A Field Practitioner's Collaborations to Produce the Best Sampling Results

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What are my options?

TRADITIONAL SAMPLING

VS

DIRECT READING TECHNOLOGIES

How to decide?

PURPOSE OF SURVEY

* Prevention
* Compliance
* Injury/illness investigation
* Complaints
* Engineering controls
* Use PPE

Develop Sampling Strategy

Based on Exposure Assessment

* Understand processes, tasks
* Observations
* Interviews
  - workers
  - maintenance
  - management

Develop Sampling Strategy

* Safety Data Sheets (SDSs)
* Previous exposure monitoring results
* Occupational exposure limits (OEL)
* Engineering controls
* Personal protective equipment (PPE)
* Personal vs. area sample

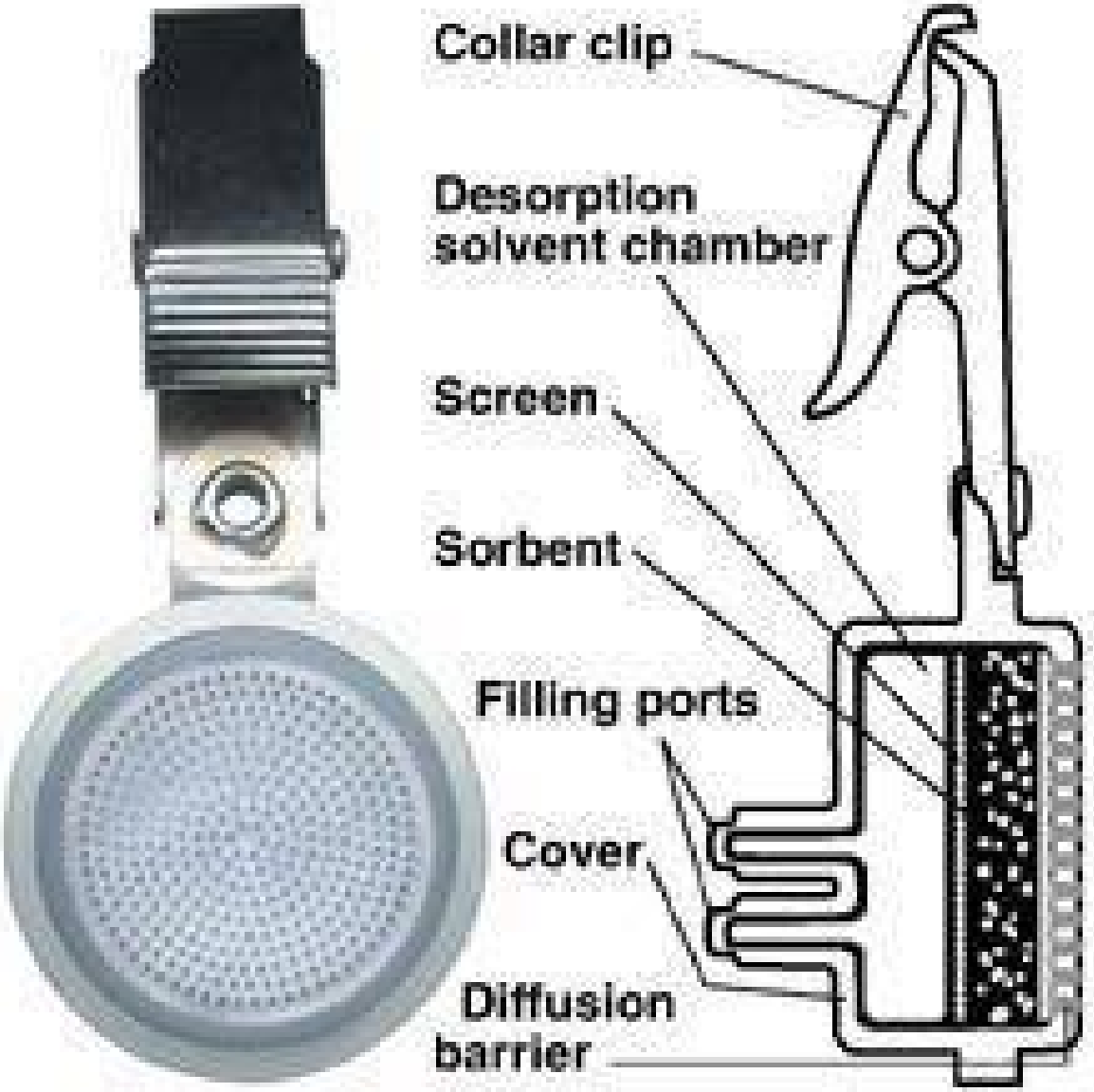
Choose Traditional Sampling

* Pumps and media
* Passive dosimeter badges
* Diffusion tubes
* Gas detector tubes

Sampler
Pump

BIOS
DryCal
DC-Lite

PASSIVE DOSIMETER BADGES


Collar clip
Desorption solvent chamber
Screen
Sorbent
Filling ports
Cover
Diffusion barrier

DIFFUSION TUBES

GAS DETECTOR TUBES

SELECT AN ACCREDITED LABORATORY

What is Accreditation?

* Recognition of an entity's competence against a specific standard
* A means for regulators and consumers to identify and select goods/services for which they can have confidence

Standard for Accrediting Laboratories

* ISO/IEC 17025:2017 General Requirements for Competence of Testing & Calibration Laboratories
* International industry standard for accreditation of laboratory testing

ISO/IEC 17025 Accreditation Means…

* The testing laboratory has been assessed and determined to be in compliance with the Standard
* Meets both **technical competence** and **management system** requirements necessary to consistently deliver technically valid test results

AIHA Laboratory Accreditation Programs, LLC (LAP-LLC)

* AIHA began accrediting IH laboratories in 1974
* **AIHA Laboratory Accreditation Programs, LLC** which was formed in 2009 by AIHA
