

# Role Of Thermal Technique In Polymer Studies

A complete thermal analysis system comprises different techniques. Each technique characterizes the sample in a particular way. The combination of all the results simplifies interpretation.

TGA measures the weight curve, DSC the heat flow. All these measurement quantities change as a function of temperature or time.

TGA is a technique that measures the change in weight of a sample as it is heated, cooled or held at constant temperature. Its main use is to characterize material with regard to their composition. Application areas include plastics, elastomers and thermosets, mineral compounds and ceramics as well as wide range of analyses in the chemical and the pharmaceutical testing.

Differential scanning calorimetry (DSC) is the most frequently used thermal analysis technique. DSC measures enthalpy changes in samples due to changes in their physical and chemical properties as a function of temperature or time.



## EXREMELY WIDE APPLICATION RANGE:

Thermogravimetry provides quantitative information on the composition and thermal stability of many different types of materials. The method is fast and can even be used with very small samples.

Control in numerous fields such as plastic, building material as plastic, building material minerals, pharmaceuticals and Foodstuffs.

Thermogravimetry provides quantitative information on the composition and thermal stability of many different types of materials. The method is fast and can even be used with very small samples.

The DSC signal can also be quantitatively evaluated, allowing transition and reaction enthalpies to be determined. The TGA/DSC is an exceptionally versatile tool for the characterization tool for the physical & chemical material properties under precisely controlled atmospheric conditions. It yields valuable information for research, development and quality.



FTIR is important for screening and identifying polymer or plastic samples. FTIR identifies chemical bond in a molecule by producing an Infrared absorption spectrum. Metal do not absorb infrared light, but polymer that contain metal can be scanned with FTIR.

FTIR spectral scan alone may not identify the type of Nylon, Pebex, or Polyester, identify a polypropylene or Acetal as a homopolymer or copolymer, or determine or determine whether a polyethylene is a high density or low density material. Further identification using other analytical techniques is necessary.

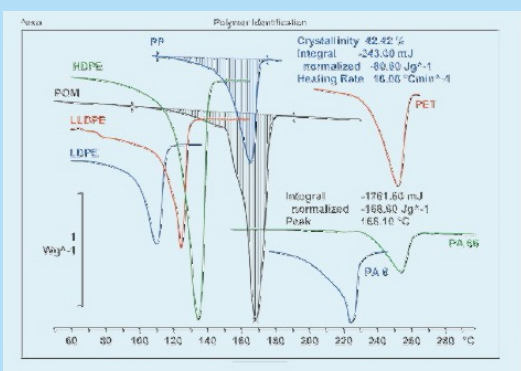
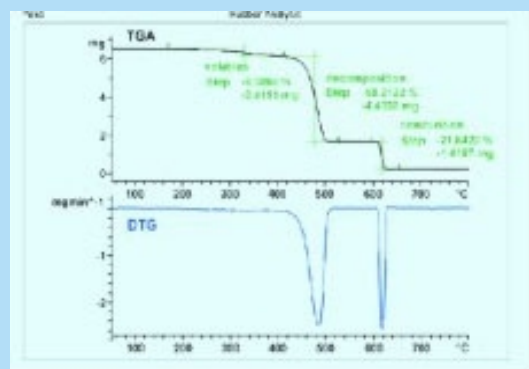
# Role Of Thermal Technique In Polymer Studies

## Examples of Thermal Events and Processes that can be determined by TGA/DSC

TGA	DSC	FTIR
<ul style="list-style-type: none"> <li>• Analysis of polymer blends and copolymer</li> <li>• Determine cure temperature for thermally cured polymer</li> <li>• Reaction rate and temperature evaluation</li> <li>• Inorganic filler content</li> <li>• Transformation temperature</li> <li>• Polymer thermal degradation profiles</li> <li>• Polymer thermal &amp; oxidative ability</li> <li>• For Polymer synthesis</li> <li>• For vulcanization and curing</li> <li>• For heterogeneous materials</li> <li>• In polymer solutions</li> <li>• For insulating materials</li> <li>• Polymer may be used in harsh conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Melting Temperature</li> <li>• Heat of Melting</li> <li>• Percent crystallinity</li> <li>• Tg of softening</li> <li>• Crystallization</li> <li>• Presence of recyclates/regrinds</li> <li>• Plasticizers content</li> <li>• Polymer blends (presence, composition and compatibility)</li> <li>• Evaluate drug and polymer purities</li> <li>• Moisture or volatile compounds</li> </ul>	<ul style="list-style-type: none"> <li>• Quantitative scan</li> <li>• Qualitative scan</li> <li>• Solids, Films, Liquids</li> <li>• Organic Samples</li> <li>• Inorganic samples</li> <li>• Plastics</li> <li>• Polymers</li> <li>• Contamination identification</li> <li>• Impurities Screening</li> <li>• Formulations, deformulations</li> <li>• Toys</li> <li>• Consumer goods</li> <li>• Household products</li> <li>• Medical device</li> <li>• Coating, adhesives</li> <li>• Comparative analysis</li> <li>• FTIR can identify chemical agents</li> </ul>

### Rubber analysis of SBR:

In rubber analysis, the sample is first heated to 600°C under inert condition. The volatile components (plasticizers, often oils) vaporize and pyrolysis of the polymer being shortly afterward of about 400°C at 600°C, the atmosphere is then switched from inert to oxidative, resulting in the combustion of the carbon black additive. Inorganic components remain behind as a residue.



### Identification of plastics:

Plastics can be identified by measuring their glass transition temperatures and melting temperatures. The figure shows the melting peaks of different polymers. The peaks clearly differ in size and their position on the temperature axis. The example of PP and POM shows that identification depends both on the melting temperature and on the enthalpy of fusion. If the type of polymer is known, the degree of crystallinity can be determined from the melting peak.