

Jihad Badra is the Engine Combustion Team leader in the Transport Technologies Research and Development Division at Saudi Aramco. He joined Saudi Aramco in 2014 after working as a Postdoctoral Researcher in the Clean Combustion Research Center at King Abdullah University of Science and Technology (KAUST). Jihad's research interest is in developing and optimizing internal combustion engine technologies with decreased net environmental impact. Jihad's current focus is on Artificial Intelligence (AI), fuel formulation for advanced engines and engine modelling using computational fluid dynamics. Jihad has more than 80 peer-reviewed papers.

Jihad received his BSc in Mechanical Engineering from the University of Balamand, Lebanon and MSc and PhD degrees in Combustion Research in Mechanical Engineering at the University of Sydney, Australia.

JIHAD BADRA

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SUMMARY

- Experimental and modeling combustion specialist with more than seven years of experience
- Areas of expertise include managing research projects, combustion, internal combustion engines, fuel formulation, chemical kinetics, CFD modeling, 1D modeling, coding, machine learning, fuel blending, exhaust after-treatment
- Extensive technical publications (60 journal publications with h-index of 18), presentations and public speaking experience
- Flexibility and adaption to work in new areas

EDUCATION

PhD

(PhD March 2008 until March 2012)

University of Sydney, Australia

I worked on micro-combustion applications both experimentally and numerically and the thesis was entitled “Experimental and Numerical Investigations of the Reactivity of Various Hydrocarbons over Platinum”

Masters of Engineering Research

(Major: Masters of Engineering Research, MER)

University of Sydney, Sydney, 2007 to 2008

Final Results: The thesis has been submitted on 31st of March 2008.

My thesis had this topic “Transient Heat Transfer Calculations from Multiple Jets Impinging on a Moving Plate”

Masters of Engineering Studies

(Major: Masters of Engineering Studies, MES)

University of Sydney, Sydney, 2006 to 2007

Final results: Honors degree. The official transcript is available upon request.

My thesis had this topic “Study of Multi-Objective Optimization Software for Industrial and Academic Purposes”

Bachelor of Science

(Major: Mechanical engineering)
University of Balamand, Tripoli, Lebanon.
AVE: 88.6.

EMPLOYMENT HISTORY

January 2020 – Present: Team lead for the Engine Combustion unit, Transport Technologies Division, Research and Development Center, Saudi Aramco, Dhahran, Kingdom of Saudi Arabia. My responsibilities are:

- Supervising 10 direct reports.
- Managing the in-house and collaborative research activities.
- The current research activities under my team are:
 - In-house experimental testing of the GCI engine.
 - CFD modeling of the GCI engine.
 - Experimental testing of the GCI fuel matrix in AVL diesel engine.
 - Collaborative research program with KAUST (FUELCOM).
 - Collaboration with Mazda and AIST on GCI engine research.
 - Collaboration with KAUST on marine engine and fuel research.

January 2014 – December 2020: Laboratory Scientist I, Fuel Technology Division, Research and Development Center, Saudi Aramco, Dhahran, Kingdom of Saudi Arabia. My responsibilities are:

- Managing the FUELCOM research program which is a multi-million dollars project between the Fuel Technology Division and the Clean Combustion Research Center at KAUST.
- Performing engine 3D CFD simulations to assist engine geometry design optimization.
- Performing experiments to understand fuel/fuel interactions to assist in designing fuels for future engines.
- Developing octane number blending rules based on engine experiments.
- Correlating octane numbers with chemical kinetic parameters such as ignition delay times and flame speeds.

August 2012 – January 2014: Post-Doctoral fellow in the kinetics group of the Clean Combustion Research Center at King Abdullah University of Science and Technology (KAUST), Kingdom of Saudi Arabia. My responsibilities were:

- Measuring the reaction rate constants of various fuels with OH using laser diagnostics and shock tubes.
- Developing rate rules using the measured rates. These determined rate rules are now implemented in many newly developed kinetic mechanisms.
- Building a combustor for micro-combustion research.

March 2007 –March 2012: Part time teaching, tutoring/demonstrating, School of Aerospace, Mechanical and Mechatronic Engineering, University of Sydney.

TEACHING

Since March 2007, I have taught many courses at different levels in the school of Aerospace, Mechanical and Mechatronic engineering at the University of Sydney, including:

- AMME2200 and AMME 5200: Thermofluids and Fluid Dynamics
- MECH3261: Fluid Mechanics
- MECH4265 and MECH5265: Combustion and Advanced Combustion
- CIVIL3612: Fluids and Environmental Engineering

I have also demonstrated some practical laboratories experiments such as refrigeration and petrol engine.

