN CIRCULATION CIRCUIT OF THE RBMK-1500 REACTOR

Lithuanian Power Engineering Institute, Kaunas, Lithuania

A successful best estimate RF.LAP5 and ATHLET models of the Ignalina nuclear power plant has been developed. These models include the reactor main circulation circuit, reactor control systems and plant safety systems required for the analysis of operational transients. Benchmarking analysis of loss of all the main circulation pumps were conducted. Calculation performed both with RELAP5 and ATHLET models of the Ignalina NPP compare favorably with plant data. The paper deals with the analysis of safety-related operational transients, such as loss-of-offsite-power and simultaneous trip of all main circulation pumps. Calculations were performed for the current reactor thermal power N_T-4200 MW. It is shown that natural circulation regimes with reliable core cooling were realized in the all cases investigated.

A.V. VLASOV, G.V. DASHKOV, V.S. DIKUN, A.V. SIVAK, A.D. SOLODUKHIN, N.N. STOLOVICH, S.P. FISENKO

EXPERIMENTAL INVESTIGATION OF NONSTATIONARY REGIMES OF A WATER-COOLING TOWER

A.V. Luikov Institute of Heat and Mass Transfer, Academy of Sciences of Belarus, Minsk, Belarus

The results of laboratory simulation of unsteady-state operation of a cooling tower are presented. It is shown that the increase in the heat efficiency of the cooling tower under such operation can reach up to 30—60%.

V.I. VOLODIN

COMPREHENSIVE THERMAL DESIGN OF HEAT EXCHANGERS

Institute of the Problems of Power Engineering, Minsk, Belarus

A mathematical model of numerical analysis of heat exchange processes, as well as the calculated design of heat exchange apparatuses are presented. The model includes three levels and allows the calculations according to the average characteristics in one- and two-dimensional approximations to be carried out. Vertical links as to the models of all levels can be realized for single-type heat exchangers. Horizontal links in the framework of the model of one level are realized for heat exchangers of different types in the circuit.

E.P. VOLKOV, G.YA. GERASIMOV, A.S. PLESHANOV

HEAT AND MASS TRANSFER UPON THERMAL DESTRUCTION OF SOLID FUEL IN A DRUM-TYPE PYROLYSIS REACTOR

"Power Engineering Institute" Joint-Stock Company, Moscow, Russia

A mathematical model of a bubble-type reactor-pyrolyzer of solid fuel particles is constructed. To elucidate the basic laws governing the mechanism of heat and mass exchange between the solid fuel particles and a heat carrier, a simplified case is considered when the sizes of all the fuel particles are identical and their mixing with the heat carrier particles occurs instantly and uniformly. On the basis of experimental investigations on the pyrolysis of Baltic shales, the kinetic parameters of the process are recovered that underlay the calculations carried out. An example of the design of a 100 t/h capacity reactor is given.

D.A. YAGODNIKOV, A.V. VORONETSKII

EFFECT OF AN EXTERNAL ELECTRIC FIELD ON HEAT AND MASS TRANSFER CHARACTERISTICS IN A POWER PLANT COMBUSTION CHAMBER

Moscow State Technical University, Moscow, Russia

It is found that the superposition of the external electric field (EEF) leads to an increase in the heat flux from combustion products to the combustion chamber wall, since the temperature of the cooling component increases in this case. At a constant fuel consumption the greatest effect (~20%) was recorded on applying constant positive voltage to the burner nozzle and the smallest (5%) in the case of a constant negative one. On the superposition of a variable EEF the intensification of the heat transfer process was -15%. The results obtained make it possible to develop practical recommendations on the intensification of combustion and heat transfer processes for increasin the efficiency of heat exchanging equipment and combustion chambers of power plants.

E.G. ZAUUCHNYJ, A.P. YAKUSHEV

DEVELOPMENT OF ECOLOGICALLY SAFE AND ENERGY SAVING MULTIPURPOSE COOLING AND HEATING POWER SYSTEMS WITH VORTICAL GAS-ENERGY DIVIDING AIR TUBES (VGEDT)

Institute of the Problems of Power Engineering, Academy of Sciences of Belarus, Minsk, Belarus

Effective cooling and heating systems with VGEDT working on compressed air with a pressure of 0.5-0.9 MPa and the consumption of 0.2— 3.3 m'/min were developed. Their application in technological processes in machine-building and petrochemical industries, for storage of reprocessed meat and milk, to a sufficient economy of energy and material resources.

V.I. ZAVELION, N.N. DAVYDOVA

COMPREHENSIVE ANALYSIS OF COMJUGATE HEAT TRANSFER AND THERMOSTRAINED STATE OF CONSTRUCTION WALLS AT VISCOUS LIQUID FLOWS IN PIPES AND CHANNELS OF COMPLEX-SHAPED CROSS SECTION

Dnepropetrovsk State University, Dnepropetrovsk, Ukraine

The problem of joint investigation of a conjugate heat-exchanger in pipes and channels and thermal stressed state of the walls is formulated. The model is based on the joint solution of the equations of hydrodynamic and energy for liquid and equations of heat-conduction and thermoelasticity for the walls of pipes and channels. For the solution of the problem the finite element and finite difference methods are used.

M.S. ZHELUDKEVICH, P.S. GURCHENKO, M.L. GERMAN, A.N. OZNOBISHIN, V.B. KOZLOVSKII

ENERGY-SAVING TECHNOLOGY OF CONTROLLED WATER-AIR COOLING FOR THERMOPROCESSING OF PIECES

A.V. Luikov Institute of Heat and Mass Transfer, Academy of Sciences of Belarus, Minsk, Belarus

The proposed technology of controlled water-air cooling which allows the selection of optimal modes of heating and cooling, the substitution of traditional quenching media and the combination of tempering with the completion of quenching, satisfies these requirements. Ecological purity the process inherent in this technology is not less urgent as compareted to the development of new energy sources.

