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Prof. Siavash H. Sohrab, Northwestern University, Evanston, USA
Prof. Haris J. Catrakis, University of California, USA
Dr. Nikolai Kobasko, IQ Technologies Inc., USA

NEW ASPECTS of HEAT TRANSFER, THERMAL ENGINEERING and ENVIRONMENT

Rhodes, Greece, August 20-22, 2008

Proceedings of the 6th IASME/WSEAS International Conference on HEAT TRANSFER, THERMAL ENGINEERING and ENVIRONMENT (HTE'08)

WSEAS Mechanical Engineering Series
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ISBN: 978-960-6766-97-8

Published by WSEAS Press
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World Scientific and Engineering Academy and Society

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Dr. Nikolai Kobasko, IQ Technologies Inc., USA

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Preface

This book contains the proceedings of the 6th WSEAS International Conference on HEAT TRANSFER, THERMAL ENGINEERING and ENVIRONMENT (HTE'08) which was held in Rhodes, Greece, August 20-22, 2008. This conference aims to disseminate the latest research and applications in Heat and Mass Transfer, Simulation, Modeling and Experimental Research in Refrigeration and Air-Conditioning, Mathematical Physics problems, Internal Combustion Engines, Steam Generators, Heat Storage, Electronic Cooling, Environmental Protection, Management of Heating Resources, Natural Resources, Social and Economic issues and other relevant topics and applications.

The friendliness and openness of the WSEAS conferences, adds to their ability to grow by constantly attracting young researchers. The WSEAS Conferences attract a large number of well-established and leading researchers in various areas of Science and Engineering as you can see from **http://www.wseas.org/reports**. Your feedback encourages the society to go ahead as you can see in **http://www.worldses.org/feedback.htm**

The contents of this Book are also published in the CD-ROM Proceedings of the Conference. Both will be sent to the WSEAS collaborating indices after the conference: **www.worldses.org/indexes**

In addition, papers of this book are permanently available to all the scientific community via the WSEAS E-Library.

Expanded and enhanced versions of papers published in this conference proceedings are also going to be considered for possible publication in one of the WSEAS journals that participate in the major International Scientific Indices (Elsevier, Scopus, EI, ACM, Compendex, INSPEC, CSA .... see: www.worldses.org/indexes) these papers must be of high-quality (break-through work) and a new round of a very strict review will follow. (No additional fee will be required for the publication of the extended version in a journal). WSEAS has also collaboration with several other international publishers and all these excellent papers of this volume could be further improved, could be extended and could be enhanced for possible additional evaluation in one of the editions of these international publishers.

Finally, we cordially thank all the people of WSEAS for their efforts to maintain the high scientific level of conferences, proceedings and journals.

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Plenary Lecture I

Exergy Efficiency and Environmental Impacts

Professor Christopher Koroneos
Laboratory of Heat Transfer and Environmental Engineering
Aristotle University of Thessaloniki
PO Box 483, 54124 Thessaloniki, Greece

Abstract: The issues relating to the environmental pollution are becoming more and more crucial as the industrialization of the third world countries runs very rapidly and the industrialized countries keep on increasing consumption of goods and electricity. The use of fossil fuels and especially coal are increasing with an alarming rate. The global warming effect is threatening our mere existence on earth, on the long run. The exergy efficiency of power plants, of any fuel, could be a measure of how well the plant is performing and at the same time how low could the emissions be. Exergy is a concept not new by any means but fairly new in its extensive use for its relation to sustainable development. The exergy efficiency as compared to energy efficiency gives a more concise picture of the performance of a power plant and is closer to its relation to the environment. In this work the issues of exergy analysis as related to the environmental impacts of power plants will be analyzed.

Brief Biography of the Speaker: Christopher Koroneos is a Chemical Engineer. He earned his PhD, Msc and BSc., all at Columbia University in the City of New York in USA, where he also taught for eight years. Presently he is teaching at the Aristotle University of Thessaloniki and the University of Western Macedonia. He is also a visiting professor at the National Technical University of Athens at the Graduate Program “Environment and Development”. His research activities include Life Cycle Assessment, Renewable Energy Systems, Environmental Systems Analysis and Design, and Exergy Analysis. He has more than 200 publications in scientific journals and scientific conferences. He is participating in many European research programs and committees.

Plenary Lecture II

Empirical Constitutive Equations - From Monotonous to Non-Monotonous Flow Curves

Professor Petr Filip
Institute of Hydrodynamics
Academy of Sciences of the Czech Republic
Pod Patankou 5, 166 12 Prague 6
Czech Republic

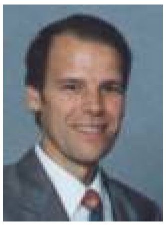
Abstract: A number of parameters appearing in the 'classical' empirical constitutive equations (rheological equations of state) describing viscosity behaviour of non-Newtonian fluids usually oscillate between two (power-law or Bingham model) and five (as e.g. Carreau-Yasuda model). With the onset of new rheologically more complex materials exhibiting non-monotonous behaviour of flow curves this range (2-5) is no longer tenable and more additional parameters are required for a proper description of the flow curves. The present contribution summarises basic classical monotonous models, and analyses a non-monotonous problem for the cases: shear viscosity vs. shear rate and shear viscosity vs. shear stress.

