



Exponent[®]
Engineering & Scientific Consulting

David Anderson, Ph.D., P.E., CFEI, CVFI

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Professional Profile

Dr. Anderson applies his mechanical and chemical engineering expertise to help clients solve complex multidisciplinary problems across a broad range of industries. He is a licensed Professional Engineer and holds a Ph.D. in Mechanical Engineering from the Georgia Institute of Technology.

Dr. Anderson is an expert in thermal and fluid systems. His project experience includes mobile and stationary engines, on- and off-road vehicles, exhaust aftertreatment and emissions systems, pumps and compressors, heat exchangers, boilers, furnaces, refrigeration systems, piping systems, cryogenic liquids, textiles and textile technology, consumer products, and medical devices.

Dr. Anderson specializes in accident evaluation and prevention, root cause analysis, fire and explosion investigation, product development and validation, and intellectual property disputes. Dr. Anderson has testified as an expert in various litigation matters in state and federal court. His expertise has also been utilized in international arbitration disputes, as an independent third party in submissions to federal agencies, and directly by industrial clients to evaluate and/or improve products or processes.

Prior to joining Exponent, Dr. Anderson worked for five years as an engine system design and development engineer at Caterpillar, Inc., on machine-engine integration for numerous products including skid steer loaders, backhoe loaders and track-type tractors. While at Caterpillar, he developed engine, transmission, and hydraulic implement cooling systems, participated in root cause investigations of engine and engine system component failures, and supported the implementation of advanced exhaust emissions aftertreatment technologies including selective catalytic reduction (SCR) and diesel particulate filtration (DPF). He was involved in all phases of the product development process, ranging from conceptualization to performance modeling, prototype design/fabrication, and testing/validation. Dr. Anderson executed numerous projects at Caterpillar as a Six Sigma Green Belt involving Failure Mode and Effects Analysis (FMEA), Design of Experiments (DOE), and Design for Six Sigma (DFSS).

Dr. Anderson's publications list and examples of project experience are provided at the end of this curriculum vitae.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Georgia Institute of Technology, 2015

M.S., Mechanical Engineering, Georgia Institute of Technology, 2013

B.S., Mechanical Engineering, North Carolina State University, 2005

Georgia Institute of Technology Leadership Fellow, 2013-2015

Sam Nunn Security Fellow, 2013

National Defense Science and Engineering Graduate Fellowship, 2012

IPST Paper Science and Engineering Fellowship, 2011

G.W. Woodruff School of Mechanical Engineering Presidents' Fellowship, 2010

North Carolina State University John T. Caldwell Scholarship, 2001

Licenses and Certifications

Professional Engineer, Georgia, #PE041588

Certified Fire and Explosion Investigator (CFEI)

Certified LabVIEW Associate Developer (CLAD)

Certified Vehicle Fire Investigator (CVFI)

Six Sigma Green Belt Certification (CSSGB)

Prior Experience

Graduate Research Assistant, Georgia Institute of Technology, 2010-2015

Freshman Grand Challenges Facilitator, Georgia Institute of Technology, 2014-2015

Visiting Researcher, RTI International, 2013

Visiting Researcher, Air Force Research Laboratory, 2011

Product Development Engineer, Caterpillar Inc., 2005-2010

Professional Affiliations

American Society of Mechanical Engineers—ASME (member)

American Institute of Chemical Engineers—AIChE (member)

National Association of Fire Investigators—NAFI (member)

SAE International—formerly Society of Automotive Engineers (member)

Patents

U.S. Patent No. 10,988,379: Reactor for Steam Reforming and Methods of Use Thereof, April 27, 2021 (Fedorov AG, Anderson DM).

U.S. Patent Application No. 17/069,493: Multilayered Multifunctional Heat-Management Material, filed October 13, 2020 (Beckham HB, Johnson RL, Anderson DM).

Publications

Anderson DM, Oelker AM, Beckham HW. Thermal Analysis of Textiles. In: Analytical Methods for a Textile Laboratory, Fourth Edition. American Association of Textile Chemists and Colorists, Research Triangle Park, NC, pp 349-373, 2023.

Berry EG, Bezecny J, Acton M, Sulmonetti TP, Anderson DM, Beckham HW, Durr RA, Chiba T, Beem J, Brash DE, Kulkarni R, Cassidy PB, Leachman SA. Slip versus Slop: A Head-to-Head Comparison of UV-Protective Clothing to Sunscreen. *Cancers* 2022; 14(3):542.

Anderson DM, Fessler JR, Pooley MA, Seidel S, Hamblin MR, Beckham HW, Brennan JB. Infrared radiative properties and thermal modeling of ceramic-embedded textile fabrics. *Biomedical Optics Express* 2017; 8(3):1698-1711.

Anderson DM, Yun TM, Kottke PA, Fedorov AG. Comprehensive analysis of sorption enhanced steam methane reforming in a variable volume membrane reactor. *Industrial & Engineering Chemistry Research* 2017; 56(7):1758-1771.