V.N. ZVEREV, V.N. KHARCHENKO

CHARACTERISTICS OF PULSE-PLASMA TRANSFORMERS OF ENERGY AT SUPERHIGH HEAT FLUXES

Moscow State University of Forest, Moscow, Russia

Results of experimental and theoretical investigations of a pulse plasma-vortex transformator of energy at the heat flux of 60 kW/cm^2 are presented. In the experiment, a current pulse of power 60 MW was transmitted from the plasma to load. The calculated characteristics of the energy transformers are compared with the experimental data.

HEAT AND MASS TRANSFER IN CHEMICAL- ENGINEERING PLANTS

F.G. AKHMADIEV, R.M. GILFANOV

MATHEMATICAL MODEL OF THE COMPOSITE HEAT AND MASS TRANSFER IN A BITUMEN PRODUCTION REACTOR

Kazan State Academy of Architecture and Civil Engineering, Kazan, Russia

A mathematical model of the composite heat and mass transfer in a film flow of a two-phase emulsion along heated inclined surfaces. This process takes place in a bitumen production reactor. Three separate stages of the process are considered: the stage of development of the thermal boundary layer, the stage of the developed heat transfer, and the stage of the developed heat and mass transfer. In the mathematical model of the process conservation equations for mass, momentum, and energy are written within the boundary layer approximation with regard for the temperature dependence of the effective viscosity of the two-phase emulsion. As a result integration of the system of equations fields of velocities, temperatures, and pressures, and thicknesses of the thermal boundary layer and the emulsion film are determined.

S.I. ALADYEV, M.V. KRASNOV

HEAT AND MASS TRANSFER INTENSITY UPON EXTRACTION OF A VAPOR COMPONENT FROM A GAS PHASE

Moscow State Academy of Fine Chemical Technology, Moscow, Russia

The possibility of desublimation of a vapor component from a gas phase as a result of employment of undercooling resulting from expansion of a mixture in an ultrasonic nozzle is investigated. The phase transition takes place on solid particles introduced into the flow immediately after the nozzle exit section. As a result of calculations based on solution of equations of conservation of mass, momentum, energy, equations of particle balance, and equations of concentration for the vapor phase optimum conditions for the process design are determined. It is demonstrated experimentally that feeding of particles does not lead to choking of the ultrasound nozzle, and extraction of vapor is almost complete.

S.M. ARINKIN

INVESTIGATION OF THE PROCESS OF PENETRATING PROTECTIVE IMPREGNATION OF LUMBER

A.V. Luikov Institute of Heat and Mass Transfer, Academy of Sciences of Belarus, Minsk, Belarus

The method of calculation of the process of penetrating impregnation of lumber is described, a PC program for calculation of impregnation parameters in the field of inertial forces and upon the uniform confining pressure of the impregnating lignid is developed. The model is based on the representation of lumber as a set of capillaries that have a number of local resistances along their length. The effect of deformation of capillaries on the impregnation process is taken into account.

D.V. ARISTARKHOV

THERMAL DESTRUCTIONS OF RUBBER WASTE IN A VAPOUR-GAS MEDIUM

Scientific Research Institute of Sanitary Technics, Moscow, Russia

Results of an investigation of thermal destruction of rubber waste in a superheated steam are reported. It is established that the solid-state products of waste destruction are similar in their characteristics to those of pyrolysis, the liquid products meet completely the specifications of the low-sulphur M40 mazut, whereas gaseous products consist mainly of hydrocarbons being monomers of natural and synthetic rubber. Investigations carried out show that the waste destruction in a superheated steam is ail efficient technique of their reprocessing into raw-material (commercial carbon) and power (M40 mazut) resources.

V.I. BADER, L.K. VASANOVA, B.P. ZHILKIN, A.M. KORYAKIN, V.V. TYULPA, G.P.YASNIKOV

HEAT TRANSFER FROM IMPINDING GAS JETS TO MOVING SURFACES OF DIFFERENT SHAPE

Ural State Technical University, Ekaterinburg, Russia

The paper presents results of an investigation on heat transfer of flat bodies moving on a pad formed by axisymmetric jet system. It was found that heat transfer is insensitive to the movement of plates. An analysis of the individual and mutual effect of body vibration and the flow pressure pulsations on the heat transfer is carried out. An explanation of the self-similarity revealed is presented. The paper also presents results of a study of heat transfer from a rotating cylinder to a system of round jets. An empirical equation describing this process is given.

V.I. BAIKOV, N.N. LUCHKO, T.V. SIDOROVICH

THEORETICAL DESCRIPTION OF LAMINAR ULTRAFILTRATION IN A FLAT-FRAME MEMBRANE MODULE

A.V. Luikov Institute of Heat and Mass Transfer, Academy of Sciences of Belarus, Minsk, Belarus

Results of a theoretical investigation of the process of ultrafiltration with gelation in a laminar flow in a flat slit channel upon nonideal membrane selectivity in the stationary formulation are presented. Expressions obtained make it possible to estimate the position of the gelation point and the distribution of the filtration rate along the channel and can be used at the stage of design of high-efficiency flat-frame membrane modules.

V.S. BERDNIKOV, V.I. PANCHENKO, S.V. SOLOVYOV

HEAT TRANSFER IN A CRUCIBLE MELT-CRYSTAL SYSTEM DURING CZOCHRALSKI SINGLE CRYSTAL GROWTH (KEYNOTE PAPER)

Institute of Thermophysics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia

Experimental investigations of local and integral heat transfer at a crystal-melt interface have been carried out. Combined buoyancy and thermo-capillary driven convection and mixed convection were studied in the following ranges of the Grashof, Reynolds, and Marangoni numbers: Gr up to 5- 10^7, Re up to $3*10^4$, and Ma up to $2*10^7$. The fluid that simulated the melt

had the Prandtl number Pr=16. The main purpose of this investigation was determination of the correlation between the local structure of the flow and regularities of the local heat transfer.

