

Exponent®
Engineering & Scientific Consulting

David Hietala, Ph.D., P.E., CFEI

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Professional Profile

Dr. Hietala employs chemical engineering principles to help solve complex problems involving reaction engineering and heat- and mass-transfer for a variety of industries and applications. His core areas of expertise include energy, sustainability, industrial chemistry, chemical process safety, and the investigation of fires, explosions, chemical releases, and equipment failures.

Dr. Hietala consults on numerous industries within the energy sector, including renewables, biomass processing, waste-to-energy, and automotive catalysis applications. He applies his knowledge and experience to the origin and cause investigation and to the prevention of fires, explosions, chemical releases, and equipment failures at the residential, commercial, and industrial scales. Dr. Hietala's expertise includes a variety of industrial chemistry topics, such as fluoropolymer and refrigerant manufacturing, air fresheners, industrial cleaning products (e.g., caustic), and heat transfer fluids. He also consults on occupational and process safety-related cases involving chemical exposure, slip-and-fall, and OSHA Process Safety Management (PSM).

Prior to joining Exponent, Dr. Hietala completed his Ph.D. in Chemical Engineering at the University of Michigan, Ann Arbor. His doctoral thesis focused on experimental characterization and model development for biocrude oil production from microalgae using high-temperature, high-pressure water. At the University of Michigan, Dr. Hietala collaborated with ecologists, geneticists, and microfluidics engineers to quantify the impact of microalgal biodiversity on process sustainability for biocrude production. Dr. Hietala also has experience with wind turbine operation and maintenance from previous employment at General Electric.

A selection of Dr. Hietala's project experiences can be found below.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, University of Michigan, Ann Arbor, 2018

M.S.E., Chemical Engineering, University of Michigan, Ann Arbor, 2015

B.S., Chemical Engineering, Cornell University, 2013

Rackham Predoctoral Fellowship, University of Michigan, 2017-2018

Licenses and Certifications

Professional Engineer, Colorado, #PE.0064373

Professional Engineer, Illinois, #062.074295

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Professional Engineer, Iowa, #P30447

Professional Engineer, Utah, #14263962-2202

40-Hour Hazardous Waste Operation and Emergency Response Certification (HAZWOPER)

FI-210, Wildland Fire Origin and Cause Determination (WA)

Certified Fire and Explosion Investigator (CFEI)

IAAI The Scientific Method for Fire and Explosion Investigation

S-190 Introduction to Wildland Fire Behavior (Online) 2023 v4

Wildland Fires Investigation (CFI Trainer)

Prior Experience

Graduate Student Research Assistant, Chemical Engineering, University of Michigan, 2013-2018

Software Support Intern, Cipherpoint Software, 2013

Renewable Energy Development Program Intern, G.E. Power and Water, 2012

Professional Affiliations

American Institute of Chemical Engineers (AIChE)

American Water Works Association (AWWA)

National Association of Fire Investigators (NAFI)

National Fire Protection Association (NFPA)

Publications

Thomas PK, Hietala DC, Cardinale BJ. Tolerance to allelopathic inhibition by free fatty acids in five biofuel candidate microalgae strains. Bioresource Technology Reports. 2023; 21:101321. doi:10.1016/j.biteb.2022.101321.

Dee SJ, Hietala DC, Sulmonetti TP. Process hazard considerations for utilization of renewable methane from biogas. Process Safety Progress 2022; Published in online in Early View. DOI: 10.1002/prs.12389.

Ogle RA, Cox BL, Hietala DC. What to do with your dust Hazard analysis. Occupational Health & Safety Magazine 2021; 90 (4):12-14.

Cox BL, Hietala DC, Ogle RA. Dust explosions and collapsed ductwork. Journal of Loss Prevention in the Process Industries 2021; 69:104350. doi: 10.1016/j.jlp.2020.104350.

Hietala DC, Savage PE. A molecular, elemental, and multiphase kinetic model for the hydrothermal liquefaction of microalgae. Chemical Engineering Journal 2020; 127007.

Hietala DC, Godwin CM, Cardinale BJ, Savage PE. The individual and synergistic impacts of feedstock characteristics and reaction conditions on the aqueous co-product from hydrothermal liquefaction. Algal

Research 2019; 42:101568.

Carruthers DN, Godwin CM, Hietala DC, Cardinale BJ, Lin XN, Savage PE. Biodiversity improves life cycle sustainability metrics in algal biofuel production. Environmental Science & Technology 2019; 53 (15):9279-9288.

Hietala DC, Godwin CM, Cardinale BJ, Savage PE. The independent and coupled effects of feedstock characteristics and reaction conditions on biocrude production by hydrothermal liquefaction. Applied Energy 2019; 235:714-728.

