

# **Pinchin Environmental & Affiliates**

- A leader in engineering, environmental health & safety solutions
- Multi-disciplinary approach by highly qualified, experienced professionals
- Established in 1981; over 300 employees
- Part of the Pinchin Group of Companies, a national network of over 35 offices with over 650 staff



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#### **Presentation Content**

- 1. Composition and use of asbestos-containing drywall joint compound (ACDJC)
- 2. Early studies of worker exposure to airborne fibres during installation of ACDJC using Phase Contrast Microscopy (PCM)
- Modern studies of worker exposure during removal of drywall with ACDJC using PCM and Transmission Electron Microscope (TEM)
- 4. Results of recent field trials of drywall removal using both PCM and TEM
- 5. Conclusions

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Engineering Environmental Health & Safety Solutions

#### Composition of Asbestos-Containing Drywall Joint Compound (ACDJC)

- ACDJC (mud, joint compound or mastic) normally contained chrysotile asbestos with gypsum, quartz, mica, clay, ground limestone and polymer additives.
- Asbestos content is most commonly 3% to 6% but could be higher in earlier formulations.
- Chrysotile prevented cracking and shrinking of the DJC
- Since DJC amounts to approximately 3% of the weight of a drywall assembly (the balance is the board itself) the content of
- ACDJC was normally formulated with QAMA Grade 7 chrysotile asbestos. Note that this could be contaminated with an extremely low percentage of amphibole(tremolite) Typically approximately 80% of the chrysotile in QAMA Grade 7 asbestos is shorter than 5 micrometres (µm)

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#### Early Studies of Worker Exposure to **Airborne Asbestos during Installation**

- Studies by Rohl, Langer, Selikoff and Nicholson (1978) and by Verma and Middleton (1980) of both dry mix and pre-mix ACDJC indicated significant fibre exposures during all taping operations (sanding, mixing and clean-up). Optical microscope (PCM) (NIOSH Phase Contrast Microscope method) was used for testing. Levels were typically between 1 fibre/cc (f/cc) and 20 f/cc during mixing of dry mix and reading and bidbar (up 25 f(ar) during curoening mix and sanding and higher (up 25 f/cc) during sweeping.
- Rohl et. al. also reported radiological abnormalities in a significant proportion of drywall workers.
- This, along with the general concern over friable ACM fireproofing and thermal insulation led to the bans on asbestos-containing DJC in the late 1970s/early 1980s.

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#### Concerns over Test Methods used in these early studies

- There were two major drawbacks to these studies: Under-reporting due to resolution of PCM – Rohl et. al. commented on a large number of airborne fibres too thin to be seen in the PCM – only resolved in the Transmission Electron Microscope (TEM)
  - Over-reporting of "asbestos fibre" concentrations due to interference and inclusion of non-asbestos fibres. Middleton (1978) during PCM testing during lagging removal from roof panels reported the presence of a high percentage of calcium sulphate (gypsum) crystals on samples taken to evaluate airborne asbestos. TEM testing showed more than 90% of the counted fibres were non-asbestos and were attributed to plaster board (drywall) disturbed during the de-lagging operation.

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#### Test Methods used to Determine Asbestos Fibre Levels TEM (NIOSH 7402) or PCM (NIOSH 7400)?

- NIOSH 7400 is an optical method which counts all airborne particles of a particular size and shape as long as they are thick enough to be seen in the microscope (thicker than about 0.25 to 0.3 microns). This may include non-asbestos fibres.
- TEM method NIOSH 7402 counts only asbestos fibres which would be visible in the optical microscope using NIOSH 7400. This eliminates interfering non-asbestos fibres but does not include thinner or shorter asbestos fibres. The result is always the same or less than NIOSH 7400.
- Therefore TEM is frequently used as a secondary test in the event that other fibres are present in the air. (gypsum!)

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#### Laboratory Testing on ACDJC in the US.

