Case study | 001591

Gas chromatography-mass spectrometry

Increasing productivity in environmental analysis using GC-MS and Thermal Desorption solution

Vapor Solutions, Viamão - RS, Brazil

"The Thermo Scientific ISQ 7610 GC-MS hardware and software lived up to our high standards."

—Rafael Sato, Vapor Solutions

Volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) are emitted in industrial flue gas and vehicle exhaust, as well as from materials such as paints, cleaning supplies, building materials, and adhesives. In addition, petroleum combustion and vapors from oil-contaminated soils and water are continuous sources of organic compounds responsible for air pollution. Environmental testing laboratories performing analysis for these compounds encounter several challenges with VOC and SVOC workflows. First, they must be able to meet the regulatory requirements for the analysis of the environmental contaminants in varying matrices. This can lead to the laboratories dealing with trace levels in one sample and extremely high concentrations in the next. Another challenge is to maintain the productivity and sample throughput of the laboratory to ensure that their customers receive their results on time. Vapor Solutions in Viamão Rio Grande do Sul, Brazil is an environmental contract testing laboratory that faces these common challenges.

Cover image: Thermo Scientific ISQ 7610 single quadrupole GC-MS connected to the Markes Thermal Desorption (TD) system

"The technical support and the rapid response we received from Thermo Fisher Scientific was excellent. This support is very important to us."

—Rafael Sato, Vapor Solutions

Rafael Sato is the Technical Director and Partner and Bruno Pereira is the Technical Manager of Vapor Solutions Laboratory. Mr. Sato gave an overview of the analysis performed at the laboratory: "Vapor Solutions is a contract environmental laboratory and we process between 1000 and 2000 samples every month. We mainly analyze vapor intrusion samples looking for chlorinated compounds and petroleum hydrocarbons. These samples are used for risk assessment of contamination plumes caused by industrial processes. The main analysis we perform is air toxics in accordance with US EPA TO-15 and US EPA TO-17." The laboratory must also meet the limits of quantitation set out by Brazilian legislation, including CETESB or CONAMA regulations.

Mr. Pereira explained one of the major challenges when performing with US EPA TO-15 and US EPA TO-17, "The biggest challenge in our laboratory is dealing with unpredictable and highly-contaminated samples. We usually start a sample analysis without any dilution to meet quantification limits for every compound on the list. Compounds with concentrations above the calibration curve can be diluted, but compounds at the lowest levels cannot be diluted. These samples can contaminate the system very quickly." The laboratory utilizes Thermo Scientific™ ISQ™ 7000 GC-MS connected to a Markes™ Thermal Desorption (TD) system with canister autosampler CIA Advantage™ for this analysis and found it could help with the varying concentrations. Mr. Pereira explained, "The ISQ 7000 can handle the high contamination and quantification at low levels and had proven to be quite robust. When the system requires cleaning, we use [Thermo Scientific™] NeverVent™ technology and there is no need to break the instrument vacuum, and therefore, there are important gains in the time required for vacuum re-stabilization."

The laboratory recently started performing the analysis of air-phase petroleum hydrocarbons (APH) in the air in accordance with the rigorous Massachusetts Department of Environmental Protection (MADEP) methodology. Mr. Sato explained further, "We wanted to implement the MADEP APH method because the state of São Paulo has just started to require this type of analysis for soil gas samples. We wanted to get accreditation for this method to stay ahead of the needs of our customers." To perform this analysis the laboratory utilized the new Thermo Scientific™ ISQ™ 7610 single quadrupole GC-MS connected to the Markes TD and CIA Advantage.