Brief Biography of the Speaker:
Study:
Charles University, Faculty of Mathematics and Physics, specialty applied mathematics, Prague
Ph.D. Study:
Institute of Mathematics, Czechoslovak Academy of Sciences, Prague
Dept of Partial Differential Equations
Ph.D.degree, Thesis: 'Oscillation of Wave Equation in Two Dimensions'

now with The Institute of Hydrodynamics, Academy of Sciences of the Czech Republic in Prague
Fields of interest: Rheology, Fluid Mechanics
Professional membership: The Society of Rheology, The Polymer Processing Society

Plenary Lecture III

From Single Heat Pipe to Heat Pipe Heat Exchangers



Professor Gheorghe Bacanu
Co-Author: Claudia Sirbu
University Transilvania of Brasov
29 Eroilor Boulevard, 500036, Brasov
ROMANIA

Abstract: The paper presents an algorithm to determine the performance of the heat pipe heat exchanger (HPHE) starting from the behaviour of different single heat pipes. The heat pipe (or thermosyphon), as a heat transfer device with an extremely high effective thermal conductivity has a self performance depending on the different operating conditions. Inside the HPHE the single heat pipe represents an elementary heat exchanger and the total number of heat pipes (which constitute the exchanger) is a combination of the elementary exchangers in a parallel, a series or a mixed arrangement.

The performance (behaviour) of each heat pipe depend, essentially, on the position inside the exchanger, taking in account that the temperatures of both fluids are variable in the longer of the exchanger. Finally, the overall performance of the exchanger is a sum of the performance of the total number of heat pipes.
The algorithm to predict the performance oh HPHE is based on the knowledge of the behaviour of HP in very different conditions (behaviour obtained by laboratory tests) and on the use of a specific software, which is presented more detailed in the paper.

Brief Biography of the Speaker: Engineer Licence degree obtained in 1974, at Faculty of Energetics, University “Politehnica" of Bucharest, Master degree in “Gestion de PME-PMI” (SMEs management) obtained in 2001 at Faculte d'Administration et Echange, Universitate Paris XII, Val de Marne, France. From 1980 Professor (Department of Termotehnics and Fluids Mechanics), University Transilvania of Brasov (teaching Thermodynamics, Renewable Sources of Energy, Energy Management, Heat and Mass Transfer Processes), and from 2004 Vice-Rector charged with the research and doctoral study.

PhD obtained in 1991 with the thesis "Optimization of Heat Pipe Heat Exchangers", (in Romanian), Participations at International Heat Pipe Conferences: Grenoble (France), Beijing (China), Tokyo (Japan), Albuquerque (U.S.A).

Plenary Lecture IV

Design ab-initio of Coherent Thermal Sources

Professor Philippe Ben-Abdallah
French National Center for Scientific Research
Laboratoire de Thermocinetique UMR CNRS 6607
Ecole Polytechnique de l'Universite de Nantes
44306 Nantes, France

Abstract: Controlling the spatial or temporal coherence of thermal light a hot body emits when it relaxes to lower states is undoubtedly one of major objectives for improving the efficiency of numerous actual technologies such as thermophotovoltaic conversion devices, radiative cooling systems, infrared gas sensors and highly directional/narrow band thermal radiators. Until recently thermal sources were considered as objects that were able to emit light only over a broad band of the infrared spectrum. Today we know this paradigm is wrong and several partially coherent thermal sources have been already fabricated. The physical origin of these unusual behaviors comes from the structures at the wavelength scale of materials used to fabricate these sources and from the presence of surface waves. Roughly speaking, in the first generation of partially coherent thermal sources, polar materials surmounted by an appropriate surface grating were used to diffract the surface phonon-polaritons into the far field. This principle has opened new prospects for engineering the radiative properties of these media. One of the best achievements in the design of coherent thermal sources has been obtained later with photonic crystals. These periodic dielectric structures-also known as photonic band gap (PBG) materials have, for almost two decades, attracted much attention because of their high potentiality in numerous applied and theoretical fields. At sufficient refractive index contrast, PBG forbid photons to propagate through them at certain frequencies, irrespective of propagation direction in space and polarization. Coupled with frequency selective surfaces photonic crystals have recently allowed the construction of narrow bands IR emitters. These last years promising results have opened prospects for the fabrication of temporally coherent IR sources when a defect is introduced into a photonic crystal. Such defects act like waveguides with a confinement achieved by means of the photonic band gap and not by total internal reflection as in traditional wave guides. The latest generation of partially coherent thermal sources, has been engineered by coupling polar layers with photonic crystals. These structures exhibit highly directional and narrow bands emission patterns for both p- and s-polarization states of the thermal light. Similar antenna-like emission patterns also have been achieved with completely different physical mechanisms using simple thin fims and more recently resonant cavities coupled with metallic layers. Another direction of research has been recently explored for designing thermal antennae with left-handed material (LHM) which are engineered from one-dimensional periodic metallic structures. Near the plasmon resonance of these structures, the effective optical index is close to zero. Therefore, in accordance with the Snell-Descartes laws, the radiation emitted by a source embedded in this medium is expected to be refracted around the normal to the surface. However, no LHM material have been built so far to operate in the infrared range. Moreover, although these structures make it possible to consider many applications at localized frequencies they seem, because of the dispersion, much more difficult to exploit for designing spatially coherent thermal sources over a broad spectral band. All distinct approaches mentioned above have led to highly directional, narrow band partially coherent thermal sources. However it is not known whether the corresponding structures truly achieve the maximum permissible coherence degree. This is due on the fact that only heuristic strategies based on trial-and-error have been followed for engineering such sources. In this lecture we present a general method for the ab initio design of coherent thermal sources by using only the first principles of optics. The ability to artificially grow, from modern deposition techniques, complex structural configurations of planar heterogeneous metallic/dielectric materials raises the issue of the best achievable thermal emitter that is with the highest directivity and/or with the narrowest band of emission in a given spectral range. This engineering design problem is formally a type of mathematical inverse problem. After an overview on the actual coherent thermal sources, I will present a new strategy to solve this problem. From our current research I will present two examples of multilayered thermal sources. These planar structures involve dielectric and metallic films only without gratings and can be used to realize coherent emission for either polarization both in the far field and in the near-field. The first

