

Energy, Environment, and Sustainability

Series Editors: Avinash Kumar Agarwal · Ashok Pandey

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# Engine Exhaust Particulates



 Springer

# **Energy, Environment, and Sustainability**

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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 the energy availability because it touches every facet of human life and its activities. Transportation and power generation are two major examples. Without the transportation by millions of personalized and mass transport vehicles and availability of  $24 \times 7$  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 the aim of spreading knowledge/awareness and catalysing 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. ISEES is involved in various activities such as conducting workshops, seminars and conferences in the domains of its interest. 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.

The second international conference on “Sustainable Energy and Environmental Challenges” (SEEC-2018) was organized under the auspices of ISEES from 31 December 2017 to 3 January 2018 at J N Tata Auditorium, Indian Institute of Science Bangalore. This conference provided a platform for discussions between eminent scientists and engineers from various countries including India, USA, South Korea, Norway, Finland, Malaysia, Austria, Saudi Arabia 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 resources for sustainable development and a cleaner environment. The conference presented five high-voltage plenary talks from globally renowned experts on topical themes, namely “Is It Really the End of Combustion Engines and Petroleum?” by Prof. Gautam Kalghatgi, Saudi Aramco; “Energy Sustainability in India: Challenges and Opportunities” by Prof. Baldev Raj, NIAS Bangalore; “Methanol Economy: An Option for Sustainable Energy and Environmental Challenges” by Dr. Vijay Kumar Saraswat, Hon. Member (S&T), NITI Aayog, Government of India; “Supercritical Carbon Dioxide Brayton Cycle for Power Generation” by Prof. Pradip Dutta, IISc Bangalore; and “Role of Nuclear Fusion for Environmental Sustainability of Energy in Future” by Prof. J. S. Rao, Altair Engineering.

The conference included 27 technical sessions on topics related to energy and environmental sustainability including 5 plenary talks, 40 keynote talks and 18 invited talks from prominent scientists, in addition to 142 contributed talks, and 74 poster presentations by students and researchers. The technical sessions in the conference included Advances in IC Engines: SI Engines, Solar Energy: Storage, Fundamentals of Combustion, Environmental Protection and Sustainability, Environmental Biotechnology, Coal and Biomass Combustion/Gasification, Air Pollution and Control, Biomass to Fuels/Chemicals: Clean Fuels, Advances in IC Engines: CI Engines, Solar Energy: Performance, Biomass to Fuels/Chemicals: Production, Advances in IC Engines: Fuels, Energy Sustainability, Environmental Biotechnology, Atomization and Sprays, Combustion/Gas Turbines/Fluid Flow/Sprays, Biomass to Fuels/Chemicals, Advances in IC Engines: New Concepts, Energy Sustainability, Waste to Wealth, Conventional and Alternate Fuels, Solar Energy, Wastewater Remediation and Air Pollution. One of the highlights of the conference was the rapid-fire poster sessions in (i) Energy Engineering, (ii) Environment and Sustainability and (iii) Biotechnology, where more than 75 students participated with great enthusiasm and won many prizes in a fiercely competitive environment. More than 200 participants and speakers attended this four-day conference, which also hosted Dr. Vijay Kumar Saraswat, Hon. Member (S&T), NITI Aayog, Government of India, as the chief guest for the book release ceremony, where 16 ISEES books published by Springer, Singapore, under a special dedicated series “Energy, Environment, and Sustainability” were released. This is the first time 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 & Directions for Future Transportation Systems”, where the panellists were Prof. Gautam Kalghatgi, Saudi Aramco; Dr. Ravi Prashanth, Caterpillar Inc.; Dr. Shankar Venugopal, Mahindra and Mahindra; Dr. Bharat Bhargava, DG, ONGC Energy Center; and Dr. Umamaheshwar, GE Transportation, Bangalore. The panel discussion was moderated by Prof. Ashok Pandey, Chairman, ISEES. This conference laid out the road map for technology development, opportunities and challenges in energy, environment and sustainability domains. 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 second ISEES

conference SEEC-2018, where these books germinated. We would therefore like to acknowledge SERB, Government of India (special thanks to Dr. Rajeev Sharma, Secretary); ONGC Energy Center (special thanks to Dr. Bharat Bhargava); TAFE (special thanks to Sh. Anadrao Patil); Caterpillar (special thanks to Dr. Ravi Prashanth); Progress Rail, TSI, India (special thanks to Dr. Deepak Sharma); Tesscorn, India (special thanks to Sh. Satyanarayana); GAIL, Volvo; and our publishing partner Springer (special thanks to Swati Mehershi).

