Proceedings of ASME 2023 ICE Forward Conference

(ICEF2023)

October 8–11, 2023 Pittsburgh, Pennsylvania

Conference Sponsor Internal Combustion Engine Division

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Two Park Avenue * New York, N.Y. 10016

© 2023, The American Society of Mechanical Engineers, 2 Park Avenue, New York, NY 10016, USA (www.asme.org)

All rights reserved. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of the publisher.

INFORMATION CONTAINED IN THIS WORK HAS BEEN OBTAINED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS FROM SOURCES BELIEVED TO BE RELIABLE. HOWEVER, NEITHER ASME NOR ITS AUTHORS OR EDITORS GUARANTEE THE ACCURACY OR COMPLETENESS OF ANY INFORMATION PUBLISHED IN THIS WORK. NEITHER ASME NOR ITS AUTHORS AND EDITORS SHALL BE RESPONSIBLE FOR ANY ERRORS, OMISSIONS, OR DAMAGES ARISING OUT OF THE USE OF THIS INFORMATION. THE WORK IS PUBLISHED WITH THE UNDERSTANDING THAT ASME AND ITS AUTHORS AND EDITORS ARE SUPPLYING INFORMATION BUT ARE NOT ATTEMPTING TO RENDER ENGINEERING OR OTHER PROFESSIONAL SERVICES. IF SUCH ENGINEERING OR PROFESSIONAL SERVICES ARE REQUIRED, THE ASSISTANCE OF AN APPROPRIATE PROFESSIONAL SHOULD BE SOUGHT.

ASME shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B7.1.3). Statement from the Bylaws.

For authorization to photocopy material for internal or personal use under those circumstances not falling within the fair use provisions of the Copyright Act, contact the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923, tel: 978-750-8400, www.copyright.com.

Requests for special permission or bulk reproduction should be addressed to the ASME Publishing Department, or submitted online at: https://www.asme.org/publications-submissions/journals/information-for-authors/journalguidelines/rights-and-permissions

ISBN: 978-0-7918-8756-1

TABLE OF CONTENTS

| Biotuels and E-Fuels Used in a Multi-Fuel-Engine as Solution for Rapid Reduction of Greenhouse | 1 |
|--|-----|
| Gas Impacts of NRMM Engines | I |
| Effect of Engine Speed and Biogas Composition on Performance of a Small Biogas-Diesel Dual-Fuel Generator | 16 |
| Austin Dahlseide, Shouvik Dev, David Stevenson, Hongsheng Guo | 10 |
| Effect of Gas Composition on the Oxidation of Gas Component Emissions of a Dual-Fuel Diesel-Natural Gas Engine at Low Load Conditions | 28 |
| Efficiency & Emissions Improvement Package for the 7FDL High-Power, Medium-Speed, Locomotive Diesel Engine | 37 |
| Alternative Spark Plug Electrode Materials for Economical, Reliable Engine Operation | 49 |
| Study of NOx Formation at Lean Conditions in a Prechamber-Ignited Two-Stroke Natural Gas Engine | 55 |
| Jacob Nowlin, Mark Patterson, Timothy J. Jacobs | |
| Hot-Surface Pilot Ignition: A Novel Sustainable Aviation Fuel Agnostic Combustion Strategy | 65 |
| Large-Bore Locomotive Engines - Numerical Simulations of Natural Gas/Diesel Dual-Fuel Operation | 74 |
| Samuel J. Kazmouz, Sicong Wu, Adam Klingbeil, Thomas Lavertu, Vijayaselvan Jayakar, Pushkar Sheth, Sameera Wijeyakulasuriya, Muhsin Ameen | / ㅋ |
| Cycle-by-Cycle Modeling of Integral Compressor Engines for Real-Time Emissions Control | 85 |
| The Development and Application of Advanced Sensor Solutions for Gaining New Insights Into Large Engines | 93 |
| Wimmer | |
| The Effects of Intake Throttling With Hot and Cold EGR in a CNG/Diesel Dual Fuel Engine | 102 |
| Mixing-Controlled Compression Ignition With Exhaust Rebreathe on a Heavy-Duty Engine - A CFD Modelling Investigation Comparing Diesel Fuel and Ethanol | 116 |
| Understanding Diesel-Pilot Assisted Methane Combustion in a Compression Ignition Engine | 131 |

