

# Anand (Andy) R. Shah, MS, MBA, PE

Principal, Director Polymeric, Composite & Non-Metallic Materials Practice



As a Principal and a Director of the Polymeric, Composite & Non-metallic Materials practice, Mr. Shah oversees materials and analysis personnel and related work across offices of ESI.

Mr. Shah conducts and leads investigations on the performance of products made from plastics, composites, and elastomeric materials for use in diverse applications. He specializes in product failure analysis, material characterization testing, investigations on the appropriateness of the choice of materials for their intended application, evaluating the influence of processing parameters on product performance, and in evaluating product design. He has published his work in numerous technical journals and is a co-author of the Fractography in Failure Analysis of Polymers book.

In his 29 years of experience, he has evaluated incidents related to product, systems, and component failures in plumbing, transportation, construction, electrical, oil and gas, chemical processing, medical, and consumer industry. His experience also includes investigating formulations of polymers in paints, coatings, adhesives, and in lubricants. He utilizes the study of interpretation of fracture surface features (Fractography) and principles of structure property relationship in polymers to provide solutions to plastic product performance and service life issues. Mr. Shah has provided testimony in matters pending before both state and federal courts.

## Licenses & Certifications

- State of Illinois License No. 062-058788
- State of Alabama License No. 38935-E

## Positions Held

### Engineering Systems Inc., Aurora, Illinois

- Principal, 2018 – Present
- Senior Managing Consultant, 2015 – 2018
- Senior Consultant, 2010 – 2015

### Illinois Institute of Technology, Chicago, Illinois

- Adjunct Faculty, MMAE Department, 2014 – 2023

### Packer Engineering, Inc., Naperville, Illinois

- Director, Materials Engineering, 2005 – 2010

### Bodycote Polymer Broutman Lab, Melrose Park, Illinois

- Manager, Materials Testing, 2000 – 2005

## Anand (Andy) R. Shah, MS, MBA, PE

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### ESi Aurora

4215 Campus Drive  
Aurora, IL 60504

### Education

BS, Biomedical Engineering, Case Western Reserve University, Cleveland, OH, 1995

MS, Macromolecular Science, Case Western Reserve University, Cleveland, OH, 1986

M.B.A., Business Administration, DeVry University, Chicago, Illinois, 2003

### Areas of Specialization

Plastic Failure Analysis

Environmental Stress Cracking in Plastics Consumer Products

Material Selection Consulting

Fatigue and Fracture Mechanics

Product Design Evaluation

Creep and Stress Rupture of Plastic

Chemical Compatibility Testing

Service Life Prediction

Analytical Testing

Non-Destructive Testing & Inspection

Mechanical Testing



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## **Broutman and Associates, Chicago, Illinois**

