# FTIR Detection of Outgassing Chemicals: Instantaneous and Comprehensive Identification and Quantitation

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September 19, 2000

3M Innovation

# Airborne Molecular Contaminants (AMC)

- ***Sources:*** plastics, tapes, adhesives, pumps, process chemicals, solvents, people, etc.
- ***Effects:*** corrosion, hazing, molecular contamination, adhesion, etc.

## Major Issue :

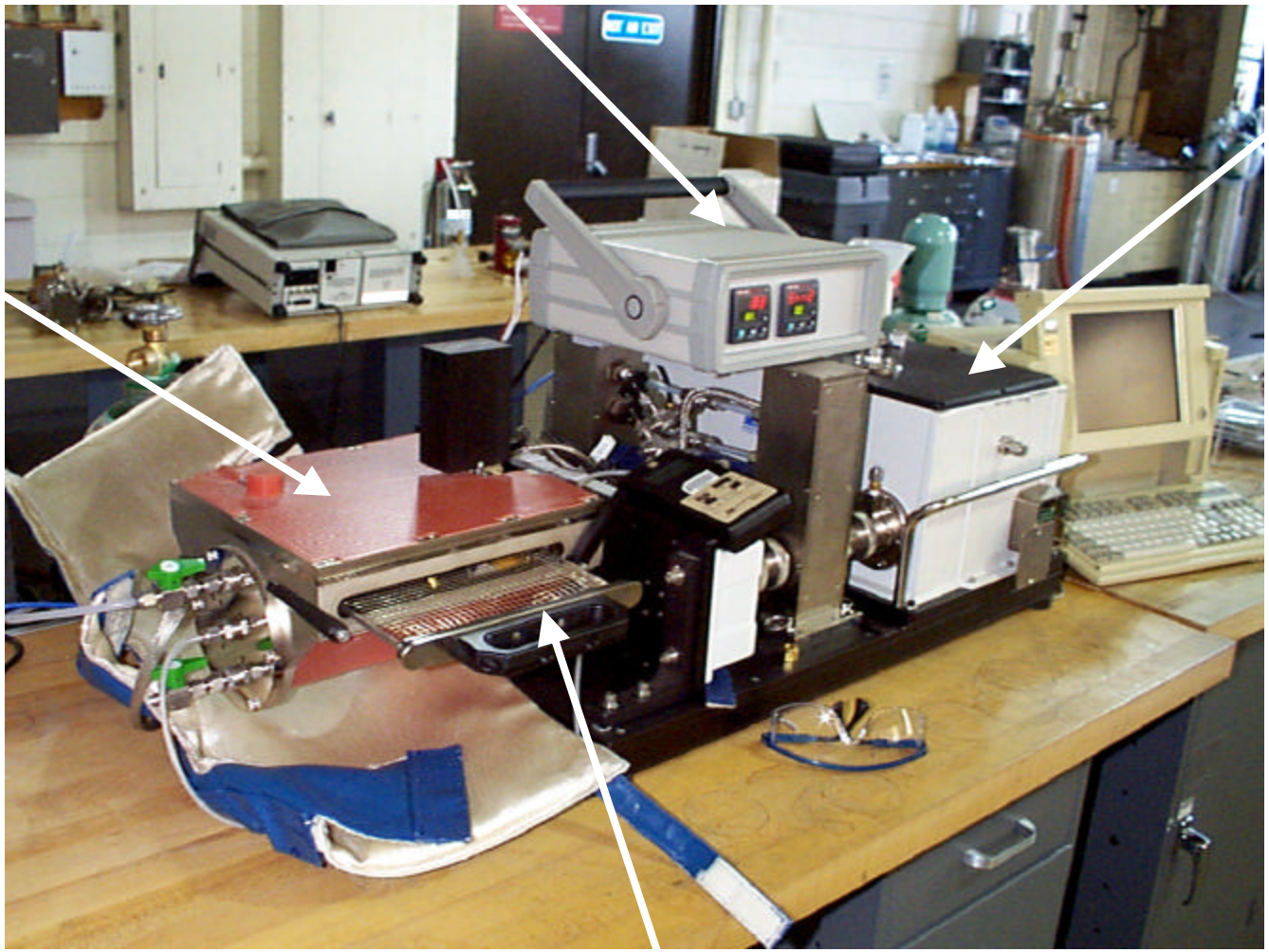
How do you quantitate and speciate molecular compounds that are “outgassed” from disk drive materials in a timely manner.

An Innovative New Alternative to
Existing Technologies ….

# Static Headspace with Fourier Transform Infrared (FTIR) Detection

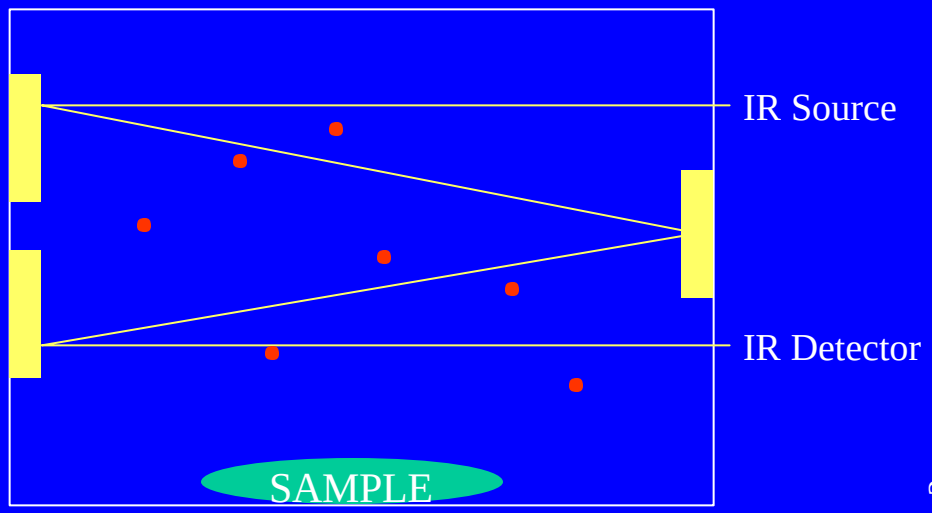
- Detection of acids, bases, volatiles and semi-volatiles simultaneously.
- Quantitation and identification of compounds.
- Fast collection and analysis time - manufacturing requirement.
- Low detection limits as required by the microelectronics industry.
- Rugged method and instrumentation for plant application.
- Simple equipment maintenance and operation.

