ASBESTOS SAMPLING & ANALYSIS

Collection

Preparation

Analysis

Instruments

Methods and Counting Rules

Instruments

- Transmission Electron Microscope (TEM)
- Scanning Electron Microscope (SEM)
- Polarized Light Microscope (PLM)
- Phase Contrast Microscope (PCM)
- Infrared Spectroscopy (IR)
- X-Ray Diffraction (XRD)

Sample Collection, Preparation, and Analysis

- Soil
- Bulk
- Air
- Dust

Collection of Soil Samples

- Collection No Different Than for Other Contaminants
- Typically Heterogeneous, Depends on Nature of Contaminant Source
- Take Appropriate Respiratory Protection
- Percent Asbestos by Weight

Soil Sample Preparation

- Need to Know Purpose of Samples Up Front
- Pick Out Large Bundles/Chunks For Weighing, Usually Under a Stereo-Microscope
- Homogenize Sample
- Regardless of the Instrument to be Used Grinding Will Give the Most Accurate and Consistent Sample Data, But…

More Soil Preparation

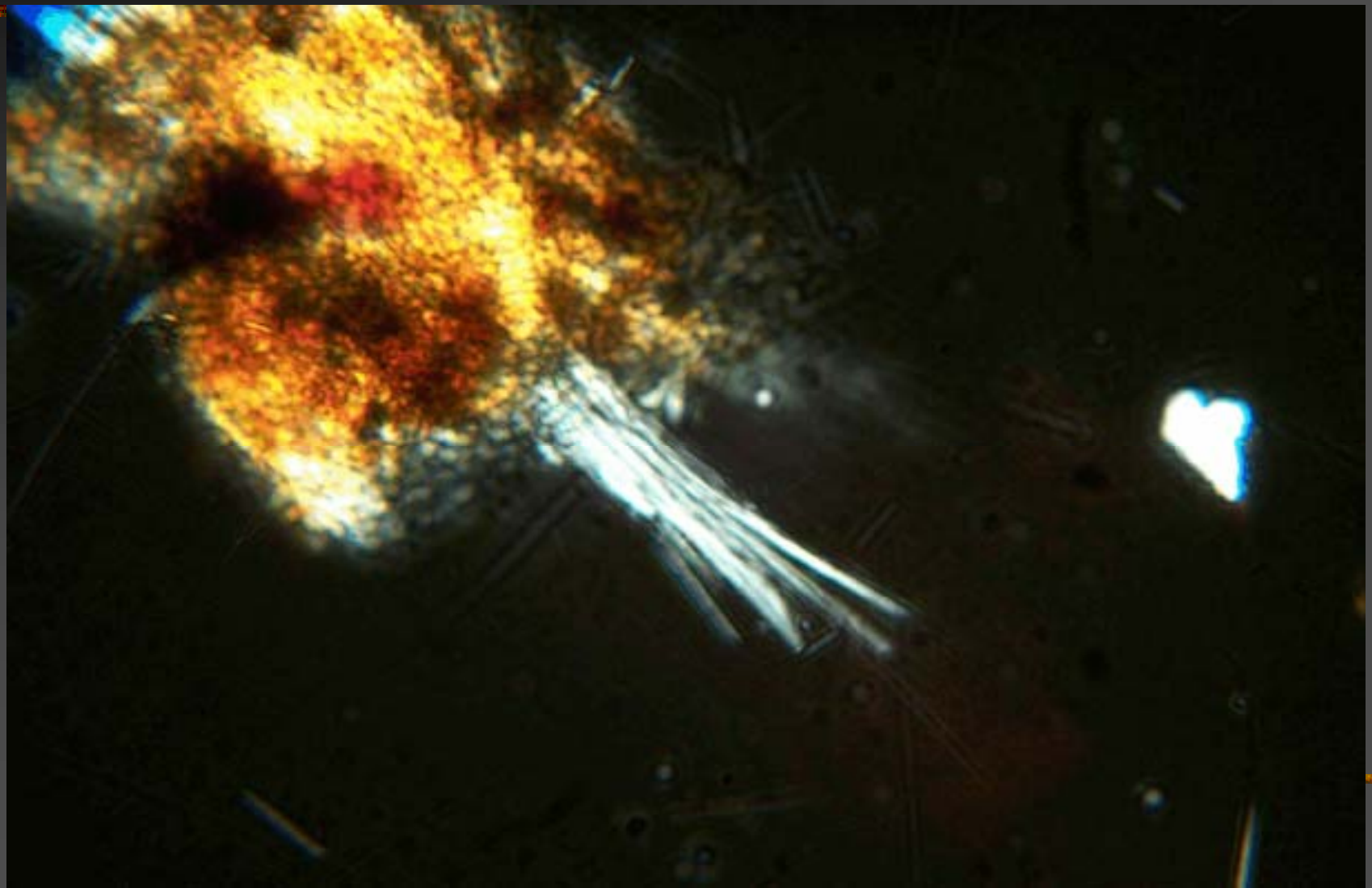
- Grinding Will Compromise Morphological Information
- Grinding May Alter Mineral Habit (e.g. Bundles vs. Free Fibers)
- Grinding May Create Cleavage Fragments
- Therefore, Qualitative Morphological Assessment Should be Done Separate From Quantitative Analysis

