Gas Chromatograph–Mass Spectrometer (GC–MS)

Make: Agilent 8890 GC with 7000E Quadrupole MS/MS EI

About the Instrument

- The Agilent 8890 GC–MS system is a highly sensitive and robust analytical platform installed at the Central Instrumentation Lab under the DST–PURSE Grant.
- The system enables precise qualitative and quantitative analysis of organic pollutants at trace levels. It is extensively used for environmental and atmospheric research, particularly in analysing volatile and semi-volatile organic compounds (VOCs & SVOCs) extracted from air sampling media.
- The instrument combines advanced gas chromatographic separation with high-resolution mass spectrometric detection, ensuring accurate molecular identification across complex environmental matrices. It is a versatile system for routine monitoring, academic research, and advanced analytical method development.

Instrument Capabilities

- High-sensitivity detection of organic compounds including VOCs, phthalates, PAHs, and alkanes (C8–C40).
- Equipped with an advanced electron ionization (EI) source for reliable fragmentation and compound identification.
- Supports high-resolution chromatographic separation with programmable temperature control.
- Automated sampling and data processing through Agilent specialised software.
- Suitable for environmental, chemical, biological, and material-based applications.
- Capable of trace-level quantification (ng/m³ to pg range) after extraction from sampling media.

Sample Type

- Extracts from charcoal tubes (for VOC monitoring).
- Filter extracts from PM_1, $PM_{2.5}$ and PM_{10} quartz/PTFE filter papers.
- Organic extracts from environmental, biological, or industrial samples.
- Liquid samples, organic solvents, and environmental extracts.

Sample Preparation

- Environmental, biological, or industrial samples collected on suitable adsorbent/ activated charcoal tubes are desorbed using suitable solvents (commonly CS_2/hexane).
- Quartz filter papers (PM_1, $PM_{2.5}$, PM_{10}) are subjected to Soxhlet, ultrasonic or solvent extraction for recovery of phthalates, PAHs, and alkanes.
- Extracts are filtered, concentrated using a rotary evaporator or N_2 gas concentrator, and transferred to GC vials.
- Internal standards are added for accurate quantification and quality assurance.
- Samples must be free from particulates and moisture before injection.

Applications

- **Environmental / Atmospheric & Particulate-Matter Applications**
  - Quantification of VOCs, phthalates, PAHs and n-alkanes (C8–C40) in ambient air, indoor/outdoor dust, filter papers (PM_1, $PM_{2.5}$, PM_{10} quartz filters) and charcoal tubes.
  - Distinguishing vehicular emissions, biomass burning, industrial emissions, and secondary organic aerosol formation through molecular-marker profiling.
  - Monitoring of organic pollutants bound to airborne particulates, evaluating size-fractionated samples and conducting health-risk assessment of inhalable/respirable fractions.
- **Biological Sample Applications**
  - Analysis of volatile (VOCs) and semi-volatile organic compounds (SVOCs) in biological matrices such as breath/headspace, tissues, and fluids (blood, urine) for exposure-assessment or biomonitoring studies.
  - Detection of phthalates and plasticizer residues in human and animal tissues/fluids for assessing uptake pathways and metabolite profiling.
  - Analysis of PAHs and persistent organic pollutants (POPs) in adipose tissue, fish tissue, and human serum to evaluate bioaccumulation and eco-toxicological impacts.
  - Identification of aliphatic hydrocarbons (C_8–C_{40}), fatty acid methyl esters (FAMEs), steranes from biological extracts (e.g., microbial lipid biomarkers, bioremediation process monitoring).
  - Monitoring the fate of chemical exposure (industrial or environmental) inside organisms by quantifying residue levels or metabolites.
- **Industrial, Material & Process Applications**
  - Detection of phthalates, plasticizers, and alkane solvents in polymers, packaging materials, rubbers, and manufacturing process streams.
  - Quantification of VOCs, light alkanes, aromatics and PAHs from stacks, fugitive emissions, incinerators and waste-to-energy facilities.
  - Use of molecular-marker GC–MS data to trace leaks, spills, or site contamination back to industrial sources (e.g., refineries, petrochemical plants, plastic recycling units).
  - Analysis of organic pollutants in sludge, wastewater extracts, char/ash samples for process validation, treatment efficiency and compliance monitoring.
  - Identification of degradation products (e.g., plasticizer leaching, polymer oxidation, residual solvents) to assess material lifespan and environmental release.
  - Supporting R&D in manufacturing, nanomaterials and environmental engineering by quantifying trace organics in materials, coatings, adhesives, composites and emerging materials.

References

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- Fausett, A. (2019). Forensic analysis of drugs of abuse with the Agilent 8890 GC (Application Note 5994-0486EN). Agilent Technologies. https://www.perlan.com.pl/uploaded/AppBundleEntityProductApplication/fileKey/224/application-forensic-analysis-drugs-of-abuse-8890-gc-5994-0486en-agilent.pdf
- Guo, H., Lee, S. C., & Chan, L. Y. (2021). Applications of gas chromatography–mass spectrometry (GC–MS) for the determination of volatile organic compounds and polycyclic aromatic hydrocarbons in ambient air: A review. Atmospheric Environment, 252, 118294. https://doi.org/10.1016/j.atmosenv.2021.118294