* AIHA-LAP accredits all testing labs to the ISO/IEC 17025 Standard

Go to website at www.aihaaccreditedlabs.org

AIHA-LAP

* Industrial Hygiene (IHLAP)
* Environmental Lead (ELLAP)
* Environmental Microbiology (EMLAP)

Accreditation Requirements

* Annual application
* Site assessment (ISO:IEC 17025:2017) every 2 years
  - Field of Testing (FoT)
  - Proficiency Analytical Testing (PAT) scores
* Technical support

Field of Testing (FoT)

VERIFY LABORATORY SCOPES

* Gas Chromatography (GC) for Solvents
* Phase Contrast Microscopy (PCM) for Asbestos in air
* Inductively Coupled Plasma (CP) for Metals
* Many more

Laboratory Assistance

Review pros and cons of sampling options

* Passive vs. active
* Different media choices
* Different analytical techniques
* Different levels of sensitivity (LOQ or RL)

Typical Sampling Guide Information

Analyte Name	Method	Technique	Media	Flow Rate (Lpm)	Air Volume (L)	RL (µg)	Compat-ibility Code	Special Handling Instructions
Inorganic Acid Scan *also see scans, p. 35*	NIOSH 7903	IC	SG-T12 (SKC 226-10-03 OR ORBO 53)	0.2-0.5	3-100	Varies	3	
Iodine	OSHA ID-212	Wet Chem	Carbon bead-T (SKC 226-80)	0.5	≥5	5	-	
Iron	NIOSH 7300/7303	ICP	MCE (or PVC-PW w/ total dust)	1-4	5-100	1	7	Do not exceed 2 mg of total dust on filter.
	OSHA ID-125G	ICP	MCE (or PVC-PW w/ total dust)	2	30-480	1	8	Welding fume method.
Isoamyl alcohol	NIOSH 1405 (OSHA 7)	GC/FID	CT (SKC 226-01)	0.01-0.2	1-10	4	1	
Isobutyl acetate	NIOSH 1450 (OSHA 7)	GC/FID	CT (SKC 226-01)	0.01-0.2	1-10	3	1	OSHA 1009 is written for passive badges (SKC 575-002 and SKC 3520). Lab will cite equivalent analytical method (OSHA 7).
Isobutyl alcohol	NIOSH 1405 (OSHA 7)	GC/FID	CT (SKC 226-01)	0.01-0.2	2-10	4	1	
Isophorone	NIOSH 2508 (OSHA 7)	GC/FID	Anasorb 747 (SKC 226-81A)	0.01-1.0	2-25	3	-	Store cold.
Isophorone diisocyanate (IPDI)	OSHA 42	HPLC	GFF-T11 (SKC 225-9002)	1	15	0.4	4	Store cold; sample open-faced; protect from light.
Isopropyl acetate	NIOSH 1450	GC/FID	CT (SKC 226-01)	<0.2	<9	2	1	

