

Exponent®
Engineering & Scientific Consulting

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Professional Profile

Andrew Worthen, Ph.D., P.E., is a senior managing engineer in Exponent's Polymers & Chemistry practice with over a decade of experience in construction material failures, plastic pipe systems, and chemical engineering fundamentals applied to materials. He advises law firms, insurers, and product manufacturers on failure analysis, construction defect litigation support, and product performance in complex regulatory environments.

Construction Material Failures

Dr. Worthen leads failure analysis investigations involving a broad range of construction materials including plastic pipe and tubing, roofing underlayment, paints and coatings, adhesives, concrete, flooring, windows, doors, and building envelope systems. He applies materials characterization, chemical analysis, and engineering fundamentals to determine root causes of failures that result in property damage, water loss, and construction disputes. His investigations address degradation mechanisms such as oxidation, chemical incompatibility, improper installation, and manufacturing defects, and he regularly evaluates compliance with applicable industry standards including ASTM test methods and building codes.

Construction Defect Litigation

Dr. Worthen provides technical consulting and expert support in complex construction defect litigation, including cases involving alleged product defects, installation failures, and material incompatibilities. He has served as a testifying expert in construction litigation matters, including deposition and trial testimony, and has supported domestic arbitration proceedings. His litigation support spans multi-party disputes involving general contractors, subcontractors, product manufacturers, and insurers, with particular depth in cases where material science and chemical engineering analysis are central to establishing causation.

Plastic Pipe Failure Analysis

Dr. Worthen has conducted dozens of failure investigations involving plastic pipe and tubing systems used in residential, commercial, and industrial construction. He evaluates crosslinked polyethylene (PEX), high-density polyethylene (HDPE), chlorinated polyvinyl chloride (CPVC), polyvinyl chloride (PVC), and polypropylene (PP) plastic piping systems, examining failure mechanisms including stress cracking, oxidative degradation, chemical attack, improper joining, and manufacturing defects. His work encompasses both field inspections and laboratory-based materials testing, and he has been retained in numerous high-profile multi-building PEX failure cases involving large-scale water damage and property loss.

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Chemical Engineering & Material Failures

Drawing on his doctoral training in chemical engineering, Dr. Worthen applies polymer physics, colloid and surface science, and materials characterization to understand how products fail and why. He evaluates material formulations, processing conditions, and end-use environments to identify the chemical and physical mechanisms underlying failures in plastics, rubbers, coatings, adhesives, and composite materials. This chemical engineering perspective distinguishes his approach in cases where degradation is driven by molecular-scale interactions, such as surfactant-induced stress cracking (including Environmental Stress Cracking or “ESC”), transition metal-catalyzed polymer degradation, or incompatible chemical exposures that may not be readily apparent from visual inspection alone.

Product Stewardship & Regulatory Risk

Dr. Worthen assists manufacturers, in-house counsel, and product development teams in navigating complex regulatory environments affecting product compliance, safety, and market access. He has led scientific assessments at multiple product lifecycle stages, from development and qualification through maturity and end-of-life, addressing regulatory concerns related to chemical contaminants, flame retardants, fluorinated chemicals (including PFAS), and product compliance. He advises clients on managing risks associated with new regulations, evolving market conditions, and sustainability and circularity claims, helping them make defensible, science-based decisions under regulatory scrutiny.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, University of Texas, Austin, 2015

B.S., Chemical Engineering, University of Toledo, 2010

Licenses and Certifications

Professional Engineer Chemical, Florida, #104678

Professional Engineer Chemical, Hawaii, #PE-21406-0

Professional Engineer Chemical, Texas, #133642

Professional Engineer Chemical, Washington, #22030226

Prior Experience

Undergraduate Research Assistant, University of Toledo, 2009-2010

Technical Services Department Co-op, Marathon Petroleum Company, Spring 2010

Environmental Department Co-op, Marathon Petroleum Company, Spring 2008, Fall 2008, Summer 2009

Professional Affiliations

American Institute of Chemical Engineers (AIChE)

American Chemical Society (ACS)

Society of Plastics Engineers (SPE)

Product Stewardship Society

American Society for Testing and Materials (ASTM)

Publications

Thelen J, Onorato J, Liebman A, Lenz O, and Worthen AJ. Microstructural Analysis of Polyolefins Using Raman Microscopy. Proceedings of the SPE Annual Technical Conference & Exhibition, ANTEC 2026.

