

Mr. Nagalia is a failure analysis investigator specializing in polymer engineering, applying forensic methodologies and the scientific method to systematically analyze and resolve failures in polymer-based materials, plastic and elastomeric components, and products and engineering systems. His investigative approach involves identifying failure modes, diagnosing root causes, and providing data-driven recommendations to enhance material performance and reliability. His expertise encompasses service life assessment of plastic components and products, where he evaluates how materials degrade over time under mechanical, thermal, chemical, and environmental stressors. He conducts chemical interaction studies to understand how polymers respond to exposure from external agents such as solvents, oils, fuels, chemicals, and environmental conditions that may lead to swelling, embrittlement, softening, or stress cracking.

With a strong foundation in material chemistry, molecular structure, and processing techniques, he evaluates the relationship between material properties and product performance. He applies ASTM and ISO standards to conduct standardized material testing and employs advanced characterization techniques, including but not limited to Fourier transform infrared spectroscopy (FTIR), Differential scanning calorimetry (DSC), Thermogravimetric analysis (TGA), and Scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS), to analyze polymer composition, degradation behavior, and failure mechanisms. His knowledge and experience with these standards, testing methodologies, and analytical techniques ensures precise material evaluation and performance assessment. By integrating these capabilities, Mr. Nagalia helps mitigate failures, enhance product reliability, and improve the performance of plastic materials in real-world applications. His work directly benefits manufacturers, product designers, quality assurance teams, regulatory bodies, and industries reliant on polymer-based components, ensuring safer and more durable materials across various sectors.

As an active member of ASM International and the Society of Plastics Engineers (SPE), Mr. Nagalia regularly presents in the failure analysis sessions at technical conferences such as SPE – ANTEC and ASM International – IMAT. He also serves on several planning committees for these professional organizations and is a Board Member of the SPE Chicago Section.

Prior to joining ESI, Mr. Nagalia was a Materials Science Instructor at Don Bosco Technical Institute, where he taught courses and managed laboratory operations. Previously, he worked as an automotive engineer, conducting failure analysis on noise, vibration, and harshness (NVH) plastic

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Education
MS, Materials Science and
Engineering, University of Texas,
2014

BE, Polymer Engineering,
University of Pune, 2012

Areas of Specialization

Material Characterization
Plastics Failure Analysis
Mechanical Testing
Non-Destructive Testing
Macromolecule Physics
Plastic Manufacturing
Product Development
Service Life Prediction
Material Selection

components for vehicle interiors. His additional experience includes ceramic material characterization and the development of concrete-based ceramic composites.

Positions Held

Engineering Systems Inc., Aurora, Illinois

- Senior Staff Consultant, 2018 - Present

Don Bosco Technical Institute, Rosemead, California

- Materials Science Instructor, 2016 - 2018

UNG Inc., Valparaiso, Indiana

- R&D Materials Engineer, 2015 – 2016

University of Texas, Arlington, Texas

- Graduate Research Assistant, 2012 – 2015

DSM, Pune, Maharashtra

- Plastics Engineer Inter, 2011

Teaching

“Mechanical Testing of Materials,” 2016 – 2018

“Non-Destructive Testing of Materials,” 2016 – 2018

“Materials for Design Engineers,” 2016 – 2018

“Introduction to Polymer Science,” 2016 – 2018

“Chemical Analysis,” 2016 – 2018

Publications

A.R. Shah, E.D. Bain, **G. Nagalia**, “A study of CPVC Fire Suppression Sprinkler Pipe Chemical Compatibility with common Plasticizers found in Wires and Cables” Society of Plastics Engineers, ANTEC® 2024, Philadelphia, PA, Mar 2025

G. Nagalia, “Wear Failures of Plastics,” ASM Handbook, Volume 11B, Characterization and Failure Analysis, ASM International, Feb 2022

