Asbestos - Recent Developments and Implications for Health Policy

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Asbestos – Recent Developments and Implications for Health Policy

Pierina Otness, Mark Feldwick, Peter N Di Marco
Department of Health, Western Australia

1 INTRODUCTION

It is impractical to propose that a site can be 'free' of asbestos fibres. Guidance from health authorities is necessary for sites to be declared acceptable for unrestricted use, such as sites that are remediated for redevelopment. Urban expansion into areas where materials containing asbestos may be located requires health risk assessment and management of material containing asbestos. However, despite extensive research, controversy still surrounds health risk assessment of asbestos in the environment.

Asbestos cement products mixed with building waste are also of concern and raise issues regarding acceptable levels for recycling and disposal.

Situations where sites should be considered potentially contaminated with asbestos include:

- Industrial land, eg. manufacturing facilities, former power stations, rail yards and shipyards, especially large workshops and depots
- Discarded asbestos waste at old waste disposal sites or other locations (eg. asbestos cement products, building waste and insulation material)
- Asbestos waste from mining or manufacture of asbestos products used as infill
- Fire and storm damaged buildings
- Urban land with fill of unknown composition
- Sites where buildings or structures have been demolished or renovated, including residential land.

Following on the work of Imray and Neville (1993), the enHealth Council has undertaken to develop guidelines for the management of asbestos in the non-occupational environment. This paper summarises the progress in development of the guidelines as agreed at a stakeholder workshop in Adelaide on 29 November 2001. The guidelines will undergo public consultation, after which they will be considered for endorsement by the enHealth Council.

2 EXPOSURE ASSESSMENT

Health risks from asbestos containing materials in soil will depend on the potential for asbestos fibres to become airborne and be inhaled. If the material is readily accessible it may be vulnerable to disturbance by people, vehicles or objects. For example, vehicle movements or construction work may release the fibres or dust.

Air or soil sampling results will provide information on the extent of the contamination but represent only a snapshot in time which, in most cases, will not be representative of exposure under various activity and conditions. Therefore, qualitative assessment of the distribution of the materials and potential for fibre release to air remains an important aspect of exposure assessment.

2.1 WIND EROSION AND WATER DRAINAGE ON CONTAMINATED SITES

Van Der Walt and De Villiers (1996) conducted laboratory and field experiments to examine asbestos fibre concentrations arising from wind erosion of asbestos tailing dumps in South Africa. They found that minimum wind disturbance at 2.7 m/s results in measurable asbestos fibre concentrations, ie. 0.008 f/mL (chrysotile), 0.023 f/mL (crocidolite) and these increased with increasing wind speed. Further, they suggested that asbestos containing wastes that are on site at an insufficient depth such that weathering, erosion, work or other activities may disturb materials and release fibres into the air, should be rehabilitated.

There is no significant migration of asbestos fibres through the soil, other than from disturbance by anthropogenic or major geologic activities. Consequently, the risk for groundwater contamination is low. In addition, the risks from ingestion of asbestos fibres are extremely low. Uncontrolled drainage of water from areas that have been contaminated with asbestos fibres may result in the further environmental dispersion of asbestos fibres from the main area of contamination, which may lead to unknown exposure of asbestos fibres in air when disturbed or released.

2.2 EXISTING GUIDELINES

The principal purpose of any soil guideline value developed through the National Environment Protection Measure process would be for regulatory purposes to enable sites to receive clearance for development rather than for the exact determination of health risk. Consideration must also be given to availability of sampling and analytical methodologies and their limitations. Imray and Neville (1993) suggested a level of < 0.001 f/mL in air and < 0.001% in soil to classify a site as uncontaminated or unrestricted and suitable for all land uses (using information from Institute of Occupational Medicine (IOM) study (Addison *et al*., 1988)). However, suitable, readily available analytical techniques to quantify low levels of asbestos have not been identified.

