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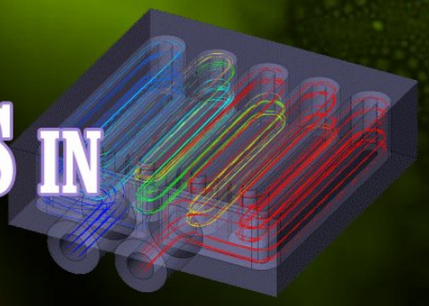
RECENT ADVANCES IN HEAT TRANSFER, THERMAL ENGINEERING & ENVIRONMENT



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Proceedings of the 7th IASME / WSEAS International Conference
on HEAT TRANSFER, THERMAL ENGINEERING
and ENVIRONMENT (HTE'09)

Moscow, Russia, August 20-22, 2009

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Preface

This year the 7th IASME / WSEAS International Conference on HEAT TRANSFER, THERMAL ENGINEERING and ENVIRONMENT (HTE '09) was held in Moscow, Russia, in August 20-22, 2009. The Conference remains faithful to its original idea of providing a platform to discuss simulation, modeling and experimental research in heat and mass transfer, refrigeration, transport phenomena, diffusion convection, conduction problems, internal combustion engines, thermal installations, steam-turbines, management of heating resources, thermal applications of solar energy etc. with participants from all over the world, both from academia and from industry.

Its success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of this conference are published in this Book that will be indexed by ISI. Please, check it: www.worldses.org/indexes as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in many Journals for further evaluation.

A Conference such as this can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

Heat Management in HP LED Devices

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Abstract: HP (high power) LEDs (light emitting diodes) with efficiency up to 100 lm/W and lifetime more than 50 000 hours become now the most effective light sources. Huge amount of heat generated in small volume of p-n junction, gives us the serious problems with it dissipation. In equipment with several HP LEDs (only in such devices we can achieve a sufficient amount of light) the special radiators or cooling elements have to be used. The optimization of such cooling system for assembled HP LED will be examine and describe in lecture. The proper thermal management of such electronic devices is now the basic challenge for widespread using of LEDs as light sources.

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 Warsaw University of Technology (Poland) in 1982. In 2005 he earned DrDegree 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 2008 Deputy Director for Research in Institute of Electrical Engineering and Electronics in PUT charged also with the bachelor/master study. He has more than 100 publications in scientific journals and scientific conferences.

Plenary Lecture 2

Differential Equations that Describe the Thermodynamically State of Gas in the Working Cavity of the Helical Screw Compressor

Assistant Professor Dan Codrut Petrilean
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Abstract: Regarding the helical screw compressor, for the compression and outlet processes, it is necessary to establish the gas parameters, taking into account the time and the rotor's rotation angle. The method is based on a differential equation system solving, equations that describe the gas state in the compressor twin cavities.
The first equation represents the gas pressure dependence of the gas volume and temperature. The second equation is the complete differential of the temperature changing, in a known period. We consider that the working process inside the cavity, for the known time interval, takes place adiabatic.

Brief Biography of the Speaker: PETRILEAN Dan Codrut is an Electromechanical Engineer, graduate of the University of Petrosani, 2000;
Master degree in "Machinery and equipment of modern technology", 2003, Faculty of Machines and Electromechanical Equipments, University of Petrosani;
Ph.D. thesis "Researches regarding the improving of the generation and use efficiency of the pneumatic energy in the mining industry", University of Petrosani, 2006;
Post-university course "Elaborating the thermoenergetical balance", Technical University of Cluj–Napoca, 2007;
Since 2007 – energetic auditor;
Since 2006 - Assistant professor at University of Petrosani, teaching Thermodynamics, Heat engineering, Fluid mechanics.
More than 50 publications in scientific journals and scientific conferences.