SKILLS

Academic skills: excellent knowledge about CFD, combustion, heat transfer, optimization, mechanics of materials.

Languages: C, C++, Matlab.

Software: CONVERGE, GT-Power, Fluent, Gambit, modeFRONTIER, Strand7, Excel, Solid works, Autocad, Chemkin, Canterra, etc.

Operating systems: UNIX, Windows (2000, XP, Vista and 7)

RESEARCH INTERESTS

- Sustainability in the energy sectors
- Engine Research
- Climate change
- Fuel Design
- Experimental Combustion
- Numerical Combustion
- Chemical Kinetics Development

- Catalytic Combustion
- Micro-Combustion Applications
- Renewable Energy
- Life Cycle Analysis
- Carbon Management

AWARDS

- Received the 2015 Harry L. Horning Memorial Award for the SAE paper 2015-01-0757, “A Simple Method to Predict Knock Using Toluene, N-Heptane and Iso-Octane Blends (TPRF) as Gasoline Surrogates”.
- University Postgraduate Award (UPA) from the university of Sydney, March 2008 – March 2012
- An industrial (Fitch Milley Engineering Pty. Ltd) scholarship to complete my research masters (MER) from 2007 to 2008
- Several partial scholarships while undergoing my Bachelor degree from 2002 to 2006
- Listed on the Dean’s Honor List few times during my Bachelor degree

PUBLICATIONS

Selected Peer-Reviewed Journal Papers

I published more than 80 peer-reviewed journal articles. Below is a list of selected ones:

1. **J Badra**, J Sim, Y Pei, Y Viollet, P Pal, C Futterer..., “Combustion System Optimization of a Light-Duty GCI Engine Using CFD and Machine Learning”, SAE Technical Paper 2020-01-1313, 2020.
2. **J Badra**, F Khaled, M Tang, Y Pei, J Kodavasal, P Pal..., “Engine Combustion System Optimization Using CFD and Machine Learning: A Methodological Approach”, Journal of Energy Resources Technology, 2020 (in press).
3. **Jihad Badra**, Abdullah S. AlRamadan, S. Mani Sarathy, “Optimization of the octane response of gasoline/ethanol blends”, *Applied Energy*, Vol. 203, 2017, 778-93.
4. Libing Wang, **Jihad A Badra**, William L Roberts, Tiegang Fang, “Characteristics of spray from a GDI fuel injector for naphtha and surrogate fuels”, *Fuel*, Vol. 190, 2017, 113-128.
5. Eshan Singh, **Jihad Badra**, Marco Mehl, S Mani Sarathy, “Chemical Kinetic Insights into the Octane Number and Octane Sensitivity of Gasoline Surrogate Mixtures”, *Energy and Fuels*, DOI: 10.1021/acs.energyfuels.6b02659, 2017.
6. **Jihad Badra**, Yoann Viollet, Ahmed Elwardany, Hong G Im, Junseok Chang, “Physical and chemical effects of low octane gasoline fuels on compression ignition combustion”, *Applied Energy*, Vol. 183, 2016, 1197-1208.

7. **Jihad Badra**, Jaeheon Sim, Ahmed Elwardany, Mohammed Jaasim, Yoann Viollet, Junseok Chang, Amer Amer, Hong Im. “Numerical Simulations of Hollow Cone Injection and Gasoline Compression Ignition Combustion With Naphtha Fuels”, *Journal of energy Resources Technology*, Vol. 138, 2016, 052202-052202-11.
8. G. Kalghatgi, H. Babiker, **J. Badra**, “A Simple Method to Predict Knock Using Toluene, N-Heptane and Iso-Octane Blends (TPRF) as Gasoline Surrogates”, *SAE International Journal of Engines*, 2015-01-0757, 2015.
9. **J. Badra**; A. Elwardany; A. Farooq, “Shock Tube Measurements of the Rate Constants for Seven Large Alkanes + OH”, *Proc. Combust. Inst.*, 35, 2014, 189-196.
10. **J. A. Badra**, A. R. Masri, C. Zhou, B. S. Haynes, “An experimental and numerical study of surface chemical interactions in the combustion of propylene over platinum”, *Combustion and Flame*, 2013, 473-485.