INTRODUCTION OF ASBESTOS FIBERS AND IMPACT ON ENVIRONMENT AND HUMANS.

TRAINING ON SAMPLING AND ANALYSIS TECHNIQUES OF AIRBONE ASBESTOS

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INTRODUCTION

- History of Asbestos:-
  - Asbestos has been used for thousands of years, with ancient civilizations using it in clothing, building materials, and even jewelry.
  - In the late 19th and early 20th centuries, asbestos use surged, particularly in the construction and manufacturing industries.
  - By the mid-20th century, the health risks associated with asbestos became more widely recognized, leading to increased regulation and eventual bans in many countries.
  - The word ‘Asbestos’ is derives from Ancient Greek which means “Permeant" or “Unbreakable"

INTRODUCTION

- Asbestos is a group of naturally occurring minerals of fibrous silicate. **Silicate minerals** are rock-forming minerals made up of silicate groups. They are the largest and most important class of minerals and make up approximately 90 percent of Earth's crust.
- Asbestos minerals that were widely used in construction, manufacturing, and other industries because of their durability, fire resistance, and insulation properties. However, asbestos has been found to be harmful to human health, and its use has been heavily regulated or banned in many countries.
- There are six types, all of which are composed of long and thin fibrous crystals, each fibre (particulate with length substantially greater than width)

Types of Asbestos

- 1. Chrysotile (White Asbestos):

- Most commonly used type (95% of all asbestos used)
  - Building insulation (pipes, boilers, etc.)
  - Brake pads and linings
  - Textiles (fireproof clothing, etc.)
  - Roofing and flooring materials
- Considered the least hazardous type, but still carcinogenic

- 2. Amosite (Brown Asbestos):

- Second most commonly used type
  - Insulation (pipes, boilers, etc.)
  - Ceiling tiles and plasters
  - Vinyl and linoleum flooring
  - Gaskets and seals
- Considered more hazardous than chrysotile

Types of Asbestos

- 3. Crocidolite (Blue Asbestos):

  - Least commonly used type
    - High-temperature insulation (furnaces, etc.)
    - Refractory materials (cement, etc.)
    - Some brake pads and linings
  - Considered the most hazardous type due to its thin, straight fibers

- 4. Anthophyllite:

  - Rarely used commercially
    - Some insulation materials
    - Refractory materials (cement, etc.)
  - Considered less hazardous than the other types

Types of Asbestos

- 5. Actinolite:

- Rarely used commercially
  - Some insulation materials
  - Refractory materials (cement, etc.)
- Considered less hazardous than the other types

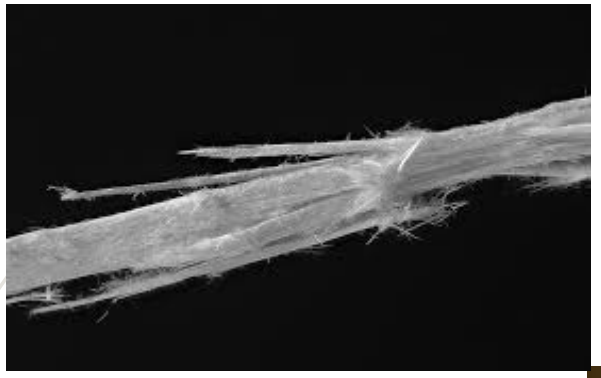
- 6. Tremolite:

- Rarely used commercially
  - Some insulation materials
  - Refractory materials (cement, etc.)
- Considered less hazardous than the other types

while some types may be considered "less hazardous," all types of asbestos are carcinogenic and can cause serious health problems. The use of asbestos has been heavily regulated or banned in many countries due to its harmful effects on human health.

Types of Asbestos

Pictures of Asbestos



Asbestos-containing Materials

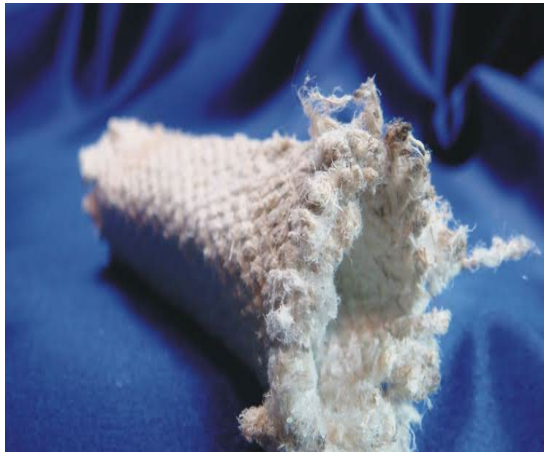
- Asbestos-containing Materials:
  - Asbestos cement (AC) pipes and sheets
  - Insulation (e.g., pipe lagging, boiler insulation)
  - Plasters and ceiling tiles
  - Textured paints and coatings
  - Brake pads and shoes- Gaskets and seals
  - Vinyl and linoleum flooring- Roofing materials (e.g., shingles, felt)