G. Nagalia, A.R. Shah “Failure Analysis of Products with Plastic to Metal Threaded Connections,” Society of Plastics Engineers, ANTEC® 2021: The Virtual Edition, May 2021

G. Nagalia, A.R. Shah, D.B. Edwards “Failure Analysis of Polymer Coating Systems,” Society of Plastics Engineers, ANTEC® 2020: The Virtual Edition, Mar 2020

G. Nagalia, Y. Park, A. Abolmaali, P. Aswath "Compressive Strength and Microstructural Properties of Fly Ash-Based Geopolymer Ceramic Composite," Journal of Materials in Civil Engineering, Dec 2016

Presentations

A.R. Shah, E.D. Bain, **G. Nagalia**, "A study of CPVC Fire Suppression Sprinkler Pipe Chemical Compatibility with common Plasticizers found in Wires and Cables" Society of Plastics Engineers, ANTEC® 2024, Philadelphia, PA, Mar 2025

G. Nagalia, A.R. Shah, Dr. E.H. Knox, and Dr. P.D. Umberger, Oct 2024 "Importance of Standard Test Methods in Investigations of FRP Composite Ladders" ASM International IMAT 2024, Cleveland, OH, Sept 2024

J.R. Babcock, M.E Weiss, **G. Nagalia**, "Characterization of over 50-year-old Polyethylene Natural Gas Distribution Pipe" ASM International IMAT 2024, Cleveland, OH, Sept 2024

G. Nagalia, L.N. Meissner, Dr. J.R. Babcock, A.R. Shah "Failure Analysis of TPU Gaskets used in Hydraulic Fluid Systems;" ASM International IMAT 2023, Detroit, MI, Oct 2023

J.R. Babcock, M.E. Weiss, **G. Nagalia**, "Failure Analysis of Spray Polyurethane Foam (SPF) Insulation," ASM International IMAT 2023, Detroit, MI, Oct 2023

B.M. May, J.G. Jordan, L.M. Marsh, M.A. Lewis, **G. Nagalia**, "Failure Investigation of a Nickel-Metal Hydride Battery Cell," ASM International IMAT 2023, Detroit, MI, Oct 2023

G. Nagalia, E.D. Bain, A.R. Shah "Failure of Plastic Components caused by response to COVID-19 Pandemic", ASM International IMAT 2022, New Orleans, LA, Sept 2022

E.J. Manuel, **G. Nagalia** "Identification of Mixed In-Service Automotive Fluids inside a CVT and Differentials," ASM International IMAT 2022, New Orleans, LA, Sept 2022

G. Nagalia, A.R. Shah "Failure Analysis of Products with Plastic to Metal Threaded Connections," Society of Plastics Engineers, ANTEC® 2021: The Virtual Edition, May 2021

G. Nagalia, A.R. Shah, D.B. Edwards "Failure Analysis of Polymer Coating Systems," Society of Plastics Engineers, ANTEC® 2020: The Virtual Edition, Mar 2020

G. Nagalia, P. Aswath "Development and Analysis of Fly Ash based Geopolymer Concrete" ASM North Texas Annual Conference, Nov 2013

Guest Lectures

"Plastic Failure Analysis and Material Selection" Industrial Design class at College of Fine & Applied Arts, University of Illinois-Urbana Champaign, Mar 2024

"Failure of Plastic Components caused by response to COVID-19 Pandemic", ASM Minnesota Chapter Meeting, Nov 2022

Peer – Reviewed Publications

“Performance Evaluation of Polyamide-12 Pipe Serviced in Acid Oil and Gas Environment” Journal of Failure Analysis and Prevention, JFAP-21-08-3139, completed review in Sep 2021

“Creep Failure Mechanisms,” ASM Handbook, Volume 11B, Characterization and Failure Analysis, ASM International, completed review in Jul 2021

“Flammability Testing,” ASM Handbook, Volume 11B, Characterization and Failure Analysis, ASM International, completed review in Jun 2021