example I will present is a quasi-isotropic source that has been imagined to radiate in the far field in a narrow spectral band for both polarization states at ambient temperature. It was found that the designed structure can be interpreted as a phonon-polariton resonant guide which converts any photon into atomic vibration at a localized frequency for both polarization states. The second example is a multilayered metallic source which strongly enhances the near-field thermal emission. I will conclude by raising some significant questions.

Brief Biography of the Speaker:

Formation et postes précédents / Background :

-Thèse de doctorat au Laboratoire d'Etudes Thermiques (CNRS-ENSMA)
-Postdoctorat at Québec University (Canda)
-Chargé de Recherche à l'Ecole Nationale Supérieure de Mécanique et d'Aérotechnique (CNRS)
-Chargé de Recherche à l'Ecole Poytechnique (CNRS)

Quelques pubications récentes/ A few recent publications :

- P. BEN ABDALLAH and B. NI
"Single-defect Bragg stacks for high-power narrow-band thermal emission Journal of Applied Physics. 97, 104910, 2005"

- P. BEN ABDALLAH, B. NI, A. OULD EL MOCTAR , N. AUBRYand P. SINGH
"Optical manipulation of neutral nanoparticles suspended in a microfluidic channel, Journal of Applied Physics, 99, 094303, 2006."

- P. BEN-ABDALLAH,
"Heat transfer through near-field interactions in nanofluids, Applied Physics Letters, 89, 113117, 2006"

- P. BEN-ABDALLAH,
"Dynamic structure and cluster formation in confined nanofluids under the action of an external force field, Physical Review E, 74, 041407 (2006)"

- J. Drevillon (PhD) and P. Ben-Abdallah,
"Ab initio design of coherent thermal sources, J. Appl. Phys., 102, 114305, 2007."

- P. Ben-Abdallah*, K. Joulain, J. Drevillon and C. Le Goff,
"Heat transport through plasmonic interactions in closely spaced metallic nanoparticles chains, Phys. Rev. B, to appear 2007"

Plenary Lecture V

Computer Graphics vs. Radiative Heat Exchange – Similarity and Differences in Description and Calculation Methods

Professor Konrad Domke
Institute of Electrical Engineering and Electronics,
Poznan University of Technology
ul. Piotrowo 3a, 60-965 Poznan,
Poland
E-mail: konrad.domke@put.poznan.pl

Abstract: Computer graphics methods and algorithms serve to create virtual reality - it means to artificial images of non existing scene. Methods and algorithms of radiative heat exchange serve to determination of temperature and power flow in heat systems, in which radiative heat exchange has occurred. In computer graphics light is modeling and tracing, in radiative heat exchange – heat radiation is testing. Both, light and heat radiation are EM waves. Physical lows of generation, propagation, reflection or absorption in those both cases are the same. But the description of those phenomena for computer graphic and for radiative heat transfer is partially different. It came from the others assumptions in both cases and from the others expectation in final result of calculations. In this lecture the comparison between both cases will be done. The similarities and the differences in:

- description of light and heat radiation phenomena,
- description of light systems and radiative heat transfer systems,
- expected results of calculations,
- acceptable assumptions,
- methods and algorithms of calculations

will be specified.

Additionally, possibility of using computer graphics methods and algorithms (also programs and software) to calculation of radiative heat exchange system will be presented.