Uses of Asbestos

- Uses of Asbestos:
  - 1. Building insulation and construction materials (e.g., asbestos cement, plasters, and pipe insulation)
  - 2. Brake pads and linings
  - 3. Textiles and fabrics (e.g., fireproof clothing, upholstery)
  - 4. Gaskets and seals
  - 5. Roofing and flooring materials

Uses of Asbestos

Some Asbestos Using Products



Impact and Health Effects of Asbestos Exposure

- Health Effects of Asbestos Exposure:
  - - Lung Cancer: Asbestos is a known carcinogen, and exposure can increase the risk of developing lung cancer.
  - - Mesothelioma: A rare and aggressive cancer that affects the lining of the lungs, abdomen, or heart.
  - - Asbestosis: Scarring of the lungs, leading to breathing difficulties and potentially serious respiratory problems.
  - - Pleural Plaques and Thickening: Scarring of the lining surrounding the lungs, which can cause breathing difficulties and pain.
  - - Pleural Effusion: Fluid buildup between the lungs and chest cavity, which can cause breathing difficulties and discomfort.

Exposure Risks

- Asbestos Exposure Risks:
  - - Occupational Exposure: Workers in industries that used or handled asbestos (e.g., construction, manufacturing, mining) are at higher risk.
  - - Environmental Exposure: People living near asbestos mines, factories, or areas with high levels of asbestos in the environment.
  - - Secondary Exposure: Family members or others who come into contact with asbestos fibers on clothing, tools, or other objects.

Regulation and Safety

- Asbestos Regulation and Safety:
  - - Bans and Restrictions: Many countries have banned or restricted asbestos use, including the EU, Australia, and Japan.
  - - Workplace Safety: Regulations and guidelines for handling asbestos in the workplace, including PPE, ventilation, and training.
  - - Asbestos Removal and Disposal: Specialized procedures for safely removing and disposing of asbestos-containing materials.

Industries New Approach

- Cellulose fibers are a type of natural fiber found in plant cell walls, primarily in wood, cotton, and other plant-based materials. They are a key component of paper, textiles, and other cellulose-based products.

  Here are some interesting facts about cellulose fibers:

  - Cellulose is the most abundant organic compound on Earth, making up about 33% of all plant biomass.

  - Cellulose fibers have a high tensile strength, making them useful for creating strong and durable materials.

  - Cellulose is a key component of paper, accounting for about 85% of its composition.

Industries New Approach

- Cellulose fibers can be extracted from various plant sources, including wood, cotton, hemp, and bamboo.

- Cellulose has many applications beyond paper and textiles, including pharmaceuticals, food additives, and even biomedical materials.

- Cellulose fibers can be modified and processed to create various types of materials, such as rayon, lyocell, and cellulose acetate.

Testing Typically Involve The Steps

Asbestos testing procedures typically involve the following steps:

1. Sampling: Collecting suspect materials or air samples for analysis.

2. Labeling: Properly labeling samples with relevant information (e.g., location, date, and material type).

3. Transportation: Transporting samples to a laboratory in a sealed container.

4. Laboratory Analysis: Using various techniques (e.g., microscopy, spectroscopy) to detect and quantify asbestos fibers.

5. Result Interpretation: Interpreting test results to determine the presence, type, and concentration of asbestos fibers.

6. Reporting: Generating a detailed report outlining the test results and any necessary recommendations.

Laboratory Analysis and Common Methods

- Laboratory Analysis:

  1. Microscopy: Using a microscope to visually identify asbestos fibers.
  2. Spectroscopy: Using techniques like XRD or ICP-MS to identify asbestos types and concentrations.
  3. Gravimetric Analysis: Measuring the weight of asbestos fibers in a sample.