Soil Sample Analysis

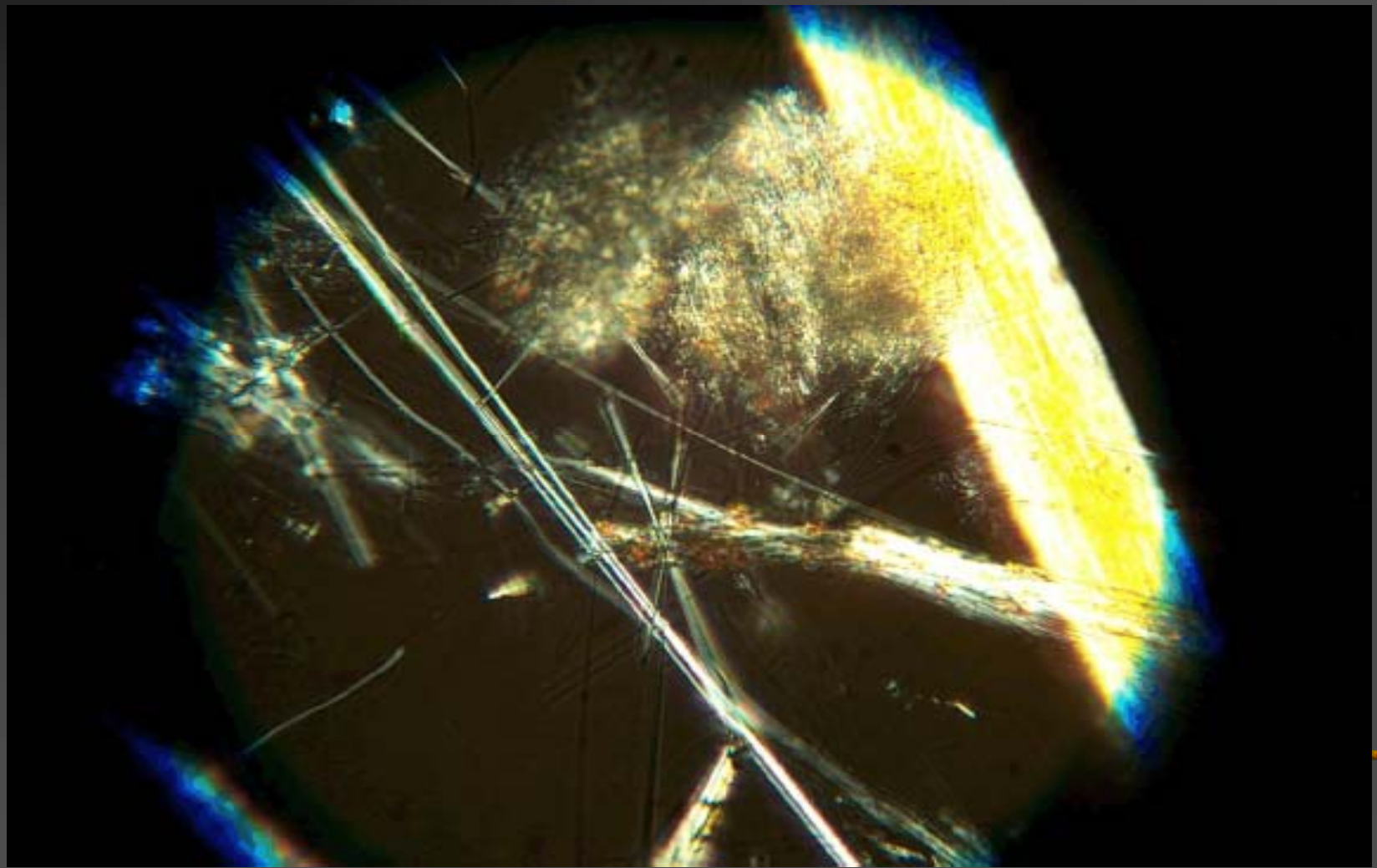
- Look At Summary Sheet
- Need Some Morphology?
  - SEM, TEM, maybe PLM
- Need Mineralogy?
  - SEM/TEM with EDS; maybe PLM; IR; XRD
- Just Need Total?
  - PLM, IR, XRD-Grind the Hell Out of Sample