Brief Biography of the Speaker: Konrad Domke is an Electrical Engineer. Master degree he obtained in 1974 at Kijev Technical University (former USSR now Ukraine) and PhD in “Surface load of heating coils” at Electrical Engineering Department of Warsaw University of Technology (Poland) in 1982. In 2005 he earned Dr hab. Degree with the thesis: “Modeling. simulation and examination of radiative heat transfer in the Radiance environment” at Electrical Engineering Department in Poznan University of Technology (PUT) (Poland). Presently, he is teaching at PUT and his research activities include: modeling of light and heat systems, radiative heat exchange calculations, LED cooling. From 2005 Vice-Dean of Electrical Engineering and Electronics Department of PUT charged with the bachelor/master study. He has more than 100 publications: in books and papers of scientific journals or conferences.

Plenary Lecture VI

Modeling and Stability Analyses of Natural Circulation Steam Generators

Professor Heimo Walter
Institute for Thermodynamics and Energy Conversion
Vienna University of Technology
Getreidemarkt 9, A-1060 Vienna, AUSTRIA
E-mail: heimo.walter@tuwien.ac.at
Web site: http://www.ite.tuwien.ac.at

Abstract: Natural circulation systems have a wide range of applications such as e. g. power cycles or industrial heating processes. Working media in process facilities or power plants are operated in either single phase or multiphase condition. Water and steam are the most widely used working media. Multiphase flow has a stronger tendency towards unstable behavior than single phase flow. These so-called fluid-dynamic instabilities can manifest themselves e. g. in the form of pressure drop or mass flow fluctuations, or fluctuations of the wall temperatures. The instabilities can cause vibrations of plant components, a non-uniform mass flow distribution in the tube bank. They can accelerate the initiation of a boiling crisis, which is characterized by a sudden rise of surface temperature due to the drop of the heat transfer coefficient, and a non-uniform heat flux or a difficult measurement and control of system parameters. Thermo-hydraulic oscillations and flow instabilities can influence the operation and the control of the plant in a negative way and therefore they are undesirable. To avoid such instable flow conditions it is necessary to know the dynamic behavior of the steam generator already in the phase of the boiler design. The paper discusses the modeling as well as the stability analyses of natural circulation systems. In the first part of the paper a short description of the theoretical background of the computer code used for the numerical simulation of the natural circulation boilers will be presented. For solving the partial differential equations of the conservation laws for the working fluid the two finite volume algorithms SIMPLER and PISO are used. The computer code is suitable for the calculation of a boiler with a different number of pressure stages. In the second part of the article the fundamentals of the analyses of the static flow instability, namely the reverse flow, will be described and the results of a stability analyses on two different boiler designs will be presented. The investigation was carried out for two different boiler designs. Both boilers are analysed under hot start-up conditions. It can be shown that design possibilities exits to influence the stability of the boilers by changing the geometry.

Brief Biography of the Speaker: Heimo Walter is a mechanical engineer. He obtained the Master degree in 1992 at the Vienna University of Technology. From 1994 to 2007 he was a University-Assistant at the institute for Thermodynamics and Energy Conversion at the Vienna University of Technology. 2001 PhD in Mechanical Engineering at the Vienna University of Technology. He is since Feb. 2007 assistent professor at the institute for Thermodynamics and Energy Conversion at the Vienna University of Technology. In Nov. 2007 he earned Dr. hab. degree with the thesis: "A contribution to the static and dynamic stability of natural circulation steam generators" at the Vienna University of Technology.

Since June 2007 - Editorial board member of the journals: Open Mechanical Engineering Journal; Open Mechanical Engineering Reviews and Open Mechanical Engineering Letters.

Since 2006 Member of ASME-American Society of Mechanical Engineering and Member of WSEAS - World Scientific and Engineering Academy and Society.

Plenary Lecture VII

A Quasi-Normal Scale Elimination (QNSE) Theory of Turbulent Flows with Stable Stratification

Professor Semion Sukoriansky
Department of Mechanical Engineering/
Perlstone Center for Aeronautical Engineering Studies,
Ben-Gurion University of the Negev,
Beer-Sheva, Israel
E-mail: semion@bgu.ac.il

Co Author

Professor Boris Galperin
College of Marine Science,
University of South Florida,
St. Petersburg, Florida
USA

Abstract: The QNSE model is a new theory of turbulence with stable and weakly unstable stratification. The model is derived in maximum proximity to first principles using the hypothesis of quasi-normality of turbulence stirring. The model explicitly resolves the stratification-induced disparity between the transport processes in the horizontal and vertical directions and accounts for the combined effect of turbulence and waves. The theory is based upon a mapping of the actual velocity field to a quasi-Gaussian field. The parameters of the mapping are calculated using a systematic process of successive averaging over small shells of velocity and temperature modes that eliminates them from the equations of motion. This approach offers a powerful mathematical tool for dealing with previously nearly intractable aspects of anisotropic turbulence. The process of successive small scales elimination results in a model describing the largest scales of a flow. Partial scale elimination yields subgrid-scale viscosities and diffusivities that can be used in large eddy simulations. The elimination of all fluctuating scales results in RANS models. The model predicts various important characteristics of stably stratified flows, such as the dependence of the vertical turbulent Prandtl number on Froude and Richardson numbers, anisotropization of the flow filed, and decay of vertical diffusivity under strong stratification, all in good agreement with computational and observational data. The theory also yields analytical expressions for various 1D and 3D kinetic and potential energy spectra that reflect the effects of waves and anisotropy. The model's results are suitable for immediate use in practical applications and have been tested versus various data sets and in numerical weather prediction systems. When implemented in the numerical weather forecast systems, the QNSE-based vertical transport coefficients substantially improve the system's predictive skills. In summary, the QNSE-based RANS models present a viable alternative to the Reynolds stress closure models widely used in meteorological, oceanographic and engineering applications.

