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Nirendra N. Mustafi · Avinash Kumar Agarwal
Editors

Alternative Fuels and Their Utilization Strategies in Internal Combustion Engines

 Springer

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Preface

Energy demand has been rising remarkably due to increasing population and urbanization. Global economy and society are significantly dependent on energy availability because it touches every facet of human life and activities. Transportation and power generation are two major examples. Without transportation by millions of personalized and mass transport vehicles and availability of 24×7 power, human civilization would not have reached contemporary living standards.

The International Society for Energy, Environment, and Sustainability (ISEES) was founded at Indian Institute of Technology Kanpur (IIT Kanpur), India, in January 2014 with an aim to spread knowledge/awareness and catalyze research activities in the fields of energy, environment, sustainability, and combustion. The society's goal is to contribute to the development of clean, affordable, and secure energy resources and a sustainable environment for the society and to spread knowledge in the above-mentioned areas and create awareness about the environmental challenges, which the world is facing today. The unique way adopted by the society was to break the conventional silos of specializations (engineering, science, environment, agriculture, biotechnology, materials, fuels, etc.) to tackle the problems related to energy, environment, and sustainability in a holistic manner. This is quite evident by the participation of experts from all fields to resolve these issues. The ISEES is involved in various activities such as conducting workshops, seminars, and conferences. in the domains of its interests. The society also recognizes the outstanding works done by the young scientists and engineers for their contributions in these fields by conferring them awards under various categories.

Third International Conference on “Sustainable Energy and Environmental Challenges” (III-SEEC) was organized under the auspices of ISEES from December 18–21, 2018, at Indian Institute of Technology Roorkee. This conference provided a platform for discussions between eminent scientists and engineers from various countries including India, USA, Norway, Finland, Sweden, Malaysia, Austria, Hong Kong, Bangladesh and Australia. In this conference, eminent speakers from all over the world presented their views related to different aspects of energy, combustion, emissions, and alternative energy resource for sustainable development and cleaner environment. The conference presented five high-voltage plenary talks

from globally renowned experts on topical themes, namely “The Evolution of Laser Ignition Over more than Four Decades” by Prof. Ernst Wintner, Technical University of Vienna, Austria; “Transition to Low Carbon Energy Mix for India”, Dr. Bharat Bhargava, ONGC Energy Center; “Energy Future of India”, By Dr. Vijay Kumar Saraswat, Honorable Member (S&T) NITI Aayog, Government of India; “Air Quality Monitoring and Assessment in India” by Dr. Gurfan Beig, Safar and “Managing Large Technical Institutions and Assessment Criterion for Talent Recruitment and Retention” by Prof. Ajit Chaturvedi, Director, IIT Roorkee.

The conference included 24 technical sessions on topics related to energy and environmental sustainability including five plenary talks, 27 keynote talks, and 15 invited talks from prominent scientists, in addition to 84 contributed talks and 50 poster presentations by students and researchers. The technical sessions in the conference included advances in IC engines, solar energy, environmental biotechnology, combustion, environmental sustainability, coal and biomass combustion/gasification, air and water pollution, biomass to fuels/chemicals, combustion/gas turbines/fluid flow/sprays, energy and environmental sustainability, atomization and sprays, sustainable transportation and environmental issues, new concepts in energy conservation, waste to wealth. One of the highlights of the conference was the Rapid Fire Poster Sessions in (i) engine/fuels/emissions, (ii) renewable and sustainable energy, and (iii) biotechnology, where 50 students participated with great enthusiasm and won many prizes in a fiercely competitive environment. Two hundred plus participants and speakers attended this four days conference, which also hosted Dr. Vijay Kumar Saraswat, Honorable Member (S&T) NITI Aayog, Government of India, as the chief guest for the book release ceremony, where 14 ISEES books published by Springer, Singapore, under a special dedicated series “Energy, environment and sustainability” were released. This was the second time in a row that such significant and high-quality outcome has been achieved by any society in India. The conference concluded with a panel discussion on “Challenges, Opportunities and Directions for National Energy Security,” where the panelists were Prof. Ernst Wintner, Technical University of Vienna; Prof. Vinod Garg, Central University of Punjab, Bhatinda; Prof. Avinash Kumar Agarwal, IIT Kanpur; and Dr. Michael Sauer, Boku University for Natural resources, Austria. The panel discussion was moderated by Prof. Ashok Pandey, Chairman, ISEES. This conference laid out the roadmap for technology development, opportunities and challenges in energy, environment and sustainability domain. All these topics are very relevant for the country and the world in the present context. We acknowledge the support received from various funding agencies and organizations for the successful conduct of the Third ISEES Conference III-SEEC, where these books germinated. We would, therefore, like to acknowledge NIT Srinagar, Uttarakhand (TEQIP) (Special thanks to Prof. S. Soni, Director, NIT, UK), SERB, Government of India (Special thanks to Dr. Rajeev Sharma, Secretary); UP Bioenergy Development Board, Lucknow (Special thanks to Sh. P. S. Ojha), CSIR, and our publishing partner Springer (Special thanks to Swati Meherishi).

