

## UG SEM-8

### Unit-3 MJC-16 (T) Analytical Methods in Chemistry

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**Materials Characterization: Thermal stability:** Determining the temperature at which a material decomposes or undergoes other thermal transformations. **Moisture content:** Measuring the amount of water present in a sample. **Ash content:** Determining the inorganic residue remaining after the organic matter is burned off. **Volatile content:** Quantifying the number of volatile substances in a sample. **Oxidation kinetics:** Studying the rate at which a material oxidizes.

**Polymer Analysis: Polymer degradation:** Investigating the thermal stability and degradation mechanisms of polymers. **Polymer blending:** Analyzing the compatibility and phase separation of polymer blends. **Polymer additives:** Studying the effects of additives on polymer properties.

**Pharmaceutical Industry: Drug purity:** Assessing the purity of pharmaceutical compounds. **Drug release:** Investigating the release kinetics of drugs from formulations. **Thermal stability:** Evaluating the thermal stability of drugs and excipients.

**Environmental Science: Waste characterization:** Analyzing the composition and thermal behaviour of waste materials. **Soil analysis:** Determining the organic matter content and thermal properties of soils. **Air pollution:** Monitoring particulate matter and other pollutants in the air.

**Food Industry: Moisture content:** Measuring the moisture content of food products. **Ash content:** Determining the nutritional value of food. **Thermal stability:** Evaluating the thermal stability of food ingredients and products.

**Other Applications: Catalyst characterization:** Studying the thermal stability and activity of catalysts. **Forensic analysis:** Investigating the composition of unknown materials. **Geological analysis:** Analyzing the mineral composition of rocks and soils.

TGA is a valuable tool for researchers and scientists in various fields, providing insights into the thermal behaviour of materials and aiding in the development of new products and processes.

#### Advantages of TGA

**Accurate method**

**Easy to use**

**Minimal sample preparation**

**Convenient and time-saving technique**

**The instrument can be used at very high temperatures**

**Versatility:** TGA can be used to study a wide range of materials, including solids, liquids, and gases. It applies to various fields such as materials science, chemistry, pharmaceuticals, and environmental science.

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**Sensitivity:** TGA can detect even small changes in mass, making it suitable for analyzing materials with low levels of impurities or additives.

**Accuracy:** TGA provides accurate measurements of mass loss or gain, allowing for quantitative analysis of thermal events.

**Simplicity:** The experimental setup for TGA is relatively simple, requiring minimal sample preparation and instrumentation.

**Automation:** Modern TGA instruments are highly automated, reducing the need for manual intervention and improving data reliability.

**Quantitative analysis:** TGA provides quantitative data on mass changes, allowing for the determination of parameters such as moisture content, ash content, and volatile matter.

**Wide temperature range:** TGA instruments can operate over a wide range of temperatures, from ambient to thousands of degrees Celsius, enabling the study of a variety of thermal processes.

**Compatibility with other techniques:** TGA can be coupled with other analytical techniques, such as mass spectrometry or Fourier-transform infrared spectroscopy, to provide more comprehensive information about the sample.

**Environmental friendliness:** TGA is generally a non-destructive technique that does not require the use of harmful chemicals or solvents.

#### Disadvantages:

**Sample Type Limitation:** Only solid samples can be analyzed

**Destructive Nature:** TGA is a destructive technique, meaning the sample cannot be recovered after analysis.

**Sample Quantity:** It requires a limited quantity of samples, which might not be feasible for very small or precious samples.

**Melting or Crystal Changes:** TGA cannot analyze melting or crystal changes directly, which can be a limitation for certain materials.

**Complex reactions:** May not distinguish between overlapping thermal events.

**Limited information:** Primarily provides information about mass changes.

**Sample volatility:** Highly volatile samples may be lost.

**Cost:** TGA instruments can be expensive.