

Characterization of Plastics in Failure Analysis

Jeffrey A. Jansen, The Madison Group

THE ULTIMATE OBJECTIVE of a failure analysis is to ascertain the mode and the cause of the failure, regardless of the material from which the part was fabricated. The investigation is performed in generally the same manner, whether the failed component was produced from metal or plastic or a combination of these materials. Thus, the same typical steps are required to conduct a comprehensive failure investigation, and these are outlined in Fig. 1. Conceptually, the failure analysis process is analogous to putting together a jigsaw puzzle. A failure analysis requires assembling bits of information into a coherent and accurate portrayal of how and why the part failed. Reaching the objectives of the plastic failure analysis—namely, the determination of the mode and cause of the failure or, expressed alternatively, evaluating how the part failed and why it failed—requires a scientific approach and broad background knowledge of polymeric materials.

Failure within plastic components can occur in several different ways, including aesthetic alteration, deformation/distortion, degradation, wear, and fracture. In the case of failure involving fracture, there are a number of common plastic failure mechanisms, such as ductile overload, impact, creep rupture, environmental stress cracking, and fatigue. The determination of the fracture failure mode involves identifying the crack-initiation mechanism and the propagation mode. This is usually ascertained using visual-based techniques such as stereomicroscopy, scanning electron microscopy, and the preparation of mounted cross sections. Assessing the mode of the failure is often not as difficult as establishing why the part failed. Evaluating why the part failed, regardless of the type of failure, usually requires analytical testing beyond the visual-based techniques. In many cases, a single cause cannot be identified because multiple integrated factors may have contributed to the failure. All the factors that affect the performance of a plastic component can be classified into one of four categories: material, design, processing/manufacturing, and service conditions/environment (Ref 1). These factors do not act independently on the

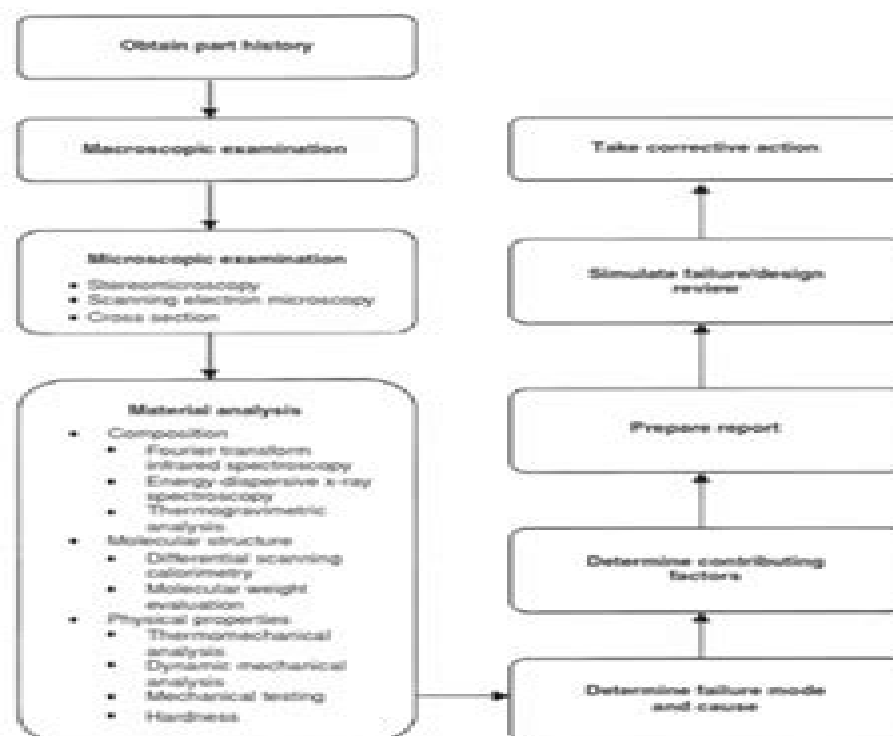


Fig. 1 Steps for performing failure analysis. The steps are the same regardless of the material.

component but instead act in concert to determine the performance properties of a plastic component. This is represented graphically in Fig. 2 (Ref 1).