“Experimental investigation of FSW process on high-density polyethylene (HDPE)” Journal of Failure Analysis and Prevention, JFAP-19-11-2360, completed review in Jan 2020

Continuing Education

- **Principles of Failure Analysis** - ASM International, Nov 8-11, 2021
- **Formulating Thermoplastics with Non-Halogen Flame Retardants: An Introduction** - Society of Plastic Engineers (SPE), Feb 2021
- **Root Cause Analysis** - J.E. Lincoln and Associates LLC, Nov 2020
- **Operation of Counterbalanced (Gas/Electric) Forklift** - OSHA Certified, Jan 2019

Professional Affiliations/Honors

American Society of Materials (ASM) International

- Author, ASM Handbook Volume 11B Chapter Article
- Member, Failure Analysis Society (FAS)
- FAS Programming Committee, Co-Chair, IMAT 2023, IMAT 2024

Society of Plastics Engineers (SPE)

- Board of Directors, SPE Chicago Section 2021-24
- Member, Failure Analysis and Prevention Technical Interest Group (FAPTIG)

American Nuclear Society

- Member
- Graduate Student of the Year, 1986, Materials Science and Technology Division

American Society for Testing and Materials (ASTM) International

- Member, Committee C14 – Glass and Glass Products
- Member, Committee D17 – Plastic Piping Systems
- Member, Committee D20 – Plastics

Project Experience

Investigations

Aerosol Can Failure Investigation

A newly purchased aerosol can, containing a multi-surface cleaner, was being utilized in a kitchen of a home residence when it slipped and fell on a carpeted floor causing the can to ricochet around before hitting and causing injury to plaintiff. The investigation involved conducting a non-destructive examination of the subject, testing of exemplar cans, performing comparative computed tomography (CT) scanning, and review of relevant technical literature. From this investigation, it was determined the subject can have a manufacturing defect that resulted in the failure incident. This defect was observed to be an insufficient crimp between the valve component and the can body resulting in separation of these components during impact and release of propellant and product cleaning mixture turning the can into a projectile with sufficient kinetic energy to do harm. This analysis was utilized by counsel to successfully settle and resolve the legal matter that had arisen as a consequence.

Spray Foam Insulation Investigation

Residential home construction was halted during installation of spray foam (SPF) insulation due to allegations of high levels of volatile organic compounds (VOCs) being released from the SPF causing an unsafe environment. This matter was investigated to provide the client with technical assistance. As part of this investigation, conducted review of file material related to the construction, review of applicable engineering standards, review of product data sheets, conducted a forensic examination which included an on-site inspection, testing of the air sampled from the interior of the incomplete residential construction site as well as testing of SPF sampled during the on-site inspection. Based on this investigation, no evidence of improper installation of SPF in the subject residence was identified. While there were some VOCs identified from the foam samples, they were none found in the air samples collected. The foam was determined to be a polyurethane material and from characterization data, it was determined to be fully cured and free of defects.

Laboratory Examination

Polymer Clothing Laboratory Examination

An alleged rail car impact was claimed to be a cause of a fatality. In support of this claim, counsel for the deceased provided opinions based on photographs of deceased clothing. An investigation was launched and as a part of it, a laboratory examination of the subject clothing including a nylon safety vest as well as review of relevant technical literature was conducted. The examination involved visual examination for macro-observations, stereomicroscopy of areas of interest as well as the fibers, yarns and weave formed by the intertwining fiber yarns in the subject clothing, and chemical analysis of fibers, and residues located on subject clothing using FTIR. The analysis of data obtained from this examination found there was no evidence of blunt force damage on the subject clothing to support the claims that were made and thus, there was no merit to the opinions offered by the opposing counsel. The analysis of the subject polymer clothing was a major part of the investigation and led to successful settlement and resolution to the litigation matter.