- Common asbestos testing methods include:

  1. Transmission Electron Microscopy (TEM): Analyzes air samples for asbestos fibers.
  2. Phase Contrast Microscopy (PCM): Analyzes air samples for asbestos fibers.
  3. Scanning Electron Microscopy (SEM): Analyzes bulk samples for asbestos fibers.
  4. X-Ray Diffraction (XRD): Identifies asbestos types in bulk samples.
  5. Inductively Coupled Plasma Mass Spectrometry (ICP-MS): Detects asbestos fibers in water and soil samples.

Laboratory Analysis and Common Methods

- Asbestos Laboratory Analysis:

1. Sample Preparation:
   - Preparing samples for analysis using various techniques (e.g., grinding, sieving)

2. Quality Control:
   - Verifying the accuracy and precision of test results
   - Using certified reference materials and blanks

3. Data Interpretation:
   - Interpreting test results to determine the presence and concentration of asbestos fibers
   - Comparing results to regulatory limits and guidelines

Sampling Methods

- Sampling Methods:

  1. Bulk Sampling: Collecting a physical sample of the material suspected to contain asbestos. Using a hammer and chisel or core drill to collect samples.

  2. Air Sampling: Collecting air samples to detect asbestos fibers in the air. Sampling in various locations and at different heights

  3. Surface Sampling: Collecting samples from surfaces using wipes or adhesive tapes. Sampling in various locations and on different surfaces.

Requirements for Sampling and Analysis

- an overview of the sampling and testing process for asbestos fibers using Phase Contrast Microscopy (PCM):
- **REAGENTS:**
- 1. Acetone,* reagent grade.
- 2. Triacetin (glycerol triacetate), reagent grade.
- **EQUIPMENT:**
- Sampler: field monitor, 25-mm, three-piece cassette with ca. 50-mm electrically conductive extension cowl and cellulose ester filter, 0.45- to 1.2-µm pore size, and backup pad.
- Personal sampling pump, battery or linepowered vacuum, of sufficient capacity to meet flow-rate requirements (see step 4 for flow rate), with flexible connecting tubing.
- Wire, multi-stranded, 22-gauge; 1″ hose clamp to attach wire to cassette.
- Tape, shrink- or adhesive-.

Requirements for Sampling and Analysis

- Slides, glass, frosted-end, pre-cleaned, 25- × 75-mm.
- Cover slips, 22- × 22-mm, No. 1½, unless otherwise specified by microscope manufacturer.
- Knife, #10 surgical steel, curved blade.
- Tweezers.
- Acetone flash vaporization system for clearing filters on glass slides.
- Micropipettes or syringes, 5-µL and 100- to 500-µL.
- Microscope, positive phase (dark) contrast, with green or blue filter, adjustable field iris, 8 to 10× eyepiece, and 40 to 45× phase objective (total magnification ca. 400×); numerical aperture = 0.65 to 0.75.
- Graticule, Walton-Beckett type with 100-µm diameter circular field (area = 0.00785 mm^2) at the specimen plane (Type G-22).
- Telescope, ocular phase-ring centering.
- Stage micrometre (0.01-mm divisions).

Sampling

- Sampling:

1. Collection: Air samples are collected using a specialized sampler, such as a cassette or a filter.
2. Filter: The sampler contains a filter, typically a mixed-cellulose ester (MCE) or polycarbonate (PC) filter.
3. Flow Rate: The sampler is set to a specific flow rate (e.g., 0.5 to 16 L/min). 400 L @ 0.1 fibre/cc
4. Sampling Time: The sampling time varies (e.g., 10-240 minutes).
5. Sample Labelling: The sample is labelled with relevant information (e.g., location, date, time).
6. Submit at least two field blanks (or 10% of the total samples, whichever is greater) for each set of samples

Sampling

- Sampling:

  7. Sample at 0.5 L/min or greater. Adjust sampling flow rate, (L/min), and time, t (min), to produce a fiber density, , of 100 to 1300 fibers/mm² (3.85×10^4 to 5×10^5 fibers per 25-mm filter with effective collection area = 385 mm²) for optimum accuracy. These variables are related to the action level (one-half the current standard), (fibers/cc), of the fibrous aerosol being sampled by: At the end of sampling, replace top cover and end plugs.

  8. Ship samples with conductive cowl attached in a rigid container with packing material to prevent jostling or damage

Analysis

1. Ensure that the glass slides and cover slips are free of dust and fibers

2. Adjust the rheostat to heat the “hot block” to ca. 70 °C

Sample Preparation: The filter is removed from the sampler and prepared for microscopy.

3. Filter Clearing: The filter is cleared with a solvent (e.g., acetone) to remove debris.

4. Fibre Counting: The cleared filter is placed under a phase contrast microscope.

5. Microscopy: The microscope operator counts the number of asbestos fibres in a specified area (e.g., 100 fields of view).

