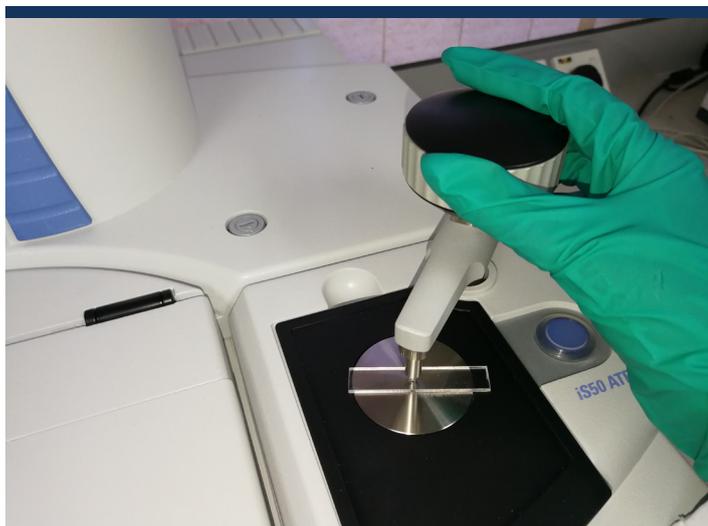


ESSENTIAL TOOLS FOR POLYMER CHARACTERIZATION



MOLECULAR SPECTROSCOPY

Instruments

- ◆ Fourier Transform Infrared Spectroscopy (FTIR)
- ◆ Raman Spectroscopy

Applications

- ◆ Used to characterize the molecular vibrations of organic & inorganics compounds include common functional groups and fingerprinting region.
- ◆ Used for both qualitative & quantitative analysis.
- ◆ Common tools used in Academic research & various industries to perform QC Check on incoming raw material
- ◆ Analyse contamination for submicron & micron sized particles
- ◆ To study reverse engineering by FTIR hyphenation with TGA
- ◆ Used to identify microplastic particles



PHYSICAL & MECHANICAL TESTING

Instruments

- ◆ Universal Testing Machines
- ◆ Hardness Tester
- ◆ Impact Tester
- ◆ Melt Flow Indexer
- ◆ Automatic Deflection Temperature / Vicat Testing Machines

Measurement

- ◆ To test the strength and performance of plastics through tensile, flexural, compression, folding endurance, impact, head distortion, Vicat, melt flow, tear and puncture tests.
- ◆ This versatile benchtop polymer testing machines can perform tests in accordance with ASTM, ISO and other international standards from test configuration through to reporting and generating results immediately for your processes.



SURFACE SCIENCE

Instruments

- ◆ Contact Angle Instruments

Measurement

- ◆ Offers the capability to measure the Contact Angle between the liquid and solid phase, Surface Free Energy of solid substrate and Surface Tension of a liquid.
- ◆ Used to predict the interaction between the liquid-solid phase.

Applications

- ◆ Widely used in industries for surface modification such as plasma cleaning.
- ◆ To study the hydrophilic & hydrophobic properties of a surface.
- ◆ In the chemical dispersion industry, it is used to study the surface tension of a liquid by comparing different surfactants and adjusting the surfactant concentration.



THERMAL CHARACTERIZATION

Instruments

- ◆ Differential Scanning Calorimetry (DSC)
- ◆ Thermogravimetric Analysis (TGA)
- ◆ Dynamic Mechanical Analysis (DMA)
- ◆ Simultaneous Thermal Analysis (STA)
- ◆ Thermomechanical Analysis (TMA)

Applications

- ◆ Changes in the morphology of a material usually affects its melting, crystallization and/or glass transition, these can be linked to many performance parameters. For semi crystalline polymers it is an important method to measure crystallinity and for thermoset polymers the curing behaviour that is being analysed.
- ◆ Thermogravimetric analysis (TGA) determines the composition & thermal stability of polymers and the effect of additives such as flame retardants.
- ◆ Dynamic mechanical analysis (DMA) is indispensable in the characterization of viscoelastic properties of filled polymers including elastic modulus, loss modulus and the glass transition



RHEOLOGY & VISCOMETRY

Instruments

- ◆ Capillary Viscometer
- ◆ Capillary Rheometer
- ◆ Rotational Rheometer

QC Parameter

- ◆ Plastic manufacturers need to verify the molecular mass / chain length of their polymers to assure and maintain quality. Determination of the solvent viscosity as a measure of the mean molecular mass of a polymer is one of the most reliable and sensitive methods for judging the molecular identity of many plastics.

Applications

- ◆ To measure the solution viscosity that is in accordance to the international norm (ASTM, ISO, DIN) by capillary viscometer.
- ◆ The shear rate of a capillary rheometer mimics the extrusion or injection moulding machines, **from 100 to > 10⁶ 1/s**. The apparent melt viscosity is given as shear stress/shear rate. It can also determine extensional viscosity, die swell and melt strength.
- ◆ Rotational rheometers provide information on viscoelastic properties of polymers. In the oscillation mode, it can provide complex viscosity and probe into the molecular structure of the polymer, like molecular weight, molecular weight distribution and molecular weight average.
- ◆ To determine the shear viscosity in the steady (flow) mode, albeit, at lower shear rates from 0.001 to 100 1/s.



PARTICLE CHARACTERIZATION

Instruments

- ◆ Particle Size Distribution Analyzer

Optimization

- ◆ It is usual for a continuous emulsion polymerization process to control the emulsion droplet size in the main reactor or mixing device. The emulsion formed in the process is desired to be of a narrow size distribution with a specific range of sizes from a few microns to thousands of microns.
- ◆ In the granulating process, the powder properties such as particle size distribution, specifically the amount of fine and coarse fractions are needed to prevent the clogging of the process line.

Applications

- ◆ Polymer based industrial products such as acrylic paint emulsion and coatings are routinely checked for their particle size distribution.
- ◆ Formation of the non-stick Teflon® coating layer for cooking utensils to ensure good adhesiveness and durability.



POLYMER PROCESSING

Instruments

- ◆ Measuring Mixers & Extruders
- ◆ Single & Twin Screw Extruders
- ◆ Torque Rheometer

Measurement

- ◆ To study the compatibility of fillers and additives with the polymer matrix at the laboratory scale. The recorded torque value, temperature, pressure and speed provide the information to optimize the process parameters as well as for upscaling purposes.
- ◆ Various accessories are available for the Single Screw & Twin-Screw Extruders, so that in addition to material compounding, the extrudate can be turned into round strand die, pellet, sheet, blown film etc.
- ◆ To study the decomposition time, fusion time, flow & cure behaviour, plasticizer and sorption behaviour of the polymer mixing, the Brabender Torque Rheometer is the ideal tool.



FIRE TESTING SYSTEMS

Instruments

- ◆ UL 94 Testing System
- ◆ Limiting Oxygen Analyzer
- ◆ TCC Cone Calorimeter
- ◆ KBT Fire Testing Systems for Cables

Measurement

- ◆ To examine the burning behaviour of plastics at different oxygen content.
- ◆ Measuring the smoke production & toxicity and heat release for polymeric materials.
- ◆ Measure the flame spread with flaming droplets.

Applications

- ◆ To measure the reaction & response of polymer composites used in printed circuit board (PCBs), electrical cables, textile products, etc in fire.
- ◆ Determine the suitability and effectiveness of different types of flame retardant additives in polymers, depending on their applications.