



**NORTH ATLANTIC UNIVERSITY UNION**

**Editors**

Frederic Kuznik

Mohamed Roushdy

Abdel-Badeeh M. Salem

**Advances in Modern  
Mechanical Engineering**

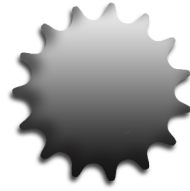
**Proceedings of the 4<sup>th</sup> International Conference on  
Fluid Mechanics and Heat & Mass Transfer (FLUIDSHEAT '13)**

**Dubrovnik, Croatia, June 25-27, 2013**

**Scientific Sponsors**







# **ADVANCES in MODERN MECHANICAL ENGINEERING**

**Proceedings of the 4th International Conference on Fluid Mechanics  
and Heat & Mass Transfer (FLUIDSHEAT '13)**

**Dubrovnik, Croatia  
June 25-27, 2013**

## **Scientific Sponsors:**



**University of  
Dubrovnik**



**Ain Shams  
University**



**University of  
Zagreb**



**Sarajevo School  
of Science and  
Technology**

# **ADVANCES in MODERN MECHANICAL ENGINEERING**

**Proceedings of the 4th International Conference on Fluid Mechanics  
and Heat & Mass Transfer (FLUIDSHEAT '13)**

**Dubrovnik, Croatia  
June 25-27, 2013**

Published by WSEAS Press  
[www.wseas.org](http://www.wseas.org)

**Copyright © 2013, by WSEAS Press**

All the copyright of the present book belongs to the World Scientific and Engineering Academy and Society Press. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the Editor of World Scientific and Engineering Academy and Society Press.

All papers of the present volume were peer reviewed by no less than two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.  
See also: <http://www.worldses.org/review/index.html>