# 3M Proprietary FTIR Static Headspace (SHS)

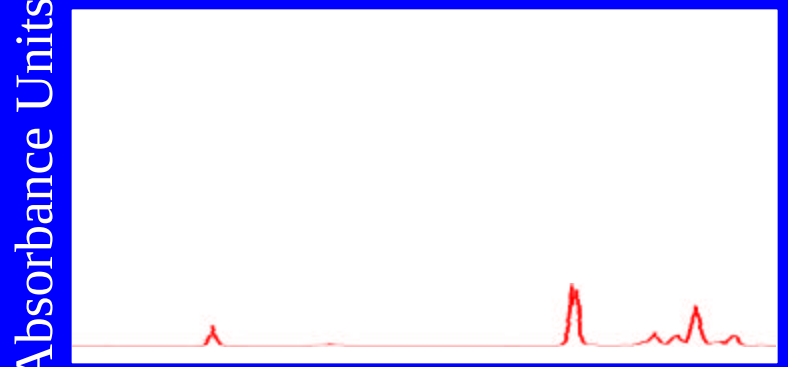


# FTIR Static Headspace (SHS): Outgassing Profile

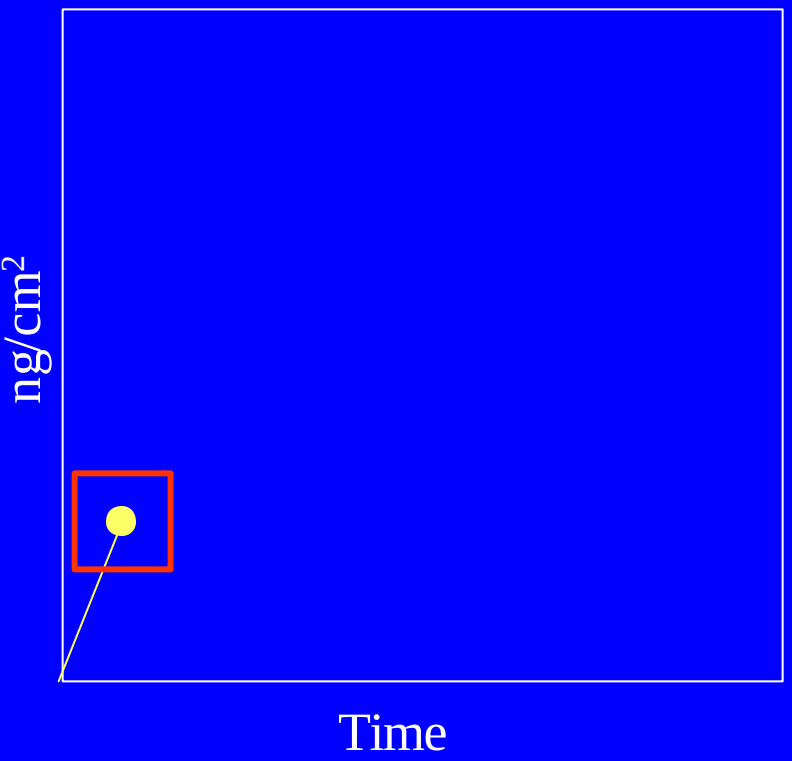
FTIR Static HS Gas Cell




FITR Spectra




Total Cumulative Outgassing vs Time



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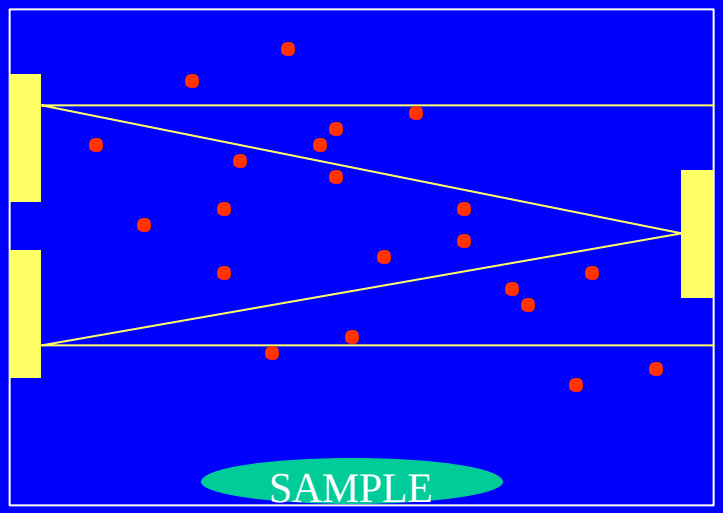


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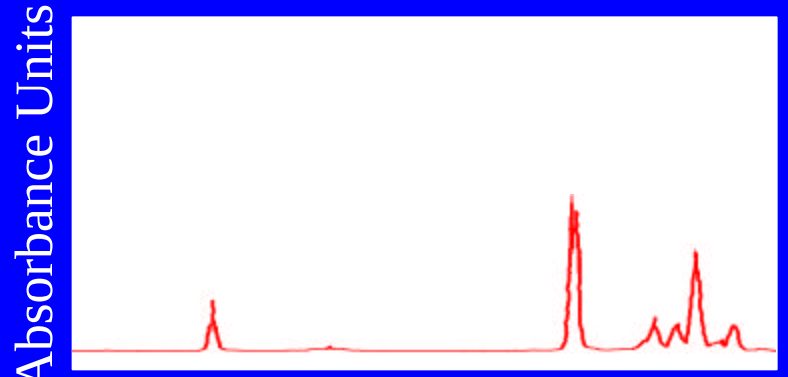


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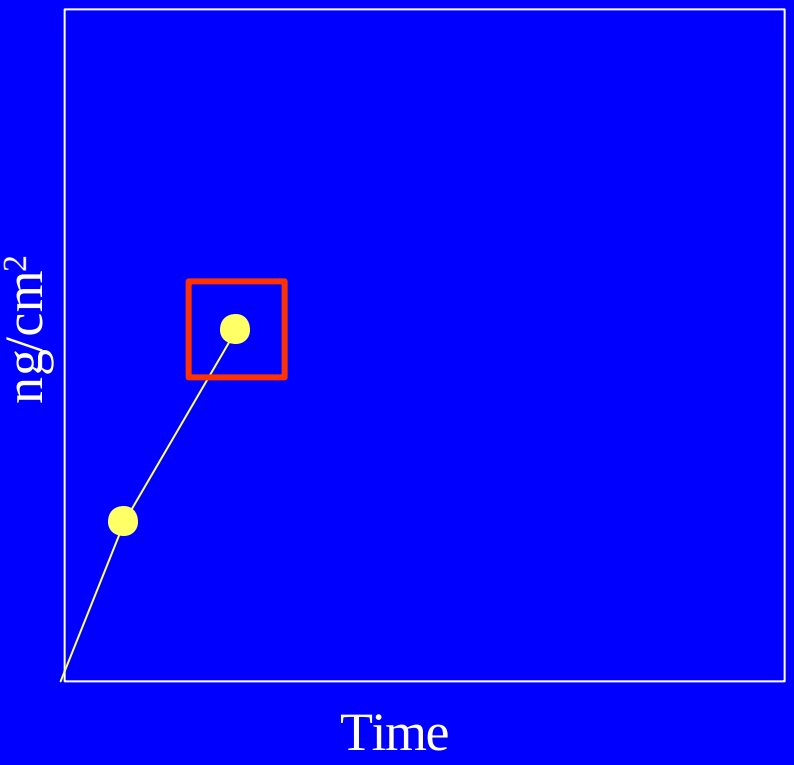

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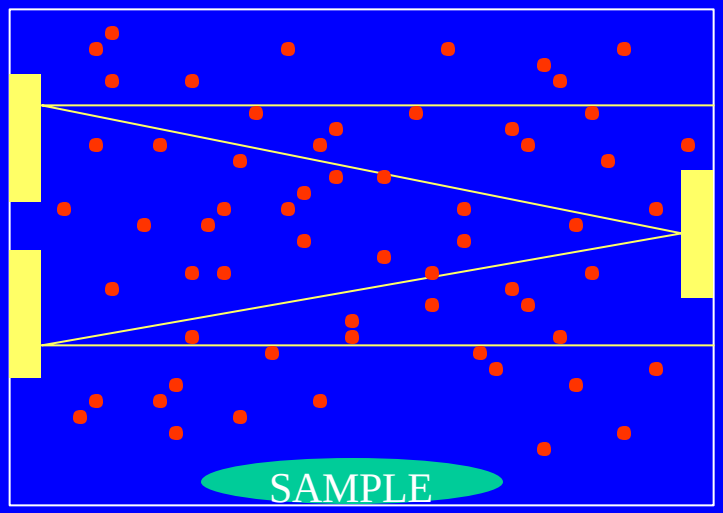


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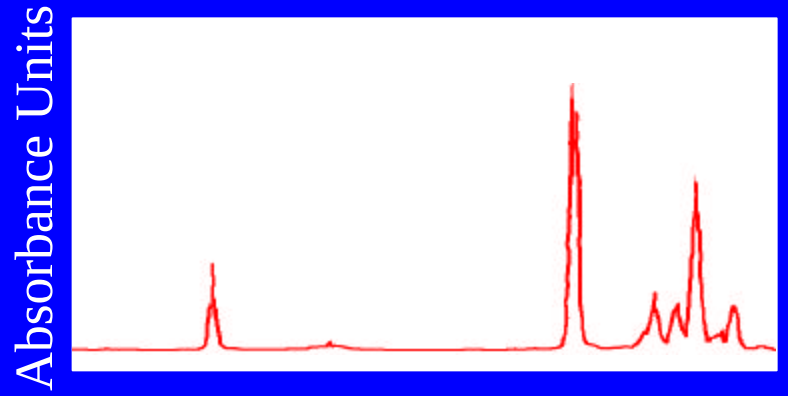


