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GAURAV NAGALIA, M.S.
SENIOR STAFF CONSULTANT

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

Areas of Specialization

- Failure Analysis
- Root Cause Investigation
- Material Characterization
- Fractography
- Mechanical Testing
- Non-Destructive Testing
- Performance Testing
- Material Selection
- Material Processing
- Service Life Prediction
- Product Design
- Product Development

Education

M.S., Materials Science and Engineering, University of Texas, Arlington, Texas, 2014
B.E., Polymer Engineering, University of Pune, Pune, Maharashtra, 2012

Professional Affiliations

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 – 2025

Society of Plastics Engineers (SPE)

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

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

Positions Held

Engineering Systems, Inc. (ESi), Aurora, Illinois
Senior Staff Consultant, 2018 – Present

Don Bosco Technical Institute, Rosemead, California
Materials Science Instructor, 2016 – 2018

UGN Inc., Valparaiso, Indiana
R&D Materials Engineer, 2015 – 2016

University of Texas, Arlington, Texas
Graduate Research Assistant, 2012 – 2015

DSM, Pune, Maharashtra
Plastics Engineer Intern, 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

Continuing Education/ Training

Attended “Principles of Failure Analysis” by ASM International, Nov 8-11, 2021

Attended Webinar on “Formulating Thermoplastics with Non-Halogen Flame Retardants: An Introduction” by Society of Plastic Engineers (SPE), Feb 2021

Attended Webinar on “Root Cause Analysis” by J.E. Lincoln and Associates LLC, Nov 2020

OSHA Certified, Operation of Counterbalanced (Gas/Electric) Forklift, Jan 2019

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

Conference 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, E.H. Knox, 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, 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

“Failure Analysis of Fiberglass Reinforced Polymer Composite Ladders”, Werner Outside Counsel Meeting Ladder Summit, IL Mar 2025

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

“Plastics Failure Analysis and Case Studies for Nalco Water, An Ecolab Company” Oct 2023

“Plastics Failure Analysis and Case Studies for G&E Electric Company” Apr 2023

“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

Select Project Highlights

Aerosol Can Failure Investigation

Investigated the failure of a multi-surface cleaner aerosol can that became a projectile after impact, causing injury to the plaintiff. The analysis involved non-destructive examination, testing of exemplar cans, comparative computed tomography (CT) scanning, and review of relevant technical literature. Identified a manufacturing defect—an insufficient crimp between the valve component and can body—that led to component separation upon impact, resulting in an uncontrolled release of propellant and cleaning mixture. Findings contributed to a successful legal resolution.

Spray Foam Insulation Investigation

Conducted a forensic investigation into allegations of elevated volatile organic compound (VOC) emissions from spray polyurethane foam (SPF) insulation at a halted residential construction site. The analysis involved reviewing construction file materials, applicable engineering standards, and product data sheets; performing an on-site inspection; and conducting air and material sampling tests. Results indicated no evidence of improper SPF installation, with VOCs detected in foam samples but absent in collected air samples. Material characterization confirmed that the SPF

was fully cured, defect-free, and consistent with polyurethane composition. Findings supported the resolution of the dispute.

Polymer Clothing Laboratory Examination

Conducted a forensic investigation into claims that a rail car impact caused a fatality, with opposing counsel basing opinions on photographs of the deceased's clothing. The analysis included laboratory examination of the subject clothing, including a nylon safety vest, along with a review of relevant technical literature. Investigative methods involved visual and stereomicroscopic examination of fabric structure, fiber and yarn analysis, and Fourier Transform Infrared Spectroscopy (FTIR) for chemical characterization of fibers and residues. Findings revealed no evidence of blunt force damage to the clothing, refuting the claims and undermining the opposing counsel's opinions. This analysis played a key role in achieving a successful legal resolution.

COVID-19 PCR Medical Device Component 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.

Mini Cooler Material Selection

Assisted an industrial client in the material selection of phase change materials (PCMs) for a mini cooler designed to maintain biological samples at specific cryogenic temperatures while minimizing temperature fluctuations. Over a six-month period, conducted a comprehensive analysis involving material characterization of competitor products, physical testing of sub-components, literature research on PCMs, and thermodynamic and heat transfer analysis. Additionally, performed a market survey to identify North American vendors with suitable PCMs and developed prototype units for performance testing. The investigation led to the selection of optimized materials backed by scientific test data, ensuring enhanced product performance for the intended application.

60-inch HDPE Pipe Failure Analysis

Investigated the failure of 60-inch diameter HDPE stormwater drainage pipelines with external corrugations, which led to surface road collapses. Conducted material analysis on failed pipe sections to assess potential causes, ruling out degradation from chemical attack or UV exposure. Determined that long-term mechanical loading induced stress on the corrugations, leading to circumferential cracking. This load transfer caused buckling of the thin-walled inner liner, ultimately resulting in failure via slow crack growth. Longitudinal cracking was attributed to fast fracture due to the developed stress state. Findings supported remediation efforts and informed future pipeline design considerations.

Composite Chemical Transfer Hose Failure Analysis

Conducted a failure analysis on a composite chemical transfer hose that failed in service after approximately 10 months of daily use, resulting in a chemical leak due to a tear at the outlet end. The investigation included visual examination, stereomicroscopy, fractography, material characterization, and a review of product literature and installation guidelines. Findings identified improper installation practices as the root cause, leading to cyclic stress buildup within the hose wall. The analysis provided actionable recommendations, enabling the client to correct installation procedures and implement targeted training for users.

Viton Gasket Failure Analysis

Investigated the failure of a full-face Viton fluorocarbon gasket in a rail tank car manway system, which resulted in hydrochloric acid (HCl) fume leakage. The analysis included material characterization, mechanical testing, stress analysis to determine proper bolting torque, and a review of external investigative reports. The root cause was traced to a crack in the Ultra-High Molecular Weight Polyethylene (UHMWPE) liner at a weld fusion joint, with weep channels in the fitting plate facilitating HCl fume exposure, leading to gasket degradation. Findings enabled the client to take immediate corrective action by addressing the primary failure source.

Volunteering Activities

Provided routine feedback to students for a 1-year engineering design class project at Neuqua Valley High School, 2023-2024

Organized food drive campaigns for Marie Wilkinson Food Pantry, Loaves & Fishes, 2023

Hands-on Volunteering at Enchanted Backpack, Hesed House, 2022-2023

ASM Teachers Summer Camp, Richard J. Daley College, Chicago, Jun 2022

ASM Students Summer Camp, UT Arlington, 2013-2014