- Perkins and Hargesheimer (2002) performed both bulk and air testing under three conditions at a military base in Alaska:
  - Laboratory conditions (dry, damp and wet) while hand stripping and sawing small sections of ACDJC in a glove bag. Air samples were collected inside the glove bag;
  - Controlled removal of ACDJC in an enclosed work area without negative pressure. Removal performed dry by hand and the area was cleaned up with straw brooms. Area and personal samples were collected.
  - Uncontrolled demolition of two housing units. One contained ACDJC only (1998). One contained ACDJC and both sheet vinyl and VAT and will not be included here (1999). Area and personal samples were collected.

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#### Perkins et. al. - Air Testing Results

 Air sampling results for various test procedures. Ranges reported include both personal and area samples for both types of demolition.

Sample and test type	PCM Result (f/cc) (NIOSH 7400)	TEM Result (f/cc) (NIOSH 7402)
Glove Bag (dry)	1.0 to 10	All below the limit of detection (<0.1f/cc)
Controlled demolition	1.1 to 8.5	All below the limit of detection (<0.060)
Uncontrolled demolition (1998)	0.13 to 1.45	All below 0.008; most below the limit of detection

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#### Conclusions Drawn by Perkins and Hargesheimer

- Air testing results showed significant differences depending on the analytical methods:
  - Results during dry work consistently higher.
    The only testing that has any validity in determining the exposure of workers to airborne asbestos is the
  - use of the TEM to eliminate non-asbestos fibres of similar dimension.
- None the less consultants and regulators continue to use PCM to test airborne levels during ACDJC removal and regulations are largely based on this testing.
- Pinchin has performed ongoing testing to determine if the results of this single study can be replicated in field trials.

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#### **Current Practices for ACDJC**

- Most jurisdictions in Canada require Type 2 procedures (disposable suits, half facepiece respirators with P100 filters, typical abatement hygiene practices but without a shower, amended water for dust suppression, HEPA vacuum, appropriate worker clean-up, enclosure as required to stop the spread of dust).
- US practice classifies this as a Class 2 operation.
- Enforcement of these procedures is marginal at best. This is particularly the case involving renovation or demolition in residential construction where the use of ACDJC is widespread.

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## Three Typical Field Trials

- In order to determine if the results of Perkins and Hargesheimer were valid on ACDJC used in Ontario, Pinchin has performed testing on more than 10 removal sites. Testing results are reported here from:
  - High-rise building storage rooms
  - Hotel room ensuite washrooms
  - Shopping centre service corridors
  - Each site contained drywall with ACDJC
- (reported in the range of 0.5% to 5% chrysotile asbestos). Other test sites produced very similar results.

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#### Test Site #1 – high rise office building storage room)

Test area –

- interior room, typical ACDJC on gypsum board, and as adhesive on concrete block
- single door sealed during work, no negative pressure,
  Ventilation turned off, vents, diffusers and entire lay-in ceiling sealed with poly to eliminate air movement,
- Workers used Type 2 (moderate risk) procedures (half facepiece respirators, disposable suits, full enclosure, waste bagged as ACM, typical worker clean up procedures)
- No water used for dust suppression (except for final cleanup of site, mopping)
- Work practices normal for removal but supplemented with saw cutting of joints to produce airborne dust.
- Approximately 300 sf of drywall removed and bagged.

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## Test work performed to remove Drywall with ACDJC in totally sealed enclosure



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#### Worst case scenarios simulated by saw cutting waste across joints to small pieces (totally dry)



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# Material bagged and area wet cleaned. Entire process subject to air monitoring.



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### Test Site #1 - Air Testing Results

 Average results of Background samples (2), Personal samples (5) and area sample in work area (1) analyzed by PCM (NIOSH 7400) and TEM (NIOSH 7402).

