



GAURAV NAGALIA, M.S.

SENIOR STAFF CONSULTANT

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Mr. Gaurav Nagalia is a polymer engineer with 10+ years' experience providing technical and management expertise. He is experienced in analysis of products manufactured from polymer, polymer composites, rubber, and ceramic materials. Mr. Nagalia applies his knowledge in material chemistry, material characterization, chemical analysis, thermal analysis, and processing techniques to investigate products from various industries. Mr. Nagalia routinely performs investigations related to plastic product failure analysis. These investigations are related to failures in polymer coatings, plastic films, sheets and laminates, polymer-based adhesives, and lubricants, molded and extruded plastic products with complex geometries such as threaded and flanged connections.

Prior to joining ESi, Mr. Nagalia was employed by Don Bosco Technical Institute as a Materials Science Instructor where he taught courses and managed laboratories associated with the department. Prior to that he worked as an engineer in the automotive industry conducting failure analysis on noise, vibration, and harshness (NVH) plastic products used for interior applications in automobiles.

Mr. Nagalia's additional experience includes characterization of ceramic materials and processing methods of ceramic materials. Mr. Nagalia has experience developing, testing, and analyzing concrete based ceramic composites.

Areas of Specialization

- Material Characterization (FTIR, DSC, TGA, SEM/EDS, XRD, XRF, DMA, GC-MS, GPC, etc.)
- Plastics Failure Analysis
- Mechanical Testing (Tensile, etc.)
- Non-Destructive Testing (CT, etc.)
- Macromolecule Physics
- Plastic Manufacturing
- Product Development
- Project Management
- Service Life Prediction
- Material Selection

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, 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 Society for Testing and Materials (ASTM) International

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

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

Technical Presentations

“Failure Analysis of TPU Gaskets used in Hydraulic Fluid Systems”; IMAT 2023, with L.N. Meissner, Dr. J.R. Babcock, and A.R. Shah, Oct 2023

“Failure Analysis of Spray Polyurethane Foam (SPF) Insulation”, IMAT 2023, with Dr. J.R. Babcock, and M.E. Weiss, Oct 2023

“Failure Investigation of a Nickel-Metal Hydride Battery Cell”, IMAT 2023, with Dr. B.M. May, J.G. Jordan, L.M. Marsh, and M.A. Lewis, Oct 2023

“Identification of Mixed In-Service Automotive Fluids inside a CVT and Differentials”, IMAT 2022, with E.J. Manuel, Sept 2022

“Failure of Plastic Components caused by response to COVID-19 Pandemic”, IMAT 2022, with Dr. E.D. Bain and A.R. Shah, Sept 2022

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

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

“Development and Analysis of Fly Ash based Geopolymer Concrete” ASM North Texas Annual Conference, with Dr. P. Aswath, 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

Publications

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

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

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

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

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

Mr. Nagalia has assisted 100+ organizations from various industries by conducting material analysis, failure analysis, and leading investigations over a span of over 300 engineering project matters. Industries that benefited from these investigations include agricultural, aerospace, automotive, construction materials, coatings, adhesives, molded plastics, rubbers, consumer products, electrical & electronics, HVAC, medical, oil and gas, packaging, pharmaceutical, plumbing, rail, and textiles, etc. Some project examples:

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, determined the subject can to 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

A 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.

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.

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.

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 product and system, 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.

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 the 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. The longitudinal cracking observed in the pipe sections was determined to be a result of fast fracture due to the stress state that developed across the pipe sections.

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 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.

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