Consider OELs

OEL: Occupational Exposure Limits

* OSHA PELs and NIOSH RELs
  Each agency publishes methods to assess against their own exposure limits.

* ACGIH TLVs (Threshold Limit Values)
  - TLVs based on toxicology, not technical feasibility
  - They do not publish / validate methods
  - Creates conflict, "How do I sample?"

Reporting Limit (RL)

The smallest concentration of analyte that can be reported with reproducible certainty

- Same concept as Limit of Quantitation (LOQ)
- Affects sensitivity, especially for STEL samples
- RLs vary by laboratory – cannot assume your laboratory will match the RL in published method
- Everyone wants the lowest RL, but balance against commercial turnaround time pressures

Recommended Flow Rates & Volumes

* How much latitude is contained in “recommended” air volume / flow rate?
* An agency cannot anticipate all sampling environments
* Air volume (total liters):

  - Enough air to achieve required sensitivity

  - Limit air to avoid an overloaded sample
* Extremely clean or dirty environments may not yield useful results in the recommended ranges

Recommended Flow Rates and Volumes

* Much more critical to stay within recommended flow rates
* Methods validated by OSHA, NIOSH, others at the given flow rates ensure:
  - Sufficient flow to capture the analyte
  - Flow slow enough to stop analyte from completely blowing through the media
  - Chemical reactions can occur properly on treated media

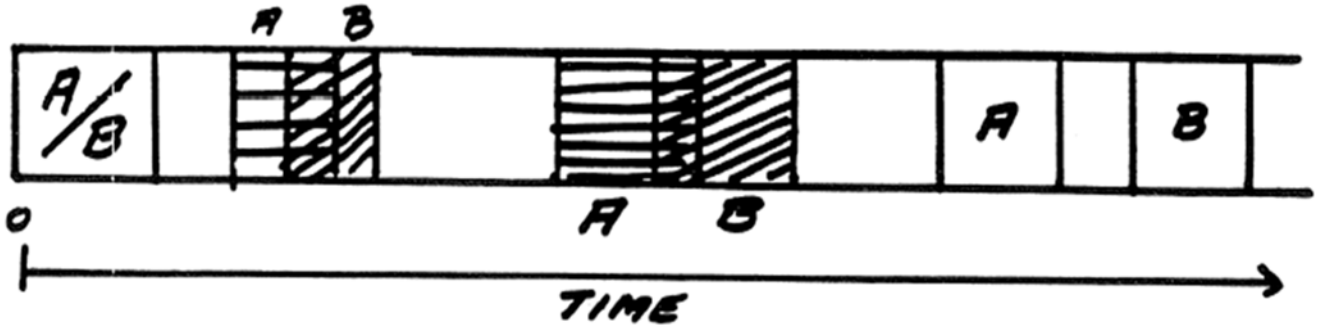
Sampling & Analytical Method Limitations

Interferences can be either:

* Positive – artificially inflating result
* Negative – artificially suppressing result

Chromatography

Separation of mixture into components, using a chromatographic column and mobile phase (gas, liquid)