Worthen AJ and Beckham H. Measurement of Water Management in Textiles. Chapter 5 in Analytical Methods for a Textile Laboratory, 4th Edition. American Association of Textile Colorists and Chemists (AATCC). 2023. ISBN 978-1-942323-22-8.

Worthen AJ, Murphy EB. Transition Metal-Catalyzed Degradation of Polymers: Review and Future Perspectives. Proceedings of the SPE Annual Technical Conference & Exhibition, ANTEC 2020.

Worthen AJ, Irving KS, Lapitsky Y. Supramolecular Strategy Effects on Chitosan Bead Stability in Acidic Media: A Comparative Study. Gels 2019. 5(1):11.

Worthen AJ, Schwartz JM, Lee DE, Robrock KR, Kalmes RM. Flame Retardants in Consumer Products: Overview and Perspective on the Proposed CPSC Ban. Proceedings of the SPE Annual Technical Conference & Exhibition, ANTEC 2018.

Mohammad L, Kim I, Beygi MR, Worthen AJ, Huh C, Johnston KP, Wheeler MF, DiCarlo DA. Foam Generation Hysteresis in Porous Media: Experiments and New Insights. Transport in Porous Media 2017. 116(2):687-703.

Qajar A, Xue Z, Worthen AJ, Johnston KP, Huh C, Bryant SL, Prodonavic M. Modeling fracture propagation and cleanup for dry nanoparticle-stabilized-foam fracturing fluids. Journal of Petroleum Science and Engineering 2016. 146:210-221.

Chen Y, Elhag AS, Worthen AJ, Reddy PP, Ou AM, Hirasaki GJ, Nguyen QP, Biswal SL, Johnston KP. High Temperature CO2-in-Water Foams Stabilized with Cationic Quaternary Ammonium Surfactants. Journal of Chemical & Engineering Data 2016. 61(8): 2761-2770.

Chen Y, Elhag AS, Reddy PP, Chen H, Cui L, Worthen AJ, Kun M, Quintanilla H, Noguera JA, Hirasaki GJ, Nguyen QP, Biswal SL, Johnston KP. Phase behavior and interfacial properties of a switchable ethoxylated amine surfactant at high temperature and effects on CO2-in-water foams. Journal of Colloid and Interface Science 2016. 470:80-91.

Kim I, Worthen AJ, Johnston KP, DiCarlo DA, Huh C. Size-dependent properties of silica nanoparticles for Pickering stabilization of emulsions and foams. Journal of Nanoparticle Research 2016; 18(4):82.

Worthen AJ, Tran V, Cornell KA, Truskett TM, Johnston KP. Steric stabilization of nanoparticles with grafted low molecular weight ligands in highly concentrated brines including divalent ions. Soft Matter 2016; 12(7):2025-2039.

Xue Z, Worthen AJ, Qajar A, Robert I, Bryant SL, Huh C, Prodanović M, Johnston KP. Viscosity and stability of ultra-high internal phase CO2-in-water foams stabilized with surfactants and nanoparticles with or without polyelectrolytes. Journal of Colloid and Interface Science 2016; 461:383-395.

Xue Z, Worthen AJ, Da C, Qajar A, Ketchum IR, Alzobaidi S, Huh C, Prodanović M, Johnston KP. Ultra-dry carbon dioxide-in-water foams with viscoelastic aqueous phases. Langmuir 2016; 32(1):28-37.

Chen Y, Elhag AS, Cui L, Worthen AJ, Reddy PP, Noguera JA, Ou AM, Ma K, Puerto M, Hirasaki GJ, Nguyen QP, Biswal SL, Johnston KP. CO2-in-water foam at elevated temperature and salinity stabilized

with a nonionic surfactant with a high degree of ethoxylation. Industrial & Engineering Chemistry Research 2015; 54(16):4252-4263.

Prigiobbe V, Worthen AJ, Johnston KP, Huh C, Bryant SL. Transport of nanoparticle-stabilized CO2-foam in porous media. Transport in Porous Media 2015; 111(1):265-285.