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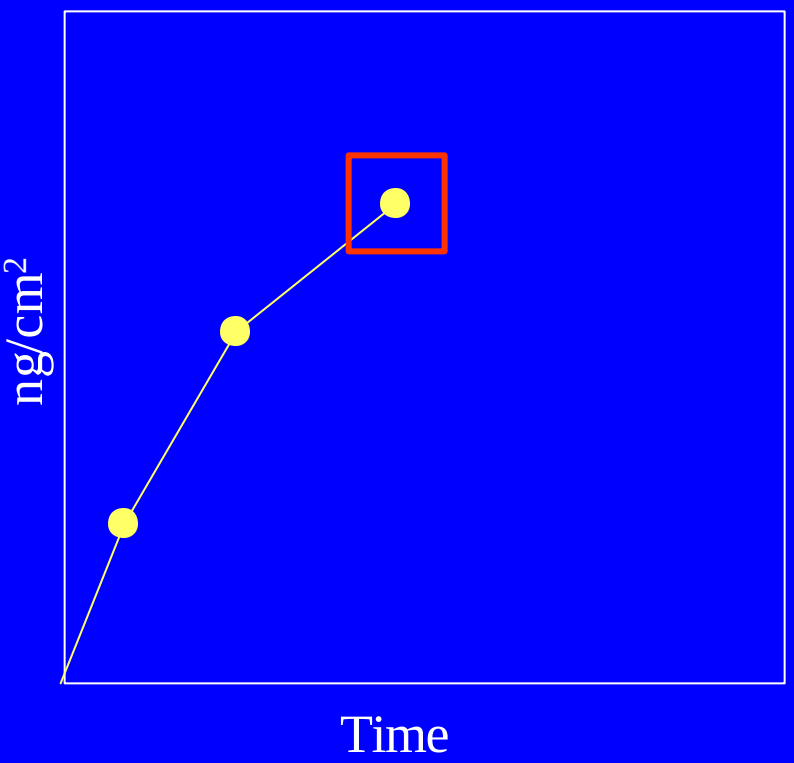

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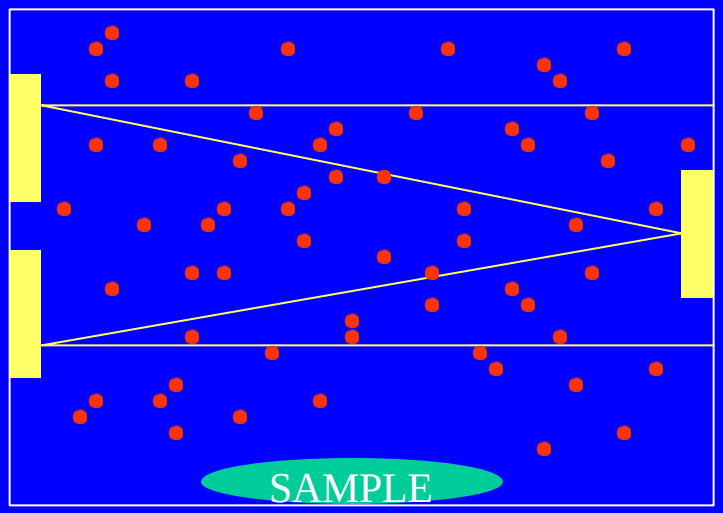


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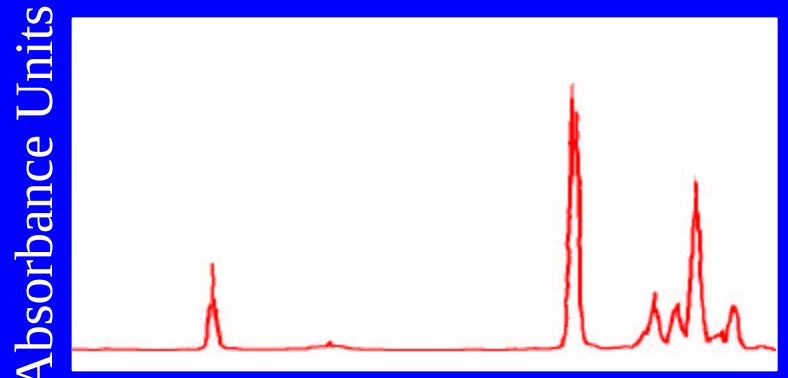


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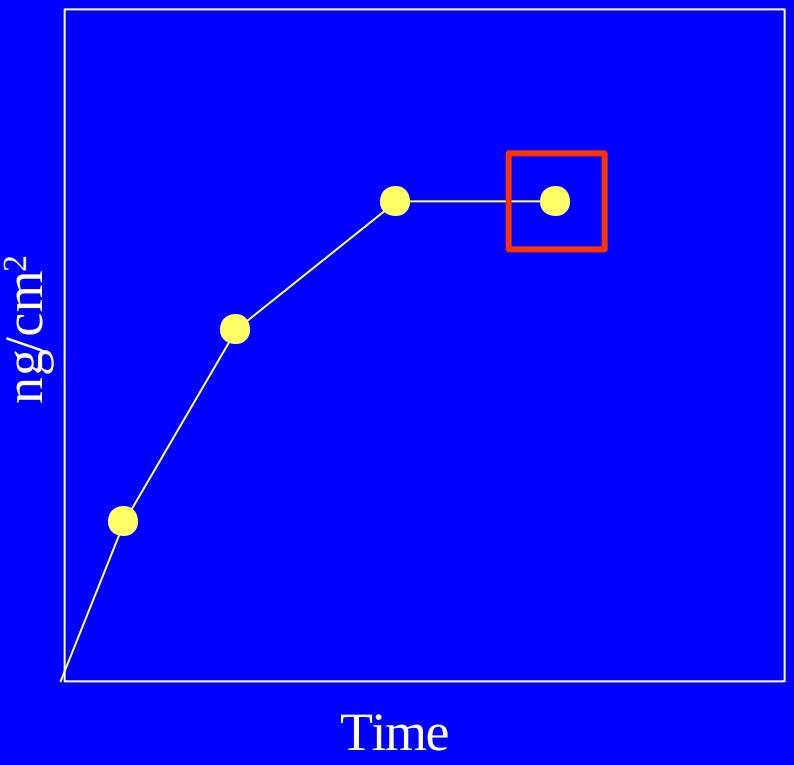

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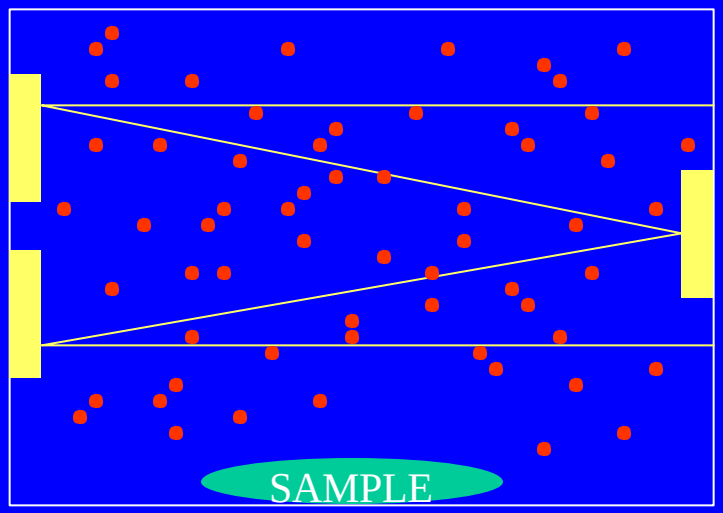


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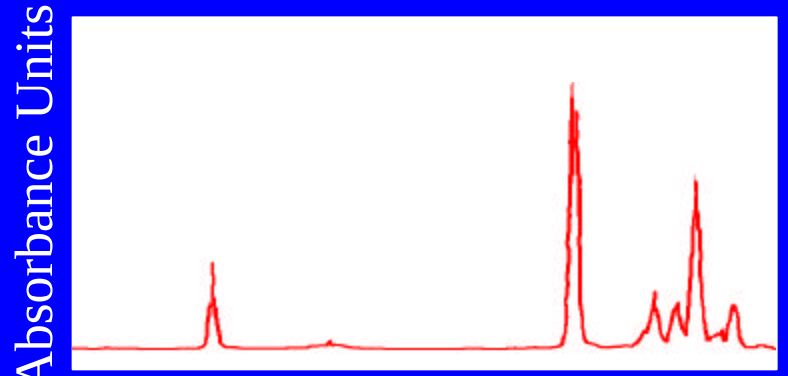