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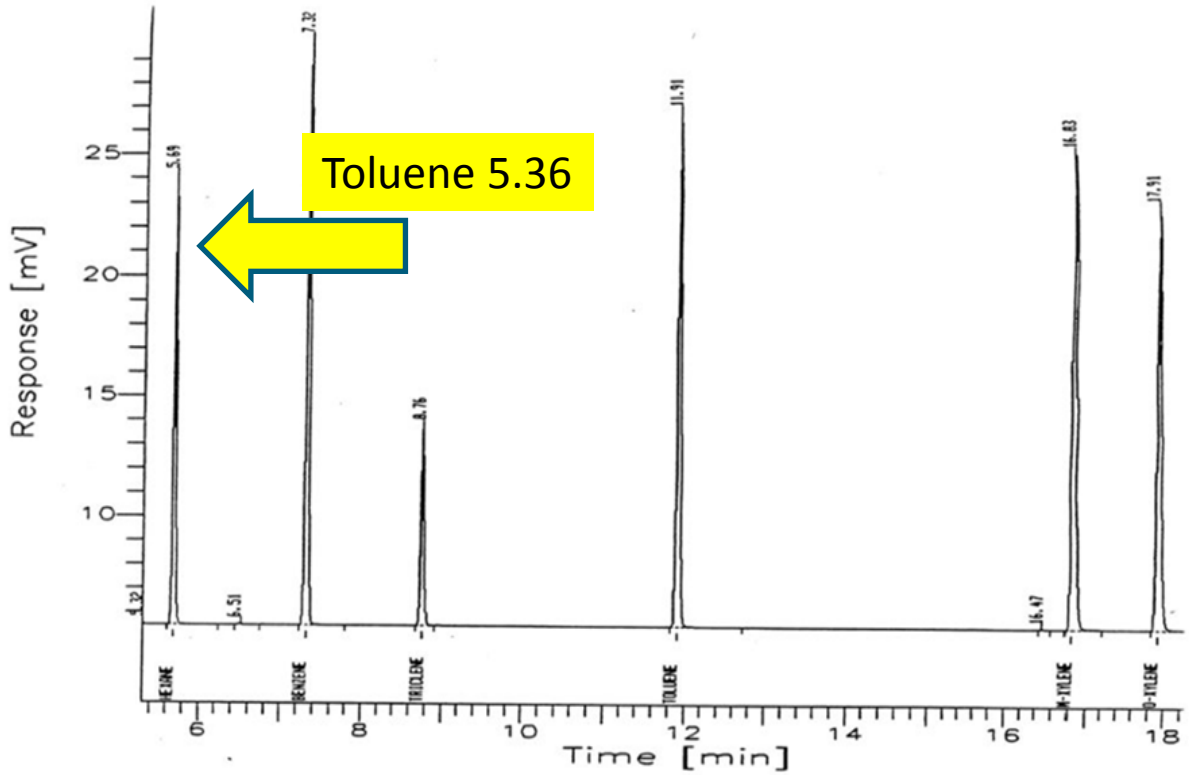
Chromatography

Chromatogram from a gas chromatograph (GC)
Toluene retention time (RT) shown:



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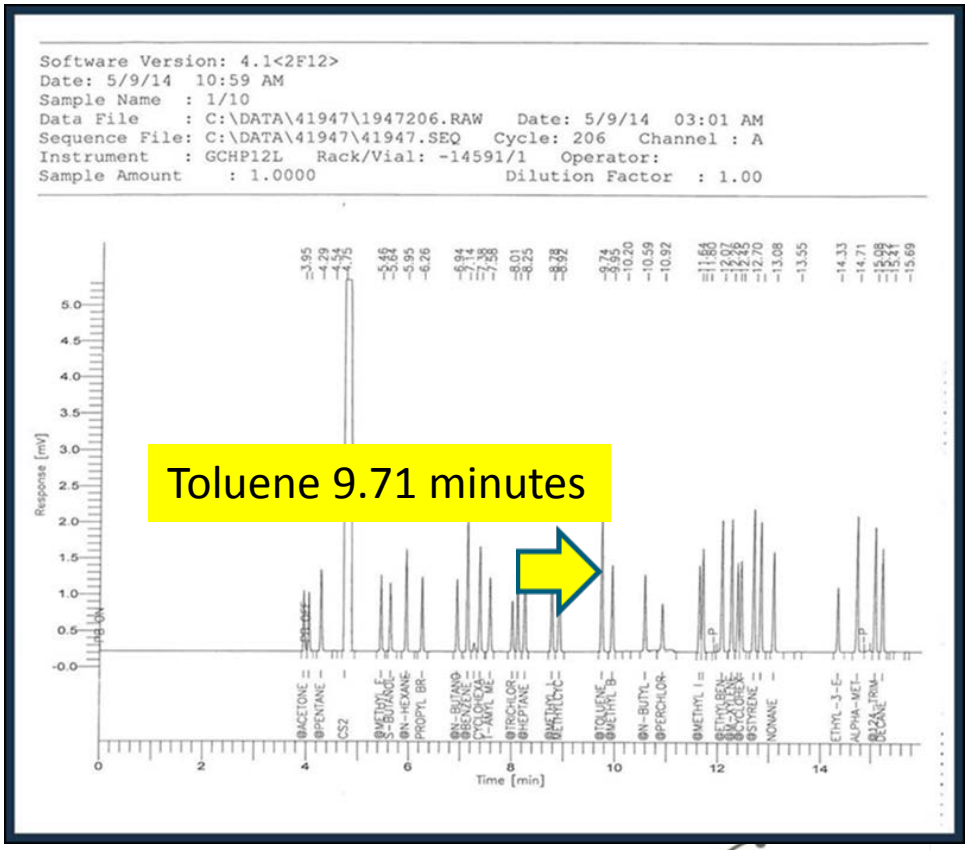
LIMITATIONS

However, with different instrument conditions, toluene