T. BERGMANN. P. BITTRICH, D.HEBECKER

MODELLIERUNG EINES RIESELF1LMABSORBERS

Martin-Luther-Universität Halle-Wittenberg. Institut für Thermodynamik. Energietechnic und Strömungsmechanik

Es wird ein Modell für die Beschreibung eines Rieselfilmabsorbers vorgestellt, in dem ein inertgasfreier Dampf von einer Lösung absorbiert wird, die gleichmäßig auf eine wassergekuhlte Rohrschlange rieselt. Im Modell werden die einzelnen Abtropfstellen für jede Rohrwendel getrennt in den abfließenden Strahl zwischen den Rohrwendeln und den Flüssigkeitsfilm auf den Rohren getrennt berechnet. Zur Ermittlung des Abtropfabstandes und des an der Rohrwendel abflieBenden Querstromanteiles wurden Rieselversuche an geneigten Rohren durchgeführt. Die Berechnung des Rieselfilmes am horizontalen Rohr erfolgt mit Hilfe eines einfachen Kräftemodells. Experimentelle Untersuchungen zur Filmausbreitung zeigten bei unterschiedlichen Benetzungsgraden eine gute Übereinstimmung mit den berechneten Profilen. Bei der Berechnung des Stoff-und Wärmeüberganges kamen herkömmliche Sherwood-bzw. Nußelt-Ansätze zur Anwendung. Parallel wurden Versuche an einem mit dem Stoffsystem NaOH-H_2O betriebenen Absorptionsversuchsstand mit einer Leistung von ca. 10 kW durchgeführt. Hierbei wurden Berieselungsdichte, Kühlwasserstrom Kühlwassertemperatur, Absorberdruck und Losungskonzentration variert. Ein Vergleich der berechneten Werte mit den Versuchsdaten zeigte eine gute Übereinstimmung. Das Modell ist allgemein gehalten und kann auf verschiedene Gerätegeometrien und Absorptionsgemische angewendet werden. Somit läßt sich mit Hilfe des Rechenmodells ein Rieselfilmabsorber als Rohrschlangenapparat auslegen bzw. optimieren.

V.V. BORISOV, R.N. RAMAZANOV, E.G. RUDAKOVSKAYA

CALCULATION OF HEAT AND MASS TRANSFER GAS-LIQUID PROCESSES IN A TUBULAR REACI'OR

Russian Chemical Engineering University, Moscow, Russia

A mathematical model of the dynamic regime of functioning of a tubular reactor for neutralization of wet-process phosphoric acid by gaseous ammonia is presented. A priliminary study of hydrodynamics of a two-phase reaction flow makes it possible to consider it being separate with a distributed source of heat and mass flows at the phase interface surface. In view of this circumstance, a combined model is used for calculation and simulation of reactor

dynamics; each section of the model consists of models of perfect- mixing reactors with respect to each of the phases divided by a zone of stagnation.

V. BORZYKH

HEAT EXCHANGE AND MOTION OF A FILM OF A STOCK MINERAL MELT UNDER THE CONDITIONS OF HIGH-TEMPERATURE HEATING

Scientific Research Institute of Building Materials at Tomsk Academy of Architecture and Civil Engineering, Tomsk, Russia

Physical and mathematical models of hydrodynamics and heat transfer in a film of a stock mineral melt formed in a rotary plasma reactor are presented. Dependences for estimation of the viscosity coefficient are obtained in the dimensionless form for both the case of the constancy of this parameter and the case when it varies with the melt temperature. The onset of the stabilized regime of flow of the melt film is determined.

A. A. BULATOV, N.KH. ZINNATULLIN, S.G. NIKOLAEVA

Evaporation modeling for a centrifugal liquid film Kazan State Technical University, Kazan, Russia

A physical and mathematical model for vacuum evaporation of a heated liquid spreading over a rotating disk is developed. The model describes also evaporation of a volatile liquid at the normal conditions. Expressions obtained take into account heat transport connected with evaporation and flow rate variability. An increase in heat transfer at high overheatings is modeled under the assumption of intense turbulization of the liquid film.

A.I. CHAIKA

MASS TRANSFER INTENSIFICATION TECHNIQUE FOR EXTRACTION FROM DISPERSED SOLID MATERIALS

Institute of Technical Thermophysics, National Academy of Sciences of Ukraine, Kiev, Ukraine

An efficient and energy saving method of heat and mass transfer enhancement in multiphase and multicomponent systems which has been successfully utilized for extraction of an active component from plant raw materials is discussed. Upon water-alcohol extraction from such medicinal herbs as haw berries and calendula flowers extraction rates are found to increase by a factor of 140 and 60, respectively, compared to those achieved usually with conventional modes.

G.G. CHERNY, N.E. APHONINA, V.G. GROMOV, V.A. LEVIN

THERMAL PROCESSES IN A GASDYNAMIC CRYSTALLIZER DURING CONTINUOUS CASTING OF METALS

Institute of Mechanics at Moscow State University, Moscow, Russia

A mathematical model of contactless forming of castings by means of creation of a gas layer between the casting and the crystallizer, which excludes friction between their surfaces, is proposed. A series of calculations of formation of a brass rod at various flow rates of injected

nitrogen is _____out. Thermal and gasdynamic characteristics of the crystallizer are studied. A fundamental possibility of realization of the continuous process in the gas-dynamic crystallizer is demonstrated.