PLM Microscope

PLM Photo of Tremolite



PLM of Amosite and Human Hair



Soil Sample Analysis-Random Notes

- To Date, SEM Strictly Qualitative, But Best to Determine Fiber Size Distribution. Quantitative Method Under Development
- PLM, Though Touted as Quantitative, is Highly Subjective and Depends Completely on Quality of Analyst. Still Cheap and Useful
- Solid TEM Solid Methods Are Expensive, Require Monster Sample Prep, and are Most Frustrated by Heterogeneity

Collection of Bulk Samples

- Building Materials/Insulation
- Material is Usually Homogeneous
- Grab Samples Usually Used
- May Involve Cutting of Discrete Section
- Percent Asbestos by Weight

Preparation/Analysis of Bulk Samples

- Analogous to Soil Samples

Air Sample Collection

- All Involve a Pump Pulling Air Across a Filter, With the Prepared Filter Going Under the Instrument (f/cc)
- Three Basic Types
  - Stationary
    - Passive, Active
  - Personnel
  - AHERA Clearance (see Part 763)

More Air Sample Collection

- The More Air Pulled Through, the Lower the Detection Level
- However, Depending on Site Conditions (e.g. dust) Large Sample Volumes May Produce Unreadable Samples
- Normal Ambient Conditions 4000L Collected at <12 /min is Practical Maximum
- Under Site Work Conditions, or Dusty Environments 1200 L is Usual Maximum, Sometimes 80 L is Maximum

More Air Sample Collection

- Sampling in Wet and/or Windy Conditions Not Advisable
- Pump Flow Rates Should Not Exceed 12-15 L/min

Air Sample Preparation

- A Small Sliver of Cassette Filter is Cut and Then Viewed for Opacity
- If Opacity Low (<10-25%) Then Sample is Sent for Direct Preparation
- If Opacity is High (>10-25%) Then Sample is Sent for Indirect Preparation

Direct Preparation

- The Sample Sliver is Etched
- Sealed in Silicon
- Mounted on a Specimen Grid
- Put Into the Microscope

Indirect Preparation

- A Portion (typically ¼) of the Original is Cut Out, Dissolved or Ashed
- This Portion of Sample is Suspended in Liquid and Then Re-filtered
- Then the Direct Preparation Procedures Followed