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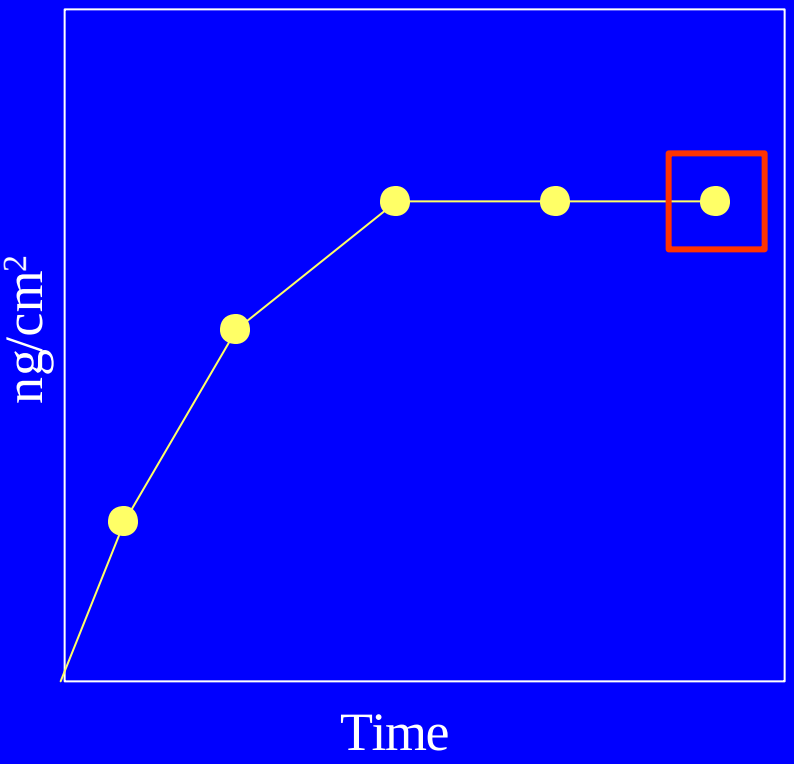
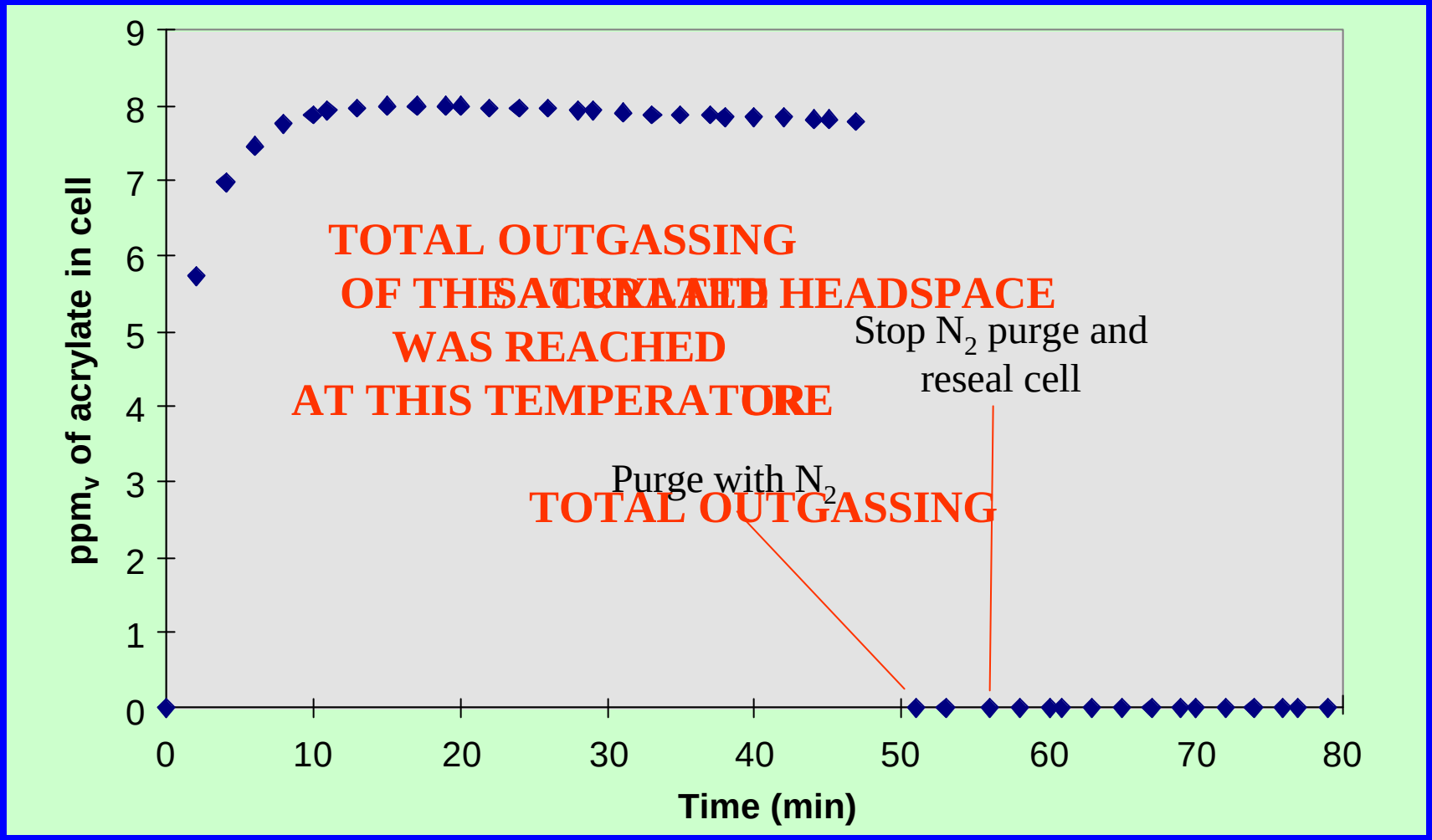
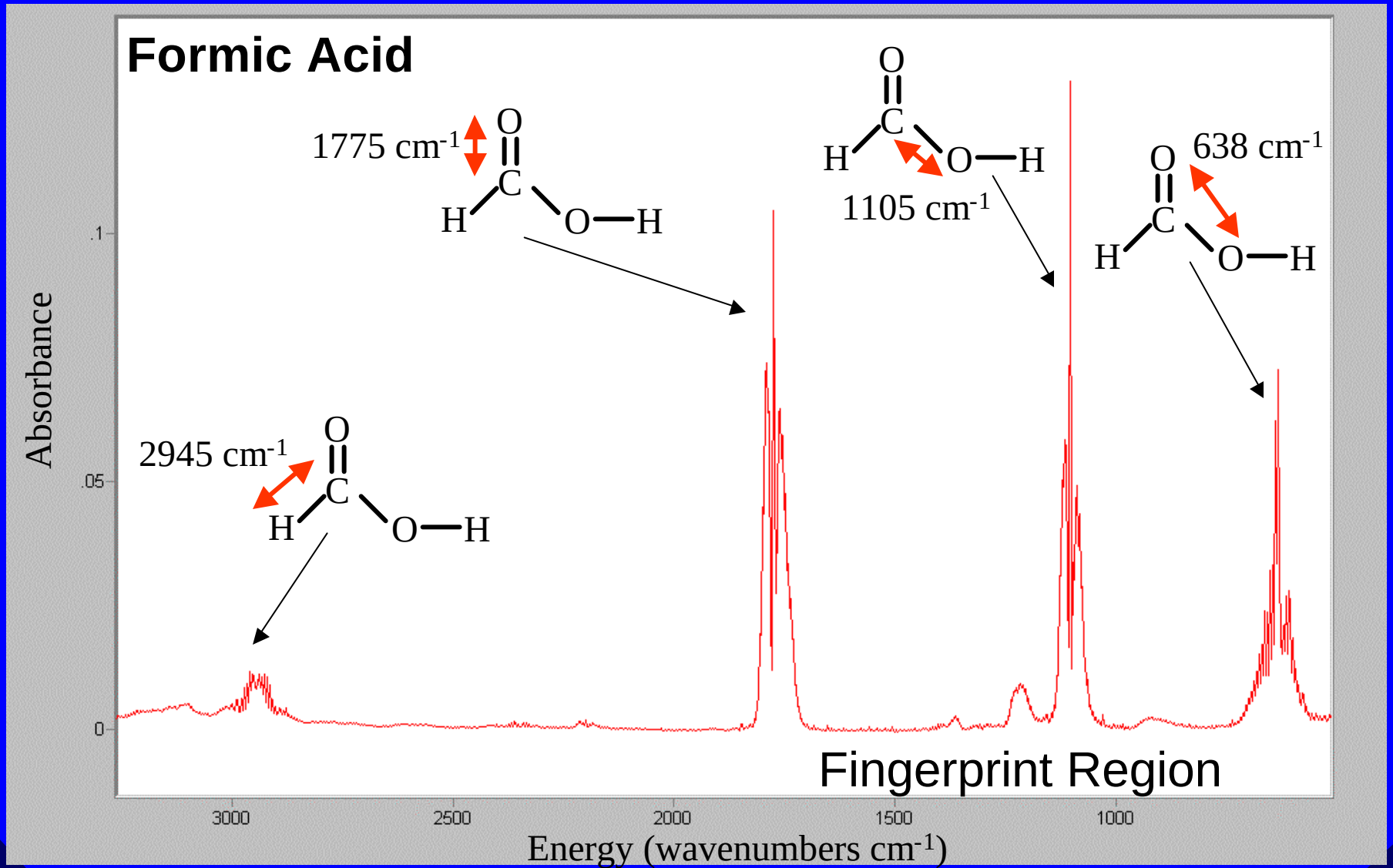