Addison *et al*. (1988) demonstrated that, with an asbestos concentration of 0.001% in dry soil (w/w homogeneous sample), the fibre concentration in air is unlikely to exceed 0.1 f/mL (occupational exposure standard) even if respirable dust up to 5 mg/m^3 is generated. The IOM study was undertaken to determine a practical limit for the asbestos content of contaminated land below which no further decontamination would be necessary. The study found that unless considerable dust clouds are generated, airborne fibre levels would be below the analytical detection limit.

Imray and Neville (1993, p 256) further argued, 'Since buried asbestos (left undisturbed) does not present a risk to health there is no scientific basis for setting an 'acceptable' level in soil. The risks depend on potential for disturbance and generation of airborne asbestos which may be inhaled.' This position still holds today.

The setting of soil guidelines is complicated by the absence of reliable and validated data on the relationship between soil and air levels. Unlike many chemicals, the generation of airborne fibres will underpin the determination of a soil level and the generation of airborne fibres is not predominantly dependent on the chemical properties of asbestos. The potential for asbestos fibres to become airborne depends on the matrix in which it is found and the state of that matrix, as well as mechanical disruption of the matrix whether by anthropogenic or natural activities.

A worst-case approach to estimating airborne fibres may be to assume that all the fibres present would ultimately be released. The problem would still remain with respect to determining the relationship between air concentrations and health effects since the epidemiological data and exposure data are insufficiently reliable to derive a dose-response relationship in non-occupational settings.

There has been an inability or unwillingness to set acceptable ambient air levels of asbestos globally, except for occupational exposure. IPCS (1988) concluded that it was unable to recommend an environmental standard. United States regulatory jurisdictions convened the 2001 Asbestos Health Effects Conference to assess the state of knowledge on asbestos and whether or not exposure limits could be established. Comment at the workshop included that there had been little progress in the state of knowledge since the 1980s that would allow a more accurate or reliable estimate of safe levels for asbestos.

2.2.1 *Air*

The following are air exposure limits that have been identified:

- Occupational exposure standard (eg, 1 f/mL for chrysotile and 0.1 f/mL for crocidolite in Australia) and a paraoccupational lower reporting concentration using the limit of detection of 0.01 f/mL (NOHSC, 1988).
- Ambient air levels of
  - 0.002 f/m^3 (sic) in Canada (Daniel, 2000)
  - 0.02 f/mL in South Africa (Van Der Walt and De Villiers, 1996)
  - 0.033 f/mL proposed in Tasmania
- A practical indoor air level of 0.001 f/mL (detection limit) has been set in Norway (Daniel, 2000).

2.2.2 *Soil*

Unofficial soil levels of 0.001% have been proposed in the United Kingdom, below which no further action is required. Clean up levels between 0.25% and 1% are used by various regions of the US EPA. Victoria has a 1% land fill criterion.

In Manukau City Council, New Zealand, where extensive remediation of asbestos cement fragments has occurred, a semi-quantitative estimate of 0.001% asbestos content has been accepted as a guideline, based on the mass of fibres in handpicked samples and the mass of soil examined.

A health investigation level of Asbestos of 0.01% fibres in soil has been proposed by the Australian Contaminated Land Consultants Association (2001).

2.2.3 *Other*

The European Union and Australia has set a cut-off of 0.1 % by weight asbestos in new products for the purpose of carcinogenic classification of the products (Schneider *et al.*, 1997; Drew Wagner, NICNAS Chemicals Framework Team Leader, 2000: Personal Communication).

The European Commission (2000) is likely to propose a level of 10 mg/kg (0.001%) for aggregates produced from recycled construction and demolition waste. This supports the uncontaminated level of 0.001% proposed by Imray and Neville (1993). Mixing of waste streams to meet this cut-off concentration is unacceptable.

2.3 ANALYTICAL METHODS

Any guideline level adopted must be measurable using a validated analytical method. The purpose of the sampling is an important determinant of the sampling or analytical method required for measuring the asbestos content in soil or air. The methods should be adequately sensitive and discriminating for the intended purposes. Importantly, a consistent approach should be adopted throughout Australia that will facilitate comparison of sample results and consistent risk management approaches.