About Air Sample Cassettes

- Only a Tiny Portion (typically 1/3700) of the Sample Viewed Under the Microscope
- Distribution of Fibers on Cassette is Not Uniform, Thought to be Either Poisson or Negative-Binomial Distribution
- Thus Typical Analyses Are Inherently Subject to Great Statistical Variation

Indirect Pros and Cons

- Pros
  - Allows information to be garnered from otherwise unreadable samples
  - Generates nearly uniform distribution of fibers on filters
- Cons
  - Involves large dilution of sample
  - Likely looses some material in sample prep
  - Possibly alters morphology and mineral habit

Air Sample Analysis

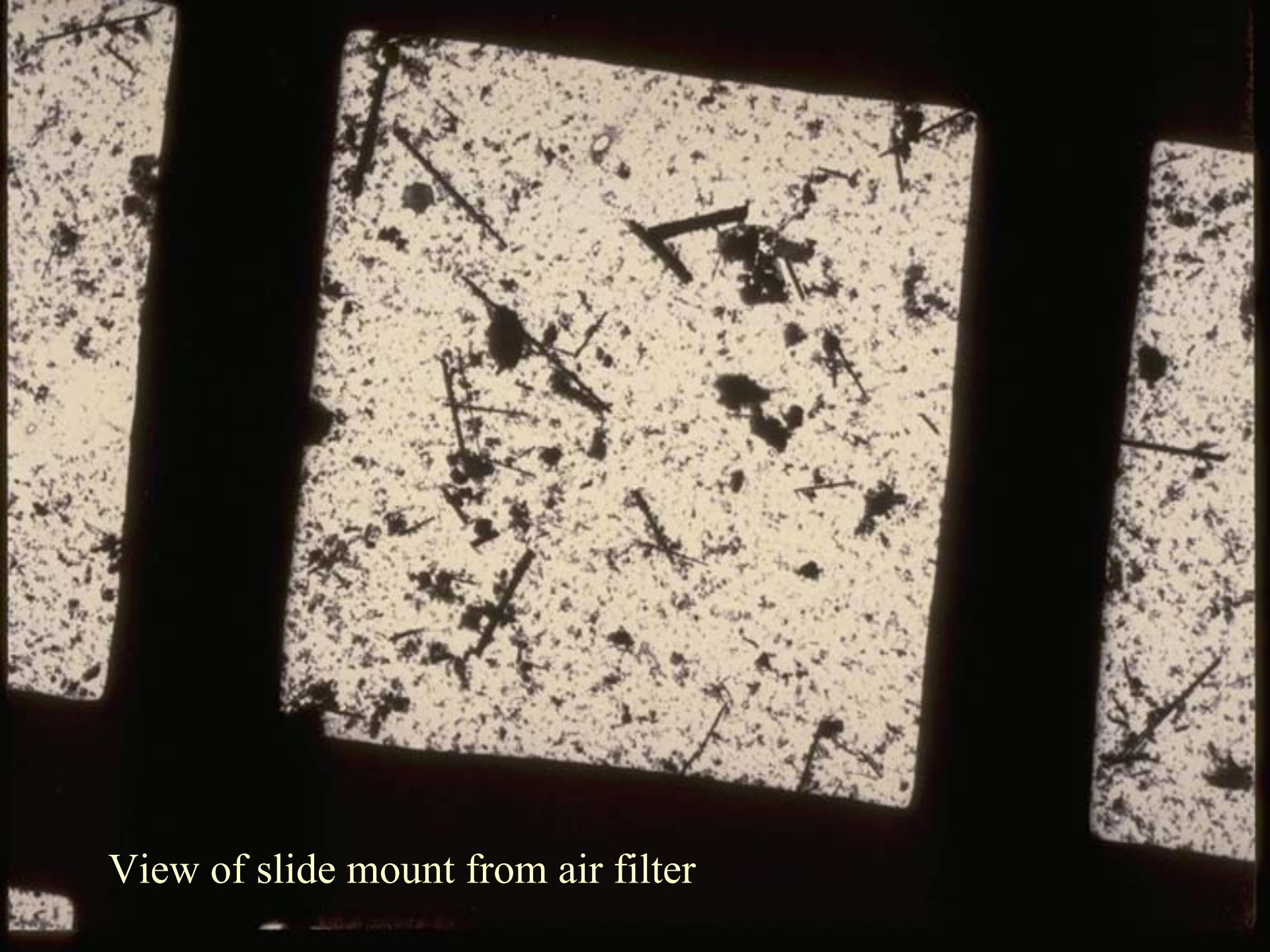
- PCM
  - NIOSH 7400
- TEM
  - NIOSH 7402
  - ISO 10-312
  - Yamate
  - AHERA