could have an RT of 9.71 minutes



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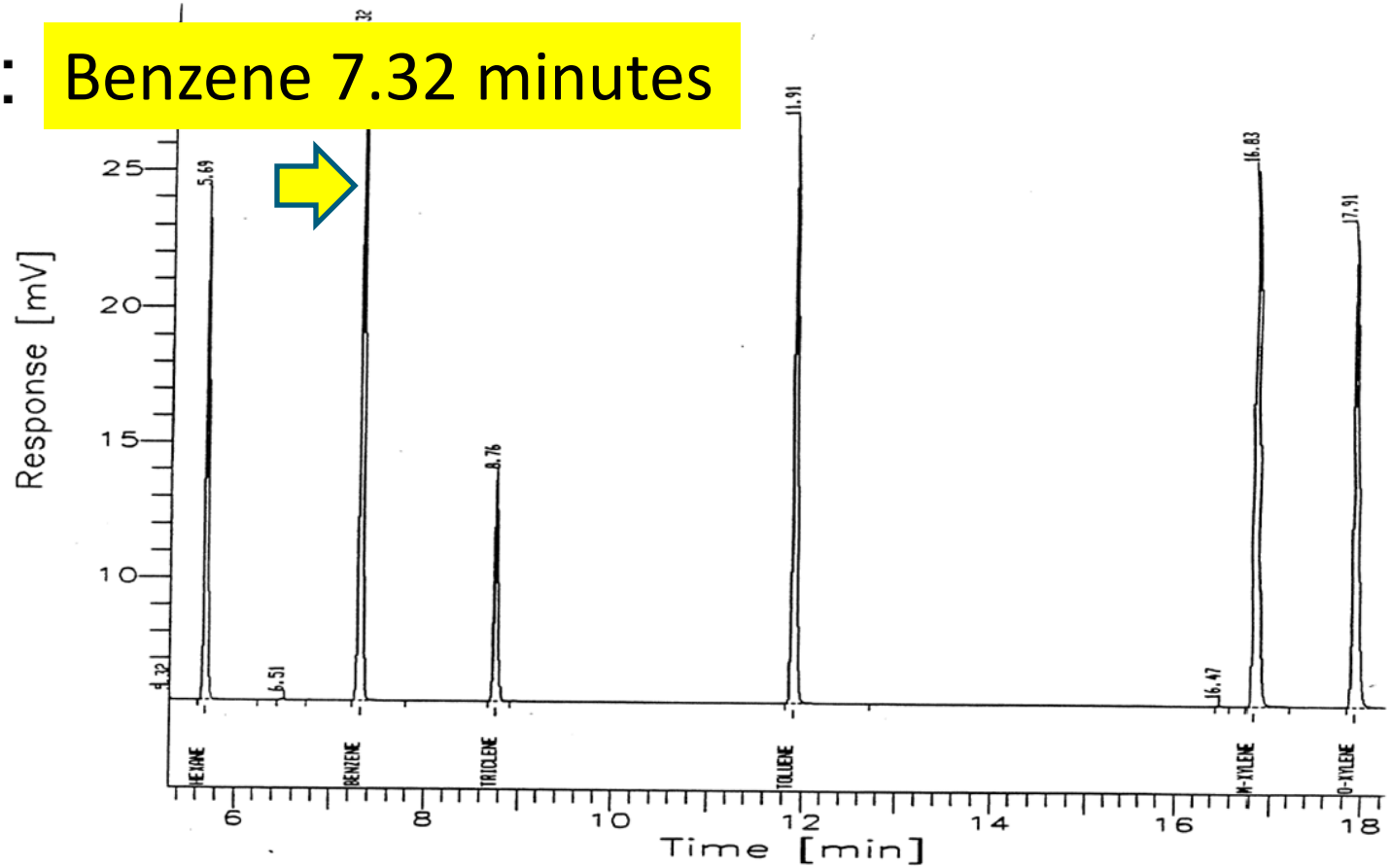
Chromatogram – Good Separation