The principal differences between how failure analyses are performed on metal and plastic materials center primarily on the techniques used to evaluate the composition and structure

Characterization And Failure Analysis Of Plastics

Shasha Hu



Characterization And Failure Analysis Of Plastics:

Characterization and Failure Analysis of Plastics ASM International, Steve Lampman, 2003-01-01 The selection and application of engineered materials is an integrated process that requires an understanding of the interaction between materials properties manufacturing characteristics design considerations and the total life cycle of the product This reference book on engineering plastics provides practical and comprehensive coverage on how the performance of plastics is characterized during design property testing and failure analysis The fundamental structure and properties of plastics are reviewed for general reference and detailed articles describe the important design factors properties and failure mechanisms of plastics The effects of composition processing and structure are detailed in articles on the physical chemical thermal and mechanical properties Other articles cover failure mechanisms such as crazing and fracture impact loading fatigue failure wear failures moisture related failure organic chemical related failure photolytic degradation and microbial degradation Characterization of plastics in failure analysis is described with additional articles on analysis of structure surface analysis and fractography **ASM HANDBOOK; TODD. MENNA, 2022** **Characterization and Failure Analysis of Plastics** Santhosh M. Malkapur, Ashish Anand, 2015 *ASM Handbook* Todd J. Menna, **Plastics Failure Analysis and Prevention** John Moalli, 2001-12-31 This book contains analysis of reasons that cause products to fail General methods of product failure evaluation give powerful tools in product improvement Such methods discussed in the book include practical risk analysis failure mode and effect analysis preliminary hazard analysis progressive failure analysis fault tree analysis mean time between failures Wohler curves finite element analysis cohesive zone model crack propagation kinetics time temperature collectives quantitative characterization of fatigue damage and fracture maps Methods of failure analysis are critical to for material improvement and they are broadly discussed in this book Fractography of plastics is relatively a new field which has many commonalities with fractography of metals Here various aspects of fractography of plastics and metals are compared and contrasted Fractography application in studies of static and cycling loading of ABS is also discussed Other methods include SEM SAXS FTIR DSC DMA GC MS optical microscopy fatigue behavior multiaxial stress residual stress analysis punch resistance creep rupture impact oxidative induction time craze testing defect analysis fracture toughness activation energy of degradation Many references are given in this book to real products and real cases of their failure The products discussed include office equipment automotive compressed fuel gas system pipes polymer blends blow molded parts layered cross ply and continuous fiber composites printed circuits electronic packages hip implants blown and multilayered films construction materials component housings brake cups composite pressure vessels swamp coolers electrical cables plumbing fittings medical devices medical packaging strapping tapes balloons marine coatings thermal switches pressure relief membranes pharmaceutical products window profiles and bone cements *Materials World*, 2004 **Handbook of Plastics Testing and Failure Analysis** Vishu Shah, 2007-03-05 Written in easy to read and use format this book updates

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Who's who in Technology ,1986 Failure Analysis for Plastics Products Rainer Dahlmann,2024-09-23 Damage to plastic products requires immediate action in often complex situations Failure and damage analysis is then an important tool for avoiding further economic losses and in the next steps for quality assurance and product safety In order to solve problems and develop remedial measures basic knowledge of plastics analysis materials and typical damage mechanisms as well as systematic approach are necessary The book supports the reader in all these points by providing a basic insight into the systematic approach and serving as a guide for practical implementation In particular manufacturing and material related aspects are also taken into account so that a comprehensive and universal method for determining the causes of damage to plastic products is presented Examples in the form of briefly summarized cases of damage from practical experience as a damage analyst round off the descriptions of the procedure **Drexel Polymer Notes** ,1989

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