YU.V. CHOVNYUK, S.A. MAKAROV, E.V. CHOVNYUK, N.R. MAKAKOVA

NONLINEAR WAVE FLOW REGIMES OF FILM CONDENSATION

Kiev State Technical University of Civil Engineering and Architecture, Kiev, Ukraine

Results of numerical and analytical investigations of nonlinear wave flow regimes of film condensation obtained within the framework of procedures of the reduction perturbation method and methods of nonlinear dispersion relationships are presented. Standard evolution equations for amplitudes of waves being formed are obtained, their distinctive features are studied.

I.V. DEREVICH

MODELLING OF AERODYNAMICS AND HEAT AND MASS TRANSFER IN THE ABSORBER OF A GAS DESUI-FU RIZATION APPARATUS

Avtomatizirovannye Sistemy Gazoochistki Stock Company, Moscow, Russia

A physico-chemical model for SO_2 absorption from industrial gases is developed. The proposed model includes the mechanism of SO_2 absorption from the flue gas by a suspension of limestone droplets, coagulation, disintegration, and vaporization of droplets, heat transfer in flue gases and aerodynamics in the absorption zone.

V.I. DROBYSHEVICH, L.V. YAUSHEVA

THE SYSTEM OF MATHEMATICAL MODELING OF THE HEAT AND MASS TRANSFER PROCESSES IN CATALYHC APPARATUSES

Computing Center of the Siberian branch of the Russian Academy of Sciences, Novosibirsk, Russia

A system of mathematical models for simulation of nonstationary processes in catalytic Teactors and the corresponding system of computational algorithms have been constructed. Software packages for generation of problems have been developed to allow the user to do mathematical modeling in the interactive mode.

S.G. DYAKONOV, V.I. ELIZAROV, A.G. LAPTEV, V.A. DANILOV

MODELING OF HEAT AND MASS TRANSFER IN A FUIDIZED BED IN A PLATE-TYPE COLUMN

Kazan State Technological University, Kazan, Russia

A 2D model of a turbulent gas (vapor)-fluid bed on a contract bubbler is considered. A closed mathematical description of transfer processes in the continuous phase is proposed in the form of mathematical corollaries of conservation laws in the differential form where the interaction of phases is taken into account by means of source terms. Equations are solved by the variation method. Calculated velocity, concentration, and temperature fields agree well with experimental data obtained upon rectification of multicomponent mixtures.

V.I. ELISEEV, YU.P. SOVIT, L.A. FLEER

NUMERICAL SIMULATION OF MOULDING A BUNDLE OF SYNTHETIC FIBERS

Dnepropetrovsk State University, Dnepropetrovsk, Ukraine

The complete problem of moulding a bundle of fibers is formulated. The problem contains equations of motion and heat transfer of thin jets of the Maxwell liquid with consideration for the crystallization process and equations of the filtration motion and heat transfer of the environment in the driven bundle of fibers. On the basis of the consideration of moulding a single fiber an iterative method of solving the complete problem is developed. As a result of consideration of model problems some laws of moulding a bundle of fibers are revealed at low-speed and high-speed modes in the blowing column.

E.M. ERMOLAEVA, E.A. ERSHOV-PAVLOV, A.N. KNAK, L.E. KRATKO, A.L.MOSSE, N.I. CHUBRIK, V.D. SHIMANOVICH

HETEROGENEOUS FLOW STRUCTURE AND HEAT TRANSFER IN A THREE-JET PLASMA REACTOR FOR TREATMENT OF A DISPERSED MATERIAL

Institute of Molecular and Atomic Physics, A.V. Luikov Institute of Heat and Mass Transfer, Academy of Sciences of Belarus, Minsk, Belarus

Results of an experimental study and modelling of heterogeneous plasma flows in a plasma reactor developed for treatment of powder materials, or liquid and solid wastes are presented. The plasma flows have been formed by a conical mixing chamber with three DC plasma torches placed at the chamber side surface. Particles of phosphate, kaoline, AI2O3 and SiO-2 with dimensions 50-100 m as a dispersed material and air as a plasma-forming gas were used. The particles were introduced at the top of the chamber. The plasma torches operated at 35 kW power per unit with gas and particle flows of 2.5-4.0 and 1.5-2.1 g/sec, respectively. High speed photo- and videorecords, as well as optical emission spectroscopy and thermolysis methods were applied for observation of the plasma flow structure and measurements of parameters of the plasma.

A.I. ERSHOV, J.P. LUNCHUCK, A.E. RABKO

THE INTENSITY OF HEAT EXCHANGE IN AN APPARATUS WITH PROFILED HEATING DEVICES

Belarusian State Technological University, Minsk, Belarus

Results of an experimental investigation of the heat transfer intensity of an evaporator with horizontal profiled heaters are presented. Experiments were carried out in the apparatus at the pressure 0.04-0.1 MPa. The dependence of the specific heat load and the coefficient of heat transfer on driving forces of the exchange process are obtained. It is found that the shape, dimensions, and the geometrical arrangement of heating elements affect the liquid circulation factor around heating elements and hence the evaporation efficiency.

A.I. ERSHOV, N.P. SAEVICH, D.G. KALISHUK

INFLUENCE OF VAPOR DISPERSING INTO A LIQUID AT SMALL TEMPERATURE DIFFERENCES BETWEEN HF.AT CARRIERS

Belarusian State Technological University, Minsk, Belarus

Results of an experimental investigation of the effect of introduction of live steam at the front portion of the boiling tube on the heat exchange at temperature difference between the steams up to 15 K are presented. It is found that the specific heat flux can be increased by 20-50%. Significant enhancement is achieved in the narrow range of ratios of flow rates of the steam produced upon boiling and the live steam being introduced which requires the even distribution of the live steam. Experimental results of tests of a two-stage distributer providing the stable steam (gas) distribution with high reliability of operation are presented.

