AXELSEMRAU
by TRAJAN

CHRONECT Workstation MOSH/MOAH

Introduction

Mineral oil hydrocarbons (MOH) are increasingly detected in food and food-contact materials. The two key groups—mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH)—pose significant challenges due to their complex composition and the diverse contamination pathways through which they enter products (e.g., from printing inks, lubricants, or environmental sources). With over 15 years of experience in MOSH/MOAH analysis, the CHRONECT Workstation MOSH/MOAH offers a breakthrough solution by combining state-of-the-art online LC-GC-FID technology with advanced automated workflows. Enhanced by the innovative methodologies detailed in our recent whitepaper, this system ensures unprecedented sensitivity, robustness, and ease of use.

System Configuration and Workflow

Online LC-GC-FID Coupling
The system is built around a seamless integration of High Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC) using a specialized interface with a heated valve unit (figure 1).

Figure 1: Heated valve unit.

This design guarantees complete solvent evaporation, preventing condensation and carryover. The GC is equipped with dual Flame Ionization Detectors (FIDs), enabling the simultaneous quantification of MOSH and MOAH in a single run - effectively reducing analysis time by half.

Automated Sample Preparation (figure 4).
To overcome the limitations of manual sample preparation and to minimize contamination and blank values, the CHRONECT Workstation implements a fully automated workflow that includes:

- **Saponification & Extraction:** Automated saponification reduces fat/oil content, followed by multiple *n*-hexane extractions that efficiently isolate the MOSH/MOAH fractions (figure 2).

Figure 2: Centrifuge as part of automatic extraction.

- **Solvent Evaporation:** An integrated evaporation module concentrates the extract, ensuring optimal conditions for subsequent analysis.

- **Automated Epoxidation:** Interferences from natural unsaturated compounds (such as squalene, sterols, and carotenoids) are minimized by an automated performic acid epoxidation step. Conducted at 65 °C for 20 minutes, this process converts interfering olefins into polar epoxides, thereby enhancing the separation and quantification of MOAH. Compared to traditional mCPBA epoxidation, this method provides greater stability, simplified workup, and superior performance even in complex matrices like palm oils.
- **Pre-Column Backflush Option:** For samples where MOSH levels greatly exceed MOAH concentrations (e.g., in certain cosmetic or polymer matrices), a pre-column backflush is available to deplete MOSH and avoid overestimation of MOAH.
- **Online Aluminum Oxide (AlOx) Purification:** An optional, fully automated AlOx purification step selectively removes natural alkanes from the MOSH fraction. This ensures that the detected MOSH "hump" represents only the target analytes (figure 3).

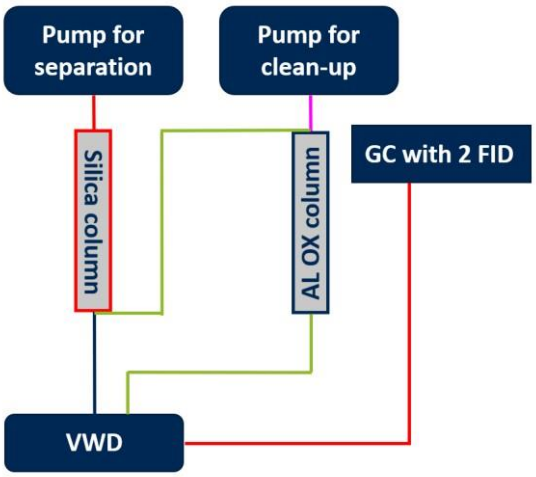

Figure 3: Schematic structure of online aluminum oxide purification.