Foster LM*, Worthen AJ*, Foster EL, Dong J, Roach CM, Metaxas AE, Hardy CD, Larsen ES, Bollinger JA, Truskett TM, Bielawski CW, Johnston KP. High interfacial activity of polymers "grafted through" functionalized iron oxide nanoparticle clusters. Langmuir 2014; 30(34):10188-10196. (Note: * denotes equal author contribution).

Dong J, Worthen AJ, Foster LM, Chen Y, Cornell KA, Bryant SL, Truskett TM, Bielawski CW, Johnston KP. Modified montmorillonite clay microparticles for stable oil-in-seawater emulsions. ACS Applied Materials & Interfaces 2014; 6(14):11502-11513.

Yu H, Yoon KY, Neilson BM, Bagaria HG, Worthen AJ, Lee JH, Cheng V, Bielawski CW, Johnston KP, Bryant SL, Huh C. Transport and retention of aqueous dispersions of superparamagnetic nanoparticles in sandstone. Journal of Petroleum Science and Engineering 2014; 116:115-123.

Chen Y, Elhag AS, Poon BM, Cui L, Ma K, Liao SY, Reddy PP, Worthen AJ, Hirasaki GJ, Nguyen QP, Biswal SL, Johnston KP. Switchable nonionic to cationic ethoxylated amine surfactants for CO2 Enhanced Oil Recovery in high-temperature, high-salinity carbonate reservoirs. SPE Journal 2014; 19(02):249-259.

Worthen AJ, Foster LM, Dong J, Bollinger JA, Peterman AH, Pastora LE, Bryant SL, Truskett TM, Bielawski CW, Johnston KP. Synergistic formation and stabilization of oil-in-water emulsions by a weakly interacting mixture of zwitterionic surfactant and silica nanoparticles. Langmuir 2014; 30(4):984-994.

Worthen AJ, Bryant SL, Huh C, Johnston KP. Carbon dioxide□in□water foams stabilized with nanoparticles and surfactant acting in synergy. AIChE Journal 2013; 59(9):3490-3501.

Bagaria HG, Neilson BM, Worthen AJ, Xue Z, Yoon KY, Cheng V, Lee JH, Velagala S, Huh C, Bryant SL, Bielawski CW, Johnston KP. Adsorption of iron oxide nanoclusters stabilized with sulfonated copolymers on silica in concentrated NaCl and CaCl2 brine. Journal of Colloid and Interface Science 2013; 398:217-226.

Bagaria HG, Yoon KY, Neilson BM, Cheng V, Lee JH, Worthen AJ, Xue Z, Huh C, Bryant SL, Bielawski CW, Johnston KP. Stabilization of iron oxide nanoparticles in high sodium and calcium brine at high temperatures with adsorbed sulfonated copolymers. Langmuir 2013; 29(10):3195-3206.

Worthen AJ, Bagaria HG, Chen Y, Bryant SL, Huh C, Johnston KP. Nanoparticle-stabilized carbon dioxide-in-water foams with fine texture. Journal of Colloid and Interface Science 2013; 391:142-151.

Bagaria HG, Xue Z, Neilson BM, Worthen AJ, Yoon KY, Nayak S, Cheng V, Lee JH, Bielawski CW, Johnston KP. Iron oxide nanoparticles grafted with sulfonated copolymers are stable in concentrated brine at elevated temperatures and weakly adsorb on silica. ACS Applied Materials & Interfaces 2013; 5(8):3329-3339.

Worthen AJ, Lapitsky Y. Stabilization of bioderived surfactant/polyelectrolyte complexes through surfactant conjugation to the biopolymer. Colloid and Polymer Science 2011; 289(14):1589-1596.

Selected Presentations

Diederichsen K, Buss H, Liffland S, and Worthen AJ. Managing Risks of Sustainability and Circularity Claims. Product Stewardship Society Annual Conference (PSX), Houston, TX, September 16-18, 2025.

Worthen AJ, Razzaque S, Mantione L. Surprises, Gaps, and Near Misses for the Product Steward. Product Stewardship Society Annual Conference (PSX), Boston, MA, October 17-19, 2023.