Pooley, MA, Anderson DM, Beckham HW, Brennan JB. Engineered emissivity of textile fabrics by the inclusion of ceramic particles. *Optics Express* 2016; 24(10):10556-10564.

Anderson DM, Nasr MH, Yun TM, Kottke PA, Fedorov AG. Sorption-enhanced variable-volume batch-membrane steam methane reforming at low temperature: Experimental demonstration and kinetic modeling. *Industrial & Engineering Chemistry Research* 2015; 54(34):8422-8436.

Yun TM, Kottke PA, Anderson DM, Fedorov AG. Theoretical analysis of hydrogen production by variable volume membrane batch reactors with direct liquid fuel injection. *International Journal of Hydrogen Energy* 2015; 40(25):8005-8019.

Yun TM, Kottke PA, Anderson DM, Fedorov AG. Experimental investigation of hydrogen production by variable volume membrane batch reactors with modulated liquid fuel introduction. *International Journal of Hydrogen Energy* 2015; 40(6):2601-2612.

Yun TM, Kottke PA, Anderson DM, Fedorov AG. Power density assessment of variable volume batch reactors for hydrogen production with dynamically modulated fuel introduction. *Industrial & Engineering Chemistry Research* 2014; 53(47):18140-18151.

Anderson DM, Kottke PA, Fedorov AG. Thermodynamic analysis of hydrogen production via sorption-enhanced steam methane reforming in a new class of variable volume batch-membrane reactor. *International Journal of Hydrogen Energy* 2014; 39(31):17985-17997.

Gittens RA, Olivares-Navarrete R, Cheng A, Anderson DM, McLachlan T, Stephan I, Fedorov AG, Rupp F, Geis-Gerstorfer J, Sandhage KH, Boyan BD, Schwartz Z. The role of titanium surface micro/nanotopography and wettability on the differential response of human osteoblast lineage cells. *Acta Biomaterialia* 2013; 9(4):6268-6277.

Anderson DM, Gupta MK, Voevodin AA, Hunter CN, Putnam SA, Tsukruk VV, Fedorov AG. Using amphiphilic nanostructures to enable long-range coalescence and surface rejuvenation in dropwise condensation. *ACS Nano* 2012; 6(4):3262-3268.

Proceedings and Presentations

Anderson DM. Science That Shapes Vehicle Technologies: Navigating the Future of Warranty Management. ENG's 11th Annual Automotive Warranty Management Summit, Barcelona Spain, June 2023.

Anderson DM, Dillon SE, Goodman A, Paris D, Mercado-Corujo H. Live Burn Data Analysis and Rundown. DRI Fire Science and Litigation Seminar, Washington DC, September 2021.

Jokar A, O'Hern S, Anderson DM, Cundy M, Ogle R. Flammable Refrigerants: Performance Comparison, Safeties and Lessons Learned. Proceedings, ASHRAE Winter Conference, art no. AT-2019-C063, Atlanta, GA, 2019.

O'Hern SC, Stern MC, Anderson DM, Ibarreta A, Myers TJ. Analysis of combustible dust flash fires on personal protective equipment. Proceedings, Hazards 27, Institute of Chemical Engineers, Birmingham, UK, May 2017.

Anderson DM. Heat Transfer in Textiles: Using fundamental principles to design better products. Industrial Fabrics Association International Expo 2016, Charlotte NC, October 2016.

Anderson DM. Textiles and radiant heat: facts and misconceptions. American Association of Textile Chemists and Colorists Spring Meeting, May 2016.

Morrison DR, Anderson DM, Smyth SA, Hetrick TM. Understanding the fire risks of eCigarettes, vapes, and mods. Proceedings, DRI Product Liability Conference, New Orleans, LA, February 2016.

Anderson DM, Nasr MH, Yun, TM, Kottke PA, Fedorov AG. Sorption-enhanced CHAMP reactor for distributed steam methane reforming. 3rd International Education Forum on Environment and Energy Science, Perth, Australia, December 2014.

Anderson DM, Kottke PA, Yun TM, Fedorov AG. Sorption-enhanced variable volume membrane reactor for hydrogen production from methane: modeling and experimental characterization. 2014 AIChE Annual Meeting, Atlanta, GA, November 2014.

Anderson DM, Kottke PA, Fedorov AG. Sorption-enhanced CHAMP class reactor for low temperature, distributed hydrogen production from natural gas. 2nd International Education Forum on Environment and Energy Science, Huntington Beach, CA, December 2013.

Anderson DM, Kottke PA, Fedorov AG. Hydrogen production from natural gas via sorption-enhanced variable volume batch-membrane reactors. 2013 AIChE Annual Meeting, San Francisco, CA, November 2013.