ISSN: 2227-4596  
ISBN: 978-960-474-307-0

# **ADVANCES in MODERN MECHANICAL ENGINEERING**

**Proceedings of the 4th International Conference on Fluid Mechanics  
and Heat & Mass Transfer (FLUIDSHEAT '13)**

**Dubrovnik, Croatia  
June 25-27, 2013**



**Editors:**

Prof. Frederic Kuznik, National Institute of Applied Sciences of Lyon, France

Prof. Mohamed Roushdy, Ain Shams University, Egypt

Prof. Abdel-Badeeh M. Salem, Ain Shams University, Egypt

**Reviewers:**

Sorin Gherghinescu

Heimo Walter

Krisztina Uzunianu

Muhammad Musaddique Ali Rafique

Mahdi Falsafioon

Calbureanu Popescu Madalina Xenia

Konstantin Volkov

Mihaela Dudita

Hamed Ziaepoor

Vasile Cojocaru

George D. Verros

M. M. Noor

Roger R. Riehl

Alina Adriana Minea

Damelys Zabala

Oguz Arslan

Isaac Yeboah

Guoxiang Liu

Gherghinescu Sorin

Rosli Abu Bakar

Elena Scutelnicu

Petr Mastny

Valeriy Perminov

Mohammad Reza Shaeri

Ioana Diaconescu

Cristian Patrascioiu

Asish Mitra

Najib Altawell

Dan Victor Cavaropol



# Table of Contents

<b><u>Plenary Lecture 1: Intense Hardening of Optimal Hardenability Steels Saves Alloy Elements, Energy, Improves Service Life of Machine Components and Makes Environment Cleaner</u></b>	9
<i>Nikolai Kobasko</i>	
<b><u>Plenary Lecture 2: Mathematical Modeling Based on Experimental Data for the Internal Combustion Engines</u></b>	10
<i>Krisztina Uzuneanu</i>	
<b><u>Transport Phenomena in Surface Alloying of Metals Irradiated By High Energy Laser Beam</u></b>	11
<i>Kiran Bhat, Pradip Majumdar</i>	
<b><u>Fatigues Tests for Aluminum Probes Joints</u></b>	25
<i>Nicolae Sandu, Nicusor Laurentiu Zaharia</i>	
<b><u>Diffusion in the Fermentation Immobilized Bed</u></b>	29
<i>S. A. Žerajić</i>	
<b><u>Chemical Reaction Rate and Diffusion Rate</u></b>	35
<i>M. Stevanovic-Huffman, J. Savkovic-Stevanovic</i>	
<b><u>Flow in Porous Media</u></b>	41
<i>Jelena Djurović</i>	
<b><u>Numerical Investigations of Spray Droplet Parameters on Combustion and Emission Characteristics in a Direct Injection Diesel Engine using 3-Zone Extended Coherent Flame Model</u></b>	47
<i>R. Manimaran, R. Thundil Karuppa Raj</i>	
<b><u>An Overview on IQ – 2 Processes and Possibility of Use Vacuum Furnaces for Quenching Steels under Pressure</u></b>	68
<i>N. I. Kobasko</i>	
<b><u>Comparison of Weathering Behaviors of Heat-Treated Jack Pine during Different Artificial Weathering Conditions</u></b>	74
<i>D. Kocaefe, X. Huang, Y. Kocaefe</i>	
<b><u>Intense Hardening of Optimal Hardenability Steels Saves Alloy Elements, Energy, Improves Service Life of Machine Components and Makes Environment Cleaner</u></b>	80
<i>N. I. Kobasko</i>	
<b><u>Cooling Intensity of Micro- and Nanofluids to Be Used as a Quenchant for Hardening of Steel Parts and Tools</u></b>	88
<i>A. A. Dolinsky, A. A. Moskalenko, T. L. Grabova, N. I. Kobasko, P. N. Logvinenko</i>	
<b><u>Interactions between Falling Spheres in the Wormlike Micellar Solutions</u></b>	94
<i>Monika Kostrzewa, Lubomira Broniarz-Press, Andreas Wierschem, Antonio Delgado</i>	



<b><u>Thermal Properties of Selected Sandstones</u></b>	100
<i>Dana Koňáková, Eva Vejmelková, Robert Černý</i>	
<b><u>Electrorheological Properties of Polypyrrole–Silver Composite Particles</u></b>	105
<i>Michal Sedlacik, Subbu Annapandiyar, Tomas Plachy, Vladimir Pavlinek</i>	
<b><u>Effect of Oligomeric Additives on the Cooling Characteristics of Mineral Oils to Improve the Heat Treatment of Alloy Steels</u></b>	111
<i>P. N. Logvynenko, A. A. Moskalenko, N. I. Kobasko, L. N. Protsenko, S. V. Riabov</i>	
<b><u>Experimental and Numerical Heat Transfer Tests in a Square Cavity: First Results</u></b>	117
<i>Giorgia Nardini, Massimo Paroncini, Raffaella Vitali</i>	
<b><u>Thermal Properties of Plaster with a Content of a Finely Ground Brick</u></b>	123
<i>Monika Čácharová, Eva Vejmelková, Martin Keppert, Robert Černý</i>	
<b><u>Projectile Velocity Increase by the Use of Separated Propellant Charge</u></b>	128
<i>Michal Hajn</i>	
<b><u>Sodium and Potassium Titanates Prepared via Microwave-Assisted Molten-Salt Synthesis and Their Use in Electrorheological Fluids</u></b>	134
<i>Tomas Plachy, Zuzana Kozakova, Vladimir Pavlinek, Ivo Kuritka</i>	
<b><u>Annular Jet Instabilities and Stagnation Point. Control of Instabilities by Modification of the Central Obstacle</u></b>	140
<i>B. Patte-Rouland, A. Danlos, E. Rouland</i>	
<b><u>The Effect Of MHD On Laminar Mixed Convection Of Newtonian Fluid Between Vertical Parallel Plates Channel</u></b>	146
<i>R. Alizadeh</i>	
<b><u>Authors Index</u></b>	152

## Plenary Lecture 1

### **Intense Hardening of Optimal Hardenability Steels Saves Alloy Elements, Energy, Improves Service Life of Machine Components and Makes Environment Cleaner**



**Dr. Nikolai Kobasko**

Fellow of ASM International (FASM)

IQ Technologies Inc.