2.3.1 Soil

Various methods are currently used to determine asbestos concentrations in soil. Partially validated methods include:

- The analytical method used for identification of asbestos in bulk materials is polarised light microscopy with dispersion staining. An Australian Standard DR 02125 (2002) *Method for the qualitative identification of asbestos in bulk samples* has been prepared from an existing draft NATA Guidance Note (1990) *Identification of Asbestos in Bulk Samples.* This is a qualitative method and results are reported as 'no asbestos detected', 'trace asbestos detected' or 'asbestos detected'. The method can be used for preliminary assessments to determine whether materials containing asbestos or asbestos fibres are present at a site. If asbestos is detected there may be no need for further quantitative analysis provided that appropriate management measures are implemented to prevent exposure.

- Davies *et al*. (1996) developed and tested a method for quantifying asbestos fibres that may be in low or trace concentrations in loose aggregates and soil (0.001%). This method uses wet sedimentation to allow the larger particles to settle out and a known quantity of the suspension is then filtered through an appropriate filter and analysed by phase contrast optical microscopy and polarised light microscopy. This method has been further developed and validated by Schneider *et al*. (1997) to provide reliable quantification down to 0.01% for determining classification of carcinogens for the European Union at a level of 0.1%. This method can be adapted in Australia for measuring trace concentrations of asbestos, when required for risk assessment or validation of site clean up.

- The US EPA superfund method (US EPA, 1997) utilises a dust generator to generate respirable dust from a soil sample. The respirable dust is collected on a filter and the filter is prepared using the direct method (ISO 10312) for analysis by transmission electron microscopy and hence has a detection limit of 0.002 asbestos structures/mL. This method selects out all of the respirable fibre content from the soil sample. This does not reflect a realistic exposure scenario. Also, if there are non-respirable asbestos clumps in the mixture they will not contribute to the risk assessment, but if the material were subjected to work, perhaps by crushing or by vehicular traffic, then that non-respirable fraction could be made respirable.

Any method used will need to provide results suitable for supporting risk assessment and will need to be reproducible within and between laboratories that may offer the method commercially. The use of optical microscopy would insure that a sufficient number of testing facilities would be available and would keep costs low. Electron microscopy may be used for analysis of difficult samples or to minimise the risk of false negatives.

2.3.2 Air

The limit of detection for monitoring fibres in air using ISO 10312 (electron microscopy method) is 0.002 asbestos structures/mL. This method is recommended for determining levels of fibres (> 5 µm long) for risk assessment in non-occupational environments. Electron microscopy is essential for adequate identification of asbestos fibres. Occupational environments are characterised by mainly asbestos fibres in air, where employee exposure occurs to dust generated from work processes involving asbestos fibres. Asbestos fibres may represent only a small fraction of the total number of particles/fibres in the non-occupational environment, where wool, cotton, glass and other fibres would be also present. Cherrie *et al*. (1989) have shown that light microscopy is a poor indicator of the actual asbestos fibre concentration (concentration was greater in approximately 40% of samples) and hence the risk. However, electron microscopy is not readily available in Australia.

Paraoccupational sampling using the membrane filter method can be used to assess dust control on sites being remediated as well as asbestos removal in buildings and has a detection limit of 0.01 f/mL.

3 RISK MANAGEMENT

Risk management options need to be selected on a case-by-case basis. Appropriate management strategies that avoid the generation of airborne fibres are the recommended approach. Containment of asbestos contamination *in situ* is the preferred option but may not meet the expectations of all stakeholders. However, it may be more appropriate to deal with the 'perceptions' that might arise from such management options rather than develop a remediation level with a high degree of uncertainty, triggering additional sampling and analysis that might not add much value to the process.

It is important to control the disturbance of material containing asbestos and also to transfer and convey this information to relevant future landowners/occupiers.

3.1 ISOLATION BY BARRIER

When:

- isolation by barrier will stabilise material and prevent disturbance and release of asbestos dust
- erosion and drainage can be controlled
- area will not be significantly disturbed in the future
- removal is difficult or not feasible.

