Diagnostic Procedures for Low-Level Asbestos Contamination in Occupied Tertiary Institutional Buildings

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Asbestos Related Disease: A Global Picture

- 125 million people worldwide exposed to asbestos in the workplace (WHO, 2020)
- Annual worldwide diagnoses have almost doubled in the last 30 years (Povtak, 2022)
  - Asbestos industry
  - Non-asbestos industry
  - Domestic and para-occupational exposures
  - Environmental exposure
Changing Risk

- Fewer incidences attributed to raw fibre handling, more cases attributed to home maintenance and renovation
- Non-occupational asbestos exposures contribute an increasing proportion of disease (Robinson, 2012)
- Malignant mesothelioma (MM) cases – approx. 30% plumbers, fitters, laggers, and 23% carpenters, builders (MBIE, 2012)
- Several thousand deaths annually can be attributed to exposure to asbestos in homes (WHO, 2020)

Four waves of asbestos exposure (Wallis et al, 2020; Data based on Landrigan, 1991)
New Zealand Timeline

- Import of raw asbestos and production of asbestos cement products begins (Kjellstrom, 2004)
- First occupational standard for airborne asbestos established (Kjellstrom, 2004)
- Import of raw blue and brown asbestos banned (Kjellstrom, 2004)
- Asbestos Exposure Register established (Kjellstrom, 2004)
- Import of asbestos-containing materials banned
- New Asbestos management and use regulations (Stock, 2019)

- Ministry of Health recognises dangers of asbestos use (Kjellstrom, 2004)
- Asbestos regulations published (occupational exposure) (Kjellstrom, 2004)
- Import of raw white asbestos banned (Kjellstrom, 2004)
- Christchurch Earthquake (6.2M) results in demolition of 10,000 and damage of 100,000 homes (Glass et al., 2017)
- Review finds that asbestos awareness in construction industry is generally low (Cosman, 2022)

- Widespread application of asbestos to boilers and pipes, and use as fire retardant. (Kjellstrom, 2004)
New Zealand’s Asbestos Story

- Limited natural occurrence
- Homes and buildings built before 2000
- Approved Code of Practice (WorkSafe 2016) - Management and Removal of Asbestos

Three types of surveys:
- Management Survey
- Refurbishment Survey
- Demolition Survey

Serpentinite with asbestos crystals, asbestos mine tailings, Upper Takaka River, Kahurangi National Park (de Lange, 2020)

UNREGULATED
- Home
  - No AMP required
- Rental
  - AMP required
- Office
  - AMP required

REGULATED

*AMP – Asbestos Management Plan
New Zealand Facts

• New Zealand’s number one workplace killer

• Asbestos-related disease deaths = 220 registered/year (Worksafe, 2022)

• 1696 MM deaths have been recorded between 1954 - 2001 (Morris, 2016)

• Average number of MM cases per year around 100 (NZ Ministry of Health, 2021)

• No national support group until 2020

Brave the Shave, (Berry 2020)

Tour Aotearoa, 3000km from Cape Reinga to Bluff (Berry, 2023)
## New Zealand Case History

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2023</td>
<td>Firefighters’ air tank filling equipment contaminated by asbestos (used to fill tanks since 2015)</td>
<td>Auckland Central City Fire Station</td>
<td>Pennington, P. (2023, June 7)</td>
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<tr>
<td>Apr 2023</td>
<td>Chrysotile Detected in Fire Station</td>
<td>Auckland Central City Fire Station – after renovation</td>
<td>Maher, R. (2023, May 10)</td>
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<tr>
<td>Jul 2022</td>
<td>Public fence found to contain asbestos, at risk of deterioration</td>
<td>South Auckland</td>
<td>Killick, J. (2022, July 19)</td>
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<tr>
<td>Oct 2021</td>
<td>Firefighters tend to fires without knowledge of asbestos in the building</td>
<td>Onehunga factory, Auckland</td>
<td>Pennington, P. (2021, October 19)</td>
</tr>
</tbody>
</table>

Firefighters’ air tanks (Eastham-Farrelly, 2019)

Christchurch Earthquake: “Asbestos fears unlikely to be realised” (Stuff, 2012)
Unitec - Auckland, New Zealand

Unitec Institute of Technology was founded in 1976 as Carrington Technical Institute. Before its merger into the New Zealand wide Te Pūkenga – New Zealand Institute of Skills and Technology last year, it was New Zealand’s largest polytechnic.

Unitec’s Te Noho Kotahitanga Marae  (Unitec, 2023)
Asbestos in buildings

- Extensive use of asbestos
- Five large conjoined buildings over four floors
- Asbestos Management Plan for buildings

Internal Asbestos-based ceiling coating - Building 113 (Steinhorn, 2023)
Asbestos Discovery - 2021

• 1st March: Request for background sampling for asbestos in a research laboratory detected asbestos concentrations exceeding trace levels (>0.01f/ml).