The editors would like to express their sincere gratitude to a large number of authors from all over the world for submitting their high-quality work in a timely manner and revising it appropriately at short notice. We would like to express our special thanks to Dr. Tapan Kumar Pradhan, Dr. Atul Dhar, Dr. Akhilendra Pratap Singh, Dr. Ludovica Luise, Dr. Joonsik Hwang, Dr. Chetan Patel, Dr. Pravesh Chandra Shukla, Dr. Sundeep Singh, Dr. Rohit Singla, Dr. Rajesh Prasad, Dr. Vikram Kumar, Dr. Dev Prakash Satsangi, Dr. Anoop Kumar Shukla, Mr. Maneesh Kumar, Mr. Neeraj Sharma, Mr. Sunil Kumar, Mr. Yeshudas Jiotode and Mr. Pawan Kumar, who reviewed various chapters of this book and provided very valuable suggestions to the authors to improve their manuscript.

This book covers different aspects of both diesel and gasoline engine particulates. The first half of this book is about diesel engine particulates, and the second half of this book is about gasoline engine particulates. This book provides a comprehensive insight into the motor vehicles' particulates, its formation and composition, location of particulates, measurement, characterization and toxicology. This book also focuses on exhaust after-treatment devices and their comparison. Apart from this, the effect of engine design and operation variables, emission legislation and emission measurement are presented. Engine exhaust after-treatment concepts such as HC adsorbed systems, NO traps and advanced engines like RCCI, GDI and HCCI engines are covered in this book. The text in every chapter is complemented by illustrations and is written by field expert.

Kanpur, India

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# Contents

## Part I General

<b>1</b>	<b>Introduction to Engine Exhaust Particulates . . . . .</b>	<b>3</b>
	Avinash Kumar Agarwal, Atul Dhar, Nikhil Sharma and Pravesh Chandra Shukla	
<b>2</b>	<b>Ultrafine Particles in Concern of Vehicular Exhaust—An Overview . . . . .</b>	<b>7</b>
	Shailendra Kumar Yadav, Rajeev Kumar Mishra and Bhola Ram Gurjar	

## Part II Diesel Particulates

<b>3</b>	<b>Image-Based Flame Temperature and Soot Analysis of Biofuel Spray Combustion . . . . .</b>	<b>41</b>
	Joonsik Hwang, Felix Sebastian Hirner, Choongsik Bae, Chetankumar Patel, Tarun Gupta and Avinash Kumar Agarwal	
<b>4</b>	<b>Characteristics and Fundamentals of Particulates in Diesel Engine . . . . .</b>	<b>55</b>
	Khawar Mohiuddin and Sungwook Park	
<b>5</b>	<b>Numerical Modelling of Soot in Diesel Engines . . . . .</b>	<b>71</b>
	Pavan Prakash Duvvuri, Rajesh Kumar Shrivastava and Sheshadri Sreedhara	
<b>6</b>	<b>Physico-chemical Properties of Diesel Exhaust Particulates . . . . .</b>	<b>121</b>
	Jianbing Gao and Guohong Tian	

## Part III Alternate Fuel Origin Particulates

<b>7</b>	<b>Oxygenated Fuel Additive Option for PM Emission Reduction from Diesel Engines—A Review . . . . .</b>	<b>141</b>
	Parameswaran Vijayashree and V. Ganesan	

<b>8</b>	<b>Technological Evolution of Spark Ignition Direct Injection Engine . . . . .</b>	<b>165</b>
	Nikhil Sharma and Avinash Kumar Agarwal	
<b>9</b>	<b>Alternative Fuels for Particulate Control in CI Engines . . . . .</b>	<b>181</b>
	Sam Shamun, Pablo Garcia and Erik Svensson	
<b>10</b>	<b>Particulate Emissions from Hydrogen Diesel Fuelled CI Engines . . . . .</b>	<b>199</b>
	Priybrat Sharma and Atul Dhar	
 <b>Part IV Gasoline Particulates</b>		
<b>11</b>	<b>Particulate Emission from Gasoline Direct Injection Engine . . . . .</b>	<b>215</b>
	Ludovica Luise	
<b>12</b>	<b>Nanoparticle Emissions in Reactivity-Controlled Compression Ignition Engine . . . . .</b>	<b>239</b>
	Mohit Raj Saxena and Rakesh Kumar Maurya	