Plenary Lecture 3

CFD Techniques for Outlining Convection and Radiation in a Closed Domain

Associate Professor Alina Adriana Minea
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Abstract: Rapid progress in the influencing technologies over the past two decades has brought CFD to the forefront of process engineering. Advances in computational technology, a sustained effort by CFD providers to implement comprehensive physical models, and advances in numerical methods have combined to make it possible for engineering and R&D groups to use CFD routinely in many process industry companies. Heat transfer is extremely important in a wide range of materials processing techniques. The transport in closed domains strongly influences the quality of the final product.
Research in thermal materials processing is largely directed at the basic processes and underlying mechanisms, physical understanding, effects of different transport mechanisms and physical parameters, general behavior and characteristics, and the thermal process undergone by the material. It is usually a long-term effort, which leads to a better quantitative understanding of the process under consideration.
This paper provides an overview of how CFD technology is currently being used in the heat transfer approach of muffle furnaces. The overview is achieved by taking into consideration of five influencing factors:effect of CFD technology, model building, mesh generation, relevant physical models and validation.
Incompressible forced convection heat transfer problems normally admit an extremely important simplification: the fluid flow problem can be solved without reference to the temperature distribution in the fluid. Thus, it can first find the velocity distribution and then put it in the energy equation as known information and solve for the temperature distribution.
Also, in this paper it is intended to expand the theoretic researches concerning heat processes intensification and their use in industrial practice.
This paper focuses on the link between basic research on the underlying transport mechanisms and the engineering aspects associated with the process. The results are focused on the heat transfer processes that occur in industrial heating equipments.

Brief Biography of the Speaker: Alina Adriana MINEA is associate professor of Heat and Mass Transfer at the Technical University Gh. Asachi Iasi, Romania, where she has also the scientific responsibility for the Heating Equipments area. Her main research interests concern heat transfer, heating equipments and simulation techniques. In these fields, she has participated as co-investigator and principal investigator at 16 research Grants and authored or co-authored over 78 published articles, 13 books and two patents published in reviewed journals or presented at international conferences. As coordinator of research, she has awarded two national grants for Young researcher and one at IDEAS competition. Also, she managed to put the bases of an international network in Heat Transfer based on an ESF networking programme proposal. As expert evaluator, she evaluated national grants for NURC council (from 2004), for MatNanTech (in 2004) and for Romanian Ministry of Research and Technology Excellence program (2005-2006 and 2007-2008). As reviewer, she worked for Springer Editing, J.Materials Science, in 2004; for Elsevier, J.Materials Processes and Tech, from 2006 to 2008, for Fp6 programs, no. EX2002B079944, from 2005 she was included as reviewer for Fp7 programs. Also, she is a technical reviewer for several international conferences. She is member of several international professional organizations: Eumat Organization; ASME, INWES, WASET and AGIR.

Plenary Lecture 4

Heat Transfer in Thermoelectricity: Modelling, Optimization and Design

Professor Myriam Lazard
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Abstract: When a temperature difference exists, a potential for power production ensues: it is the principle of thermoelectricity, it could provide an unconventional energy source for a wide range of applications even if the efficiency of the thermoelements is rather low. As a consequence, there is an increasing use of thermoelectric devices in many fields such as aerospace, automotive and building applications. On the other hand, the coupled effects involved in such systems usually leads to complex modelling. In order to predict the performances of the device, several methods could be used: experimental, numerical and semi-analytical. For the experimental ones, the device must already exist whereas numerical and semi-analytical methods could provide more or less realistic predictions.
In a first part, a semi-analytical method has been chosen in order to better understand the underlying physical phenomena and the contribution of the different effects. A thermal modelling of a thermoelectric leg is presented. The aim is to determine the expressions of the temperature within the thermoelement and also the heat fluxes. Indeed these two quantities are needed to determine the performance of the device by calculating the efficiency of the element or for instance by evaluating the COP. The steady-state and the transient cases are considered. The Joule contribution is taken into account (introducing a source term in the heat transfer equation) and the effect due to the Thomson coefficient is investigated.
In the second part, the design of a thermoelement for instance applied to Radioisotope Thermoelectric Generators (RTGs) is investigated. As no single thermoelectric material presents high figure of merit over a wide temperature range, it is therefore necessary to use different materials and to segment them together in order to have a sandwiched structure: in this way, materials are operating in their most efficient temperature range. Even if the thermoelectric figure of merit is an intensive material property of prime importance, it is not the only one: indeed the expression of the reduced efficiency involves another parameter called the compatibility factor, which must be considered and controlled to determine the relevance of segmentation. Not only the reduced efficiency but also the compatibility factor are then plotted for different n-type and p-type elements such as skutterudite as function of the temperature. Thanks to these considerations, the design of the segmented thermoelectric device is investigated in order to optimize the efficiency and once the materials chosen, to determine the best operating conditions and especially the relative current density which is the ratio of the electric current density to the heat flux by conduction.