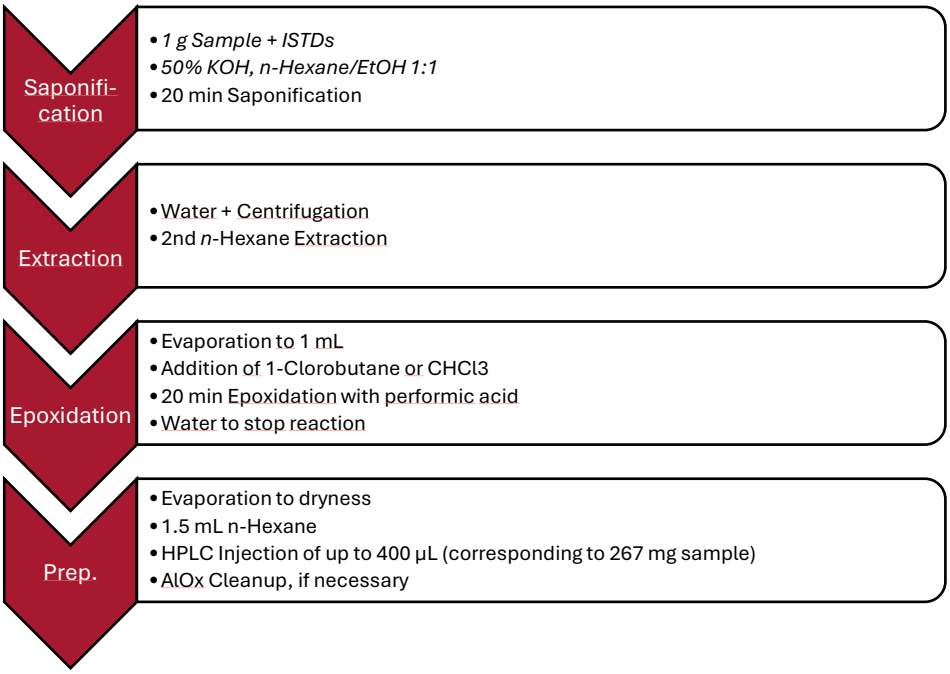

Figure 4: Automated Workflow for the analysis of MOSH/MOAH in edible oils and fats.

Figure 5: Control unit.

Integrated Software and Evaluation

The complete system is managed via the CHRONOS software, which provides intuitive control and real-time monitoring via the CHRONECT LC-GC Interface (figure 5). Additionally, the specialized evaluation software, Chrolibri, automatically processes complex “hump”

chromatograms - subtracting interfering peaks and delivering accurate quantitative results in line with international standards (DIN EN 16995, DGF C-VI 22 (20), and ISO 20122:2024, figure 6).

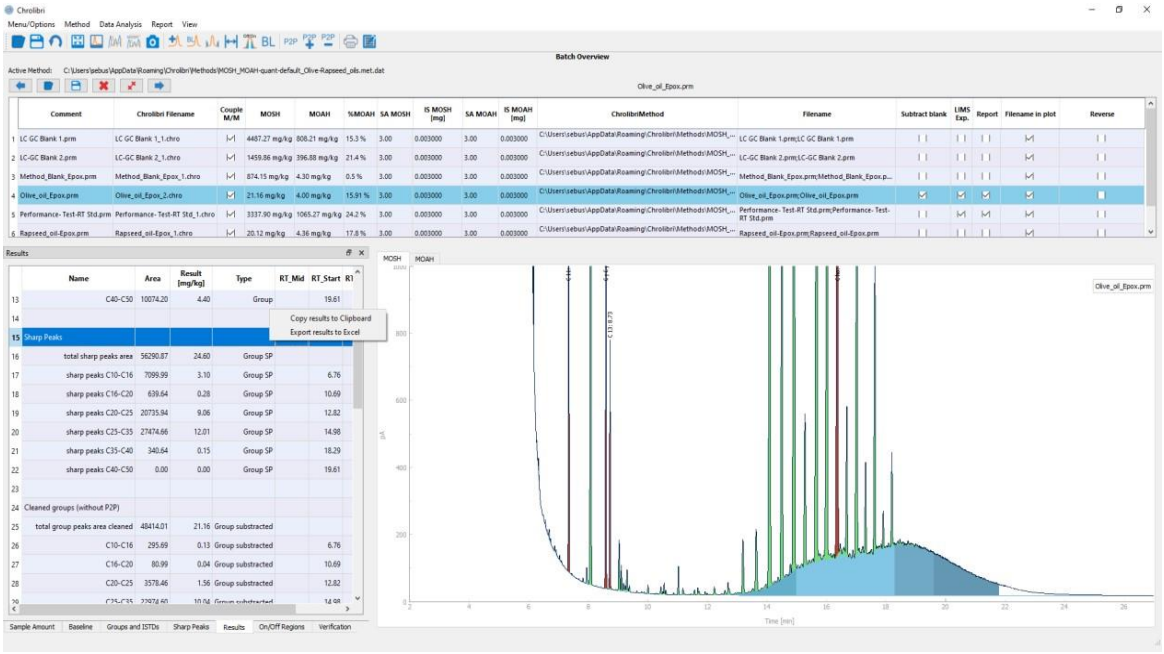

Figure 6: Evaluation of MOSH/MOAH analyses with Chrolibri.