Failure Analysis

Medical Device Failure Analysis

A health care testing manufacturing company was having quality issues due to imperfections such as surface cracking developing in a manufactured component used in COVID-19 PCR Rapid test equipment during early stages of COVID pandemic in 2021 halting production and causing a backlog of inventory resulting in a loss of over hundred thousand dollars daily. These cassettes were made of injection molded polystyrene having a biaxial oriented polystyrene (BOPS) film welded on the outer surface. Failure analysis conducted included visual examination and polymer characterization of multiple cassettes. Based on the analysis, it was concluded that the cracking was illusionary and due to wrinkling in the film layer attributed to welding process issues, but cassette body remained intact and free of defects. This analysis helped the client navigate the production quality issues and make crucial decisions to improve their welding process and resume production.

60-inch HDPE Pipe Failure Analysis

Failure in the form of both circumferential and longitudinally oriented cracking of subsurface storm water drainage pipelines made of high-density polyethylene (HDPE) having corrugations on the outside surface and having an internal diameter of 60 inches resulted in collapse of surface roads leading to an investigation and remediation efforts. Analysis of sections of the failed pipes was conducted to assist with this investigation. From this analysis, material degradation or embrittlement of the HDPE material due to chemical attack or UV exposure was ruled out. The failure in the pipe sections was concluded to be a result of corrugations being stressed due to long-term mechanical loading resulting in circumferential cracking. The loading got transferred onto thin walled inside liner component, stressing the liner resulting in buckling and eventual failure from slow crack growth failure mechanism.

Chemical Transfer Hose Failure Analysis

A composite chemical transfer hose that was being used daily for approximately 10 months had failed in service due to a tear developing through the wall at the outlet end, resulting in a chemical leak. Failure analysis of this subject hose included conducting a visual examination, stereomicroscopy, fractography, material characterization, review of product literature, and a review of installation and assembly guidelines. The root cause of the failure was determined to be a consequence of installation-related practices leading to the development of higher-than-expected stresses within the hose wall consistently over regular intervals of time for a period of ten months. This analysis enabled the client to take immediate action and correct installation practices and provide appropriate training to users.

Viton Gasket Hose Failure Analysis

A full-face Viton fluorocarbon gasket that was part of a rail tank car manway system fitting plate assembly was failing resulting in leakage of hydrochloric (HCl) fumes that the tank car was transporting. The failure analysis involved conducting material characterization, mechanical testing, a stress analysis to determine the appropriate torque values for bolting the gasket to fitting plate, and review of investigative reports by other parties. Based on this analysis, the main leak site was identified to be located at a crack in the Ultra-high molecular weight polyethylene (UHMWPE) liner at a weld fusion joint. It was concluded that weep channels within the fitting plate acted as passages for the leaking HCl fumes causing continuous chlorine exposure resulting in surface degradation and wear deformation of the Viton gasket. This analysis enabled the client to take immediate action and redirect efforts in addressing the main failure.

Material Selection

Mini Cooler Material Selection

During a six-month timeframe, assisted an industrial client in conducting material selection of phase change materials (PCMs) as part of product development of a mini cooler product designed to be used for holding biological samples at specific cryogenic temperatures and protect from temperature fluctuations. Multiple phases involved conducting material characterization of competitor products and systems, physical testing of sub-components, conducting literature research on PCMs, conducting material, thermodynamics, and heat transfer analysis, conducting a market survey to locate vendors with comparable PCMs in the North America marketplace, and building and conducting performance testing on prototypes with candidate PCMs. This overall analysis resulted in selection of appropriate materials providing optimized performance for the intended application supported by scientific test data.

Volunteering Activities

- Neuqua Valley High School - Provided routine feedback to students for a 1-year engineering design class project, 2023-2024.
- Marie Wilkinson Food Pantry, Loaves & Fishes - Organized food drive campaigns, 2023
- Hesed House - Hands-on Volunteering at Enchanted Backpack, 2022-2023
- Richard J. Daley College, Chicago - ASM Teachers Summer Camp, June 2022
- UT Arlington - ASM Students Summer Camp, 2013-2014