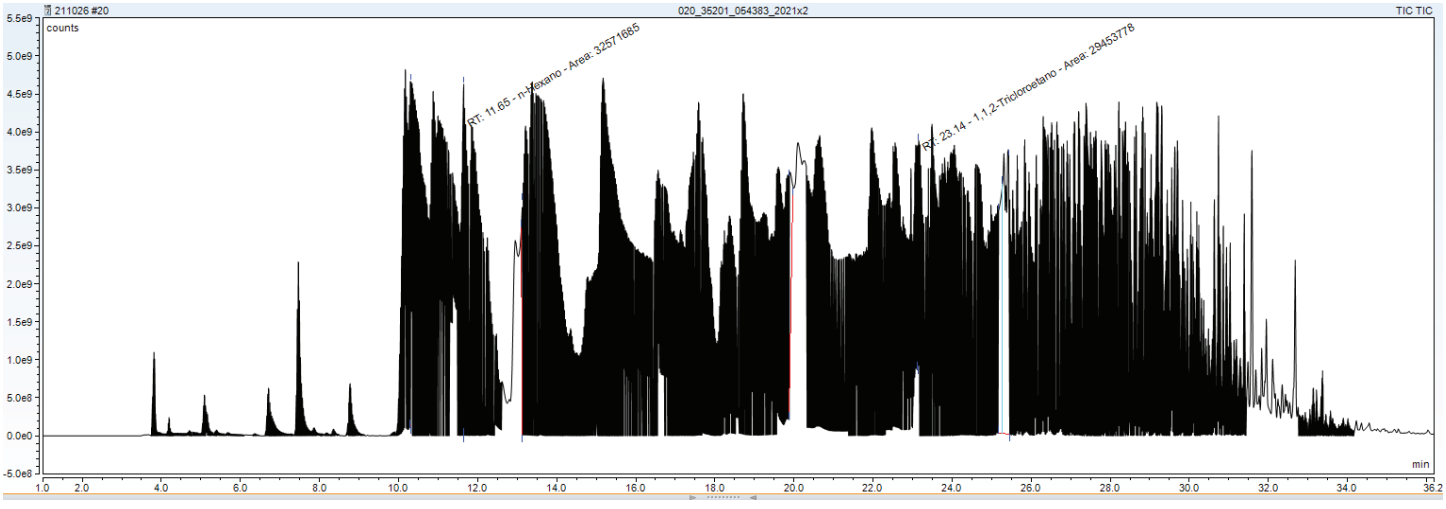

Figure 1. TIC from US EPA TO-15 showing a highly contaminated sample

> "The Thermo Scientific ISQ 7610 GC-MS allowed us to eliminate errors in manual data processing by automating the process. This allowed us to increase the productivity of the laboratory."
>
> —Bruno Pereira, Vapor Solutions

Implementing the APH method was not a straightforward task. Mr. Pereira elaborated, "To quantify the APHs, which appear at different ranges of contamination, can be a very manual process. It involves using total ion chromatogram (TIC) channels for aliphatic compounds and selected ions for aromatics. Manual integration can vary by user and is prone to error. We needed the software to be able to automate this process." Automating the integration process was key to ensuring accurate results for the analysis and saving valuable analyst time.

Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software controls the full TD-GC-MS system and facilitated automation of data processing for the APH method and implementation of QC standards. Mr. Pereira went into more detail, "With help from Thermo Fisher Scientific, it was possible to solve every challenge. For the aliphatic range evaluated by TIC acquisition mode, the smooth channel function in combination with average filters to reduce noise was used. For the aromatic ranges evaluated by scan mode acquisition over a limited mass range, the inhibition function was used for the calibration curve runs. We also were able to implement a new quality control for evaluating the recovery of the internal standards."

In the future, Vapor Solutions would like to develop additional environmental methods and services. Mr. Sato added, "We have four laboratories that comprise our group and partnership. In the coming years, we would like to develop a GC/FID 3D TPH fractioned solution, PFAS analysis in air, water, and soil, and we are looking for solutions for FTIR analysis." Vapor Solutions will continue working with Thermo Fisher Scientific in the future as Mr. Sato explained, "We had a great experience working with Thermo Fisher Scientific technical support and we still reach out to them if we need anything. We will continue working with them in the future to develop new methods."

