PY-GC-MS OF POLYMERS

REPSOL
Technology Lab

Short Description

Analytical Pyrolysis technique hyphenated to GC-MS is used to obtain structural information of macromolecules by GC-MS analysis of their thermal degradation products in the absence of oxygen.

Deliverable

Document containing the pyrogram of the sample together with the requested information, which is adapted to the client's needs. It is mainly accompanied by the identification of the pyrolysis products.

Benefits

- Key areas where Py-GC-MS is applicable: quality control in production, product development and forensic science.
- Allows studying materials and compounds that are not suitable for traditional GC-MS analysis.
- Allows studying polymeric structures from pure systems to multi-block polymers.
- Minimal sample preparation. Solvent is not required for most applications, meaning that low concentration monomers, residual solvents, additives and crosslinking agents can be identified without adding additional contaminants.

GC-MS with a MultiPurpose Sampler (MPS), Thermal Desorption Unit (TDU) and Pyrolysis Module (PYRO)

Differential Features

- Technology Lab has a pyrolysis module that can pyrolyze solids and liquids (between 350 and 1000 ° C) in a very flexible and automatic way, and determine thermal decomposition products in the GC-MS.
- It allows different pyrolysis techniques (pulsed, fractional and sequential pyrolysis), working with polymer solutions (subsequently venting the solvent, which enables the highly precise introduction of small amounts of polymer in solution), cold injection in split or narrow band mode (the pyrolysis products can be transferred to the GC-MS with the cold injection system (CIS) or thermochemolysis to improve the chromatographic analysis of polar functional groups, such as carboxylic acids.
- Our deep knowledge in this sector allows us to characterize the thermal degradation products of different polymers and additives.

Pyrolysis module with Platinum filament, transport adapters and sample holders (Gerstel)

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Requirements

- Small amount of sample, in the range of micrograms to milligrams, typically with 300 µg of polymer a complete characterization is possible.

Limitations

- Reproducible experimental conditions are required to obtain reliable comparisons between different laboratories.
- Inhomogeneous samples can have variable results.
- Does not detect most inorganic components.
- Py-GC-MS is a destructive technique.

The Product in Depth

By Py-GC-MS the polymers are converted into lower molecular weight products by the action of heat. The relative proportions of the produced products depend on the composition of the samples, the temperature and the time it is applied. The composition and relative abundance of the pyrolysis products are characteristic for a given polymer and their determination allows the identification of materials that cannot be determined otherwise. This technique can also provide quantitative analysis of polymer structure, including monomer composition, stereochemistry, tacticity, and molecular arrangements in homo and copolymers.

Py-GC-MS is applied extensively to synthetic and natural polymers when more precise results are required for standards, directives (such as RoHS) or specific research.

At Technology Lab we offer equipment and knowledge to apply Py-GC-MS to polymers adapted to customer needs.

Some Use Cases

- Microstructure, polymer and biopolymer additives: polyethylene, polypropylene, polymethylmethacrylate, rubber, polystyrene, PVC, EVA, waxes, polyurethane, lignin, cellulose, polylactic acid, paints, dyes, resins, coatings, wood, textiles, oils, etc.
- Forensic analysis of car paints.
- Multi-component analysis of tattoo inks and discrimination of counterfeit products.
- Analysis of environmental samples: hydrocarbon source rocks, synthetic and natural polymers, organic constituents of microorganisms, natural aquatic and terrestrial organic matter (NOM), etc.
- Soil bioremediation.
- Compliance with regulations.