- Senior Research Engineer, 1997 - 2000

## **Publications**

- "A Study of CPVC Fire Suppression Sprinkler Pipe Chemical Compatibility with common Plasticizers found in Wires and Cables," Society of Plastics Engineers, ANTEC® 2025 Conference, Philadelphia, PA, March 3-6, 2025, with Dr. Erich D. Bain, Mr. Gaurav Nagalia
- "Best Safety Practices for Stability of PVC Pipe Bundles During Transport," Proceedings of the XXXVth Annual International Occupational Ergonomics and Safety Conference, Munich, Germany, October 9-10, 2023, with Dennis B. Brickman, Gary Rogers, Lance Rewerts and John Petersen
- "Fracture of Plastics" Characterization and Failure Analysis of Plastics, ASM Handbook, Volume 11B, ASM International, 2022, with D.B. Edwards
- "Failure Analysis of Products with Plastic to Metal Threaded Connections," Society of Plastics Engineers, ANTEC® 2021: The Virtual Edition, with D. B. Edwards
- "Failure Analysis of Polymer Coating Systems," presented at the Society of Plastics Engineers, ANTEC® 2020: The Virtual Edition, with G. Nagalia and D. B. Edwards
- "Service Lifetime Assessment of Polymeric Material Products," ASM Handbook, Volume 11, ASM International, 2020, with D. B. Edwards
- "Failure Analysis and Prevention," Fracture of Plastics, ASM Handbook, Volume 11, ASM International, 2019, edited with D. B. Edwards
- "Preventing Failures in Elastomeric Resistance Bands," Proceedings of the Society of Plastics Engineers Annual Technical Conference, Anaheim, CA, May 8-10, 2017, pp. 1-11 with Dennis B. Brickman, Joseph F. Grzetic, and Joseph T. Eganhouse
- "Computed Tomography X-Ray Imaging – A Technique for Non-Destructive Examination of Plastic Products," Society of Plastics Engineers Annual Technical Conference, Orlando, Florida, March 2015, with J. G. Jordan and Dr. A. Richards
- "Determination of Environmental Stress Cracking Failure Mode in Investigation of CPVC Fire-Suppression Sprinkler Pipe Failures," Proceedings of the Society of Plastics Engineers Annual Technical Conference, Orlando, Florida, April 1-4, 2012, with D. B. Edwards
- "Failure Analysis of Plastic Crimp Fitting Assemblies," Proceedings of the Society of Plastics Engineers Annual Technical Conference, Boston, Massachusetts, May 1-5, 2011, with D. E. Duvall and D. B. Edwards.
- "Preventing Plastic-Product Failures," Plastics Engineering, July 2010, pp. 22-27
- "A Discussion on Prevention of Plastic Product Failures," Society of Plastics Engineers Annual Technical Conference, Orlando, Florida, May 2010
- "The Effect of Marking Paint on Walking Surface Slip Resistance," International Conference on Slips, Trips and Falls 2007: From Research to Practice, August 2007, with D. G. Curry, R. Reinke and J. Kidd
- "Role of Finite Element Analysis – A Computer Aided Engineering Technique in Failure Analysis of Plastic Products," Proceedings of the 12<sup>th</sup> Annual International Conference on Industrial Engineering Theory, Applications, and Practice (IJIE'07), Cancún, Mexico, November 2007, with K. Nakamoto and B. Agarwal
- "Characterization of Continuous Fiber Reinforced Chemically Bonded Ceramic Composites," Materials Science & Technology 2006: Ceramic Matrix Composites, Cincinnati, Ohio, October 2006, with M. Pareek, J. Rigsby and B. Agarwal

- “Significance of Creep Rupture and Stress Relaxation Data in Product Design and Material Suitability Evaluation,” Annual Technical Conference of Society of Plastics Engineers, May 2005
- “Prediction of Service Life in a Chemically Active Environment Using Stress Rupture Data,” Journal of Applied Medical Polymers, Autumn 2000, Vol. 4, No. 2, pp. 88-93, with Dr. P. K. So and L. J. Broutman
- “Mechanical Strength Properties of Silicone Gel Filled Breast Prosthesis after Explanation,” Sixth World of Biomaterials Congress Meeting, Kamuela, Hawaii, May 2000
- “An Alternative Method for Determining the Hydrostatic Design Basis for Plastic Pipe Materials,” Proceedings of the International Plastic Pipe Symposium, Goteborg, Sweden, September 14-17, 1998, with L. J. Broutman, E. F. Palermo, and D. B. Edwards
- “Stepwise Fatigue Crack Propagation in Polyethylene Resins of Different Molecular Structure,” Journal of Polymer Science: Part B: Polymer Physics, Vol 36, pp. 2355-2369 (1998), with Dr. A. Hiltner and Dr. E. Baer
- “Fatigue Acceleration of Slow Stepwise Crack Growth in Polyethylene Pipe Materials,” International Symposium on Plastic Piping Systems for Gas Distribution, October 1997, with Dr. A. Hiltner and Dr. E. Baer
- “Study of Polyethylene Pipe Resins by a Fatigue Test that Simulates Crack Propagation in Real Pipe,” Journal of Materials Science, April 1997, with Dr. A. Hiltner and Dr. E. Baer
- “Correlation of Fatigue Crack Propagation in Polyethylene Pipe Specimens of Different Geometries,” International Journal of Fracture, September 1996, with Dr. A. Hiltner and Dr. E. Baer
- “Correlation of Fatigue Crack Propagation between Compact Tension and Real-Pipe Geometry,” Society of Plastics Engineers Annual Technical Conference, May 1996, with Dr. A. Hiltner and Dr. E. Baer

