Technological Advances and Solutions for Reducing Methylene Chloride in Laboratory Settings

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Why Reduce Methylene Chloride?

- Methylene chloride ($MeCl_2$) is a known neurotoxicant and a suspected carcinogen.
- Exposure risks include dizziness, respiratory distress, and long-term health effects.
- New EPA TSCA Rule enforces strict limits on $MeCl_2$ use and exposure.

Concerning Fact: Methylene chloride has been used in some food-related applications, including as a post-harvest fumigant for strawberries.

Why we care about reducing $MeCl_2$

EPA considers $MeCl_2$ an "UNREASONABLE risk" under laboratory conditions:

- Serious Inhalation Hazard
- Cancer risk – short & long term exposure
- Central nervous system and organ toxicity
- Human body metabolizes $MeCl_2$ into carbon monoxide and formaldehyde

Best ways to reduce $MeCl_2$ in an environmental laboratory

Combination of

Elimination/Substitution (not possible with current EPA methods; ATP available)

Engineering controls (Air system, hoods)

Administrative practices (minimize quantities in purchasing, sample volume, etc.)

Personal protective equipment (appropriate gloves, lab coats)

Implementation of Exposure Control Compliance Deadlines

Entity Type	Initial Monitoring	Prevent Exposure	Full Implementation
Private Sector	May 5, 2025	Aug 1, 2025	Oct 30, 2025
Federal Agencies	Nov 9, 2026	Feb 8, 2027	May 10, 2027
Federal Contractors	Nov 9, 2026	Feb 8, 2027	May 10, 2027

Why $MeCl_2$ Is Used

- Effective solvent: pulls non-polar analytes of interest.
- High density and volatility aid in clean separations.
- Well-optimized for current EPA extraction methods.

Merit prioritizes human safety and environmental responsibility.

Real-time monitoring, safety training, and spill protocols in place.

Partnerships for green chemistry and solvent waste minimization.

Human & Environmental Safety

What Merit Laboratories is Doing to Ensure Lab Safety

- Custom- Engineered labs for isolation and containment of $MeCl_2$.
- Robust staff training and safety-first policies.
- Internal audits to monitor and improve chemical use.

Extraction Lab
Most expensive lab in our building

- 100% Fresh air (no recycled air)
- EMERGENCY 30 air changes per hour
- Sophisticated pressure system
  - Negative air pressure
  - Completely sealed laboratory
  - No drains (spills contained)

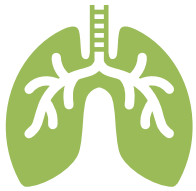
Engineering Controls: Most expensive lab in our building

- Extraction labs are maintained under negative air pressure.
- Prevents vapor migration to other lab areas.
- All solvent vapors are vented through advanced exhaust systems.

Air Vents for Heavy Vapors

$MeCl_2$ is heavier than air and settles low.

Floor-level air vents actively pull $MeCl_2$ vapors away from analysts.



Designed to protect breathing zones and minimize exposure.

Fresh Air Exchange

Sealed Lab Infrastructure

- Floor-to-wall seals prevent chemical migration.
- Spills are fully contained within the extraction lab.
- Critical for maintaining lab zone integrity.

Emergency Ventilation Protocols

Emergency vent button instantly maximizes exhaust system.

Quickly evacuates $MeCl_2$ vapors in case of spills or exposure incidents.

Part of comprehensive safety response plan.

Air System Summary

- Negative pressure rooms, floor-level vents, and fresh air systems.
- Sealed infrastructure and emergency exhaust protocols
- Combined, these ensure a safe environment for staff and samples.

Eliminate or Minimize $MeCl_2$ when possible

Solids

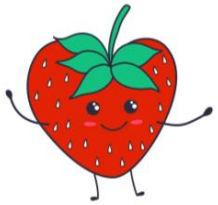
Switch to microwave extraction

- Replaced sonication with microwave for soil extractions.
- Applies to SVOCs, PNAs, DRO,
- PCBs and Pesticides hexane instead of $MeCl_2$
- Reduces solvent usage while improving efficiency.

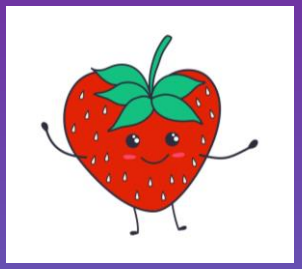
Improvement on methods to minimize $MeCl_2$

Soxhlet
300 ml

Sonication
150 ml



Microwave
12.6 ml



Microwave for the WIN!

Lower Solvent Volumes

Liquids

- Optimized liquid-liquid extraction: 500 ml sample / 180 ml solvent.
- Maintains analytical performance with less chemical waste.
- Supports green lab goals without sacrificing quality.

Solid Phase Extraction (SPE)

Adopted SPE for TCLP SVOC extractions.

Uses minimal solvents and delivers clean results.

Supports shift toward low-impact methods.

SPE for the Win

Ongoing Innovations

- Developing SPE for PCBs and Method 625.
- Actively improving lab workflows to support solvent reduction.
- Investing in scalable, sustainable techniques.

Ongoing Innovations

The goal is to not compromise on quality

- Solvent-less extraction technique by Entech
- Supported liquid extractions by different SPE manufacturers
- Microextractions that rely on more sensitive detection technologies (i.e. GC/MS/MS)

Winner to be announced…

Regulatory Collaboration

- Working with EPA to modernize legacy methods.
- Advocating for solvent volume flexibility in official protocols.
- Encouraging adoption of newer technologies in federal standards.

Industry Collaboration

- Partnering with vendors and peer labs for innovation.
- Sharing data and strategies to reduce $MeCl_2$ across the industry.
- Supporting a community of safe, sustainable science.

A Safer Future

- Merit is committed to solvent-free and low-risk practices.
- Combining innovation, collaboration, and advocacy.
- Leading the industry toward a safer tomorrow.

A Safer Future Together.
Thank you.

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