Analytical Performance and Capabilities

- **Sensitivity and Quantification:** The automated workflow achieves limits of quantification (LOQs) as low as 1 mg/kg for both MOSH and MOAH, even in challenging matrices such as edible oils and fats. This sensitivity meets the most stringent regulatory requirements.
- **Robustness and Reproducibility:** Minimizing manual intervention reduces blank values and variability. International validation tests demonstrate relative standard deviations as low as 8.8%, confirming the method's robustness.
- **High Throughput:** By automating critical steps, the system allows for the processing of up to approximately 30 samples per day - even if all sample preparation steps are integrated (saponification, double excration, evaporation, epoxidation and AlOx cleanup) - thereby maximizing laboratory productivity.

Flexibility and Expandability

The CHRONECT Workstation MOSH/MOAH can be extended by different options:

High Capacity Extension

This option enables to run up to 60 samples with the AWF. The option includes a 200cm robot and additional modules for the higher capacity

Fract & Collect

This option allows the targeted collection of a fraction for further analysis with other methods (figure 7). Very often a GCxGC-MS analysis is used. This method should allow the qualitative composition of e.g., the MOAH fraction in case of positive MOAH findings to allow more precise conclusions about the origin and a more in-depth evaluation of the sample.

MOSH depletion

It allows the determination of MOAH in samples that have a very high percentage of MOSH, such as petrolatum-based cosmetics. Only the depletion of the MOSH content allows the determination of the MOAH content.

Determination of the sterol distribution

The MOSH/MOAH system can be supplemented by sterol analysis. With the CHRONECT Workstation Sterols, the sterol distribution in edible oils can be determined fully automatically.

Determination of further quality parameters

Furthermore, different quality parameters of edible oils, such as alkyl esters and stigmastadiene, can be analyzed.

Figure 7: Fraction collection tool.

Trainings

Appropriate sample handling, prevention of blank values, use of correct chemicals and sample vessels are pitfalls that influence the result. To support the users in these important points, Axel Semrau works together with Funke Analytic Consult. This enables us to offer a training program specially adapted to MOSH/MOAH analysis.

Key Benefits for Laboratories

- **Enhanced Accuracy and Sensitivity:**
  With a fully automated sample preparation and analysis process, laboratories can achieve precise MOSH/MOAH quantification even at very low contaminant levels (LOQ of 1 mg/kg).
- **Increased Efficiency and Reduced Labor:**
  Automation minimizes the risk of human error and reduces the time-consuming nature of manual sample preparation, leading to faster turnaround times and cost savings.
- **User-Friendly Operation:**
  The intuitive software interfaces (CHRONOS and Chrolibri) facilitate rapid setup, easy monitoring, and straightforward data evaluation, reducing training requirements.
- **Regulatory Compliance:**
  The system complies with current international standards (DIN EN 16995, DGF C-VI 22 (20), ISO 20122:2024) and ensures that your laboratory's methods meet or exceed legal requirements. At the same time, it offers to work fully automatically according to an improved version of ISO 20122:2024.

Conclusion

The CHRONECT Workstation MOSH/MOAH sets a new benchmark in the analysis of mineral oil hydrocarbons by integrating cutting-edge automation with advanced analytical techniques. It is the result of continuous development in close cooperation with more than 150 customers. This state-of-the-art system not only simplifies the analytical process but also delivers fast, reliable, and highly sensitive results—empowering laboratories to ensure food safety and regulatory compliance with confidence

Technical data

Specifications	Values
MOSH/MOAH measuring system using LC-GC-FID according to DIN EN 16995, supports DGF C-VI 22 (20), ISO 20122:2024 *Note: DIN EN 16995 is mentioned for compatibility reasons, the method has officially been retracted in 2024*	Includes HPLC with UV detector, GC with 2 FIDs and oven chamber illumination, CHRONECT Robotic Autosampler, LC-GC-Interface, consumables for 6 months, data system for evaluation, Factory Acceptance Test, installation and Site Acceptance Test
Number of LC-GC channels	2 channels, optionally expandable to 3
Temperature valve unit	Room temperature up to 150 °C, typical operating temperature 80 °C
Option: Automatic epoxidation	supports ethanolic epoxidation according to Nestola, compliant with DGF C-VI 22 (20)
Option: Online aluminum oxide cleanup	includes additional pump, valve set and matching columns
Option: Automated workflow for edible oils and fats	Supports performic epoxidation according to Nestola, includes evaporation unit and vacuum pump
Supported Hardware	Agilent 8890 GC, Agilent 1260 Infinity II, Shimadzu GC-2030, Shimadzu LC-40

The CHRONECT Workstation MOSH/MOAH is a development by Axel Semrau.

Subject to technical changes
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