## Book Contributions

- “Fractography in Failure Analysis of Polymers,” 2<sup>nd</sup> Edition, Elsevier ISBN 978-0-443-29149-4 with Dr. Michael D. Hayes and Dale B. Edwards, 2024
- Technical Review of “Rudin and Choi’s Elements of Polymer Science and Engineering,” 3<sup>rd</sup> Edition, Elsevier ISBN: 978-0-12-382178-2
- “Fractography in Failure Analysis of Polymers,” Elsevier ISBN 978-0-323-24272-1 with Dr. Michael D. Hayes and Dale B. Edwards, 2015
- “Strength of the PC-SAN Interface as Determined by Delamination of Polymer Microlayers,” a chapter in Interfacial Aspects of Multicomponent Polymer Materials, with Dr. A. Hiltner and Dr. E. Baer

## Technical Presentations

- “Importance of Standard Test Methods in Investigations of FRP Composite Ladders;” IMAT 2024, with Dr. E.H. Knox, and Dr. P.D. Umberger, Oct 2024
- “Best Safety Practices for Stability of PVC Pipe Bundles During Transport,” XXXVth Annual International Occupational Ergonomics and Safety Conference, Munich, Germany / Hybrid, Dennis Brickman, Gary Rogers, Lance Rewerts and John Petersen, October 9, 2023
- “Failure Analysis of TPU Gaskets used in Hydraulic Fluid Systems,” IMAT 2023, with L.N. Meissner, Dr. J.R. Babcock, and Gaurav Nagalia, Oct 2023
- “Failure of Plastic Components caused by response to COVID-19 Pandemic,” IMAT 2022, with Dr. E.D. Bain and Gaurav Nagalia, Sept 2022



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"Quantifying Oxidative Degradation in Polyolefin Pipe by IR Spectroscopy," ANTEC Conference, Orlando, Florida Society of Plastic Engineers Annual Conference, with Dr. Donald E. Duvall, 2018

"Failure Analysis of Plastic Gas Piping," U.S. Department of Transportation, Transportation Safety Institute/PHMSA Seminars on Pipeline Failure Investigation Techniques, 2014 – 2016

Instructor for Failure Analysis and Prevention Annual Seminar Course offered by ESi, June 2015, August 2018, August 2023

"Introduction to Fiber-Reinforced Plastic Composites," The Lewis University Romeoville, Illinois Adjunct Professor, 2010 to 2013

Instructor for Failure Analysis and Prevention Annual Seminar Course offered by Society of Plastics Engineers and Bodycote Materials Testing, 2000-2004

## **Professional Affiliations/Honors**

### **Society of Plastics Engineers (SPE)**

- Member

### **American Society of Testing and Materials (ASTM)**

- Member

### **Society for Biomaterials**

- Member

### **Society for Advancement of Materials and Processing Engineering (SAMPE)**

- Member

## **Honors and Awards**

- Chairman for Failure Analysis and Prevention Special Interest Group of Society of Plastics Engineers for Annual Technical Meeting in Orlando, Florida, 2014-2015
- Technical Program Chair (TPC) for Failure Analysis and Prevention Special Interest Group of Society of Plastics Engineers for Annual Technical Meeting in Orlando, Florida, 2012-2013
- Moderator of Failure Analysis and Prevention session at Society of Plastics Engineers (SPE) ANTEC meetings – 2000, 2009, 2010
- Peer reviewer for Journal of Applied Polymer Science, Journal of Material Science, Society of Plastics Engineers, Society for Biomaterials and Journal of Failure Analysis and Prevention