Worthen AJ, Rackl SM, Grzebyk K, Hearon S. Fluorinated Chemistry and Consumer Product Compliance Challenges. Product Stewardship Society Annual Conference (PSX), Louisville, KY, October 18-20, 2022.

Worthen AJ, Rackl SM, Grzebyk K. Fluorinated Chemicals and Challenges to Product Stewardship. Product Stewardship Society Annual Conference (PSX), Anaheim, CA, September 28-30, 2021.

Worthen AJ, Murphy EB. Transition Metal-Catalyzed Degradation of Polymers: Review and Future Perspectives. SPE Annual Technical Conference & Exhibition, ANTEC 2020, Virtual, March 30-May 5, 2020.

Worthen AJ, Schwartz JM, Lee DE, Robrock KR, Kalmes RM. Flame Retardants in Consumer Products: Overview and Perspective on the Proposed CPSC Ban. SPE Annual Technical Conference & Exhibition, ANTEC 2018, Orlando, FL, May 7-10, 2018.

Worthen AJ, Taghavy A, Aroonsri A, Kim I, Johnston KP, Huh C, Bryant SL, DiCarlo DA. SPE 175065, Multi-scale evaluation of nanoparticle-stabilized CO_2-in-water foams: From the benchtop to the field. SPE Annual Tech. Conf. and Expo., Houston, TX, September 28-30, 2015.

Worthen AJ, Xue Z, Parikh PS, Dickey TR, Cornell KA, Quintanilla H, Huh C, Bryant SL, Johnston KP. Salt-tolerant and interfacially active nanoparticles which generate viscous and stable CO_2-in-brine foams. 5th International Colloids Conf., Amsterdam, Netherlands, June 21-24, 2015.

Worthen AJ, Foster LM, Dong J, Yu G, Bollinger JA, Truskett TM, Bryant SL, Bielawski CW, Johnston KP. Emulsions of oil in seawater stabilized with particles and surfactants. American Institute of Chemical Engineers Annual Meeting, Atlanta, GA, November 16-21, 2014.

Worthen AJ, Parikh PS, Chen Y, Bryant SL, Huh C, Johnston KP. Carbon dioxide-in-water foams stabilized with a mixture of nanoparticles and surfactant for CO_2 storage and utilization applications. GHGT-12, Austin, TX, October 5-9, 2014.

Worthen AJ, Johnston KP, Hirasaki GJ, Nguyen QP, Bryant SL, Huh C, Chen Y, Elhag AS. Design of surfactants and nanoparticles for CO_2 sequestration, Enhanced Oil Recovery, and electromagnetic imaging. 247th American Chemical Society National Meeting & Expo, Dallas, TX, March 16-20, 2014.

Worthen AJ, Bagaria HG, Chen Y, Bryant SL, Huh C, Johston KP. Carbon dioxide-in-water foams stabilized with nanoparticle and surfactant amphiphiles. 245th American Chemical Society National Meeting & Expo, New Orleans, LA, April 7-11, 2013.

Worthen AJ, Bagaria HG, Chen Y, Bryant SL, Huh C, Johnston KP. SPE 154285, Nanoparticle stabilized carbon dioxide in water foams for Enhanced Oil Recovery. SPE Improved Oil Recovery Symposium, Tulsa, OK, April 14-18, 2012.

Project Experience

Construction Material Failures

Dr. Worthen has led failure investigations across a wide range of construction materials in both litigation and consulting contexts, including roofing systems, coatings, adhesives, concrete, flooring, and building envelope components. Representative engagements include:

- Investigated the root cause of paint failures at a major regional hospital, evaluating coating formulation, surface preparation, application conditions, and adhesion mechanisms to determine the cause of premature coating breakdown.
- Investigated coating failures on concrete tilt-wall panels in a commercial construction dispute proceeding to arbitration, evaluating coating composition, surface preparation, and application practices against applicable standards.
- Investigated damage to floor coatings, plastic components, and electrical parts at a food processing facility following sanitation cleaning operations, evaluating whether cleaning chemical exposure caused the observed material degradation.
- Investigated roofing underlayment failures in multiple related construction defect matters, evaluating asphalt and felt underlayment composition and performance against applicable standards, including providing trial testimony.
- Investigated fiber-reinforced sheet pile and wale beam failures at a marine construction site, evaluating fiberglass composite material performance and construction discrepancies.
- Investigated alleged contamination and degradation of plastic construction materials in an apartment complex, evaluating whether mold remediation chemicals caused corrosion and material damage to mechanical systems.
- Investigated waterproof coating performance issues on asphaltic coatings in a commercial property dispute.
- Investigated an in-ground pool leak alleged to result from seam separation, evaluating liner material performance.
- Investigated bubbling and delamination of resilient vinyl flooring used in healthcare applications at major hospitals in the Pacific Northwest.