Distinct peaks: Benzene 7.32 minutes



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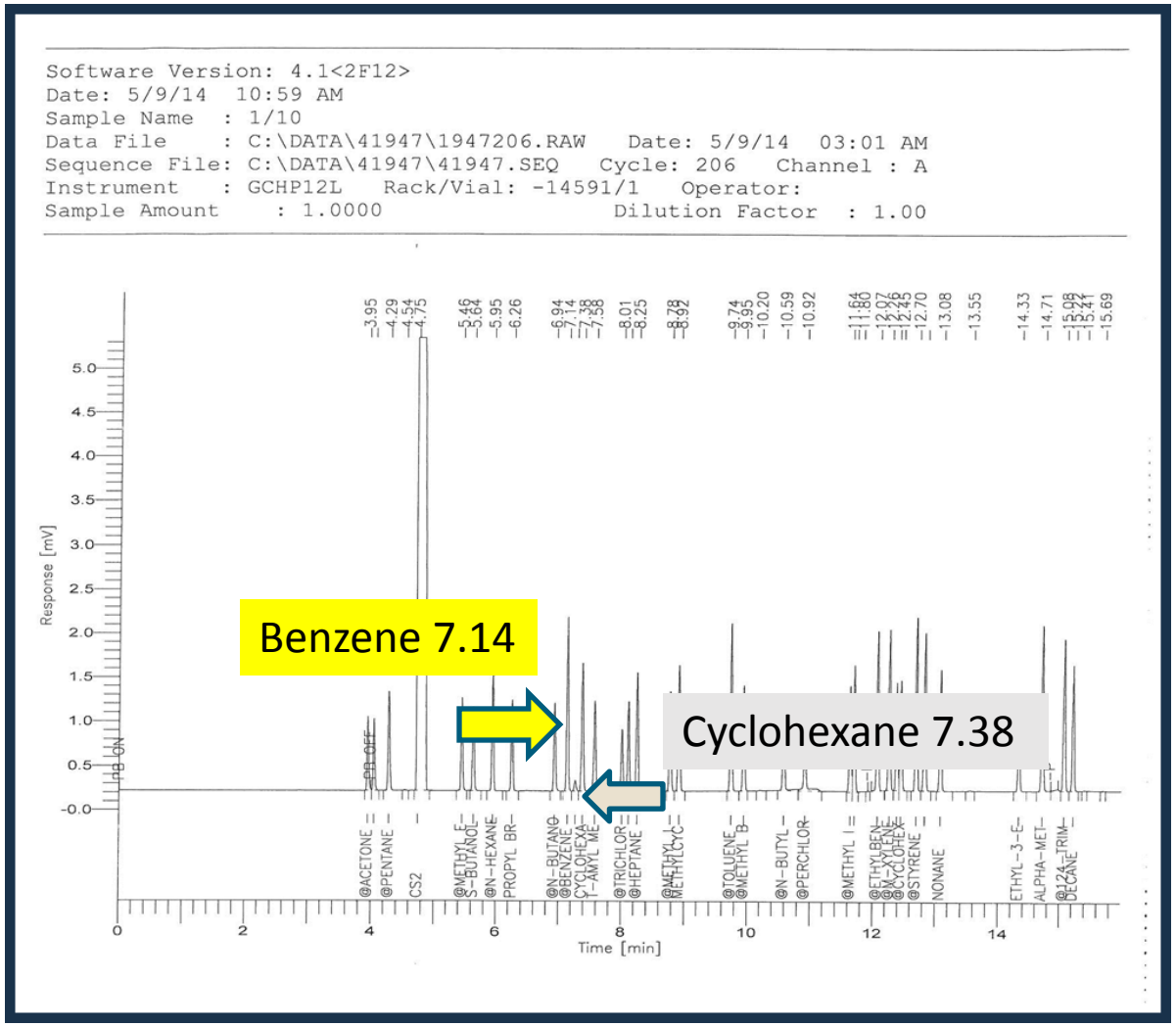
Chromatogram – Less Separation

More Components:



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Limitation Example

* Retention time is not absolute proof of chemical identity
* For GC analysis, additional options are:
  - Second column confirmation
  - GC/MS confirmation
* Similar concepts of interference can apply to other techniques
  - Chromatography (HPLC, IC)
  - XRD

Limitation Example

* Excessive particulate loading an analytical challenge
* Most methods (OSHA/NIOSH) recommend a particulate loading ≤ 2 mg (2,000 µg)
  - This is too much particulate!

* Excessive particulate may require dilution – can raise RL

Laboratory Assistance

Use validated methods, BUT;

* Laboratory can provide guidance based on ”typical” personal sampling
* Every sampling situation is different

Sample Handling and Shipping

* Cross contamination
* Overnight vs. ground
  - Cold vs. ambient
  - Time of year
  - Distance
* Tracking number/Reputable courier
* Delivery date (holiday, weekend)

Chain-of-Custody Paperwork

Provide good information to prevent miscues:

* Be specific on turn-around time request
* Notify laboratory about rush requests
* Request specific analytical methods
* Note information as relates to samples

What Do the Numbers Mean?

Practitioner's responsibility to interpret results!

Unexpected results

* Significant difference in results
* One positive, remainder none detect

Understand test limitations

Choose Direct Reading Instruments

DIRECT READING INSTRUMENTS

* Improved, well established technologies
* More user friendly
* Better applications

  - Photo Ionization Detectors (PID)

  - Fourier Transform Infrared Spectroscopy (FTIR)

  - Chip Measurement Systems (CMS)

Choose Direct Reading Instrumentation

SELECT REPUTABLE SERVICE PROVIDER

* Rental vs Purchase
* Technical support
* Quality
* Cost

Service Provider Technical Support

Best instrumentation to achieve goal

* Sensitivity
* Interferences
* Ease of Use
* Calibration

FINAL THOUGHTS

As sampling options increase:

* need to communicate and collaborate with your laboratory and service providers

Questions?