6. Fibre Identification: The operator identifies the type of asbestos fibre (e.g., chrysotile, amosite, crocidolite).

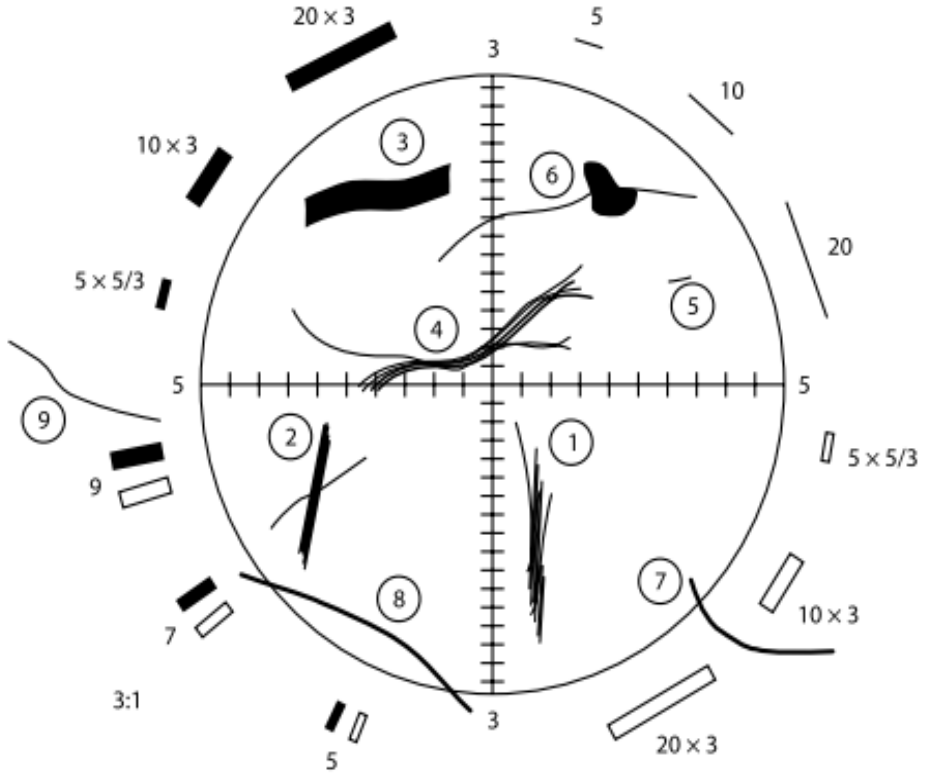
Result Interpretation

These rules are sometimes referred to as the "A" rules:

Object	Count	Discussion
1	1 fiber	Optically observable asbestos fibers are actually bundles of fine fibrils. If the fibrils seem to be from the same bundle, the object is counted as a single fiber. Note, however, that all objects meeting length and aspect ratio criteria are counted whether or not they appear to be asbestos.
2	2 fibers	If fibers meeting the length and aspect ratio criteria (length >5 µm and length-to-width ratio > 3 to 1) overlap, but do not seem to be part of the same bundle, they are counted as separate fibers.
3	1 fiber	Although the object has a relatively large diameter (>3 µm), it is counted as fiber under the rules. There is no upper limit on the fiber diameter in the counting rules. Note that fiber width is measured at the widest compact section of the object.
4	1 fiber	Although long fine fibrils may extend from the body of a fiber, these fibrils are considered part of the fiber if they seem to have originally been part of the bundle.
5	Do not count	If the object is ≤ 5 µm long, it is not counted.
6	1 fiber	A fiber partially obscured by a particle is counted as one fiber. If the fiber ends emanating from a particle do not seem to be from the same fiber and each end meets the length and aspect ratio criteria, they are counted as separate fibers.
7	½ fiber	A fiber which crosses into the graticule area one time is counted as ½ fiber.
8	Do not count	Ignore fibers that cross the graticulate boundary more than once.
9	Do not count	Ignore fibers that lie outside the graticule boundary.

APPENDIX B. COMPARISON OF COUNTING RULES

Figure 2 shows a Walton-Beckett graticule as seen through the microscope. The rules will be discussed as they apply to the labeled objects in the figure.