Sample type	PCM Result (f/cc) (NIOSH 7400)	TEM Result (f/cc) (NIOSH 7402)
BACKGROUND	0.17	0.015
PERSONAL	2.28	All below the limit of detection (<0.030)
AREA	0.33	Below the limit of detection (<0.004)
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#### Test Site #2 – Hotel Ensuite Bathrooms

#### Work area –

- Numerous hotel ensuite bathrooms; work required the removal of drywall overhead with ACDJC,
- Ventilation isolated, HEPA vacuum used to extract some air from work area,
- Workers used Type 2 (moderate risk) procedures,
- Hand tools to break and tear down drywall,
- Amended water used sparingly for dust suppression during breaking and sawing of drywall (including ACDJC on joints,
- Waste transported from the area in covered bins

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#### Test Site #2 Air Testing Results

 Average results of Personal samples (3) and Area samples in work area (5) during removal, cutting and cleaning analysed by PCM (NIOSH 7400) and TEM (NIOSH 7402 and ISO 10312).

PERSONAL  0.9  All below the LOD (<0.05	Sample type	PCM Result (f/cc) (NIOSH 7400)	TEM Result (f/cc) (NIOSH 7402)
AREA 0.8 ranged from 0.01 to 0.02	PERSONAL	0.9	All below the LOD (<0.05)
aepenaing on volume )	AREA	0.8	All below the LOD (LOD ranged from 0.01 to 0.09 depending on volume )

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#### Test Site #3 -Shopping Centre Corridor

- Work area
  - interior corridor, not accessible to employees,
  - Ventilation turned off and isolated, no negative pressure.
  - Workers used Type 2 (moderate risk) procedures,
  - Hand tools to break and tear down drywall.
  - Amended water used sparingly for dust suppression during breaking of drywall,
  - Waste transported from the area in covered bins but disposed of as non-asbestos waste.
  - Air samples also analysed by ISO 10312 to provide results of all asbestos longer than 0.5 µm

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#### Air Testing Methods and Results

 Average results of Personal samples (5) and Area samples in work area (2) analysed by PCM (NIOSH 7400) and TEM (NIOSH 7402 and ISO 10312).

Sample type	PCM Result (f/cc) (NIOSH 7400)	TEM Result (f/cc) (NIOSH 7402)	TEM Result (s/cc) Structures >0.5μm (ISO 13012)
PERSONAL	2.28	All below the LOD (<0.03)	0.09
AREA	0.33	Both below the LOD (<0.01)	0.05

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#### PCM Results are Meaningless to Measure or Control Worker Exposure during ACDJC Removal – However is NIOSH 7402 appropriate?

- Threshold Limit Value/Time Weighted Average (TLV/TWA) established by ACGIH established as 0.1 f/cc for all types of asbestos using PCM.
- Only fibres longer than 5 μm with a 3:1 aspect ratio are included in the count. Tumor development is most closely associated with long (>8 μm) and thin (<0.25 μm) fibres(Stanton fibres).
- All North American Occupational Exposure Limits are based on asbestos fibres longer than 5 µm. This is what we all use when measuring worker exposure.
- Many gypsum crystals fall into this range and are hence included in the PCM count. The TEM (NIOSH 7402 eliminates these non-asbestos fibres and is the appropriate method to determine asbestos exposure.

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## Other test sites in Ontario and Newfoundland and Labrador

- Field testing of numerous sites (over 10) with similar numbers of air tests has NEVER once shown any asbestos fibre levels in the work area above 0.01f/cc even during the actual removal work using NIOSH Method 7402.
- This result is 10 times lower than the current TLV-TWA established by ACGIH.
- In addition the airborne fibre levels are lower (even during active ACDJC removal) than the cleanliness required to clear or approve a Type 3 site for the entry of unprotected workers and the general public in every Canadian jurisdiction (0.01 f/mL).

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#### Why is Drywall Removal still Type 2 Although Testing Shows it to be "clean"?

- Historical concern over the testing of the 1970s which used the PCM and included non-asbestos "fibres" in the total fibre count.
- Risk avoidance by health and safety professionals and workers towards relaxing any precautions related to asbestos work.
- The inertia of regulators and the need to reverse a regulation which has cost many millions of dollars to building owners (but which will cost many billions more if not corrected).
- The fact that drywall removal has become a major and profitable part of the asbestos removal industry (what percentage of your business would vanish?).

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