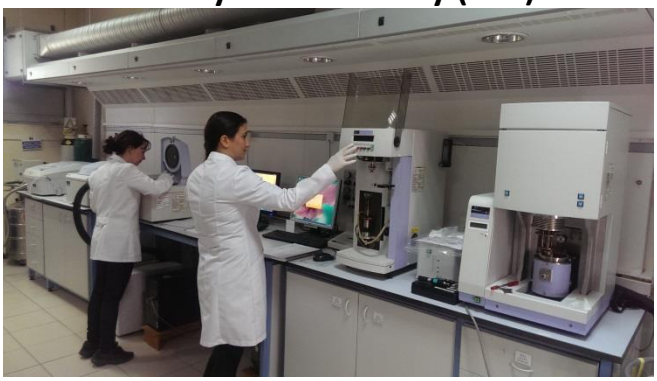
Thermal Analysis Laboratory (TAL)



The aim of the thermal analysis systems is to define the changes in physical properties of a substance (weight, evolved or absorbed heat, dimension, conductivity, magnetic properties) subjected to a controlled temperature program (heating or cooling) in a specified atmosphere as a function of temperature or time.
Thermal analysis of the materials are important for industry and research facilities. In R&D Center, Differantial Scanning Calorimeter (DSC), Thermogravimetric Analysis and FTIR Spectrometer System (TGA-FTIR), Thermogravimetric Analysis and Differantial Thermal Analysis System (TGA-DTA), Dynamic Mechanical Analysis (DMA) ve Dilatometry instruments are used to define the thermal properties of the materials.

GENERAL PRINCIPLES

Differential Scanning Calorimetry (DSC):
DSC measures the amount of energy (heat) absorbed or released by a sample as a function of temperature or time when it is subjected to a controlled temperature program (heating, cooling or holding at a constant temperature). By DSC method, different thermal properties of different types of materials (polymers, elastomers, alloys, metals, seramics, food, medicine, etc.) can be defined:

- Glass transition temperature,
- Melting and crystalization temperature and enthalpy,
- Crystallization degree of polymeric materials,
- Oxidation induction time of polymers (OIT),
- Heat capacity,
- Phase transitions, etc.

Thermogravimetric Analysis (TGA) ve Fourier Transform Spectrometer (FTIR) System (TGFT):
Thermogravimetric analysis (TGA) is a technique which measures weight loss/gain of a material as a function of temperature or time in a controlled atmosphere. Fourier Transform Spectrometer (FTIR) is used to analyse the evolved gas from the TGA analysis.

Thermogravimetric Analysis ve Differantial Thermal Analysis System (TGA-DTA):
TGA-DTA is a technique measuring the difference in temperature and weight simultaneously between a sample and a reference (a thermally inert material) as a function of temperature or time.
Melting and sublimation temperatures, weight loss/gain, phase transtions and oxidation of different materials can be defined by TGA-DTA.

Dilatometry (DLM):
Dilatometry is a technique to define the dimensional changes of the materials as a function of temperature or time. Thermal expansion coefficient, glass transition temperature, expansion/tension/permeation/softening behaviour of the materials can be defined by dilatometry.

Dynamic Mechanical Analysis (DMA):
DMA is one of the method used to characterize the viscoelastic properties of the materials**.** Generally it measures energy loss (viscous properties) and energy storage (elastic properties). DMA is one of the sensitive methods which measures the glass transition temperature.

CASE STUDIES

- Polyethylene terephthalate (PET) is a polymer used to produce food and beverage cups. Depending on the applied thermal procedures, PET can be amorphous or semi-crystalline. Glass transition temperature (T_g) and %crystallization amount can affect the properties of PET. By DSC spectrum, glass transition temperature and %crystallization amount of PET can be defined (Figure1).

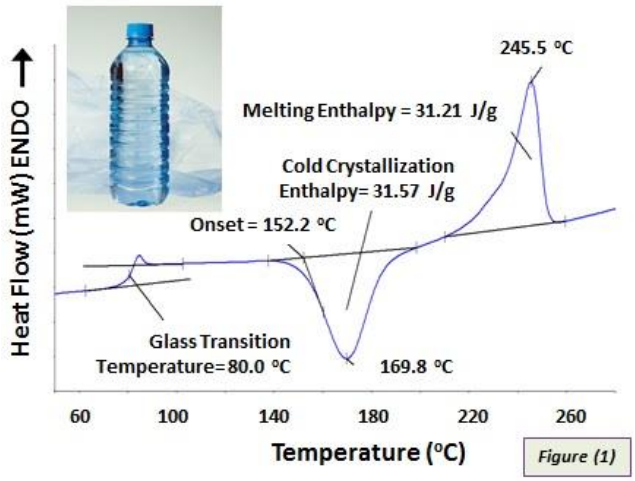


Figure (1)

- By DSC instrument, Oxygen Induction Time (OIT) of plastics (polymer) can be measured (Figure 2). When plastics are subjected to oxygen atmosphere under high temperatures (above melting temperatures), their decomposition times can be defined. This time (OIT) gives information about long-term stability of the materials.