Brief Biography of the Speaker: Semion Sukoriansky is an Associate Professor of Mechanical Engineering at Ben-Gurion University of the Negev, Israel. Concurrently, he served as a Chairman of Center for the Magneto-Hydrodynamic Studies at Ben-Gurion University (2000-2007).

In 1988 his Ph.D. work earned The American Nuclear Society Award in recognition of significant achievements in the area of fusion science and engineering.

Plenary Lecture VIII

Class of Exact and Approximate Heat Transfer Solutions for Non-Canonical Bodies

Professor Andris Buikis
Department of MeInstitute of Mathematics and Computer Science,
University of Latvia,
Raina bulv. 29, Riga, LV1459,
Latvia
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Web site: http://www.lza.lv/scientists/buikis.htm

Abstract: In applications very often we meet heat transfer problems for bodies of complicate structure; particularly they can be represented as bodies consisting of finite number of tangentially connected canonical sub-domains. We propose to call such domains as regular non-canonical domains (or bodies). By canonical sub-domain we understand body of simple structure, e.g. rectangle, cylinder, ball. For canonical sub-domain with traditional type boundary conditions the Green function method (or variable separation method) can be applied in classical way, but it can't be applied directly for the regular non-canonical domain. Typical example of regular non-canonical domain is system with extended surfaces in form of rectangular fin (L-shape domain).

The proposed modification of the Green function method for regular non-canonical domains is based on the idea: in each canonical sub-domain the junction conditions (e.g., conjugations conditions) on the common boundary with the alongside canonical sub-domain is replaced with certain classical boundary condition with unknown right hand side. Then the Green function method for each canonical sub-domain is applied in traditional form. The junction conditions finally allow expressing the exact solution of the original problem on the mentioned common boundary in the form of the system of 2nd kind Fredholm integral equations. For the regular non-canonical domain consisting of two canonical sub-domains the solution is reduced to one Fredholm integral equation. Simpler, but then approximate class of solutions for regular non-canonical domains can be obtained on the basis of original method of conservative averaging.

As main applications of both approaches we consider two important application areas: intensive steel quenching and heat transfer in systems with extended surfaces.

Brief Biography of the Speaker:
Professor Andris BUIKIS

- Professor, University of Latvia
Faculty of Physics and Mathematics, Department of Mathematics
- Head of Laboratory of Mathematical Technologies, Institute of Mathematics and Computer Science,
University of Latvia

Born: March 15, 1939, Valka, Latvia

Interests:

- Mathematical Modelling
- Mathematical Problems of Heat and Mass Transfer, Especially for Layered Media

- Analytical and Numerical Methods for Partial Differential Equations
- Innovative Energetic
- Philosophy of Science

Languages: German, English, Latvian, Russian

Education:

- University of Latvia (Faculty of Physics and Mathematics), 1963
- Dr.math. (Candidate of Science in former USSR), University of Latvia, 1970
- Dr.habil.math. (Doctor of Science in former USSR), University of Kasan, Russia, 1988
- Professor, University of Latvia, 1991

Experience:

- Junior Researcher, Senior Researcher, Computing Centre, University of Latvia, 1962 - 1972
- Assistant Professor and Head of Chair of Applied Mathematics, Faculty of Physics and Mathematics, University of Latvia, 1972 - 1976
- Assistant Professor and Head of Chair of Differential Equations and Numerical Methods, Faculty of Physics and Mathematics, University of Latvia, 1976 - 1984
- Senior Researcher, Faculty of Physics and Mathematics, University of Latvia, 1984 - 1986
- Assistant Professor, Chair of Differential Equations and Numerical Methods, Faculty of Physics and Mathematics, University of Latvia, 1986 - 1988
- Senior Researcher, Head of Laboratory of Mathematical Physics, Institute of Physics, Latvian Academy of Sciences, 1988 - 1991
- Director, Institute of Mathematics, Latvian Academy of Sciences and Latvian University, 1991 - 1996; 2003 - 2006
- Head of Laboratory of Mathematical Physics (1996 -2006) and Head of Scientific Council (1996 – 2003), Institute of Mathematics, Latvian Academy of Sciences and Latvian University
- Director, Science and Dialogue Centre of Latvia, 1993 -2007
- Head of Laboratory of Mathematical Technologies (2006-), Institute of Mathematics and Computer Science, University of Latvia

Plenary Lecture IX

Modelling of Thermal Comfort Conditions in Buildings

Professor Lajos Barna
Department of Building Service and Process Engineering,
Budapest University of Technology and Economics
H 1541 Budapest,
HUNGARY

E-mail: barna@epgep.bme.hu
Web site: http://www.lza.lv/scientists/buikis.htm

Abstract: The enhancement of buildings' energy performance puts emphasis on meeting the comfort requirements indoors, as the acceptable environments have to be provided from less energy.