Brief Biography of the Speaker:
- Associate Professor, Mechanical Engineering, Institute in Engineering and Design (InSIC), Ecole des Mines, (since 2002).
- Post Doctoral Position, Thermoelectricity, Lab. Physics of Materials (LPM), Ecole des Mines de Nancy (2001).
- PhD, "Modelling of the combined conductive-radiative heat transfer in a semi-transparent medium. Parameters estimation", Lab. Energetics & Mechanics Theoretical and Applied, (LEMTA), Institut National Polytechnique de Lorraine (2000).
- MSME and BSME, Institut National Polytechnique de Lorraine (1995).
- MSMaths and BSMaths, Elie Cartan, Universtite Henri Poincare (1995,1994).

Research interests include:
- Heat Transfer in Manufacturing Processes (turning, injection...)
- Radiative Transfer in Semi-Transparent Media
- Inverse Problems, Parameters Estimation
- Thermoelectricity : modelling and simulations

Teaching :
- Undergraduate and graduate levels, Engineering schools
- Heat transfer, thermodynamics,numerical methods, mathematics

Member of the Editorial Board of the journal CESES

Plenary Lecture 5
Application of Green Energy Technologies in Developing Countries

Associate Professor Ugur Atikol
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Abstract: Statistics and projections show that not only the rate of energy consumption, but also the carbon emissions of developing countries are rising very fast. The energy efficiency technologies that are available in the industrialized countries may not always be feasible for transfer to developing countries. Readily available economic and social indicators, supported by more detailed end-use research, can be used to determine which technologies are suitable for a given developing country. Case studies performed in Northern Cyprus and Turkey show that in Northern Cyprus, transfer of these technologies would be more successful in the residential and commercial sectors, whereas in Turkey, they would be more feasible for the industrial sector.

Green energy is a term used to describe sources of energy that are considered to be environmentally friendly and non-polluting, such as geothermal, wind, and solar power. The technologies associated with green energy need to be introduced in energy systems in order to achieve environmental sustainability. However, these technologies are usually expensive and government subsidies are needed for their implementation. In developing countries inefficiencies within the energy infrastructure, lack of awareness, planning and institutional formation constitute another dimension to the difficulties of implementation of such technologies. For example in Turkey the grid losses in the electric power system is 20% on average. In N. Cyprus 92% of the dwellings have very poor thermal envelopes and heat losses are 50-70% more than that of well insulated buildings. These losses would be even more precious if the use of green energy technologies is put into effect.

The objective of this paper is to introduce an algorithm of applying measures to facilitate the effective application of green energy technologies in developing countries. Firstly it is sought to minimize the wasteful use of energy and then propose mechanisms for the implementation of green energy technologies. It is recognized that energy efficiency applications at the demand-side of the power system are not very effective unless there are improvements in the power infrastructures of these countries. The rate of increase in the power capacity needs can be decreased in two steps: Firstly, the component associated with the old infrastructure is to be dealt with. In this category, the inefficient equipment related to the supply-side of the electrical system needs to be examined and programs for improvements should be devised. By this way, the rate of increase of power capacity should be reduced to the levels of that of GNP. Once the problems related to the infrastructure are minimized, the application of demand-side measures can be expected to reverse the order of the rising trends of power capacity and GNP. Consequently, The application of green energy technologies (such as solar and wind energy systems) is expected to create more impact and would be more meaningful.

Brief Biography of the Speaker: Ugur Atikol is associate professor of Thermodynamics, Energy Management and Building Services at the Eastern Mediterranean University of Gazimagusa, N. Cyprus, where he has also the responsibility of directing the Energy Research Centre. He is a Certified Energy Auditor and has 20 years of experience in HVAC engineering. He took part as a resource efficiency expert in the USAID sponsored Resource Efficiency Achievement Project (REAP) for N. Cyprus between 2005 and 2007. His main research interests are Energy Efficiency, Energy Management and Solar Energy. In these fields, he authored or co-authored over 20 scientific papers published in reviewed journals or presented at international conferences. He wrote a chapter titled “Energy Efficiency: Developing Countries” in the Encyclopedia of Energy Engineering and Technology edited by Taylor & Francis. He was one of the co-founders of the Cyprus Chapter of Association of Energy Engineers (AEE) of which he was elected as the first president in 2006. One year later he took part in the foundation of the Energy Professionals Association (EPA) in northern Cyprus. He reviewed manuscripts in “Energy-the International Journal” and “Journal Scientia Agricola”.

