Enhance Composites Research and Development with Advanced Material Analysis

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Abstract

Composite plastic materials stand at the forefront of industrial innovation, offering unparalleled benefits that are reshaping manufacturing paradigms. Their lightweight nature coupled with exceptional strength makes them indispensable in sectors where performance and efficiency are paramount. They also offer unique versatility for tailored properties, such as thermal resistance or electrical conductivity. From aerospace to automotive, industries employ composites to contribute to energy savings and increased longevity of products, driving sustainability in industry practices. As industries strive for cutting-edge advancements, composite plastics emerge as a key enabler, fostering the development of next-generation products that meet the evolving demands of technology and society.

Analytical techniques such as thermal analysis, rheology, and mechanical analysis are commonly used to characterize the composition, behavior, and physical properties of composites for efficient manufacturing and reliable products. These Techniques will help answer the key questions of whether the composite is fully cured or not, how the cure kinetics impact the manufacturing process, and whether the composite performs well or not during the application.

By analysing the DSC thermograms, researchers can determine the optimal cure cycle, evaluate the degree of cure, and understand the effects of different formulations on the curing behavior of composites. Rheology is the study of the flow and deformation of materials under stress and plays a crucial role in understanding how to optimize composite processing. Mechanical analysis encompasses three primary techniques: monotonic testing, fatigue testing, and dynamic mechanical analysis (DMA). DMA is a method used to study the viscoelastic behavior of composites. Lastly, fatigue testing uses cyclical imposition of force to assess material life under specific conditions. As processing techniques change and advance, it is important to understand their impact on the resulting lifetime performance of a part. Using these techniques enables research scientists to better select and understand their composites and process engineers to enhance manufacturability. See how today's leading instruments help improve the material selection process.

Figure 1: DMA temperature ramp tests on crosslinked elastomers with different crosslinking density