F.M. GIMRANOV, S.A. KONEV, N.KH. ZINNATULUN

CALCULATIONS OF THE NONISOTHERMIC ABSORPTION PROCESS IN CENTRIFUGAL FILM APPARATUSES

Kazan State Technological University, Kazan, Russia

Nonisometric film absorption of a fluid flowing in a centrifugal field with consideration for heat exchange with the surrounding medium is considered. The problem is solved on the basis of integral relationships within the framework of the boundary layer approach. Simultaneous solution of transfer equations made it possible to investigate the process in detail. It is shown that the diffusion boundary layer is not described by one function along the fluid current direction, but depends on heat exchange with ambient gas and heat release during absorption. The length of the diffusion boundary layer thus may serve as a scaling parameter in estimation of the efficiency of the process.

L.S. GORDEEV, N.V. MENSHUTINA, A.YU. VINAROV, E.V. GUSEVA, A.V. SKOROKHODOV

MODELLING OF MASS TRANSFER PROCESSES IN MEMBRANE BIOREACTORS

Russian Chemical Engineering University, Moscow, Russia

A mathematical description of membrane bioreactors is developed. The mathematical model contains kinetics models of biological processes, models of mass transfer, models of hydrodynamic processes, and models of filtration on the membrane. Operation of bioreactors of different construction is analyzed for different types of biochemical reactions. Two regimes (batch and continuous) have been calculated. The modeling has proved that citric acid production is possible in the continuous regime if a membrane bioreactor is used.

A.S. GORSHKOV, O.P. NIKIFOROVA, A.F. KANDALOV

FILM DEVICE FOR TRIETHOXYSILANE PRODUCTION

State Scientific Research Institute of Chemistry and Technology of Organoelemental Compounds, Moscow, Russia

A film reactor for triethoxysilane production with a working element with outer irrigation has been designed. In order to provide stable conditions of the fluid flow holding elements with the shape of longitudinal cylindric bars were fixed on the working surface. Integration of the Navier- Stokes equation was carried out and dependences for the film thickness were obtained. Experimental data made it possible to deduce an equation for calculation of the heat transfer

coefficient as applied to triethoxysilane production. On the basis of dependences obtained major constructional dimensions of the commercial reactor with the capacity of 300 t/y were calculated. Such a reactor is presently under operation.

L.G. GRIGORYAN, S.P. LESUKHIN, A.V. TIMONIN

HEAT AND MASS TRANSFER UPON CONDENSATION OF VAPOR WITH INCONDENSABLE GAS IN A NONADIABATIC APPARATUS WITH VERTICAL CONTACT GRIDS

Samara State Technical University, Samara, Russia

Design and the method of calculation of a nonadiabatic apparatus with vertical contact grids (AVG) is presented. This apparatus enables to execute the process of condensation in the presence of noncondensable (inert) gas. The advantage of the new condenser over the conventional apparatus is shown. Essential increase in the total heat transfer factor is reached as a result of active hydrodynamic interaction of the vapor-gas mixture, and the liquid, which results in a decrease in both diffusion resistance and thermal resistance of the liquid film. The countercurrent character of interaction of the gas and liquid makes it possible to carry out efficient fractional condensation.

B. JACIMOVIC, S. GENIC

CHARTS FOR MEAN FLUID TEMPERATURES IN SURFACE HEAT EXCHANGERS

University of Belgrade, Beograd, Yugoslavia

The significance of the mean fluid temperatures in the heat exchangers is based on their use for the estimation of use thermophysical properties of fluids which are necessary for the heat transfer coefficients calculation; calculation of the mean tube wall temperature, necessary for the mechanical design of the heat exchangers, etc. In the common engineering practice mean of fluids in heat exchangers are usually taken as the mean arithmetical temperatures. But, the mean fluid temperatures differ from the mean arithmetical ones except in the case of countercurrent flow with R = 1. For all other types of heat exchangers when P P (R) mean temperature is just approximately equal to the mean arithmetical temperatures ( ). Although it is not visible in the commonly used charts for the surface heat exchanger design, hereby presented charts for TEMA E-type heat exchangers show that the mean fluid temperatures and consequently the tube wall temperature depend on the flow combination.

A.L. KALABIN

MEAT AND MASS TRANSFER IN THE PROCESS OF FILAMENT FORMATION UPON FIBRE SPINNING FROM A POLYMER SOLUTION

Tver State Technical University, Tver, Russia

On the basis of a mathematical model of gelatination upon diffusion of a precipitating agent into jets of the polymer solution an analysis of heat and mass transfer of the process is earned out. An equation that determines the dependence of the dimensions of the zone of total gelatination on time. The time dependence of variation of the area of gelatination is analyzed. Based on the model an estimate of the dependence of the gelatination time on main parameters of the technological process is obtained. Two stages are revealed in the gelatination process.

E.A. KAPUSTIN, V.N. LOGOZINSKAYA

HEAT AND MASS TRANSFER IN GAS JET-LIQUID REACTORS

Azov Coast Technical State University, Mariupol, Russia

Distinctive features of interaction of high-speed gas jets flowing into a liquid, formation of dissipative spatiotemporal structures, peculiarities of heat and mass transfer in and between these structures are considered. Methods of determination of products composition at the exit of the reaction zone upon blowing of oxygen into the iron-carbon melt, kinematic factors of turbulent transfer in the liquid and motion speed of the thermoconvective front are presented.

L.P. KHOLPANOV

NONLINEAR METHODS OF SOLUTION OF CHEMICAL ENGINEERING AND THERMOPHYSICAL PROBLEMS IN SYSTEMS WITH AN INTERFACE. SELF-ORGANIZATION, CHAOS, AND TURBULENCE

Institute for Novel Chemical Problems of the Russian Academy of Sciences, Chernogolovka, Moscow region, Russia

Methods of solution of nonlinear transfer equations for momentum, matter, and energy with nonlinear dependences of transfer coefficients on physicochemical properties of a system in Newtonian and non-Newtonian liquids are proposed.