• 7th March: Bulk analysis* (using PLM) from windowsill and flat surfaces under disturbed air test found 9.5f/ml chrysotile! Request for TEM analysis made.

• 17th March: Room isolated, surrounding areas tested.

• 18th March: Worksafe contacted, additional monitoring and further testing requested.

*analysis provided by external accredited lab in Auckland

New Asbestos Lab for microbial assessment of associated biofilms (Blanchon, 2022)
Methods

- **Air**
  
  Minimum vol 480 litres air, flow rate between 1-16 liters/min, 1-2m inlet height. 2 liters/min for 4 or 8 hours recommended for static sampling

- **Disturbed air**
  
  Brushing on horizontal surfaces with brush/broom. All levels/heights of possible contamination undertaken, duration of dust disturbance.

- **Surface testing**
  
  Wipe surface with clean fabric or filter paper), using adhesive tape, and/or micro-vacuum to collect samples. **No conc limit/threshold**

Analysis using Phase Contrast Microscopy (PCM) for air and Polarised Light Microscopy (PLM) for bulk samples (Australian Standard, AS 4964) (WorkSafe NZ, 2016).
Problems with Surface Sampling

- Australian (AHCA, 2021), UK (HSE UK, 2021) and US (OSHA, 2020) guidance on asbestos analysis do not recommend swab sampling and analysis using PLM (no standardised scientific method).

- Unreliable for assessment of asbestos risk in a building.

- Unfeasible for most asbestos-containing buildings to be completely asbestos-free.

- Should not be used in place of air monitoring

New Zealand has no commercial TEM labs

TEM preferred over PLM (ASTM D6480-5), and can infer corresponding airborne respirable fibres (Ashley et al., 2011)

Straight chrysotile fibres from ACM, building 115 under TEM analysis (Vigliaturo, 2022)
Results

• 189 swab samples
  • 11 contained chrysotile.

• Internal air monitoring
  • 21 sites
  • 7 positive samples

• External air monitoring
  • 28 sites
  • 12 positive samples

• One exceedance of 0.01f/ml found internally (outside lift shaft close to new lab)

<table>
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<tr>
<th>Sample ID</th>
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<th>Sample ID</th>
<th># fibres</th>
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Footnotes:
• Fibres >10 exceed 0.01f/ml (trace level)
• Swabs are mandatory as part of a CLASS A - 4 Stage Clearance ONLY
Asbestos Source?

- Previous history of jet blasting asbestos-based (Super Six) roof during extensive clean (with lichen remover) – 29th November 2017
- New lino in the lab – 17th December 2020
- Other suspects – asbestos containing whole building wrap-around waterproof membrane? Recently cleaned to remove pigeon guano – 7th October 2020
- Multiple sources but no widespread severe contamination

Pigeon guano on asbestos-containing building waterproof membrane (Blanchon, 2020)
Actions Taken

- Testing identified asbestos fibres on landings, windowsills and other external areas.
- Substantial pieces of ACM found external to the buildings.
- All buildings evacuated and a 6-metre perimeter was established around the affected buildings.
- Staff comms both verbal and on intranet.
- Support line set up and email provided to address concerns.
- Extensive internal cleaning of two buildings.

9.5 fibres = less than 0.01F/ml
None were asbestos
Recommended Procedure

Step 1
• Find likely asbestos containing debris as identified on Asbestos Survey.

Step 2
• Seal off the area/room and call in a reputable asbestos consultant.

Step 3
• Refer to Asbestos Management Survey (AMS) report and the Asbestos Management Plan (AMP) for more information.

Step 4
• Take a bulk sample for analysis as per the Asbestos survey guidance.

Step 5
• Complete air sampling if there is a suspicion that ACM’s have deteriorated or have not been managed in accordance with the recommendations in the AMS and the AMP.

Step 6
• Analyse the results from the bulk sample and air monitoring to determine the best course of action.

Step 7
• Use a combination of PCM and TEM analysis to give accurate results.
Conclusions

• Comprehensive framework for determining asbestos exposure risk as well as better asbestos awareness for institutions with buildings containing ACM is required in New Zealand and elsewhere.

• There is no clear forensic procedure for asbestos in buildings which should include:
  • Reduced reliance on swabs (especially as sole forensic strategy).
  • Awareness that a single fibre should not conclude that air monitoring results will produce a result higher than trace level i.e. 0.01f/ml.
  • The importance of the use of TEM analysis.
We would like to thank:

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- The Mesothelioma Support and Asbestos Awareness (MSAA) Trust board and the Mesothelioma Community of New Zealand, their families and carers.
References