# Determination of Extent of Outgassing in SHS FTIR



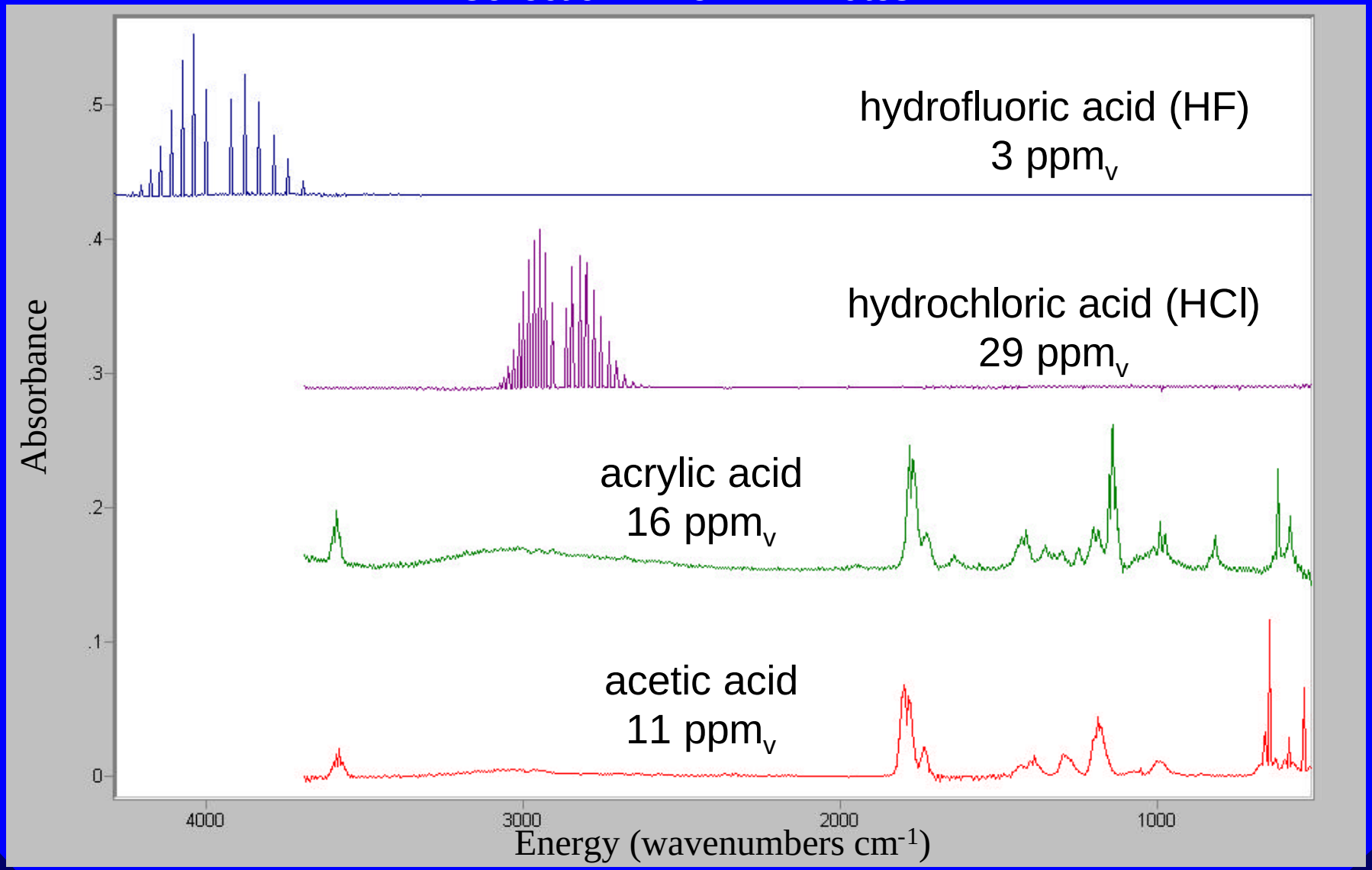

Label Tape at 85 C

# The Basic Principle of Infrared Spectroscopy

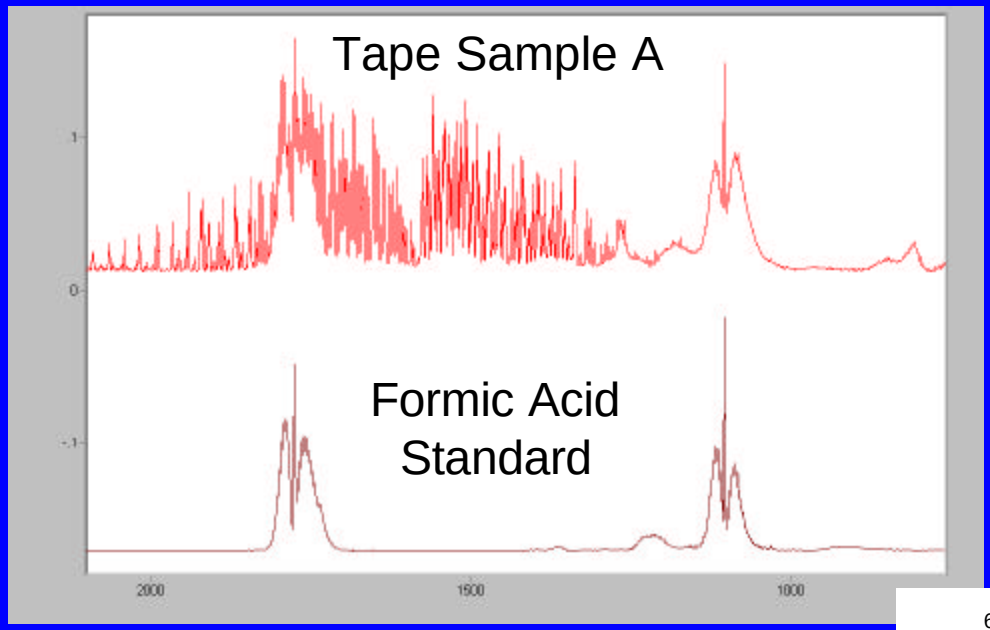


# FTIR Detection of Acids

Collection Time < 2 minutes



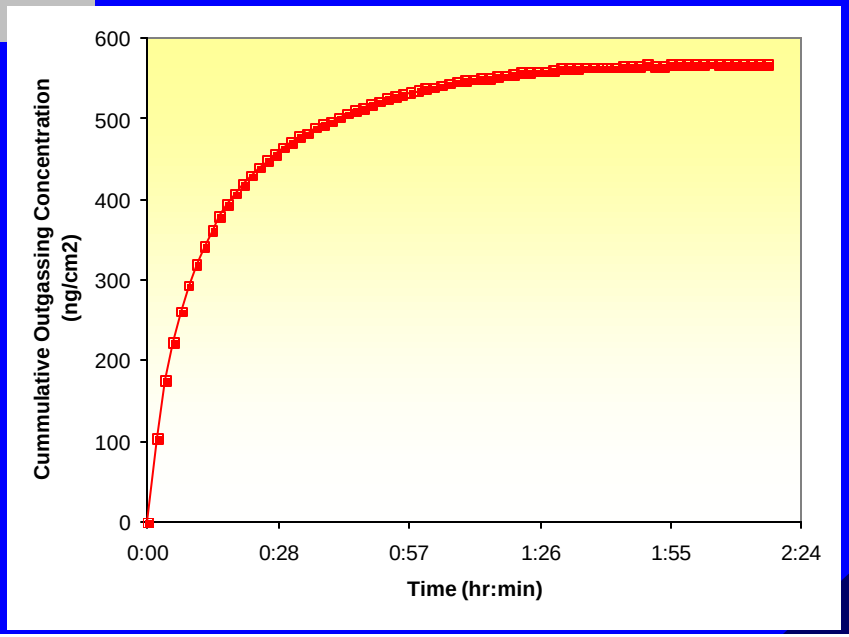
# Example of Outgassing Acids in Tape Products




FTIR outgassing spectra of a tape sample and standard at 85 °C

Formic acid detected in outgas after ***2 minutes***.