Calculation & Quality Control

A	Total of fiber counted		2
B	Area of the filter paper		422.9
C	Constast Area		0.00786
D	Number of fields Counted		100
E	Average Flow Rate(LPM)		1
F	Sampling duration(min)		480
G	Total flow of air cm3	E*F*1000	480000
H	Result (fibre/cc)	A*B*E/C*D*G	0.002

1. Fibre Concentration: The number of fibres are calculated per unit area (e.g., fibres per square millimetre).

2. Results: The results are reported as the number of fibres per cubic meter (f/cc) of air.

3. Comparison: The results are compared to regulatory limits (e.g., OSHA, EPA).

Calculation & Quality Control

- Quality Control:

1. Sample Handling: Samples are handled carefully to prevent contamination.
2. Microscope Calibration: The microscope is calibrated regularly.
3. Operator Training: Microscope operators undergo training and proficiency testing.
4. Blanks: Blank samples are analysed to ensure laboratory quality control.

Testing Protocols, Certifications and Accreditation and Safety Precautions

- Asbestos Testing Protocols:
  1. NIOSH 7400: A protocol for testing asbestos fibers in air samples.
  2. OSHA ID-160: A protocol for testing asbestos fibers in bulk samples.
  3. EPA 600/R-93/116: A protocol for testing asbestos fibers in water and soil samples.
- Certifications and Accreditation:
  1. AIHA-LAP: A certification program for laboratories testing for asbestos.
  2. NVLAP: A certification program for laboratories testing for asbestos.
  3. ISO/IEC 17025: A standard for laboratory accreditation.
- Safety Precautions:
  1. Personal Protective Equipment (PPE): Wearing appropriate gear when handling asbestos-containing materials.
  2. Containment: Isolating the area where asbestos testing is being conducted.
  3. Decontamination: Properly cleaning equipment and surfaces after testing.

An overview of Testing methods

- NIOSH 7400 is a method for testing airborne asbestos fibers. Here's an overview:
  - Method: Phase Contrast Microscopy (PCM)
  - Uses: Air samples
  - Detection limit: 0.1 fibers per cubic centimeter (f/cc)
  - Sample collection: Filter cassettes or impingers
  - Analysis: Counting asbestos fibers in a microscope field
- Other methods for fiber testing:
- NIOSH 7402:
  - Method: Transmission Electron Microscopy (TEM)
  - Uses: Air samples
  - Detection limit: 0.001 f/cc
  - Sample collection: Filter cassettes or impingers
  - Analysis: Identifying asbestos fibers using TEM

An overview of Testing methods

- ASTM D5755:
  - Method: PCM or TEM
  - Uses: Bulk samples (e.g., soil, vermiculite)
  - Detection limit: 1% asbestos by weight
  - Sample collection: Physical samples
  - Analysis: Identifying asbestos fibers using PCM or TEM

- ISO 22262-1:
  - Method: PCM or TEM
  - Uses: Air samples
  - Detection limit: 0.01 f/cc
  - Sample collection: Filter cassettes or impingers
  - Analysis: Counting asbestos fibers in a microscope field

An overview of Testing methods

- OSHA ID-160:
  - Method: PCM
  - Uses: Air samples
  - Detection limit: 0.1 f/cc
  - Sample collection: Filter cassettes or impingers
  - Analysis: Counting asbestos fibers in a microscope field

- EPA 600/M4-82-020:
  - Method: TEM
  - Uses: Bulk samples (e.g., insulation, ceiling tiles)
  - Detection limit: 1% asbestos by weight
  - Sample collection: Physical samples
  - Analysis: Identifying asbestos fibers using TEM

An overview of Testing methods

Here are some Indian standards related to asbestos testing:

1. IS 11451: Method for determination of airborne asbestos fibers using phase contrast microscopy (PCM).

2. IS 16231: Guidelines for sampling and analysis of asbestos fibers in air.

3. IS 16764: Method for determination of asbestos in bulk materials (such as insulation, ceiling tiles, etc.) using transmission electron microscopy (TEM).

4. IS 17322: Code of practice for safety and health requirements in asbestos industries.

5. IS 18836: Guidelines for asbestos management in buildings.

An overview of Testing methods

6. IS 20551: Method for determination of asbestos fibers in water using TEM.

7. BIS 11711: Code of practice for safe handling, storage, and transportation of asbestos.

8. BIS 11712: Code of practice for asbestos abatement and disposal.

9. NPCB (National Productivity Council of India) Guidelines: For asbestos survey, sampling, and analysis.

10. Central Pollution Control Board (CPCB) Guidelines: For asbestos waste management and disposal.

thank you