The comfort of the occupant is determined by the heat exchange between his body and his indoor environment. The heat exchange mainly depends on the temperature of the surrounding surfaces and the air temperature as well as on the velocity of the air movement. The temperature, the velocity distribution and the heat exchange between the human body and its' surroundings can be described by analytic and numeric models. The steps of the modelling are the following:

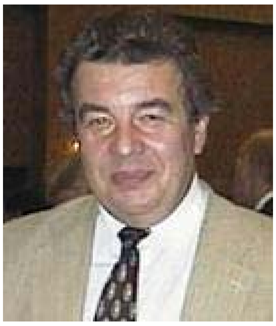
- creating a geometric model,
- definition of the equations and differential equations that can be applied to the phenomenon; setting of the initial and boundary conditions,
- elaboration of the mathematic or numeric model,
- modelling of the temperature and the velocity distribution in the space, and of the heat exchange between the occupant and his environment for the set conditions.
  The paper discusses and evaluates mathematic and numeric modelling examples.

Brief Biography of the Speaker:

Name: Dr. Lajos Barna PhD
Qualifications: MSc in Mechanical Engineering in 1972, Technical University of Budapest
University positions:
Associate professor, 1999-
Comprehensive examination in mechanical engineering: 1983; PhD: 1998.
Teaching and research experience:
Lecturer of several subjects for building service engineering students: Heating, Water supply, Gas supply, District heating supply. Tutor of diploma works.
Major subjects of research works:
Energetic examination and evaluation of buildings;
Modelling of comfort conditions in building;
Investigation of air supply conditions in the room of gas appliances.
He has more than 100 publications in scientific journals and scientific conferences.

Plenary Lecture X

Non-Equilibrium Effects in Thermal and Mechanical Interaction of Droplets with Streaming Flows



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Abstract: Investigations of acute problems of phase transitions in continua mechanics need adequate modeling of evaporation, which is extremely important for the curved surfaces in the presence of strong heat and mass diffusion fluxes. Working cycle of heat pipes is governed by the active fluid evaporation rate. Combustion of most widely spread hydrocarbon fuels takes place in a gas-phase regime. Thus, evaporation of fuel from the surface of droplets turns to be one of the limiting factors of the process as well. The problems of fuel droplets atomization, evaporation being the key factors for heterogeneous mixtures reacting mixtures, the non-equilibrium effects in droplets atomization and phase transitions will be taken into account in describing thermal and mechanical interaction of droplets with streaming flows. In the present lecture processes of non-equilibrium evaporation of small droplets will be discussed. The rate of droplet evaporation is characterized by a dimensionless Peclet number (Pe). A new dimensionless parameter characterizing the deviation of phase transition from the equilibrium will be introduced, that makes it possible to investigate its influence on variations of the Peclet number and to determine the range of applicability for the quasi-equilibrium model. It will be demonstrated, that accounting for non-equilibrium effects in evaporation for many types of widely used liquids is crucial for droplets diameters less than 100 microns, while the surface tension effects essentially manifest only for droplets below 0.1 micron. Investigating the behavior of individual droplets in a heated air flow allowed to distinguish two scenarios for droplet heating and evaporation. Small droplets undergo successively heating, then cooling due to heat losses for evaporation, and then rapid heating till the end of their life time. Larger droplets could directly be heated up to a critical temperature and then evaporate rapidly. Atomization of droplets interferes the heating and evaporation scenario.

Brief Biography of the Speaker: Prof., Dr.Sc. habilitat Nickolay N.Smirnov received his M.S. and Ph.D. degrees in Physics and Mathematics from Moscow M.V.Lomonosov State University in the years 1976 and 1980 respectively. He defended habilitation dissertation in 1990 and got a degree of Dr.Sc.-hab. Degree of Scenior Scientist was awarded in 1987, degree of full Professor was awarded in 1994. He is currently full professor in the Faculty of mechanics and Mathematics and deputy dean, Head of Wave Processes Laboratory and deputy director of Gas and Wave Dynamics Department. He was Visiting Professor in the Karlsruhe University, Germany (in 1994), in Free University of Brussels, Belgium (1995/96 and 2000). Prof. N.N. Smirnov was elected the Corresponding Member to Russian Academy of Technological Sciences in 1992. He received Shuvalov's prise (1993) for the book "Heterogeneous Combustion". Since 1992 he is a member of the Combustion Institute (Int.), since 2007 President of the Combustion Institute Russian Section. Full member of the Scientific Council of Russian Academy of Sciences on Combustion and Explosion since 1995, since 1999 – Vice President of the Council. Member of the Microgravity Science Committee of the International Astronautical Federation since 1995. Member of the Scientific Council on Ecology of the Russian Space Agency since 1994. Corresponding Member of Russian Academy of Natural Sciences since 1998, academician since 2007. Corresponding Member of International Academy of Astronautics since 2005, Commission 1 Space Physical Sciences Secretary. He is a member of the board of Combustion and Flame, Acta-

Astronautica and other national and international journals, science foundations, congresses. He was awarded Kapitsa Gold Medal of the Academy of Natural Sciences for the scientific discovery, S.P. Korolev and M.V. Keldysh medals of the Russian Federation of Cosmonautics.