J. KLEMES, A. KOKOSIS, L.L. TOVAZHNYANSKI, P.A. KAPUSTENKO, L.M. ULIEV, A.YU. PEREVERTAILENKO, B.D. ZUUN

APPLICATION OF THE PINCH ANALYSIS TO THE PROBLEM OF ENERGY CONSERVATION IN UKRAINE: CRUDE OIL DISTILLATION STUDY

University of Manchester Institute of Science and Technology, Manchester, Kharkov State Polytechnical University, Kharkov, Poland.

Results of optimization of a heat network of a crude oil distillation unit with the help of the Pinch analysis are presented. For this purpose a detailed investigation of heat flows on the unit was carried out, and a mathematical model based on digitization of temperature and enthalpy, of the system of heat flows and balance relationship between them and cost characteristics of equipment and consumed energy being also included into the consideration is developed.

N. KOLOSKOVA, V. DUBROVSKAYA, V. ORLYANSKIY, V. SHKLYAR

HYDRODYNAMIC GAS AND LIQUID FLOW IN CONTACT HEAT AND MASS TRANSFER EQUIPMENT WITH NET PACKINGS

National Technical University of Ukraine, Kiev, Ukraine

Results of an experimental investigation of hydrodynamics characteristics of gas and liquid flows in contact heat and mass transfer equipment with a net packings that permitted to obtain maximum values of gas velocity depending on the geometrical sizes and irradiation density are presented. A method that makes it possible to increase the permissible velocities of media motion by a factor from 1.5 to 2 means of the gas supply through distributors is proposed. A

generalizing empirical equation for evaluation of the packing hold-up which takes into account characteristics of the liquid is proposed.

M.L. KONOVALOV, V.V. BELOBORODOV

KINETICS OF NONISOTHERMAL DISTILLATION OF POLYCOMPONF.NT MIXTURES IN A WATER STEAM FLOOD

Krasnoyarsk Institute of Commerce, Krasnoyarsk, Russia

The analytical solution of the problem of nonisotharmal distillation of polycomponent mixtures in a water steam flood is presented. Kinetic dependences for the nonisothermal distillation process are obtained. The analytical solution of the problem is compared with results obtained by numerical methods.

L.I. KRASOVSKAYA

CALCULATIONS OF THERMAL TREATMENT OF DISPERSED GLASS- FORMING CHARGE IN A FLOW PLASMA REACTOR

A.V. Luikov Institute of Heat and Mass Transfer, Academy of Sciences of Belarus, Minsk, Belarus

A mathematical model for flow and heat transfer of a dispersed glass-forming charge used for vitrification of radioactive wastes in an electric arc plasma reactor is developed under the assumption that the composition of products is equilibrium. Optimum operation conditions are determined for a 200 kW plasma reactor.

P.P. LOBODA

PROSPECTS OF HEAT AND MASS TRANSFER MODELLING UNDER INTENSIFICATION AND SCALING-UP OF TECHNOLOGICAL PROCESSES

Ukrainian Institute of Food Technologies, Kiev, Ukraine

A universal spatiotemporal dependence is proposed and fundamental physical constants are calculated with its help. This establishes the theoretical basis for modelling upon enhancement and scaling of technolocal processes.

YU.E. LUKACH, N.V. SHAFARENKO, I.O. MLKULYONOK, G.L. RYABTSEV

CLEANING OF WASTE WATERS FROM ORGANICS BY PERVAPORATION (KEYNOTE PAPER)

National Technical University of Ukraine, Kiev, Ukraine

The paper presents new pervaporation nonporous synthetic rubber membranes. It is proposed to use pervaporation for cleaning of chemical production waste waters from organics. The production pervaporation unit with the effective membrane area of 20 m has been already practically used.

V.V. LUSHCHIKOV, A.V. ROMANOVSKY

HEAT TRANSFER BETWEEN AN IMMERSED SURFACE AND A GAS- SOLID PARTICLES SYSTEM

Minsk

Experimental data on nonstationary heat transfer from a copper sphere to the air-polystyrene system are obtained at various velocities of air. The two-temperature model of heat transfer in dispersed media was used to obtain a correlation dependence of Nu on Re when the heat transfer coefficient is constant.

A.M. LYKOV, N.N. NAUMENKO

CALCULATION OF THE COOLING RATE OF MELTS

"Mattelch" Scientific and Production Enterprise, Moscow, Russia

Analytical dependences for calculation of the hardening rate of melt over the entire melt volume at different instants are obtained. These dependences make it possible to determine optimum parameters of the process (specific heat flux and its action time). The dependences are presented in the form of generalized variables that make it possible to reduce the amount of calculations and to analyze more thoroughly the influence of parameters of the process including the effect of thermophysical parameters of the material on the hardening rate of the melt. Values of the hardening rate determined from the formulas agree satisfactorily with results of numerical calculations carried out by other authors.

V.P. MLRONOV, T.V. SOKOLSKAYA

MODELLING OF HEAT AND MASS TRANSFER IN HIGH-PERFOMANCE EQUIPMENT

Ivanovo State Chemical Engineering Academy, Ivanovo, Russia

Algorithms and programs for modelling of heat- and mass transfer in high-performance equipment are developed. Two approaches to the solution of the problem are proposed.

A.I. MOSHINSKII

Russian Scientific Center "Applied Chemistry", St. Petersburg, Russia

Crystallization of a polydispersed system of crystals for continuous crystallization in cascades of apparatuses is considered. The main purpose of the work was to determine such a functional dependence between the parameters under which the process is optimum. It is adopted that the optimum regime is the regime with maximum variance of the size of particles about its given mean value. It is assumed that the process follows the kinetic mode Basic formulas are obtained and certain limiting situations are analyzed.