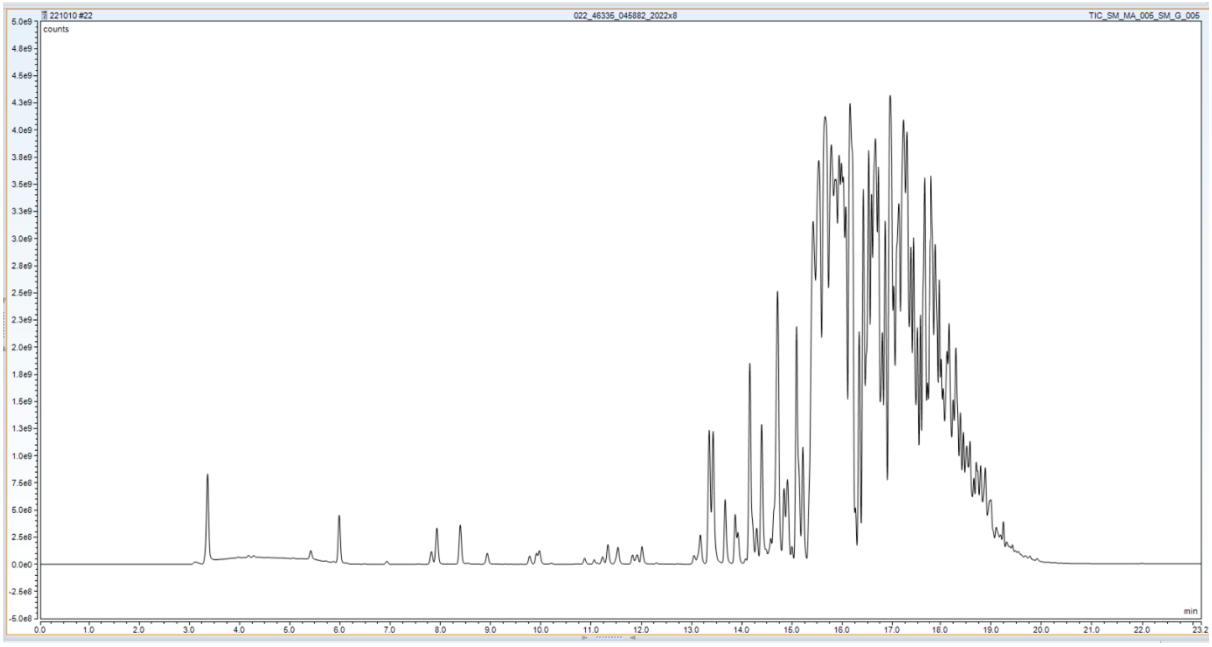

Figure 2. Quantification of aliphatic range of APH analysis utilizing TIC acquisition mode

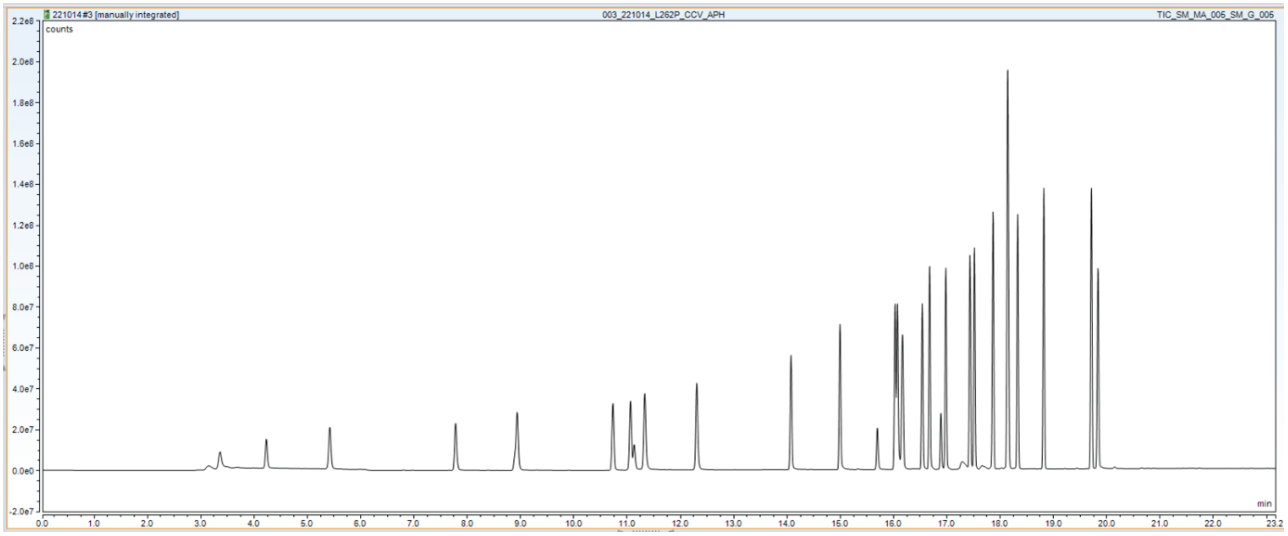

Figure 3. Quantification of aromatic range of APH analysis using scan mode over a limited mass range

Conclusion

Minimizing environmental pollution and contamination is critical to ensuring the health and safety of people, animals, and ecosystems. The ISQ 7610 single quadrupole GC-MS in combination with the Markes TD and Chromeleon CDS, offers significant advantages for targeted quantitative analysis in environmental samples, including:

- Reduction in maintenance time with NeverVent technology
- Automation of sample and data processing
- Sensitivity to ensure confidence in ultra-trace results
- Extended linear dynamic range to allow trace and high-concentration samples to be analyzed in a single injection

These benefits enable environmental analytical testing laboratories to adapt to stay ahead of analytical challenges.

Vapor Solutions laboratory equipment

About Rafael Fernando Sato

Graduated in Chemistry and MBA in Environmental Management from the University of São Paulo. He has nine years of technical and commercial experience in an environmental analysis laboratory, 1 year in environmental consulting and 2 years in a vapor intrusion sampling service company. Today, he serves as Director at the Vapor Solutions Laboratory and is Leader in the Vapor Intrusion Working Group of the AESAS Association.

About Bruno Christófano Corona Pereira

Bachelor's Degree in Chemistry and Chemical Engineering from Faculdades Oswaldo Cruz. He has 12 years of experience in the environmental market, nine years of technical experience in an environmental analysis laboratory and three years in a vapor intrusion sampling service company. Today, he serves as Technical Manager at Vapor Solutions Laboratory.

About Vapor Solutions

Vapor Solutions is a laboratory specializing in soil vapor/air analysis that has been developing and using innovative techniques for the assessment of contaminated areas since 2017. In addition to the company's quest for excellence and quality results from chemical analyses, Vapor Solutions is focused on offering high-performance technologies to environmental consultancies and Brazilian industries.

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