Jackrel SL, Narwani A, Bentlage B, Levine RB, Hietala DC, Savage PE, Oakley TH, Denef VJ, Cardinale BJ. Ecological engineering helps maximize function in algal oil production. Applied and Environmental Microbiology 2018; 84 (15) e00953-18.

Godwin CM, Lashaway AR, Hietala DC, Savage PE, Cardinale BJ. Biodiversity improves the ecological design of sustainable biofuel systems. GCB Bioenergy 2018; 1-14.

Hietala DC, Koss CK, Narwani A, Lashaway AR, Godwin CM, Cardinale BJ, Savage PE. Influence of biodiversity, biochemical composition, and species identity on the quality of biomass and biocrude oil produced via hydrothermal liquefaction. Algal Research 2017; 26:203-214.

Godwin CM, Hietala DC, Lashaway AR, Narwani A, Savage PE, Cardinale BJ. Ecological stoichiometry meets ecological engineering: Using algal polycultures to enhance the multifunctionality of algal biocrude systems. Environmental Science & Technology 2017; 51:11450-11458.

Godwin CM, Hietala DC, Lashaway AR, Narwani A, Savage PE, Cardinale BJ. Algal polycultures enhance coproduct recycling from hydrothermal liquefaction. Bioresource Technology 2017; 224:630-638.

Narwani A, Lashaway AR, Hietala DC, Savage PE, Cardinale BJ. Power of plankton: Effects of algal biodiversity on biocrude production and stability. Environmental Science & Technology 2016; 50:13142-13150.

Hietala DC, Faeth JL, Savage PE. A quantitative kinetic model for the fast and isothermal hydrothermal liquefaction of Nannochloropsis sp. Bioresource Technology 2016; 214:102-111.

Hietala DC, Savage PE. Reaction pathways and kinetics of cholesterol in high-temperature water. Chemical Engineering Journal 2015; 265:129-137.

Conference Proceedings and Presentations

Hietala DC, Wechsung A. Obviously New or Just a Copy – Engineers Play a Critical Role in Evaluating Patent or Trade Secret Infringement Claims. American Institute of Chemical Engineers, 2023 Fall National Meeting, Orlando, FL, November 5-10, 2023.

Cox BL, Hietala DC, Walters MS, Dee SJ. Ignition sources are free: A Discussion of common (and uncommon) ignition mechanisms for gaseous fuels and combustible dusts. American Institute of Chemical Engineers, 2023 Spring National Meeting and 19th Global Congress on Process Safety, Houston, TX, March 12-16, 2023.

Dee SJ, Hietala DC, Stern MC, Sulmonetti T. Process hazard considerations for utilization of renewable methane from biogas. American Institute of Chemical Engineers, 2022 Spring National Meeting and 18th Global Congress on Process Safety, San Antonio, TX, April 10-13, 2022.

Hietala DC, Cox BL, Ogle RA, Walters MS. Mechanics of Hot Caustic Solution Eruptions. American Institute of Chemical Engineers, 14th Midwest Regional Conference (virtual), March 1-2, 2022.

Lardinois TM, Hietala DC, Cox BL, Dee SJ, Ogle RA, Walters MS. Learnings in material flash point characterization from the Lac-Mégantic rail disaster. American Institute of Chemical Engineers, 14th Midwest Regional Conference (virtual), March 1-2, 2022.

Hietala DC, Cox BL, Dee SJ, Ogle RA, Walters MS. So, What's the Point? Navigating Flammability Classification when Flash Point is Ambiguous. Mary Kay O'Connor Process Safety Center, 2021 International Symposium, October 19-21, 2021.

Cox BL, Ogle RA, Hietala DC. Distillation column explosion. 2020 Spring National Meeting and, 16th Global Congress on Process Safety (virtual), August 17-20, 2020.

Hietala DC, Cox BL, Dee SJ, Morrison DR. Incident Investigation is not Root Cause Analysis. American Institute of Chemical Engineers, 2020 Spring National Meeting and, 16th Global Congress on Process Safety, (virtual), August 16-19, 2020.

Cox, BL, Hietala, DC, Ogle RA. Dust Explosions and Collapsed Ductwork. Mary K O'Connor Process Safety Center 22nd Annual International Symposium, College Station, TX, October 22-24, 2019.

Godwin CM, Hietala DC, Lashaway AR, Narwani A, Savage PE, Cardinale BJ. Ecological stoichiometry of algal biocrude production: Polycultures balance tradeoffs in nutrient use efficiency. 2017 ESA Annual Meeting, August 6-11, 2017.

