

Energy, Environment, and Sustainability

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# Gasoline Compression Ignition Technology

Future Prospects



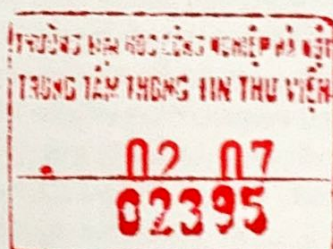
 Springer




Gautam Kalghatgi · Avinash Kumar Agarwal ·  
Harsh Goyal · Moez Ben Houidi  
Editors

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## Preface

Gasoline Compression Ignition (GCI) engines offer the prospect of diesel-like high efficiency while making the control of particulates and NO<sub>x</sub> emissions much easier. In the GCI concept, gasoline-like fuels, which are much more difficult to autoignite compared to diesel fuels, are used with injection strategies that enable partially premixed combustion. However, there is much more time to mix the fuel with oxygen in the cylinder compared to diesel fuel so that premixed combustion becomes much easier and particulate and NO<sub>x</sub> emissions can be reduced substantially. The injection pressures can be lower than in modern diesel engines, using diesel fuel, where very high injection pressures have to be used to promote premixed combustion. Moreover, the focus of the after-treatment system shifts to controlling HC and CO rather than particulates and NO<sub>x</sub>. Hence, a GCI engine can be cheaper than a modern diesel engine while providing a similar high efficiency. In addition, a GCI engine could be run on low octane fuels which offer further benefits by reducing energy and greenhouse gas (GHG) emissions in the refinery during manufacture. The GCI concept has been studied and has been demonstrated in the laboratory but a lot of engineering development is needed to make it applicable in practical engines which can operate over a wide range of speed and load while meeting efficiency and emissions requirements.

This book has eleven chapters addressing various issues important to GCI engines. We hope it will be useful to professionals and students interested in this technology.

The International Society for Energy, Environment and Sustainability (ISEES) was founded at the Indian Institute of Technology Kanpur (IIT Kanpur), India, in January 2014, to spread knowledge/awareness and catalyze research activities in the fields of Energy, Environment, Sustainability, and Combustion. Society's goal is to contribute to the development of clean, affordable, and secure energy resources and a sustainable environment for society and spread knowledge in the areas mentioned above, and create awareness about the environmental challenges the world is facing today. The unique way adopted by ISEES 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, conferences, etc., in the domains of its interests. The society also recognizes the outstanding works of young scientists, professionals, and engineers for their contributions in these fields by conferring them awards under various categories.

Fifth International Conference on "Sustainable Energy and Environmental Challenges" (V-SEEC) was organized under the auspices of ISEES from December 19–21, 2020, in virtual mode due to restrictions on travel because of the ongoing Covid-19 pandemic situation. This conference provided a platform for discussions between eminent scientists and engineers from various countries, including India, Spain, Austria, Bangladesh, Mexico, USA, Malaysia, China, UK, Netherlands, Germany, Israel, and Saudi Arabia. At this conference, eminent international speakers presented their views on energy, combustion, emissions, and alternative energy resources for sustainable development and a cleaner environment. The conference presented two high voltage plenary talks by Dr. V. K. Saraswat, Honorable Member, NITI Ayog, on "Technologies for Energy Security and Sustainability" and Prof. Sandeep Verma, Secretary, SERB, on "New and Equitable R&D Funding Opportunities at SERB."

The conference included nine technical sessions on topics related to energy and environmental sustainability. Each session had 6–7 eminent scientists from all over the world, who shared their opinion and discussed the trends for the future. The technical sessions in the conference included Emerging Contaminants: Monitoring and Degradation Challenges; Advanced Engine Technologies and Alternative Transportation Fuels; Future Fuels for Sustainable Transport; Sustainable Bioprocessing for Biofuel/Non-biofuel Production by Carbon Emission Reduction; Future of Solar Energy; Desalination and Wastewater Treatment by Membrane Technology; Biotechnology in Sustainable Development; Emerging Solutions for Environmental Applications' and Challenges and Opportunities for Electric Vehicle Adoption. 500+ participants and speakers from all over the world attended this three days conference.

The conference concluded with a high voltage panel discussion on "Challenges and Opportunities for Electric Vehicle Adoption," where the panelists were Prof. Gautam Kalghatgi (University of Oxford), Prof. Ashok Jhunjhunwala (IIT Madras), Dr. Kelly Senecal (Convergent Science), Dr. Amir Abdul Manan (Saudi Aramco), and Dr. Sayan Biswas (University of Minnesota, USA). Prof. Avinash K. Agarwal, ISEES, moderated the panel discussion. 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 agencies and organizations for the successful conduct of the Fifth ISEES conference V-SEEC, where these books germinated. We want to acknowledge SERB (Special thanks to Dr. Sandeep Verma, Secretary) and our publishing partner Springer (Special thanks to Ms. Swati Meherishi).

The editors would like to express their sincere gratitude to the authors from all over the world for submitting their high-quality work on time and revising it appropriately at short notice. We would like to express our special gratitude to the reviewers, who

reviewed various chapters of this monograph and provided their valuable suggestions to improve the manuscripts.

Oxford, UK  
Kanpur, India  
Thuwal, Saudi Arabia  
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