A.L. MOSSE, E.M. ERMOLAEVA

INTERCOMPONENT HEAT TRANSFER OF A DISPERSED MATERIAL IN A PLASMA REACTOR WITH MULTIJET MIXING CHAMBER

A.V.Luikov institute of Heat and Mass Transfer, Academy of Sciences of Belarus, Minsk, Belarus

Results of an investigation of the interphase heat exchange of the particles of a dispersed material in a plasma reactor with multijet mixing chambers are reported. The effect of the

concentration of the dispersed material on the heat flux to the reactor walls is established. Experimental data on the interphase heat exchange of various particles are unified in the dimension- less form. The results are compared with known dimensionless dependences on interphase heat exchange. On the basis of the results a model of interaction of dispersed materials with plasma flows of different structures is developed.

A.V. NIKITIN, V.A. LIOPO

CALCULATION OF CONDENSATION FROM A MULTICOMPONENT VAPOR-GAS MIXTURE AT LOW CONCENTRATIONS

Grodno State University, Grodno, Belarus

A software package that can be used in engineering calculations of heat and mass transfer processes and required equipment is developed. The software runs on an IBM PC/AT under MS DOS. The algorithm of calculations is designed for the following scheme: the gas-vapor mixture is introduced into a cooler where it is being cooled from the temperature T_1 to T_2. In doing so, one of the components of the flow condenses, whereas other com ponents dissolve in the condensate. It is assumed that the condensation rate- is higher than the dissolution rates of the components in the condensate.

V.S. POLONSKY, A.V. ORLOV, I.L. MOSTINSKY, V.I. ZALKIND, O.G. STONIK, N.P. AFANASYEV, V.A. POVELISTYN

HEAT TRANSFER DURING HEATING OF A STRIPE OF A HARD BODY BY A HOT GAS JET

Institute for High Temperatures of the Russian Academy of Sciences, Moscow, Russia

To destruct materials by erosion preliminary heating may be helpful. We solved a model problem: heat wave propagation from a heated rectangular site at the concrete-air interface. The method of Greens functions was applied. The problem of the preliminary heating of the cut was modelled also for the cut that have been already made to a certain depth. In the case the model consists in propagation of a heat wave from the heated interval which moves in the continuum. Here, the interval models the inclined jet of the heating agent.

O.L. POLYAKOV, B.I. BROUNSHTEIN, S.I. KOSTENKO, I.R. SILAKOVA

SURFACE PHENOMENA DURING HF ABSORPTION BY WATER AND CHEMISORBENT WATER SOLUTIONS

Russian Scientific Center "Applied Chemistry", St. Petersburg, Russia

Results of investigations of absorption of hydrogen fluoride (with the concentration in the gas phase 0.17-0.42 g/m^3) on an experimental installation with the flow of monodispersed droplets of 5% aqueous solution of NaOH are presented. Values of mass transfer coefficients within the limits of experimental errors correspond to calculated values at the limiting resistance of the gas phase and reference data at short-time contacts. It is assumed that the decrease in the absorption rate at long-time contacts and its increase upon chemisorption are due to surface phenomena.

B.A. ROGOV

ON THE PROBLEM OF HEAT TRANSFER IN SCRAPER HEAT EXCHANGERS FOR FAT-CONTAINING EMULSIONS

All-Russian Scientific Research Institute of Fats, St. Petersburg, Russia

Results of an analysis of cylindrical scraper heat exchangers used in heat transfer processes is carried out with consideration for thermophysical properties of the raw material, basic parameters and operation regimes of the equipment. The value of the proportionality factor in the heat transfer equation for subcooling heat exchangers for fat-containing emulsion is obtained.

L.V. ROMANOVA, I.I. GAGONIN

APPLICATION OF AN INCLINED CONDENSER FOR THE EFFICIENT PURIFICATION OF VAPOR-GAS

State University of Phytopolymers, St. Petersburg, Russia

A new method of application of a surface condenser as an apparatus for cleaning of a steam-gas mixture from soiling substances is developed.

N.M. SAMSONOV, L.S. BOBE, V.M. NOVIKOV, B.YA. PINSKY, N.V. RYKHLOV, V.A. SOLOUKHIM, V.G. RIFERT, P.A. BARABASH

INVESTIGATION OF HEAT AND MASS TRANSFER IN DISTILLATION EQUIPMENT FOR SPACE STATION WATER RECYCLING SYSTEM

Scientific Research and Designing Institute for Chemical Machine Budding

Distillation equipment for water cleaning from urine in microgravity has been developed and studied. The distillation unit consists of a rotary mass-transfer evaporator with a wire-mesh insert, a thermoelectric heat pump, a condenser, and a separator. Investigation of heat and mass transfer in the evaporator is carried out and the effect of rotor RPM, wire-mesh water concentration, and air velocity are discussed. Equations for heat and mass transfer coefficients in the evaporator based on an expanded analogy of heat and mass transfer processes are presented.

YU.I. SHANIN, O.I. SHANIN, L.A. IZHVANOV, A.I. SOLOVEI

HEAT PROCESSES IN DEVELOPMENT OF THE METAL HYDRIDE CHEMOTHERMAL PUMPS

"Luch" Scientific and Production Amalgamation, Podolsk, Russia

The choice of materials of hydride couples upon desing of cooling machines and thermal pumps operating in the temperature range-50..+200 C. The effect of the slope and hysteresis of isotherms in the "pressure- composition" variables, which affect substantially the cycle efficiency and the choice of operation parameters, is analyzed. Various methods of increasing the effective thermal conductivity are analyzed. Certain results are presented, and problems emerging when designing an installation for production of cold water with temperature not higher than 4°C are discussed.