Fully outgassed at 570 ng/cm$^2$ or 41 ppm$_w$ after 120 minutes.



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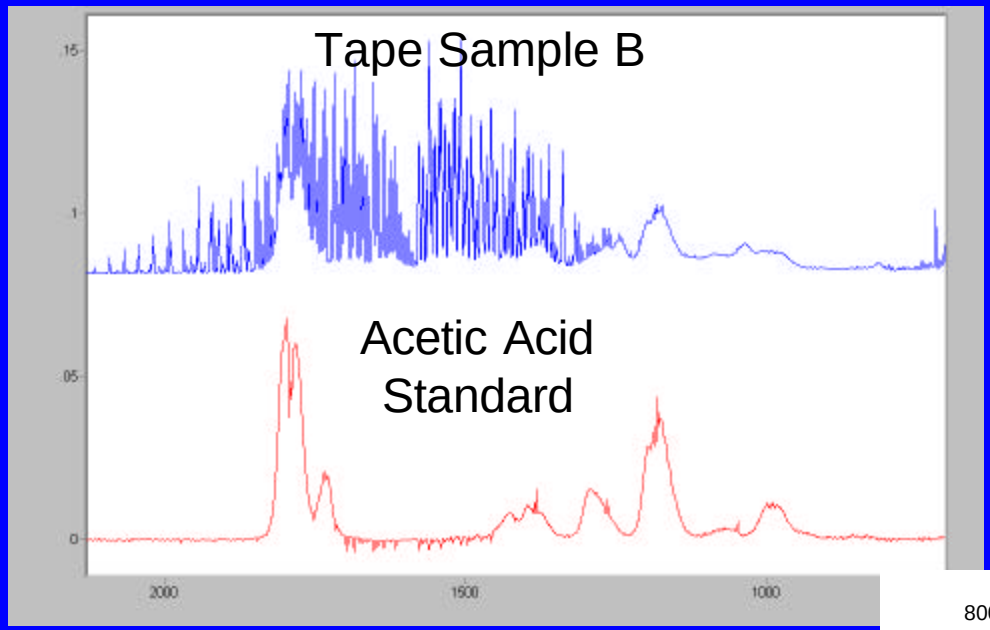
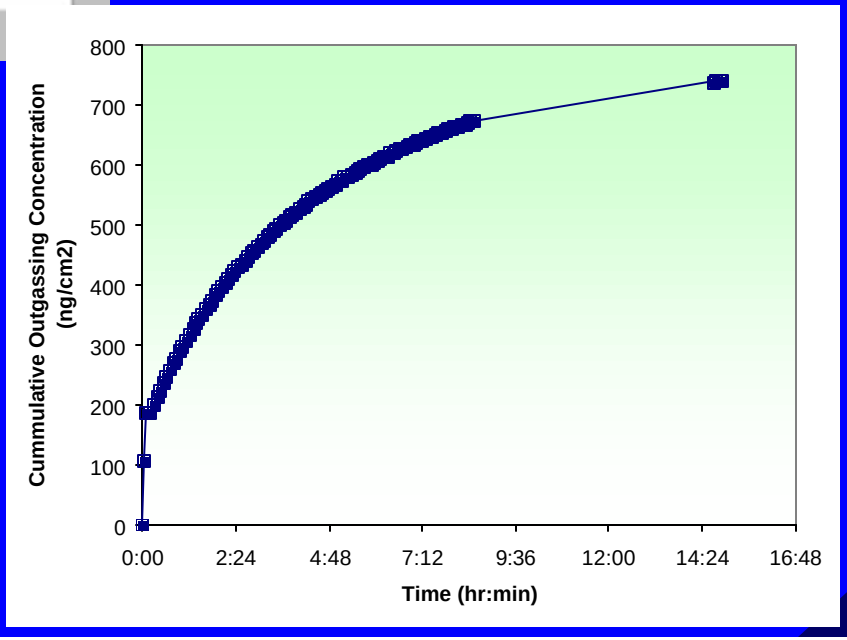



FTIR outgassing spectra of a tape sample and standard at 85 °C

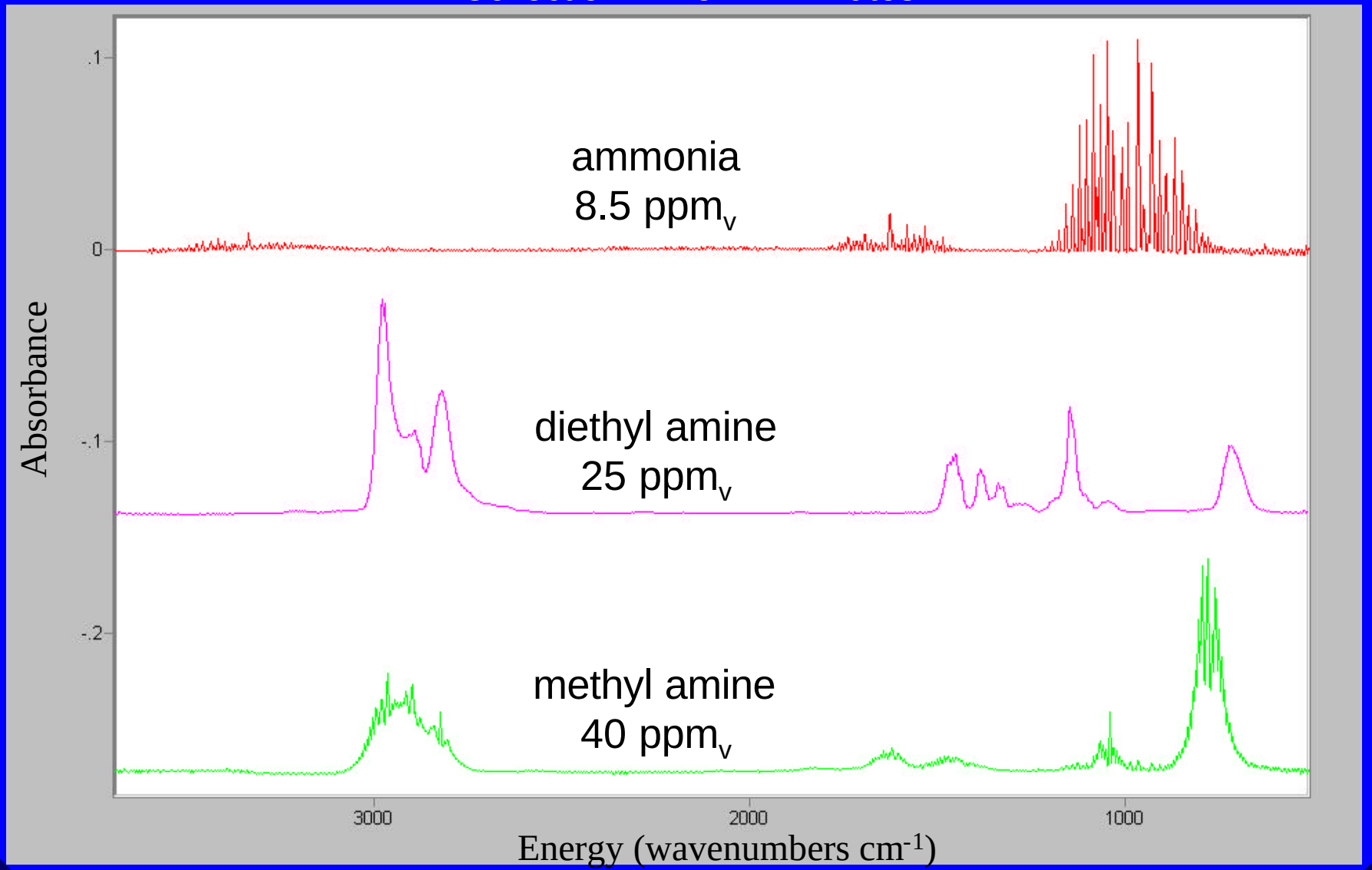
Acetic acid detected in outgas after ***2 minutes***.

Fully outgassed at 740 ng/cm$^2$ or 33 ppm$_w$ after 14 hours.