PCM Analysis

- Normally 250-400x
- Can’t Distinguish Between Cat Hair and Asbestos
- Near Useless in Environmental/ Residential Settings
- Provides No Mineralogy
- Required by OSHA for Health And Safety
- Can Resolve only Fibers >5um long/ >0.25 um wide

TEM Analysis

- Normally 400-20,000x (can be 100,000x +)
- Can Get Definitive Morphology/Mineralogy
- The More Grids Counted, the Lower the Detection Level
- Different Methods Have Different “Counting Rules.” Thus the Same Specimen, In the Same Microscope, Could Give Different Results Depending on the Method
- Look at Second Summary Sheet



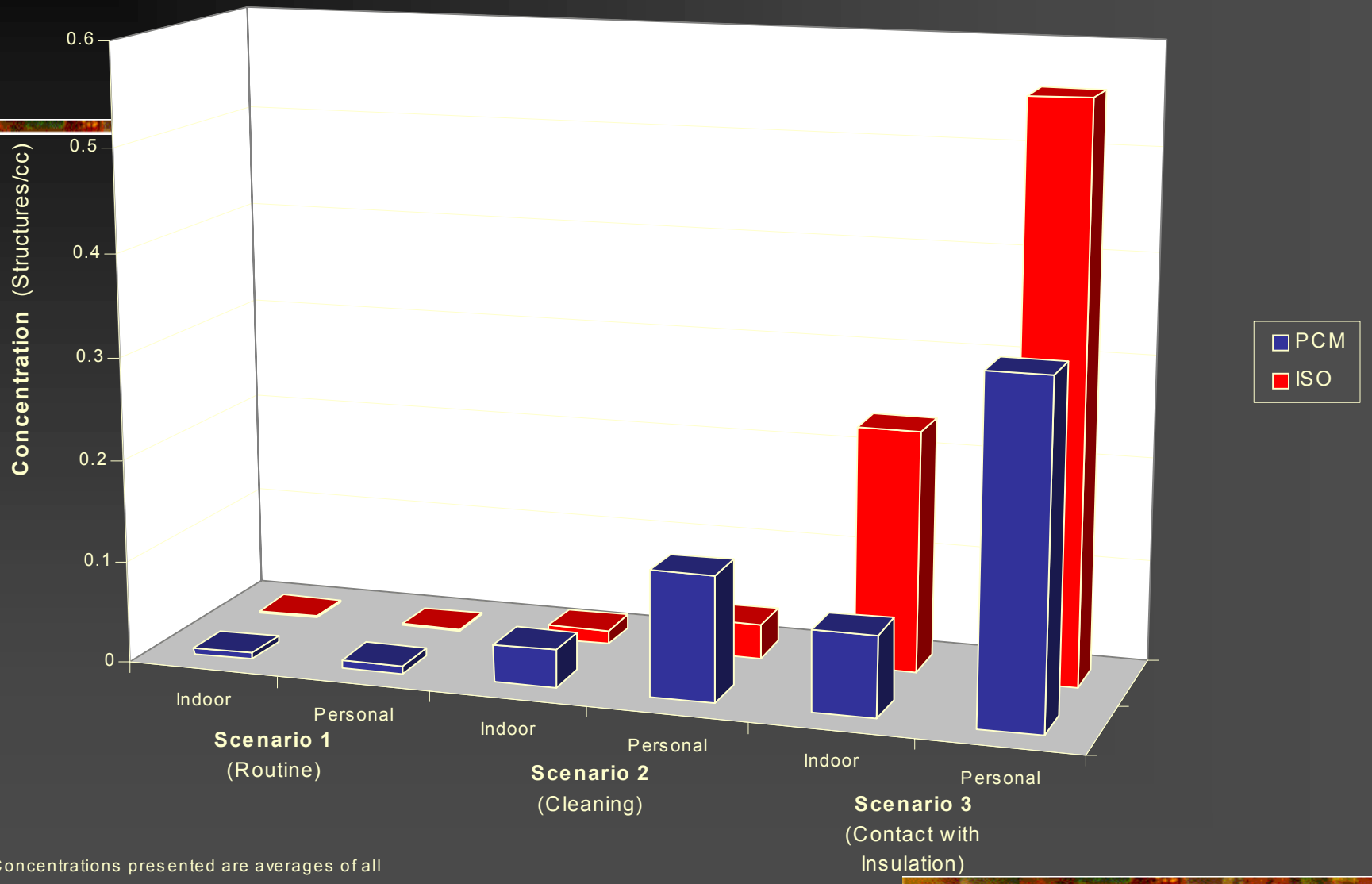
View of slide mount from air filter

More Air Samples

- The Selection of How Air Samples are Collected (e.g.- Stationary vs. Personnel), Prepared, and Analyzed (e.g. PCM vs. TEM; or NIOSH 7402 vs. ISO 10-312) Will Have a Profound Effect on the Resulting Data
- The OSC Should Be Cognizant of All These Factors Before Making Risk Decisions