Published 8 books and more then 150 papers in peer reviewed journals, and 150 communications to scientific meetings in the fields of Mechanics, Physical Chemistry, Wave Dynamics, Combustion and Explosion, Space Physical Sciences.

Plenary Lecture XI

Coagulation-Flocculation Processes in Water/Wastewater Treatment: The Application of New Generation of Chemical Reagents

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Abstract: Drinking water of high quality is essential for human beings. Additionally, the discharge criteria of wastewaters are becoming stricter, according to the new legislation in force, in order to prevent environmental pollution and/or degradation of drinking water sources. A very important step of water and wastewater treatment is coagulation-flocculation, which is widely used, due to its simplicity and cost-effectiveness. Regardless of the nature of the treated sample (various types of water or wastewater) and the overall applied treatment scheme, coagulation-flocculation is usually included, either as pre- or post-treatment step. The efficiency of coagulation-flocculation strongly affects the overall treatment performance; hence the increase of the efficiency of coagulation stage seems to be a key factor for the improvement of the overall treatment efficiency.

The aim of this paper is to provide an overall description of coagulation-flocculation process and its applications in water and wastewater treatment. The significance of coagulation–flocculation in the area of water or wastewater treatment is reviewed and evaluated, emphasizing the several applications employed, including destabilization of colloids, removal of inorganic and organic matter (particulate and/or dissolved), removal of metals and anions (arsenic, phosphate etc), as well as removal of pathogenic microorganisms. Furthermore, the latest developments in the coagulation field, regarding the evolution of the coagulation reagents is also under investigation. The development of the simple pre-polymerized coagulants (i.e. polyaluminium chloride, polyferric sulphate) seems no longer to be sufficient enough. The need for more effective coagulants has lead to the development of new coagulant categories, via the introduction of various additives in the structure of the pre-polymerized coagulants. The first effort was reported 15 years ago, suggesting the use of silica in the form of poly-silicates for such a purpose. Nowadays, the range of additives has expanded, including organic compounds, such as anionic, cationic or non-ionic polyelectrolytes, leading to new composite coagulant reagents. Overall, it is evident that the tendency in the coagulation field nowadays is the production of modified composite chemical agents, which they are becoming more and more complicated, regarding their composition, although they are simpler in their applications.

Brief Biography of the Speaker: Dr. Anastasios Zouboulis is Professor of Chemical & Environmental Technology, Department of Chemistry, Aristotle University of Thessaloniki and has a great experience in the field of water and wastewater treatment technologies, wastewater management, reclamation and reuse. He is author/co-author of more than 150 papers, published in scientific journals and of more than 100 papers published in the proceedings of national & International conferences. He has supervised 5 Ph.D. and 10 M.Sc. Theses and more than 50 Diploma theses. He has participated in more than 40 national and international research and demonstration projects, funded by E.U. and from local sources (ministries, industries, companies etc.), while he was Scientific Responsible in the 25 of them, regarding mainly with the fields of wastewater treatment processes, environmental biotechnology, as well as the treatment of industrial solid toxic wastes by the application of appropriate stabilization methods. His international reputation was recognised by his election as (foreign) member in the Russian Academy of Sciences (since 2003). He is also an active consultant for several local industries in the field of environmental protection, a national expert for the horizontal activities of FP6 and FP7 (EU), and he is acting often as a reviewer/evaluator for scientific publications, as well as for several EU or national research projects. He is also member of the Editorial Board of scientific publications (Separation Science & Technology, Water Research, Journal of Hazardous Materials and Chemosphere – among others), as well as a member of the Organizing and Scientific Committee of several national and international conferences (over 20).

Plenary Lecture XII

General Information about Renewable Energy Sourses and Biofuels

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University of Thrace-Greece
GREECE

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Abstract: The beginning of the 21st century finds humans more familiar with the concept of sustainable development. We must prevent the degradation of our environment focusing in more friendly technologies. This need lead scientists to the use of other energy sources that can be used with the same efficiency but won't have damaging effect to the environment. The increased vehicle number that usually uses petroleum-based fuels results to dangerous emissions production such as carbon monoxide (CO), carbon dioxide ($CO2$), hydrocarbons (HC), nitrogen oxides (NOx) and others. These emissions besides the fact that lead to environmental degradation they also constitute a threat for human health. People's concern about the risks associated with hazardous pollutants results to an increased demand for renewable fuels as alternatives to fossil fuels [1,2,3]. That tendency is depicted on the Kyoto's pact, setting a goal of 8% reduction of $CO2$ until 2012 globally, and the European policy willing to double the inland production of renewable energy from 6% to 12%, and to increase the energy efficiency by 18% compared to that of 1995, as well as the 5,75% substitution at national level in all the members states of fossil fuels with biofuels, as predicted in the late directive of 2003. Bioenergy production as heat, electricity, and liquid fuels represent (2002) 14% of the World's primary energy supply. About 25% of that amount is used in industrialized countries, while the other 75% is used in developing countries. [4,5,6].