Plenary Lecture 6

Non-Stationary Nucleate Boiling as a Law of Nature and a Basis for Designing of IQ Technologies

Dr. Nikolai Kobasko
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Intensive Technologies Ltd, Kiev, Ukraine
E-mails: nikobasko@yahoo.com

Abstract: The non – stationary nucleate boiling or self – regulated thermal process exists independently on will of people [1]. It can be observed during meteorites falling into rivers, lakes, seas and oceans. It is also observed on other planets where liquid is on their surface. The regularities of self-regulated thermal process are widely used in the practice when quenching of steel parts or cooling of forgings. In the plenary lecture the duration of non – stationary nucleate boiling will be discussed from the point of view of its practical use. It has been established that duration of non – stationary boiling is directly proportional to square of thickness of a body and inverse proportional to thermal diffusivity of a material, depends on configuration of a body, liquid properties and its velocity. The non – stationary nucleate boiling (self –regulated thermal process) is followed by amazing regularities:
-The surface temperature during nucleate boiling is maintained at the level of boiling (saturation) point.
-During this period an average effective heat transfer coefficients, generalized Biot numbers and Kondratjev numbers can be found. They significantly simplify cooling rate calculation of steel parts at their core. With size changing of a body and thermal properties of a material, the average generalized Biot number and Kondratjev number remain the same, i.e. have the same value.
-One can adjust surface temperature of steel part as prescribed by means of adjusting pressure even in condition when real Biot number Bi > . The last regularity allows governing the phase transformation during quenching.
Using established regularities, the new intensive quenching (IQ) technologies were developed: IQ-1; IQ-2: IQ-3. Additionally, during applying these new methods of quenching into the practice, very important two findings were discovered: the steel superstrengthening phenomenon [2, 3] and optimal quenched layer [4] which provides maximal residual compressive stresses at the surface of steel parts. Both factors increase service life of steel parts. Instead of oils plain water is used as a quenchant, no environmental problems appear here.

Brief Biography of the Speaker: Dr. Nikolai Kobasko received his PhD from the National Academy of Sciences of Ukraine in 1969. He is a leading expert on quenching and heat transfer during the hardening of steels. He is the author and co-author of more than 250 scientific and technical papers, several books and brochures, and more than 30 patents and certificates. In 2004, Dr. Nikolai Kobasko received the Da Vinci Diamond Award and Certificate in recognition of an outstanding contribution to thermal science. Dr. Nikolai Kobasko is Co-Editor of the WSEAS TRANSACTIONS on HEAT and MASS TRANSFER and is a member of Editorial Board for International Journal of Mechanics (NAUN) and Journal of ASTM International (JAI). He was the Head of the laboratory of the Thermal Physics Institute of the National Academy of Sciences of Ukraine. He is co-founder of two consulting companies: IQ Technologies Inc. Akron, USA (1999) and Intensive Technologies Ltd, Kiev, Ukraine (2000). The aim of both companies is material savings, ecological problems solving and increaing service life of steel parts.
At present he is the Director of Technology and R&D of IQ Technologies Inc., Akron, USA and also President of the Intensive Technologies Ltd., Kiev, Ukraine. More information is provided in http://www.intensivequench.com and http://www.itl.kiev.ua.

Plenary Lecture 7

Explicit General Ray Method for Solution of Coefficient Inverse Problems for Heat Transfer

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Abstract: The problem of the recognition of the multi component structure in heat transfer investigations is considered. It can be posed as the inverse coefficient problem for PDE with variable coefficient. The new explicit General Ray (GR) method for solution of this type of problems is proposed. In the case of noised input data the regularization with Recursive Spline Smoothing is used. Proposed method is justified theoretically, realized by fast and stable algorithms and MATLAB software, which quality is demonstrated by numerical experiments.

Brief Biography of the Speaker: Grebennikov Alexander Ivanovich was born at 17 of April 1950 in Gorky city, Russia. The student of the Faculty of Calculating Mathematics and Cybernetics (FCMC) of Gorky State University at 1967-1972. Postgraduate student of the FCMC of Moscow State University (MSU) at 1972-1975. Was graduated PhD in 1976. Scientific interests: splines; data processing; inverse and ill-posed problems; fast algorithms in numerical analysis and applications. Publications: more than 120 articles in journals and proceedings, 2 texts of lectures, 5 monographs. Work: assistant professor of the FCMC MSU at 1976-1989; senior staff scientist of Scientific Research Computing Center (SRCC) MSU at 1989-1994; Head of Laboratory in SRCC MSU at 1995-1999; full professor of the Faculty of Physic and Mathematic Sciences of Autonomous University of Puebla, Mexico from 1999 to present day. Adres: Av. San Claudio y Rio verde, Ciudad Universitaria, FCFM, CP 72570, Puebla, tel./fax (52 222) 8920073, e-mail: agrebe@fcfm.buap.mx

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