The editors would like to express their sincere gratitude to large number of authors from all over the world for submitting their high-quality work in a timely manner and revising it appropriately at a short notice. We would like to express

our special thanks to Dr. Atul Dhar, Dr. Pravesh Chandra Shukla, Dr. Nikhil Sharma, Prof. V. S. Moholkar, Dr. Vikram Kumar, Dr. Dev Prakash Satsangi, and Prof. V. Ganesan, who reviewed various chapters of this monograph and provided their valuable suggestions to improve the manuscripts.

Currently, IC engines are facing many challenges related to fuel supply, energy efficiency, and emissions, which require serious research efforts. This monograph is based on the production and utilization aspects of different liquid and gaseous alternative fuels. In the last few years, methanol and DME have gained significant attention of energy sector because these fuels can be easily utilized in all kinds of engines with very less modifications. Few sections related to alcohols especially methanol are an important aspect of this book. We hope that the book would be of great interest to the professionals, postgraduate students involved in fuels, IC engines, engine instrumentation, and environmental research.

Kanpur, India
Varanasi, India
Rajshahi, Bangladesh
Kanpur, India

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About the Editors



Dr. Akhilendra Pratap Singh is working at IIT Kanpur. He received his Masters and PhD in Mechanical Engineering from Indian Institute of Technology Kanpur, India in 2010 and 2016, respectively. His areas of research include advanced low-temperature combustion; optical diagnostics with special reference to engine endoscopy and PIV; combustion diagnostics; engine emissions measurement; particulate characterization and their control; and alternative fuels. He has edited seven books and authored 21 chapters, 40 research articles in international journals and conferences. He has been awarded with “ISEES Best Ph.D. Thesis Award (2017),” “SERB Indo-US Postdoctoral Fellowship,” (2017) and “IEI Young Engineer Award” (2017). He is a member of numerous professional societies, including SAE, ASME, and ISEES.



Prof. Yogesh C. Sharma is a full Professor in Department of Chemistry, Indian Institute of Technology (BHU) Varanasi, India. He is Fellow of the Royal Society of Chemistry (FRSC), UK, and a Fellow (Elected) of the Biotech. Research Society of India (FBRIS). His areas of interest include adsorption and diffusion, water remediation, renewable energy, biodiesel production, and synthesis of heterogeneous catalysts for biodiesel production. He authored four books and published more than 150 research papers in reputed international journals. He is a highly cited research author and has ~8000 citations with h-index of 41.



Dr. Nirendra N. Mustafi received his PhD on particulate emissions from a dual fuel engine operated on alternative gaseous fuels (NG and biogas) from The University of Auckland, New Zealand in 2008. Then, he joined back to the department of mechanical engineering at Rajshahi University of Engineering & Technology (RUET), Bangladesh. He was appointed Professor at RUET in 2013, where he taught different courses of mechanical engineering such as heat transfer, thermodynamics and applied thermodynamics, internal combustion engines, automobile engineering, and renewable energy. He also served as the Head of mechanical engineering department, Dean of faculty of mechanical engineering, and Director of Institute of Energy and Environmental studies at RUET. His research experiences and interests lie on engine particulate matter emissions measurement and characterization, dual fuel engines, alternative fuels for IC engines, simulation analysis of SI engine performance and emissions, sustainable and renewable energy engineering energy conversions, and waste-to-energy. Currently, he is staying at Indian Institute of Technology, Kanpur, India, as a visiting Fellow in mechanical engineering. He has authored and co-authored more than 30 papers in journals and conferences.



Prof. Avinash Kumar Agarwal joined IIT Kanpur in 2001. He worked at the Engine Research Center, UW@Madison, the USA, as a PostDoctoral Fellow (1999 – 2001). His interests are IC engines, combustion, alternate and conventional fuels, lubricating oil tribology, optical diagnostics, laser ignition, HCCI, emissions and particulate control, and large bore engines. He has published 270+ peer-reviewed international journal and conference papers, 35 edited books, 63 books chapters and has 7850+ Scopus and 11900+ Google Scholar Citations. He is an associate editor of ASME Journal of Energy Resources Technology. He has edited “Handbook of Combustion” (five Volumes; 3168 pages), published by Wiley VCH, Germany. He is a Fellow of SAE (2012), Fellow of ASME (2013), Fellow of NASI (2018), Fellow of Royal Society of Chemistry (2018), Fellow of ISEES (2015), and a Fellow of INAE (2015). He is a recipient of several prestigious awards such as Clarivate Analytics India Citation Award-2017 in Engineering and Technology; NASI-Reliance Industries Platinum Jubilee Award-2012; INAE Silver Jubilee Young Engineer Award-2012; Dr. C. V. Raman Young Teachers Award: 2011; SAE Ralph R. Teetor Educational Award -2008; INSA Young Scientist Award-2007; UICT Young Scientist Award-2007; INAE Young Engineer Award-2005. He received Prestigious Shanti Swarup Bhatnagar Award-2016 in Engineering Sciences.

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