Renewable fuels will probably replace petroleum-based fuels in the near future because petroleum reserves are not sufficient enough to last many years. Also, the severe environmental problems around the world will eventually lead to the use of more environmentally friendly technologies.

Brief Biography of the Speaker:
Charalampos Arapatsakos
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Titles
-Mechanical Engineer, Ph.D. (Democitus University of Thrace-Greece), Assoc. Professor on University of Thrace-Greece

Present Responsibilities
-Member of Technical Chamber of Greece
-Member of Electrical and Mechanical Engineering Association.
-Member of Combustion Institute of Greece

Participations
I took part in many research programs, which referred to biofuels, gas emissions, antipollution technology.

Research domains
Biofuels and their use in internal combustion engines, power variation from the use of biofuels, gas emissions and mechanical damages.

Special Session I

Empirical Constitutive Equations - From Monotonous to Non-Monotonous Flow Curves

Organizer:

Professor Petr Filip
Institute of Hydrodynamics
Academy of Sciences of the Czech Republic
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Brief Biography of the Organizer:

Study:
Charles University, Faculty of Mathematics and Physics, specialty applied mathematics, Prague
Ph.D. Study:
Institute of Mathematics, Czechoslovak Academy of Sciences, Prague
Dept of Partial Differential Equations
Ph.D.degree, Thesis: 'Oscillation of Wave Equation in Two Dimensions'

now with The Institute of Hydrodynamics, Academy of Sciences of the Czech Republic in Prague
Fields of interest: Rheology, Fluid Mechanics
Professional membership: The Society of Rheology, The Polymer Processing Society

Special Session II

Quench - Process Design, Equipment and Non- Destructive Control of Materials

Organizer:

Dr. Nikolai Kobasko
Director of technology and R&D of "IQ Technologies Inc", 655 S. Broadway, Akron, Ohio 44311, USA, Tele/Fax 216.381.8159.
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Topics:

- Quenchants, their properties and regularities:
  - Critical heat flux densities
  - Initial heat flux densities during immersion of steel parts into quenchants
  - Non- stationary nucleate boiling
  - Non- stationary film boiling
  - Convection
  - Databases for cooling capacity of quenchants

- New methods of quenching:
  - Intensive quenching
  - Cryogenic quenching
  - Induction quenching
  - Thermo- mechanical heat treatment
  - Press quenching
  - Quenching under pressure
  - Gas quenching
  - Vacuum quenching
  - Controlled quenching and other

- Advanced models and new methods of calculations for design and quench- process investigation
  - Residual stress and distortion of steel after quenching
  - Optimization of the processes of quenching
  - Different kind of equipment for heat treatment of steel parts
  - Non- destructive control and evaluations of materials and process

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Brief Biography of the Organizer:

Dr. Nikolai Kobasko is a leading expert in the world on quenching and heat transfer during hardening of steels. Dr. Kobasko became a leading authority on intensive quenching practices worldwide. He is the author of more than 200 scientific and technical papers, 6 books and more than 30 patents and certificates. In 2004 he received the Da Vinci Diamond award and Certificate in recognition of an outstanding contribution to the Thermal Science. He was the head of the laboratory at the Thermophysics Institute of the National Academy of Sciences of Ukraine. At present time he is the President of the "Intensive Technologies Ltd", Kiev, Ukraine and Director of technology and R&D of the "IQ Technologies Inc", Akron, USA. More information is provided in: http://www.itl.kiev.ua, http://www.intensivequench.com

Comments: Heat treating of materials, especially quenching, is connected with the heat and mass- transfer processes and need to improve environment conditions during metallurgical processes.
Intensive quenching technologies (IQ) were developed in the recent years which have the following benefits:
1. Uses less costly, environmentally friendly quenchants (usually plain water) instead of expensive hazardous oil, resulting in the significant reduction of heat treatment cost and in cost saving from environmental waste stream management, cleaner plant , lower insurance, better work environment, etc.
2. An intensive quenching process allows reducing the duration of the carburization cycle by 40-50%. In some cases, it is possible to fully eliminate the carburization cycle by using the IQ process. This, in turn, will result in the significant improvement of a heat-treating equipment production rate and in tremendous savings of energy and improvement environment condition. During carburization significant emission of CO2 is observed which results in global warming of our Planet.
3. Achieves the grater productivity of the quenching equipment since IQ processes provide faster cooling rate.
4. Increases service life of steel parts by 2-3 times as compared with oil quenching. It means that by 2-3 times less is wasting of steels which effect environment condition during their manufacturing..
At the Conference will be widely discussed results of investigations achieved by International Team within the Project "Database for cooling capacities of various quenchants to be developed with the modern computational and experimental techniques." More information is provided in: http://www.wseas.org/propose/project/wseas-projects.htm

978-960-6766-97-8