

EDS

Engineering,
GM DAEWOO Auto & Technology.
Standards

THERMAL ANALYSIS OF PLASTICS

EDS-T-7543

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1. PURPOSE

The purpose of this standard is to specify thermal analysis of all plastic materials applied to GMDAT motor vehicles for evaluation of their material properties by measuring such properties in terms of temperature.

2. SCOPE

Thermal analysis is an important analysis method in polymer analysis and quality management. Thermal analysis can be categorized into DSC (Differential Scanning Calorimetry), TGA (Thermogravimetric Analysis) and TMA (Thermomechanical Analysis) depending on measurement parameter.

2.1. DSC (Differential Scanning Calorimetry)

Sample material is heated or cooled at a certain rate and the material's unique properties such as melting point, crystallization temperature together with thermal volume are measured to verify material properties and thermal characteristics.

2.2. TGA (Thermogravimetric Analysis)

TGA depicts mass change of heated material against temperature or time for measurement of decomposition temperature and material composition of plastic materials.

2.3. TMA (Thermomechanical Analysis)

TMA measures deformation of material in terms of temperature and time when the sample is heated to certain temperature level under a load.

3. MEASUREMENT ITEMS

3.1. DSC

- 3.1.1. Melting Temperature (T_m), Melting Heat (ΔH_f)
- 3.1.2. Crystallization Temperature (T_c), Crystallization Heat (ΔH_c)
- 3.1.3. Glass Transition Temperature (T_g)
- 3.1.4. Decomposition Temperature (T_d), Decomposition Heat (ΔH_d)
- 3.1.5. Thermal Capacity (ΔC_p)
- 3.1.6. Polymer Crystallinity
- 3.1.7. Chemical Reaction Speed

3.2. TGA

- 3.2.1. Thermal Decomposition Temperature (T_d)
- 3.2.2. Relative Thermal Stability

3.2.3. Thermal Insulation Effect of Non-combustible Material

3.2.4. Composition Analysis

3.2.5. Ash Content

3.3. TMA

3.3.1. Softening point

3.3.2. Coefficient of Thermal Expansion

3.3.3. Viscosity

3.3.4. Gel Time & Temperature

3.3.5. Modulus

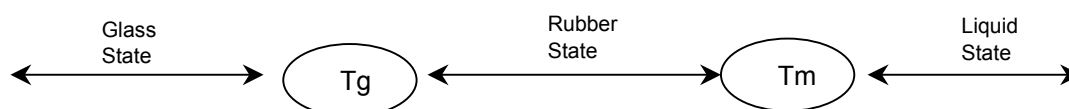
3.3.6. Creep/stress relaxation

4. TERMINOLOGY

4.1. Thermal Analysis: Analysis method that measures changes in physical and chemical properties of sample based on temperature variation under certain conditions. These changes are converted to electrical output and recorded in terms of temperature or time.

4.2. Melting Temperature (T_m): The temperature when crystalline polymer turns to viscous liquid form.

4.3. Glass Transition Temperature (T_g): As polymer material is heated, it loses hardness at a certain temperature and begins to manifest softness like rubber. T_g refers to this temperature.



4.4. Crystalline Polymers: Polymers where polymer chains are arrayed in regular form. They have melting temperature (T_m), glass transition temperature (T_g), contraction rate is high, has either opaque or translucent state. They are excellent in chemical resistance and tear resistance but low friction coefficient. (e.g.: PE, PP, POM, Nylon, and most thermoplastic polyesters)

4.5. Amorphous Polymers: Polymers where polymer chains are arrayed in irregular patterns and have only glass transition temperature (T_g). Amorphous polymers are mostly transparent except cases containing rubber to enhance mechanical strength. (e.g.: PS, PC, SAN, ABS, PMMA, PSU, etc.)

4.6. Thermoplastics: Thermoplastic materials are primary molded by heating initially, then can be molded again easily by applying heat for the second time. They consist of polymers that are either linear or have some branches. (e.g: Olefins, styrene family and engineering plastics)