| Predicting Diesel Engine Cetane Number and Similarity for Newer Commercial Sustainable | 1.42 |
|--|----------------|
| Aviation Fuels | 143 |
| Investigation of the Laminar Burning Velocity and Exhaust Characteristics of Methane-Ammonia- | |
| Hydrogen Ternary Blends | 153 |
| Md Nayer Nasim, Behlol Nawaz, Shubhra Kanti Das, Joshua Landis, Amr Shaalan, Noah Van Dam, Juan Pablo Trelles, Dimitris Assanis, J. Hunter Mack | |
| Effect of Hydrogen Enrichment on Combustion and Emissions of a Heavy Duty Natural Gas - Diesel Dual Fuel Engine at Low and Medium Load Conditions | 162 |
| Hongsheng Guo, Amin Yousefi, Shouvik Dev, Brian Liko, Simon Lafrance | - |
| The Application of Argon-Oxygen Atmosphere to Investigate the Formation and Evolution of Fuel | |
| Nitrogen Oxides During the Oxidation of Hydrogen-Ammonia Fuel Mixtures Under Representative | 170 |
| Engine In-Cylinder Conditions | , 1 <i>7</i> 2 |
| Investigation of the Effect of Ammonia Addition on the Two-Stage Ignition Process of Dimethyl | |
| Ether Based on Chemical Kinetic Analysis | 184 |
| Juan Ou, Ruomiao Yang, Yuchao Yan, Zhentao Liu, Jinlong Liu | |
| Numerical Investigation of the Effect of Ammonia Addition on the Performance of a Stoichiometric Operated Natural Gas Spark Ignition Engine | 210 |
| Ruomiao Yang, Yuchao Yan, Juan Ou, Zhentao Liu, Jinlong Liu | ∠10 |
| Combustion Research in Wide DCN Range Synthetic Aviation Fuels in a High Compression Ratio | |
| Engine | 221 |
| Valentin Soloiu, Amanda Weaver, James Willis, Aidan Rowell, Nicholas Dillon | |
| Propyl Oxymethylene Ether-Ignited Natural Gas Dual Fuel Low Temperature Combustion - a Low Carbon Pathway for High Efficiencies and Low Emissions | 238 |
| Abhinandhan Narayanan, Stephen Mundy, Hariraja Thothadri, Justin Gray, Yamini Baskara | 256 |
| Babu, Stephen Lucas, Bret Windom, Kalyan Kumar Srinivasan, Sundar Rajan Krishnan | |
| Performance and Emissions of an SI Engine Fueled With DME-Propane Blends | 253 |
| Hafîz Ahmad Hassan, King Ankobea-Ansah, David Wickman, William De Ojeda, Carrie Hall | |
| Evaluation of the Performance and Exhaust Emissions of a 4 Cylinder CI Engine Operating With | 262 |
| Dimethyl Ether (DME) and Propane Blends | 263 |
| King L. Ankobea-Ansah, Hafiz Ahmad Hassan, David D. Wickman, William De Ojeda, Carrie M. Hall | |
| Experimental Investigation of a Butylcyclohexane / Propylcyclohexane Based Naphthenic Bio- | |
| Blendstock Surrogate Fuel for Use in a Compression Ignition Engine | 276 |
| Rodrigo Ristow Hadlich, Zhongnan Ran, Ruinan Yang, Ofei Mante, David Dayton, Dimitris Assanis | |
| Combustion Performance and Emissions Characterization of Methane-Hydrogen Blends (Up to | |
| 50% by Vol.) in a Spark-Ignited CFR Engine | 286 |
| Effects of Hydrogen on Combustion in Ammonia-Diesel Dual Fuel Engine and Demonstration of | |
| Autothermal Catalyst to Reform Ammonia Into Hydrogen | 296 |
| Yoichi Niki, Koichi Hirata, Kazuyuki Kobayashi, Yuki Shimizu | |