- DRAFT -

Asbestos Concentration

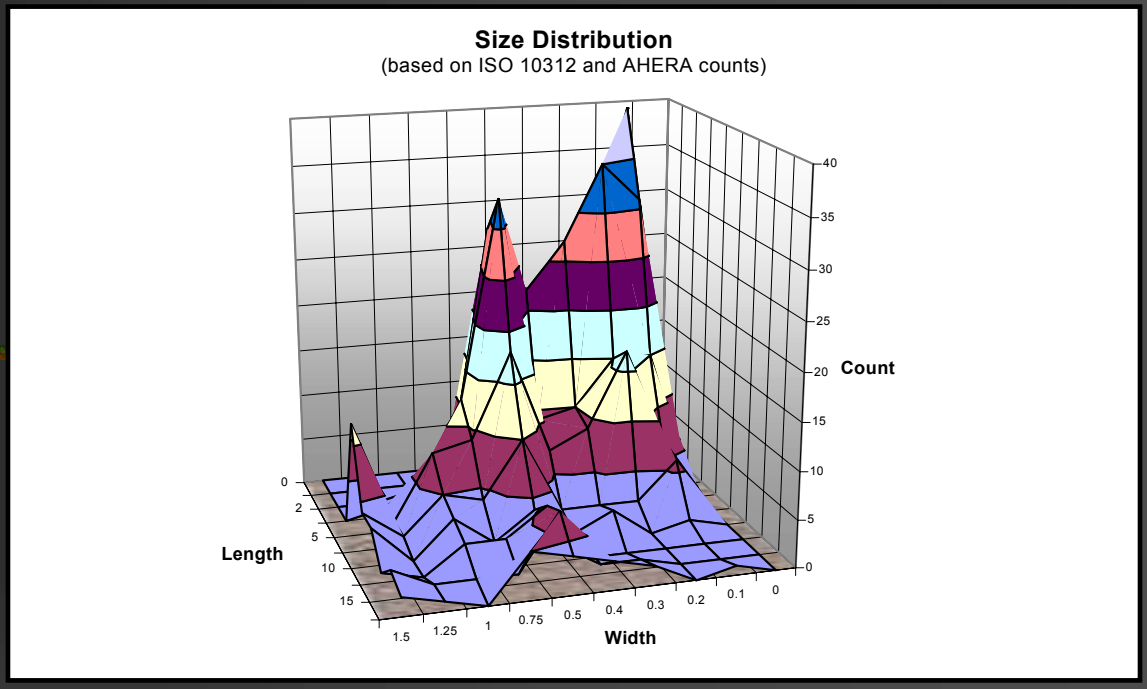


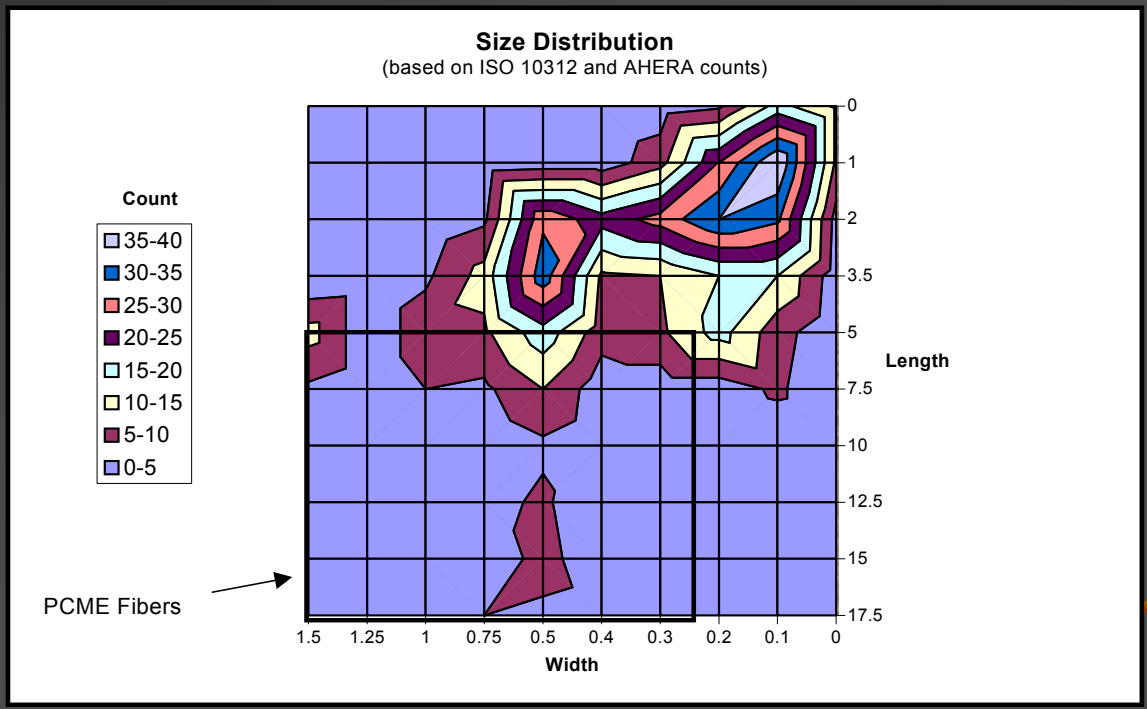
Note: Concentrations presented are averages of all non-zero values that were above the detection limit.