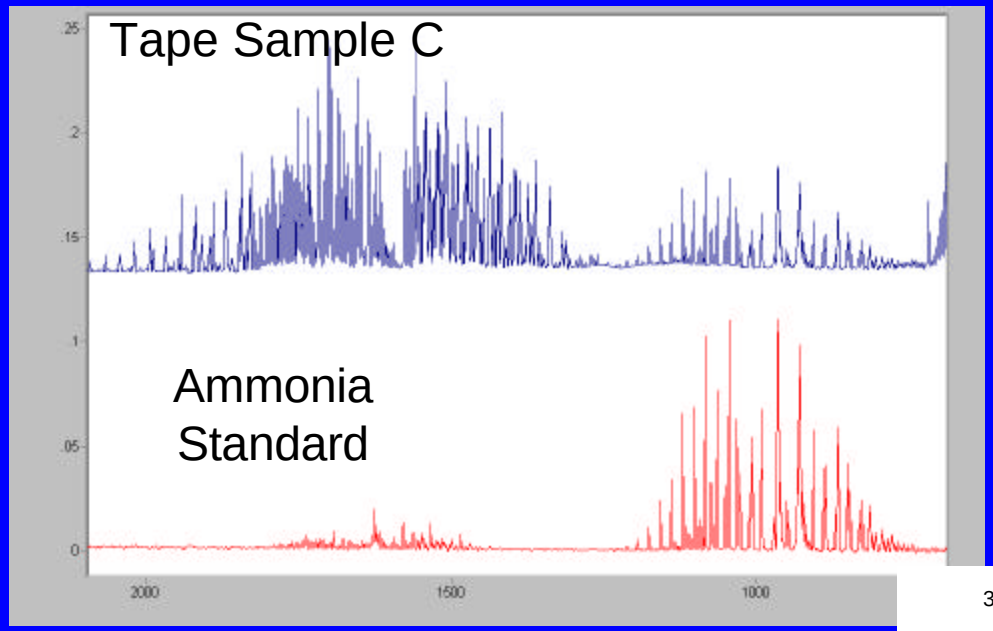


# FTIR Detection of Bases

Collection Time < 2 minutes



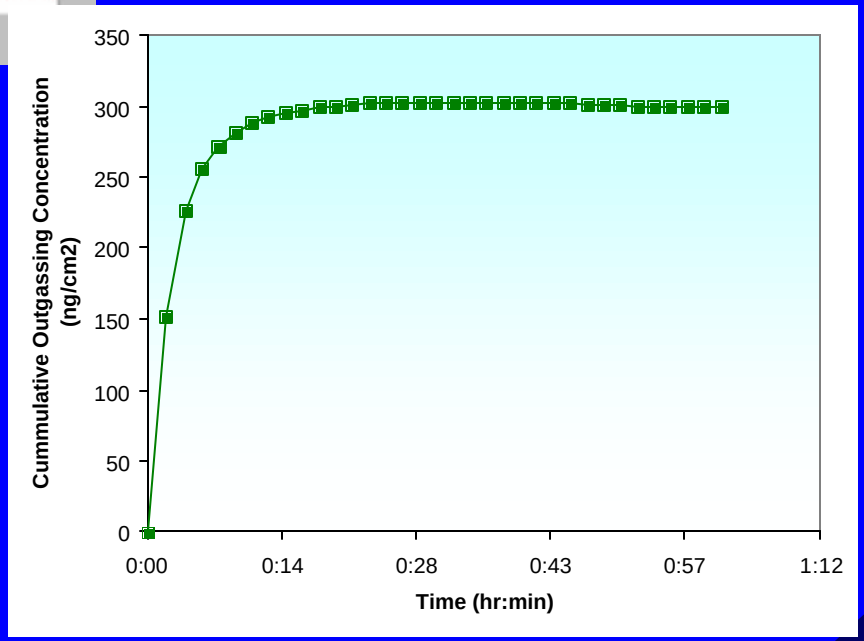
# Example of Outgassing Bases in Tape Products




FTIR outgassing spectra of a tape sample and standard at 85 °C

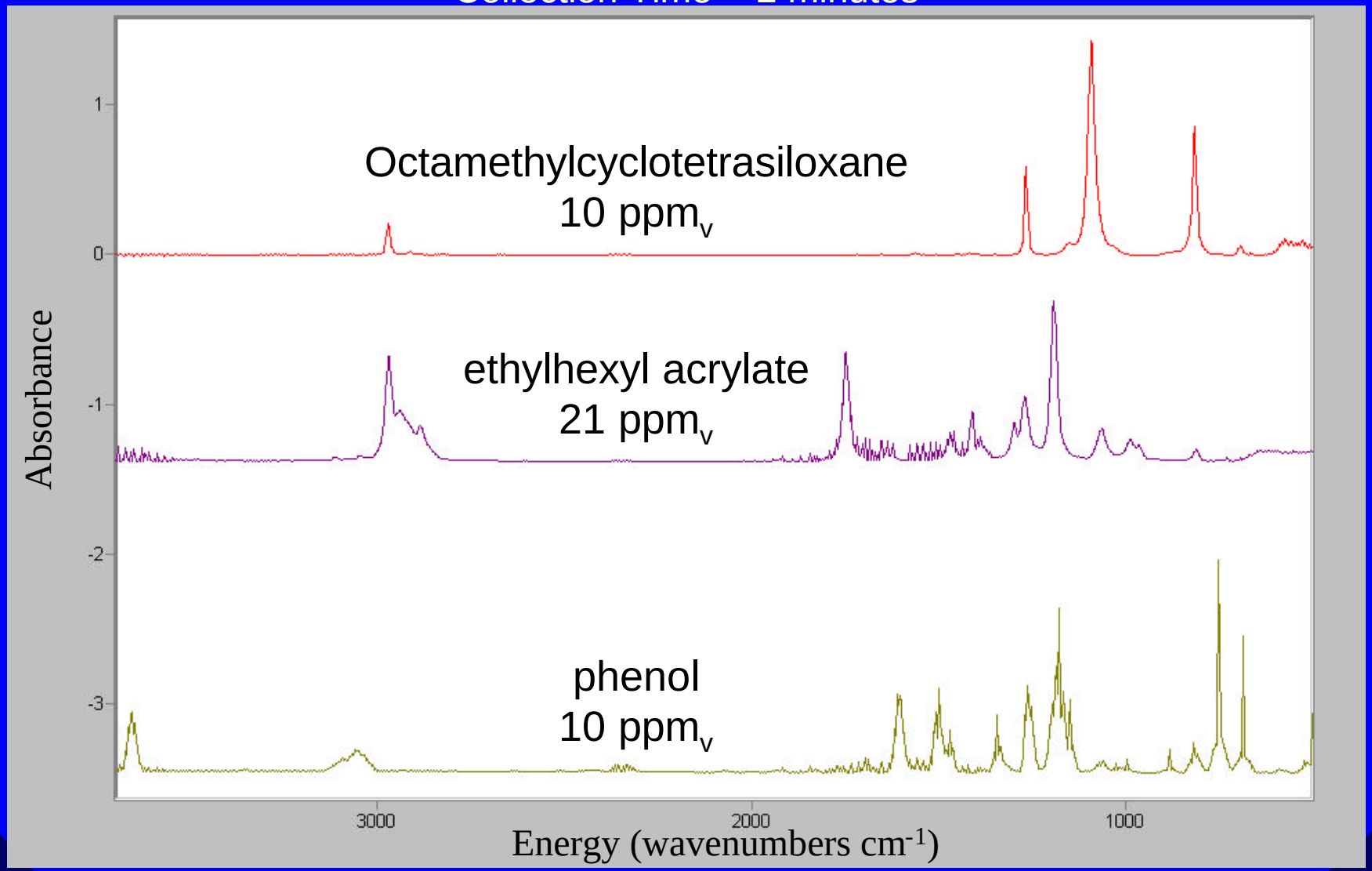
Ammonia detected in outgas after ***2 minutes***.

Fully outgassed at 245 $ng/cm^2$ or 32 $ppm_w$ after 30 minutes.