| Spark Plasma Stretching and Flame Propagation via High Frequency Pulsed Current Management | 305 |
|--|-----|
| Data-Driven Detection and Prediction of Spray Collapse Characteristics for Multi-Component Fuel Mixtures | 313 |
| Fengnian Zhao, Ziming Zhou, Wensong Liu, David L. S. Hung | 515 |
| Investigation of Practical Delivery of Radical Species for Main Chamber Seeding Using a Radical-Generating Pre-Combustion Chamber | 323 |
| Ignition Systems for SI-ICE Fueled by Alternative and Renewable Fuels | 330 |
| Cellular Instabilities in Spherically Expanding Hydrogen-Oxygen-Carbon Dioxide Flames | 340 |
| Experimental Study and Analysis of Ultra-Low Temperature Fuel Spray With a Heavy-Duty Injector Under Vaporizing Conditions | 350 |
| Experimental Study of the Impact of Ethanol Content on Partially Premixed Combustion With Ethanol-Gasoline Blends | 363 |
| Empirical Investigation of Reactivity-Controlled Compression Ignition Engine Fuelled by Ethanol and DME at Low Engine Load | 375 |
| Optimization of the Combustion Chamber Design of a Natural Gas-Diesel Dual Fuel Engine Running at Low Load | 386 |
| Experimental Demonstration of a High-Power Density Electric Generator | 398 |
| 48V High Power Hybrid Architecture for MHD Off-Road Applications | 407 |
| Potential of H2-Assisted Light-Off of Oxidation Catalyst in H2-Diesel Dual-Fuel Engines | 419 |
| Multi-Fidelity Neural Network Regression for Efficient Training of Energy-Assisted Diesel Engine Control System | 432 |
| Validation of a 1D Modeling Technique to Predict Performance of Turbocharged Engines Including a Double Scroll Turbine With Connection Valve | 453 |
| Quantitative Validation of a Computational Fluid Dynamics Methodology for Gasoline Sprays Under Cold Start Conditions Dimitris Assanis, Joonsik Hwang, Gaurav Guleria, Dario Lopez-Pintor, Scott W. Wagnon, Russel Whitesides | 461 |

| Computational Investigation on the Effects of Pre-Chamber Volume in an Active Narrow-Throat | |
|---|-----|
| Pre-Chamber Engine | 471 |
| Turner, Hong G. Im | |
| A Computational Analysis of Fuel Evaporation and Mixing in a Methanol Opposed-Piston Engine With a Passive Pre-Chamber | 482 |
| Rafael Menaca, Mickael Silva, Kevin Moreno-Cabezas, Giovanni Vorraro, James W. G. Turner, Hong G. Im | |
| The Use of PD Patterns to Evaluate the Wear-Resistance and Manufacturing Quality to Estimate Expected Lifetime of Ignition Coils | 492 |
| Design of a Novel Impulse Turbine for a Supercharged Single Cylinder Diesel Engine - A Simulation Approach | 500 |
| High-Performance Alloys for Conventional ICE and Hydrogen ICE Applications | 513 |
| Hydrogen Internal Combustion Engine Component Investigation and Development for Heavy Duty Truck Applications | 522 |
| Jason Bieneman, Fabio Araujo, Nikhil Nachappa Iychodianda Kushalappa | |
| Novel Approaches to Improve the Performance of a Single Cylinder Engine by Turbocharging, Supercharging and Turbo-Compounding - A Comparative Study | 533 |

Author Index