A.L. SHUYAKOV, A.I. SMORODIN, V.A. KIRPIKOV

SIMULATION OF THE ORTHO-PARA CONVERSION PROCESS UNDER POLYTHERMIC CONDITIONS

"Kriogenmash" Stock Company, Balashikha, Moscow region, Russia

A mathematical model of an ortho-para conversion reactor for production of liquid hydrogen is considered. The problem was reduced to solution of three linear nonhomogeneous differential equations with constant coefficients, and initial and boundary conditions. An analytical solution of the system is presented.

A.YU. SNEGIREV, L.V. KONOVALOV, K.M. AREFYEV

MATHEMATICAL MODELING OF HEAT AND MASS TRANSFER IN AUTOGENOUS GENERATORS WITH THE AIM OF FORCASTING OF DROPS AND DUST REMOVAL AND CRUST AND LINING SLAG FORMATION

State Technical University, St. Petersburg, Russia

A two-range mathematical model of the temperature field in lining of a unit with top blowing of oxygen is presented along with results of calculations for an autogen melting unit at "Severonikel" works.

YU.P. SOVIT, V.I. ELISEEV, A.P. TOLSTOPYAT, K.M. KOVAL

MODELING OF GAS DISTRIBUTION AND HEAT TRANSFER IN MULTIZONE FURNACES

Dnepropetrovsk State University, Dnepropetrovsk, Ukraine

Results of visualization of filtration currents in a laboratory installation simulating the furnace at Oskol electrometallurgical plant are presented. Areas of motion of cooling and recovering gases are shown. A mathematical problem on motion of filtration flows and heat and mass transfer of the gas and material in the furnace is formulated. Model problems are solved; good conformity of borders of areas of currents of cooling and recovering of gases with experimental patterns of currents is observed.

A.V. STEPANOV

EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER AND MODELLING OF THE REACTION TUBULAR FURNACES (KEYNOTE PAPER)

Institute of Bio organic Chemistry and Petrochemistry, Kiev, Ukraine

Results of investigations of heat transfer for reaction tubular furnaces arc presented. A general mathematical model for pyrolysis and steam generation is applied to correlate the tube and coil dimensions and variables of the process for any given feedstock and conversion.

V.B. TROSHENKIN, G.A. TKACH, B.A. TROSHENKIN

HEAT TRANSFER BETWEEN AN ALLOY AND WATER DURING HYDROGEN PRODUCTION IN CYLINDER REACTORS

Institute for Problems of Mechanical Engineering, Kharkov, Ukraine

Improvement of the process of hydrogen production by changing composition of alloys is considered. An investigation of outward heat transfer between phases is carried out. It is shown that outward heat transfer does not restrict the intensity of the reaction. The process was carried out in a reactor at the pressure 30-40 atm and maximum temperature 310-385°C.

A.YU. VALDBERG, N.M. SAVITSKAYA

AN APPROACH TO THE CALCULATION OF CONTACT HEAT EXCHANGERS OPERATING IN THE REGIME OF FULL EVAPORATION OF A SPRAYING LIQUID

Scientific Research Institute on Industrial and Sanitary Gas Cleaning, Moscow, Russia

A method of calculation of contact heat exchangers operating in the regime of full evaporation is proposed. Two main approaches to solving the problem of evaporative cooling of gases are employed. The first approach is based on balance equations that characterize the total quantity of heat and mass being transferred from one medium to another, boundary values of heat and mass exchange processes parameters, and values of coefficients of heat and mass transfer calculated by empirical (criterial) dependences. The second approach is based on calculation of local factors of the process proceeding in the heat exchanger, i.e., takes into account time-dependence variations in the gas flow moisture content, temperature, flow velocity, and masses of media during their contacting.

N.M. VOSKRESENSKII, O.YU. OSTOSHEVSKAYA, M.S. SAFONOV, S.I. SARDYUKOV

HEAT AND MASS TRANSFER IN A TUBULAR REACTOR FOR AMMONIA DECOMPOSITION WITH THE DEPOSITED CATALYST BED

Moscow State University, Moscow, Russia

A reactor for ammonia decomposition with more uniform heat supply to the entire bulk of the thin catalyst bed deposited on a cylindrical heat- conducting support is proposed. Such a catalyst bed improves considerably the reactor efficiency per unit mass of the catalyst. A mathematical model of this reactor in laminar and turbulent flows is constructed. In the inlet section where the ammonia mole fraction in the mixture is rather high, the kinetic model with the zero-order reaction on the wall is used; in the other section of the reactor, the external-diffusion isothermal model is applied. Calculations for estimating the dependence of the ammonia mole fraction al the outlet on the heat flux at various loads in different flows are performed.

A.F. ZALETNEV, V.V. KLYUCHKIN, V.F. ZHARKO, S.D. UMAROV, YU.V. RYKOV, I.YU. PEWAT

HEAT EXCHANGE EFFICIENCY IMPROVEMENT IN OIL EXTRACTION DISTILLERS

All-Russian Scientific Research Institute of Fats, St. Petersburg, Russia

The report presents results of comprehensive investigations on improvement of the technology of distillation of vegetable oils solutions in carbon hydride solvents. Hydrodynamic principles of interphase heat and mass exchange in oil extraction distillers are discussed. Data on

technical and technological possibilities of industrial application of steam-jet burners for solution components separation are reported.

V.N. ZVEREV

GAS SEPARATION EFFICIENCY IN PLASMA CHEMICAL VORTEX DEVICES WITH INTENSIVE HEAT AND MASS TRANSFER

Moscow State University of Forest, Moscow, Russia

Distinctive features of intense heat and mass transfer in pulsed plasma chemical reactor-separators are considered. A model of plasma motion in the devices is developed. The calculated dependence of plasma parameters and the gas separation coefficient are compared with experimental data.