Anderson DM, Fedorov AG. Improved CHAMP-class reactors enabling a sustainable route to hydrocarbon processing for mobile and distributed power generation. 1st International Education Forum on Environment and Energy Science, Waikoloa, HI, December 2012.

Kottke PA, Anderson DM, Fedorov AG. Condensation enhancement with micro and nano-structured amphiphilic surfaces. 2012 Power MEMS Workshop, Atlanta, GA, December 2012.

Anderson DM, Gupta MK, Voevodin AA, Hunter CN, Putnam SA, Tsukruk VV, Fedorov AG. Mechanisms of condensation on amphiphilic nanostructured surfaces. ASME 3rd Micro/Nanoscale Heat & Mass Transfer International Conference, Atlanta, GA, March 2012.

Anderson DM, Gupta MK, Voevodin AA, Hunter CN, Putnam SA, Tsukruk VV, Fedorov AG. Controlling water condensation in energy systems using nanostructured surfaces. 4th International Forum on Multidisciplinary Research and Education in Energy Sciences, Honolulu, HI, December 2011.

Berry EG, Bezecny J, Acton M, Sulmonetti TP, Anderson DM, Beckham HW, Durr RA, Chiba T, Beem J, Brash DE, Kulkarni R, Cassidy PB, Leachman SA. Slip versus Slop: A Head-to-Head Comparison of UV-Protective Clothing to Sunscreen. *Cancers* 2022; 14(3):542.

Project Experience

A representative sampling of example project experience across Dr. Anderson's practice areas is listed below.

Engine Systems

- Investigated the failure of various internal combustion engines used in backup power generation, transportation vehicle, and stationary pumping/compressing applications
- Developed a screening methodology to identify and restrict the sale of aftermarket automobile parts that could be used to defeat the emissions control systems of diesel and gasoline engines
- Reviewed and assessed the engineering justification for elements of the emission control strategy—including dosing of urea, modulation of exhaust gas recirculation rates and fuel injection timing in response to ambient/driving conditions, and soot/sulfur regeneration strategies—on various diesel engines used in on-road vehicles, ranging from passenger sedans to Class 8 trucks
- Analyzed emissions data collected by portable emissions measurement systems (PEMS) to compare on-road emissions performance and fuel consumption to that demonstrated on dynamometer certification test cycles
- Performed root cause analyses and evaluated field failure warranty data on the failures of various core engine, engine system, and exhaust aftertreatment system components

Thermal Systems

- Evaluated the reduction in energy absorption of roofing materials due high albedo (i.e., solar reflective) coatings and estimated the potential energy savings in various climate regions
- Quantified the solar absorptive and thermal emissive behavior of foil coatings used in an unmanned lunar landing module to regulate surface temperatures
- Audited the infrared thermal imaging inspection program used to proactively address maintenance issues in electrical transmission and distribution equipment by identifying thermal anomalies prior to component failure
- Assessed residual moisture in building materials after storm-related water intrusion using moisture meters (both pin-type and pinless) and infrared thermography
- Evaluated and developed strategies to prevent the formation and sublimation of frozen droplets due to residual moisture present during a vacuum sterilization process

Biomedical and Textile Technologies

- Performed a root cause analysis on the failure of a medical pump and conducted a design of experiments to assess sensitivities to deviations in operating conditions
- Conducted heat transfer measurements on textile products to evaluate potential claims of intellectual property infringement
- Investigated thermal burn injuries that occurred due to exposure to either low (e.g., cryotherapy) or high temperatures and the efficacy of thermal protective garments
- Developed a methodology to make and analyze thermal emissivity measurements on various textile products including garments, pain patches, and kinesiology tape
- Designed and executed custom test methodologies to evaluate the thermal and moisture management performance of outdoor apparel
- Evaluated the protection against ultraviolet light provided by solar-protective garments in direct comparison to that offered by sunscreen at various coating thicknesses

Consumer and Industrial Products and Equipment

- Investigated fires involving a range of battery-powered consumer products
- Advised equipment manufacturers in the transition to low global warming potential (GWP) flammable natural refrigerants by conducting testing, analysis, and quantitative risk assessments of the potential for flash fires, jet fires, overpressure, and explosions
- Investigated fatalities involving exposure to hazardous environments including carbon dioxide, carbon monoxide, and inert nitrogen
- Analyzed the operation and PLC controls of various industrial equipment (e.g., furnaces, boilers, valves and piping systems, etc.) to investigate the causes of explosions, flash fires, and/or unintentional chemical releases
- Investigated various vehicle and engine fires including incidents involving post-collision fuel releases of fuel, ignition of vehicle components and/or contents, and engine component failures
- Investigated flash fires involving propane or butane grills, stoves, and/or fireplaces in apartment complexes, personal residences, and portable cooking equipment
- Evaluated defect claims associated with the design, construction, and operation of the pumps, boilers, dryers, heat exchangers, HVAC systems, and separation equipment in various industrial facilities