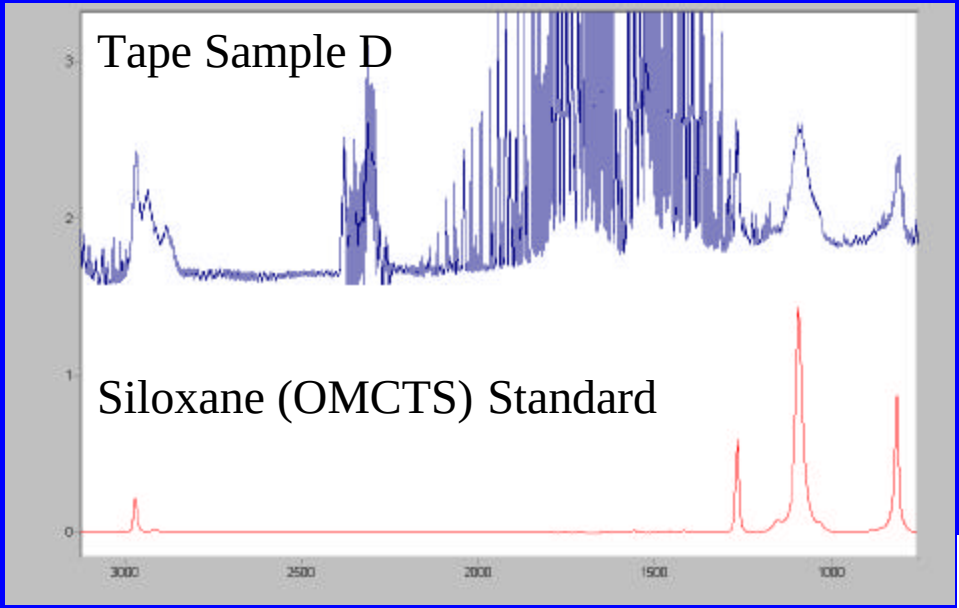


# FTIR Detection of Semi-Volatiles

Collection Time < 2 minutes



# Example of Outgassing Semi-Volatiles in Tape Products

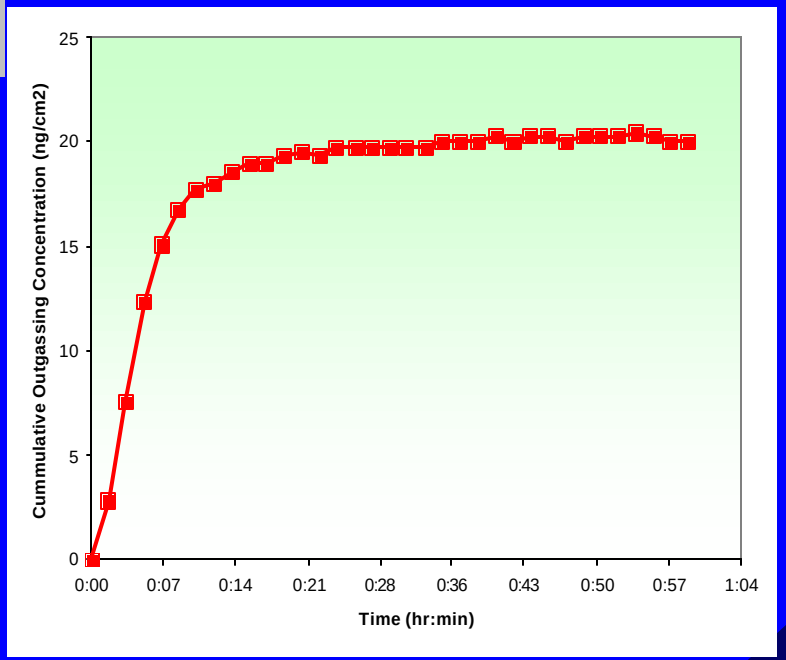



FTIR outgassing spectra of a tape sample and standard at 85 $^{o}$C

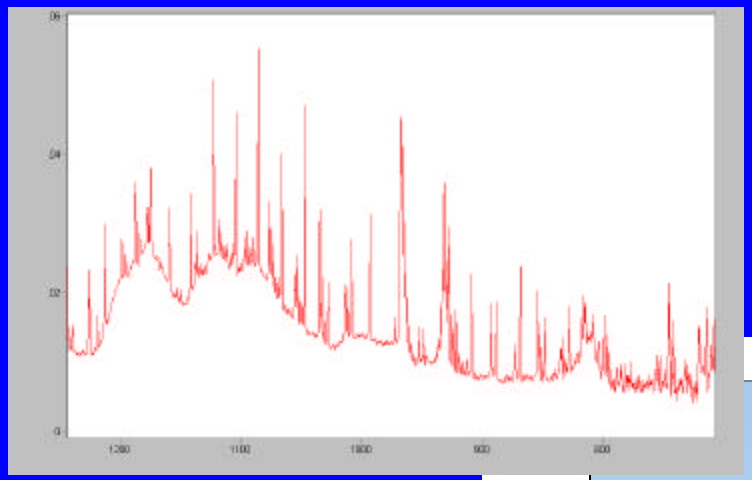
Note: OMCTS is a surrogate standard for all siloxanes through the 800 $cm^{-1}$ band.

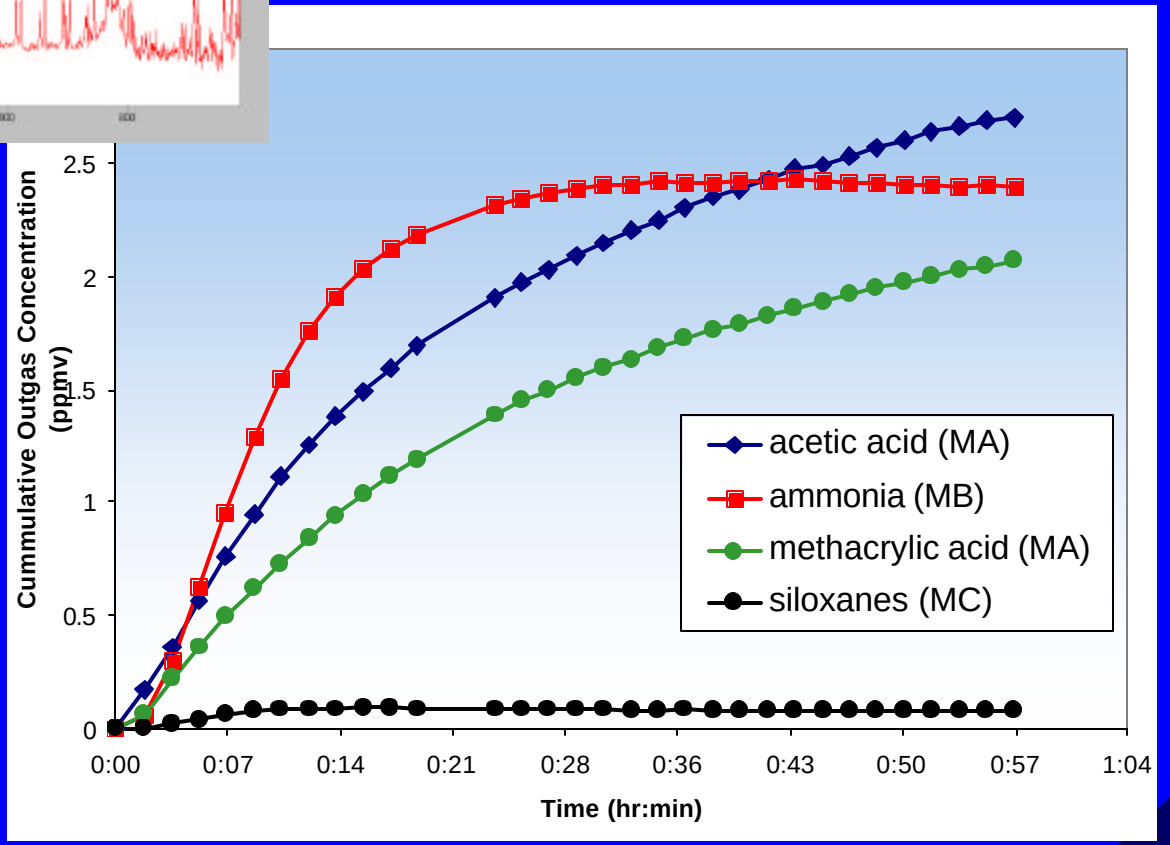
Siloxanes detected in outgas after ***2 minutes***.

Fully outgassed at 20 $ng/cm^2$ or 2 $ppm_w$ after 30 minutes.



# Simultaneous Detection of Multiple Compounds in Tape Samples





# FTIR Static Headspace

- Can quantitate and speciate, in a timely manner, molecular compounds that are “outgassed” from materials destined for the hard disk drive.

- Useful on manufacturing floor for routine evaluation of semi-finished or finished goods for unwanted contaminants and control charting.

- Useful in product development and product certification activities.