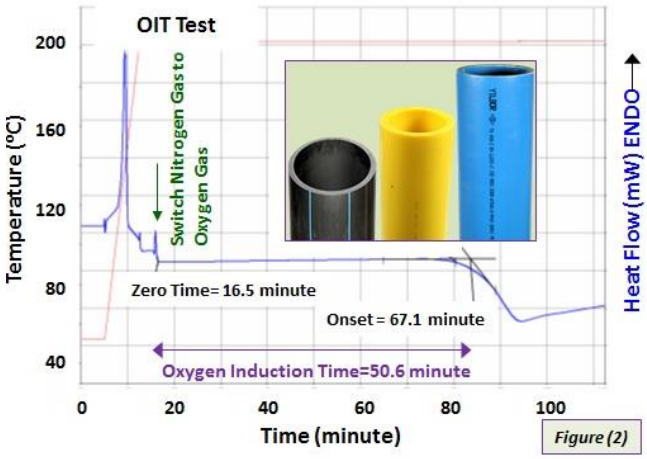


Figure (2)

- TGA instrument can be used to define fillers and/or fiber content of the polymer and composite materials. Filler content can affect the produced materials properties (thermal expansion coefficient, elastic modulus, and resitance). TGA thermogram of glass fiber/epoxy composite material is given (Figure 3).

- From the dilatometry result of the material taken from plastic pipe, average thermal expansion coefficient defined at different temperature scales and glass transition temperature of the material can be defined (Figure 4).

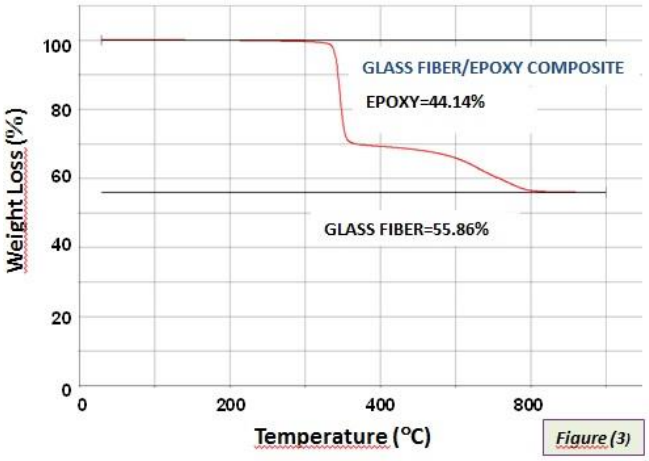


Figure (3)

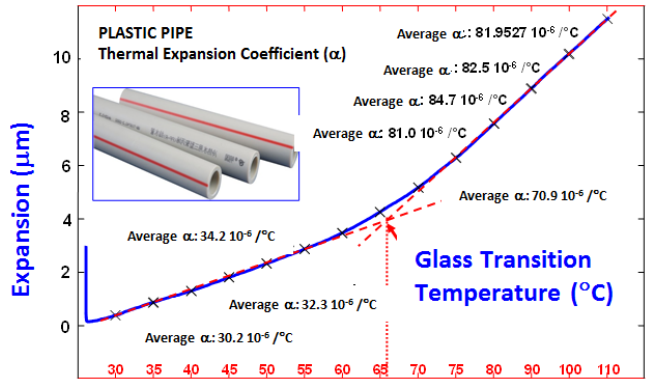


Figure (4)

ACCREDITATED METHODS

Thermal Analysis Laboratuvary was accrediated in 31.12.2013 by Turkish Accreditation Agency with 4 methods.

EN ISO 11357-1, TS EN ISO 11357-1 Plastics – Differential Scanning Calorimetry (DSC) – Part 1 General Principles

EN ISO 11357-2, TS EN ISO 11357-2 Plastics – Differential Scanning Calorimetry (DSC) – Part 2 Determination of Glass Transition Temperature

EN ISO 11357-3, TS EN ISO 11357-3 Plastics – Differential Scanning Calorimetry (DSC) – Part 3 Determination of Melting and Crystallization Temperature and Enthalpy

EN ISO 11357-6, TS EN ISO 11357-6 Plastics – Differential Scanning Calorimetry (DSC) – Part 6- Determination of Oxygen Induction Time (OIT)

EN ISO 11358, TS EN ISO 11358 Plastics – Thermogravimetric Analysis of Polymers (TG)- General Principles

PROFICIENCY TESTS

Themal Analysis Laboratory joins international profiency tests from 2011. Z-scores obtained from proficiency tests are all successful and compatible with ($|z| \leq 2$) ISO/IEC 17043 standard.

İLETİŞİM BİLGİLERİ

Laboratory Manager: Elif Kemeröz
Experiment Principals: Ebru Deniz,Aysun Güney,Güler Çelik
Laboratory Tel: +90 312 210 6451
Laboratory e-mail: mlabtal@metu.edu.tr