Construction Defect Litigation

Dr. Worthen has provided technical support and expert testimony across a substantial portfolio of construction defect litigation matters, including multi-party disputes in state court, federal court, and domestic arbitration. Representative engagements include:

- Served as a testifying expert in construction defect litigation involving roofing underlayment failures, providing both deposition and trial testimony regarding material composition, performance, and causation.
- Provided technical analysis and expert testimony in multiple construction defect matters involving PEX plumbing systems in high-rise residential and hotel buildings in Hawaii, supporting law firms representing owners, contractors, and developers.
- Provided mediation testimony in construction defect litigation matters to translate technical findings into useful takeaways for attorneys, judges, mediators, and insurance carriers, supporting successful resolution of multi-party disputes.
- Investigated alleged construction defects at a large multi-unit residential building involving fire stopping materials, plastic pipe, CPVC, and building envelope systems, evaluating material compatibility and installation practices in support of litigation counsel.
- Supported multiple domestic arbitration proceedings involving welded PVC and HDPE pipe systems, evaluating welding procedures, material properties, and failure mechanisms.
- Investigated delamination of cabinetry in several commercial disputes, evaluating contact adhesive failure mechanisms, adhesive manufacturing practices, and installation practices.

Plastic Pipe Failure Analysis

Dr. Worthen has investigated plastic pipe and tubing failures across a wide range of systems, pipe materials, and end-use environments, with particular depth in PEX failures in multi-unit residential and hospitality construction. Representative engagements include:

- Investigated PEX tubing failures at multiple high-rise condominium buildings in Honolulu, Hawaii, evaluating oxidative degradation, chlorine exposure, installation practices, and manufacturing quality in systems supplied by a major PEX manufacturer; supported multiple law firms across related matters.
- Investigated PEX plumbing failures at hotel properties in Hawaii and the Pacific Northwest, evaluating failure mechanisms including slow crack growth and oxidative degradation in domestic water systems.
- Investigated HDPE pipe failure in a produced water pipeline that resulted in an environmental spill, evaluating chemical compatibility, material properties, and installation conditions.
- Investigated HDPE pipe failure in a water distribution application involving a wrongful death claim, evaluating pipe material properties and failure mechanisms.
- Investigated polypropylene plumbing component failures at a residential building, evaluating material composition, joining methods, and degradation mechanisms.
- Investigated CPVC pipe and fire sprinkler system issues at a large multi-unit residential building, evaluating material compatibility between CPVC and fire stopping sealants and other construction materials.
- Investigated CPVC pipe failures that caused water damage to a commercial building, evaluating cracking mechanisms and installation practices.
- Investigated failures of welded PVC and HDPE pipe systems in an industrial application, evaluating welding procedures and material performance.
- Investigated a leaking rubber hose at an assisted living facility, evaluating hose material properties, aging mechanisms, and failure cause.
- Investigated a water loss at a high-rise commercial building originating from a plumbing fitting failure, evaluating fitting material properties and installation conditions.

Chemical Engineering & Material Failures

Dr. Worthen applies chemical engineering principles to failure investigations involving complex material systems, including polymer formulations, adhesives, coatings, and specialty chemicals. Representative engagements include:

- Investigated unexpected gelation and processing problems in a fiberglass resin system for a composite manufacturer, evaluating resin chemistry, catalyst systems, and processing conditions to identify the source of premature cure.
- Investigated a trade secret dispute involving emulsion and demulsifier formulations, evaluating chemical composition and formulation design through analytical chemistry methods.
- Investigated contact adhesive failures in cabinetry and laminate products, evaluating adhesive chemistry, application conditions, and substrate compatibility.
- Investigated brine chemistry and composition in a truck-mounted spray rig used for road ice prevention, evaluating chemical composition and raw material properties.