Fiber size distributions

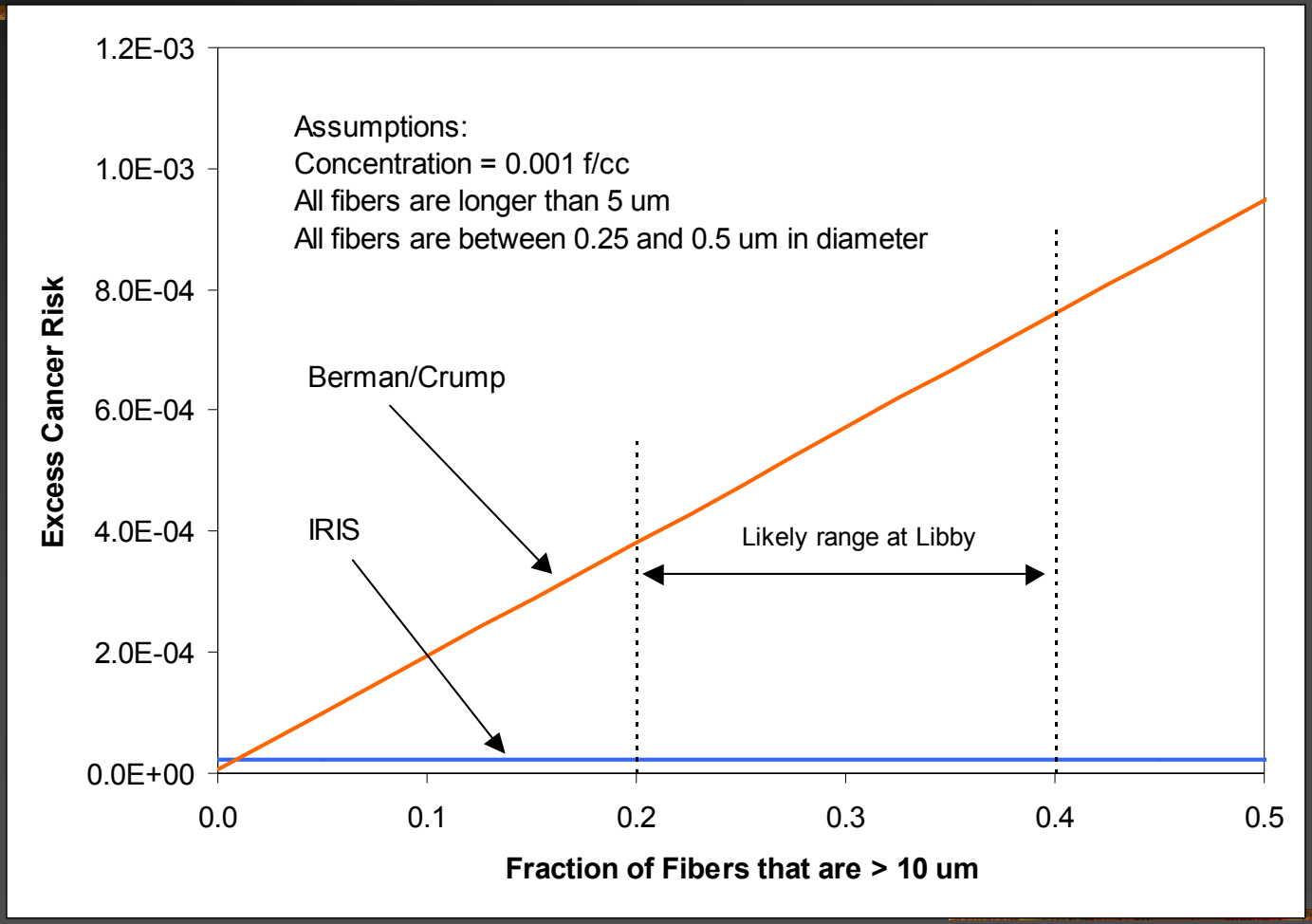
Analysis of fiber size Distribution Indicates that only 30% Fall within the regulated range.

EPA risk assessments Use only regulated (or PCME) fibers to calculate risks.





Why Risk Assessment Methodology Makes a Difference



Dust Sample Collection

- Wipe Samples
- Microvac On to an Air Filter
- Gives Indication of Surface Loading
- Fibers/cm2 of Surface Sampled

Dust Sample Preparation/Analysis

- Dust Samples Are Near Universally Handled Liked “Indirect” Air Samples
- Should Be Thought of As Quasi-Quantitative
- Good Indicators of Relative Loading (both on and off-site), But Are Not Easily Translated Into Risk or Quantitative Risk Assessments
- Good Before/After Tests

Other Random Asbestos S&A Issues

- Cleavage Fragments vs. Born Fibers vs. Transition Fibers
- OSHA “Regulated” Fibers vs. the Universe of Amphibole Fibers vs. Asbestos as a Hazardous Substance
- Fibers <5 um in Length