



Problem Solving Guide for Thermal-Mechanical Analysis Laboratory

Polymer / Plastics Industries

THEME: With the current state of the industry scientists are constrained for time and resources, and the days of specialists dedicated to a career in one field are long gone. The rationale for preparing this type of problem solving guide is to help the scientific staff engaged in Thermal-Mechanical analytical techniques extract the maximum possible information of pertinent issues from one integrative source. We are hopeful that the availability of this type of guide in a Thermal-Mechanical laboratory will reduce the dependence on the numerous books, publications, outside consultants, and most importantly, provide the expertise that otherwise would take decades to acquire. Information in this guide is presented in the form of “**60 Problems & Their Suggested Solutions**” so that the R&D scientists can quickly relate to their relevant issues.

Here are some examples of the problems discussed in this guide; for details see attached Table of Contents:

Question 1: *I am a polymer processing engineer working with various types of extrusion equipments. How can TGA help me in my manufacturing responsibilities?*

Question 2: *When analyzing Glass Transition (T_g) by DSC, I come across various shapes as opposed to the classical sigmoidal shape. What is to be learned from this information, how can I clarify the T_g , and what value should be reported ?*

Question 3: *How can I separate the “Chemical” basis of a polymer’s melting temperature (T_m) without sacrificing the information on its “Physical-Processing History” effects?*

Question 4: *I work in the plastic film industry and have a TMA unit. Besides differentiating unoriented, uniaxial, and biaxially oriented films from each other, explain to me how I can detect subtle differences in terms of draw ratio and the orientation process. Also, can I determine the dimensional stabilization temperature of the film during its manufacturing process ?*

Question 5: *Regarding the measurement of Tg by DSC, TMA and DMA, I understand each technique is different and within each technique there are different experimental variables influencing the value obtained. Nevertheless, Tg of a material with a given composition and a given processing history must have a characteristic value. How do you propose consolidating various techniques in to providing that characteristic value within $\pm 2^{\circ}\text{C}$?*

About the Author

Dr. Yash P. Khanna had a 27 years tenure at AlliedSignal's (now Honeywell) corporate research & technology center in Morristown, NJ. He joined AlliedSignal in 1975 with MS degrees in Analytical Sciences / Chemical Analysis & Process Control and then obtained, on a part-time basis, another MS and a Ph.D. in Polymer Science & Engineering from the Polytechnic University in Brooklyn, New York. During the 1985-2001 period, Dr. Khanna was a Research Group Leader / Senior Principal Scientist responsible for Thermal Analysis & Polymer Melt Rheology. His 27 years career is credited with over 120 research publications, 21 US patents, Society of Plastics Engineer's **International** "Engineering/Technology" **Award** (2001) and North American Thermal Analysis Society's Fellowship (1988) and its highest honor, the **Mettler Award** (1997). A highpoint of Dr. Khanna's career has been in identifying several new phenomena in 40-60 years old polymers during the course of routine analytical characterization. During 1990-2001, Dr. Khanna also held positions such as Business Unit Liaison to Specialty Films division and the key technologist for Packaging Resins business where the fundamental knowledge from Thermal / Rheology formed the basis of new product / process development as well as technology marketing in **North America** and **Europe**. These contributions to AlliedSignal's businesses were recognized through 5 Special Recognition awards (1991-1998) and 3 business awards, "**Growth**", "**Sale of the Year**", and "**Save of the Year**" (1997-1998).

TABLE of CONTENTS

Chapter I	Fundamentals of Polymers Critical to Thermal-Mechanical Analysis
Chapter II	Thermogravimetric Analysis (TGA) Principle, Applications, & Limitations Best Operating Conditions 10 Frequently Encountered Issues & Recommended Solutions
Chapter III	Differential Scanning Calorimetry (DSC) Principle, Applications, & Limitations Best Operating Conditions Glass Transition Science & Technology Data on Common Polymers 12 Frequently Encountered Issues & Recommended Solutions Crystallization from Solid State 2 Frequently Encountered Issues & Recommended Solutions Melting Transition Science & Technology Data on Common Polymers 16 Frequently Encountered Issues & Recommended Solutions Measurement of Crystallinity Crystallization Rates from Molten State Science & Technology 4 Frequently Encountered Issues & Recommended Solutions Advances in DSC Techniques: Topem [®] , Hyper, and Modulated DSC
Chapter IV	ThermoMechanical Analysis (TMA) Principle, Applications, & Limitations Best Operating Conditions 7 Frequently Encountered Issues & Recommended Solutions
Chapter V	Dynamic Mechanical Analysis (DMA) Understanding ViscoElasticity ; the Basis of DMA Principle, Applications, & Limitations Best Operating Conditions 10 Frequently Encountered Issues & Recommended Solutions Advances in DMA Techniques: Variable %RH Chamber
Appendix	Key Publications Inserted

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