Hietala DC, Koss CK, Narwani A, Lashaway A, Godwin CM, Cardinale BJ, Savage PE. Effects of microalgal polycultures on quality of biomass for biocrude oil production via hydrothermal liquefaction. American Institute of Chemical Engineers, 2016 Fall National, San Francisco, CA, November 13-18, 2016.

Savage PE, Hietala DC, Sheehan JD. Reaction networks and kinetics for hydrothermal conversion of biomass to biocrude. Abstracts of Papers of the American Chemical Society, 2016; 252.

Hietala DC, Faeth JL, Savage PE. Advances in kinetic modeling of hydrothermal liquefaction of microalgae. American Institute of Chemical Engineers, 2015 Fall National Meeting, Salt Lake City, UT, November 8-13, 2015.

Project Experience

Energy and Sustainability

- As a doctoral candidate, experimentally characterized and developed mathematical models to describe the reaction kinetics and pathways for biocrude oil production from microalgae via hydrothermal liquefaction.
- Led an interdisciplinary team to develop, troubleshoot, maintain, and operate several multi-functional testing apparatuses for heterogeneous catalysts used in vehicle exhaust gas NOx reduction applications. More specifically, these apparatuses leveraged mass flow controllers (MFCs), tube furnaces, and Fourier-transform infrared spectroscopy (FTIR) continuous gas analyzers to test SCR, DOC, and DPF catalysts.
- Applied chemical engineering principles to investigate power plant related failures, for example through analysis of plant operational data to evaluate claims that poor performance and equipment failure was caused by exceedances outside of approved design specifications.

Fire, Explosion, Chemical Release, and Equipment Failure Investigation

Residential Fire and Explosion Investigation

- Consumer products containing lithium ion or lithium polymer (LiPo) batteries: Investigated origin and cause of fires involving products such as hoverboards, vacuum cleaners, scooters, battery banks, and remote-controlled (RC) airplanes.
- 120V or 240V powered consumer products: Investigated origin and cause of fires involving products such as spas (hot tubs), saunas, blowers, fans, extension cords, power strips, printers, radios, space heaters, food dehydrators, coolers, refrigerators, and laser engravers.
- Flammable liquids: Investigated origin and cause of fires involving portable ethanol fireplaces.
- Vehicles: Investigated origin and cause of a fire involving a snowmobile.

Commercial and Industrial Fire, Explosion, Chemical Release, and Equipment Failure Investigation

- Fires and Explosions: Investigated origin and cause of warehouse fires, a float glass manufacturing fire, a perchloric acid railcar fire and explosion, a range stove fire, a fuel tanker truck fire, a soy grain cooker hangar bearing fire, a wastewater reclamation facility explosion, a process water holding tank explosion, pressure vessel (boiler and reboiler) explosions and failures, a hazardous waste processing facility explosion, grain mill and elevator combustible dust explosions, a silicone manufacturing facility explosion, and fires and explosions arising from the mixing of incompatible chemicals.
- Chemical Releases: Investigated chlorine railcar failures and releases.
- Equipment Failures: Investigated flame arrester failures, furnace heat exchanger failures, steam boiler commissioning failures, a grain silo collapse, and a water tank collapse.

Industrial Chemistry, Occupational Safety, and Chemical Process Safety

- Evaluated fluoropolymer end-of-life processing in bench-scale applications representative of full-scale incinerators.
- Evaluated intellectual property (IP) claims surrounding refrigerant manufacturing processes.
- Evaluated false advertising claims pertaining to the technology and performance of plug-in scented oil (PISO) air freshener devices, including experimental studies using gas chromatography (GC-MS) and computational fluid dynamics (CFD) studies.
- Evaluated historical use of polychlorinated biphenyls (PCBs) in applications such as transformers.
- Evaluated chlorine (hydrogen chloride (HCl), chlorate, and perchlorate) chemistry in process water and chemical release scenarios.
- Investigated occupational safety incidents involving exposure to industrial cleaning products, such as caustic soda (sodium hydroxide).
- Investigated slip-and-fall cases related to salt-induced ice melt.
- Evaluated OSHA Process Safety Management (PSM) programs, including Process Hazard Analysis (PHA) and Management of Change (MOC).

Engineering, Procurement, and Construction (EPC), International Arbitration (IA) and Insurance Claim Disputes

- Analyzed plant process data, design specifications, operating procedures, and commissioning documentation to evaluate claims in EPC, IA, and insurance claim disputes.

- Applied chemical engineering principles to evaluate work performed (e.g., by contractors and EPC vendors) as it relates to scope of work, generally accepted engineering practices, and post-failure recovery.

Additional Education & Training

Dr. Hietala has extensive experience with computational software including Excel, Matlab, Mathematica, Aspen Properties, Aspen Plus, and Aspen HYSYS.