- Investigated rubber hose failure in an industrial application that contributed to an explosion, evaluating hose material properties, chemical compatibility, and potential degradation mechanisms.
- Investigated polymer webbing failures on cargo tie-downs aboard a roll-on/roll-off (RoRo) vehicle carrier, evaluating material properties and degradation mechanisms.
- Investigated failure of plastic valves used in a food contact application, evaluating material compatibility, chemical exposure, and failure mechanisms.

Product Stewardship & Regulatory Risk

Dr. Worthen has led product stewardship and regulatory compliance assessments for manufacturers across consumer products, medical devices, and industrial applications. Representative engagements include:

- Led a flame retardant research and analysis program for a major appliance manufacturer, evaluating plastic additive systems and regulatory compliance requirements.
- Supported a manufacturer of fluid handling equipment to evaluate a potential product recall scope due to material performance concerns of a polymer-based material.
- Supported a medical device manufacturer with complaint data review, sensor performance evaluation, and risk assessment for an infusion system.
- Supported a major food and beverage company in a product performance and product stewardship investigation related to product packaging performance.
- Supported a solar panel manufacturer with regulatory compliance concerns due to potential manufacturing and materials issues, evaluating product failure modes and effects.
- Supported a specialty chemical company in evaluating a polymer-based superabsorber technology for expansion into the cosmetics market, assessing formulation design and product performance.
- Conducted a compliance evaluation of electronics for a technology company, assessing potential failure modes and product performance relative to regulatory requirements.
- Supported a flooring product manufacturer with per- and polyfluoroalkyl substances (PFAS) concerns, examining manufacturing processes and identifying potential sources of PFAS.

Deposition & Trial Testimony

Dr. Worthen has experience translating materials science, polymer, and chemical engineering analysis into expert opinions on product performance, failure causation, and compliance with consensus standards in construction defect, product liability, and commercial litigation. He has provided deposition and trial testimony in state courts in Florida, Hawaii, Oklahoma, and Texas.

Expert Services Related to PEX Plumbing Failures in High-Rise Residential Construction.

- Provides expert consulting services on behalf of a general contractor in a construction defect matter involving cross-linked polyethylene (PEX) plumbing failures in a large high-rise residential condominium in Hawaii.
- Assessments include site observations, water chemistry testing, and laboratory characterization of failed tubing, including optical microscopy, Fourier-transform infrared spectroscopy (FTIR), and oxidation induction time (OIT) analysis.

- Analyses address the root causes and contributing factors of the tubing failures, including the influence of bend guides, differences between original and repaired tubing, and the manufacturer's labeling, claims, and formulation changes.
- Opinions also relate to the standards used to test and certify PEX tubing (ASTM F876, NSF 14, NSF 61, ASTM F2023) and responses to manufacturer's expert reports.

Expert Services Related to Roofing Underlayment Performance and Water Intrusion Claims.

- Provides technical support in litigation, including deposition and trial testimony, on behalf of a roofing underlayment manufacturer in multiple residential reroofing disputes alleging product defects following water intrusion events.
- Assessments include evaluation of how the asphalt-saturated felt underlayment was designed, manufactured, certified, and advertised, and whether laboratory testing demonstrated that it met the requirements of the applicable ASTM specification.
- Analyses include the application of consensus standards (ASTM D226 and ASTM D4869) and the Florida Building Code to the product at issue, and the role of weather and installation conditions in causing the observed water intrusion.
- Opinions relate to whether field observations and testing performed by opposing experts demonstrated a manufacturing or design defect in the underlayment.
- Also provides critical review of opposing experts' reports, including their application of test standards, building code provisions, and engineering concepts to the product.

Expert Services Related to Product Liability and Commercial Disputes.

- Provided deposition testimony in a product liability matter in Oklahoma state court on behalf of a sports equipment manufacturer.
- Provided deposition testimony in a commercial dispute in Texas state court on behalf of a chemical manufacturer.
- Assessments relate to product performance, including laboratory testing, manufacturing process review, and evaluation of alleged failure modes and potential root causes.