Akron, USA

&

Intensive Technologies Ltd

Kyiv, Ukraine

E-mail: NKobasko@aol.com

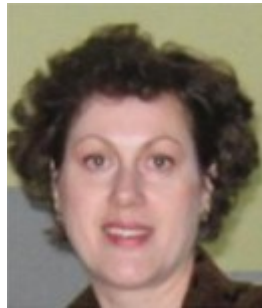
**Abstract:** Manufacturing steels of optimal chemical composition, combined with intensive quenching, is an important step to save essential alloy elements and make the environment cleaner. As a rule, alloy steels are hardened in oils or high concentration polymers to prevent crack formation during quenching. However, slow cooling in oils requires more alloy elements to provide the needed surface hardness and hardenability. To provide an optimal hardened layer and optimal residual stress distribution in machine components after intensive cooling, chemical composition of steel must be properly optimized to create high compressive residual stresses at the surface of steel parts after intensive quenching. Compressive residual stresses and high cooling rate within the martensite range result in additional strengthening of material. Both high compressive residual stresses at the surface of steel parts and additional strengthening (superstrengthening of the material) increase significantly their service life and save expensive alloy elements. After intensive quenching machine components, made of optimal hardenability steels, provide the following benefits: (1) high compressive residual stresses at the surface of steel parts are formed; (2) the super strengthening phenomenon in the surface layers take place; (3) mechanical properties of material at the core of steel parts are significantly improved due to high cooling rate during intensive cooling; (4) crack formation decreases due to compressive residual stresses at the surface and low tensile residual stresses at the core where material is softer. (5) distortion of steel parts decreases because the core does not swell. All of these factors increase service life of machine components, save energy and improve environment condition in heat treating industry.

These important problems are widely discussed in the plenary lecture and appropriate results of computer simulations of technological processes are provided.

**Brief Biography of the Speaker:** Dr. Kobasko received his Ph.D. from the National Academy of Sciences of Ukraine. He is a leading expert on quenching and heat transfer during the hardening of steels. He was the Head of the laboratory of the Thermal Science Institute of the National Academy of Sciences of Ukraine. He is Director of Technology and Research and Development for IQ Technologies, Inc., Akron, Ohio and supervisor of Intensive Technologies, Ltd, Kyiv, Ukraine. The aim of both companies is material savings, ecological problem-solving, and increasing service life of steel parts. He is an ASM International Fellow (FASM). Dr. Kobasko is the author and coauthor of more than 270 scientific and technical papers, several books and more than 30 patents and certificates. He received the Da Vinci Diamond Award and Certificate in recognition of an outstanding contribution to thermal science. Dr. Nikolai Kobasko was Editor-in-Chief and Co-Editor of the WSEAS Transactions on Heat and Mass Transfer; and is currently a member of the Editorial Board for the International ASTM Journal "Materials Performance and Characterization (MPC).

## Plenary Lecture 2

### Mathematical Modeling Based on Experimental Data for the Internal Combustion Engines



**Associate Professor Krisztina Uzuneanu**

Thermal Systems and Environmental Engineering Department

“Dunarea de Jos” University of Galati

Romania

E-mail: kuzuneanu@ugal.ro

**Abstract:** The mathematical model is, in an unpretentious sense, an attempt to describe as really as possible a time-developing process or phenomenon regardless of the type of phenomenon envisaged; modeling aims to analytically highlight some difficult – to-see or even imperceptible issues. At the same time, mathematics makes available to researchers analysis methods and methodologies able to provide a meaningful explanation of both causes and effects of such less known phenomenological aspects.

The functional components of the engine result by adapting some adjustable parameters such as: cooling agent temperature, overcharge pressure, etc. In this paper, the internal combustion engine will be analyzed as an object adjustable according to the adopted parameter.

**Brief Biography of the Speaker:** Dr. Krisztina Uzuneanu graduated Faculty of Mechanical Engineering of University “Dunarea de Jos” of Galati in 1984 and she obtained the title of Doctor Engineer in 1998.

Since 1987 she followed the academic career at “Dunarea de Jos” University of Galati as assistant, lecturer and associate professor. Dr. Uzuneanu is a visiting professor at different universities: Universidade do Minho, Portugal, Universita degli Studi di Genova, Italy, Universita degli Studi di Salerno, Italy, Pannon University Veszprem, Hungary, Erciyes University Kayseri, Turkey and visitor scientist of Universidade do Minho Guimaraes, Portugal where she was awarded with a post-doc NATO grant in 2002 - 2003.

Research fields are connected with applied thermodynamics, alternative fuels for internal combustion engines, modeling the thermal stresses of different parts of internal combustion engines, renewable energy and pollution.

Dr. Uzuneanu published over 100 articles in national and international conferences proceedings and she is author of 3 books.

The research work was done as member of 20 research contracts financed by European Commission and Romanian Ministry of Education and Research and director of 5 research contracts financed by industry.

Dr. K. Uzuneanu is member of Romanian Society of Thermodynamics since 1990 and member of Balkan Environmental Association since 2011.