Disadvantages:

- hazard remains
- cost for large areas may be near removal cost
- management plan and public record required
- may affect property values.

Permanent hard cover in the form of buildings, roads, pavements and car parks is an effective long-term method of dealing with the contamination and allows the land to be used gainfully.

Urban redevelopment provides an opportunity to decide on long term, practicable management strategies. For example, contained asbestos material can be removed from land under private ownership and contained under permanent hard cover areas that are unlikely to be disturbed or change ownership, including roads and pavements.

A management/control strategy needs to include:

- prevention of water erosion (may be controlled through adequate site drainage)
- ensuring integrity of clean areas. A geotextile barrier can be placed to separate asbestos containing material from clean material and to alert to the presence of a hazard. Any work undertaken at or below the warning barrier should be undertaken following safety precautions outlined in a management plan and the barrier should be repaired or replaced into its original position
- establishment of a public record. A public record should be kept of any sites that contain buried asbestos-containing materials to reduce the risk of buried asbestos being inadvertently disturbed in the future. The register should contain details of the site and the type and condition of any asbestos products found and should be made available for inspection
- mechanisms for alerting future owners and workers

The long term uses of such land may be restricted to those that do not necessitate subsequent excavation for any purpose. For example, industrial or commercial developments, car parks, parkland, recreational areas etc. are preferred to residential developments on sites with asbestos containing materials.

Well–established and properly maintained vegetation can provide adequate protection (ICRCL, 1990). The site should be inspected periodically to check that the underlying material is not disturbed or the vegetation cover damaged (eg. by fire). The local authority may decide to carry out the inspections and undertake any immediate work required to protect the public; where the land is still in use the responsibility lies in the first instance with the landowner or occupier.

3.1.1 Leaving asbestos containing material in situ

When:

- there is negligible risk of/from exposure
- asbestos waste is stable and not likely to be disturbed or eroded.

Disadvantages:

- hazard remains
- may engender fear and concern in the community
- a management plan and public record is required
- may affect property values

In determining whether this is the most practical management option it is necessary to consider what amount of asbestos fragments or fibres in the soil constitutes an appreciable risk to health. Given the state of knowledge on the assessment of exposure to soil asbestos levels, this is difficult to estimate with a low degree of uncertainty. While current scientific knowledge suggests that low intensity, infrequent exposure to airborne asbestos fibres is unlikely to result in asbestos-related health effects, the knowledge is not sufficiently robust to estimate the levels that would constitute an exposure sufficient to cause health effects.

Where the risk is assessed as being relatively low, the response may be to simply inform the occupants of the site so they are aware of the presence of the hazard and the conclusions made regarding the risk (enHealth, 2001).

3.2 ASBESTOS CEMENT FRAGMENTS IN SOIL

As discussed by Imray and Neville (1993) removal of asbestos cement fragments mixed with other fill involves the excavation and disposal of considerable amounts of other material. In most situations this is an impracticable solution, mainly because the cost of disposal for the material will be the same as for asbestos waste.

When fragments of asbestos cement are found on the surface or at depth it may not be necessary to estimate the number of fragments present in the volume of affected soil. The type of asbestos present should be confirmed by microscopy. The whole volume in which fragments are located should be regarded as contaminated.

Action may be taken to decontaminate the area by reducing the number of fragments present to levels that do not constitute a health risk are safe and are aesthetically acceptable. An average of 0.001% w/w asbestos in soil has been used in New Zealand and Western Australia by calculating the approximate weight of asbestos fibres within the asbestos cement fragments and averaging this over the impacted soil. This is a very conservative estimate as it relies on the default assumption that all asbestos fibres within fragments will be available to be released as respirable fibres.

In summary, where there is obvious contamination by. fragments, the action taken will be to:

- confirm by microscopy that fragments contain asbestos
- consider the volume of soil containing visible fragments to be contaminated (no additional sampling of the soil is required)
- implement risk management options.

3.3 REMOVAL

When:

- asbestos material is present where free fibres are likely to be released
- material is subject to wind or water erosion and drainage cannot be controlled
- area is likely to be significantly disturbed in the future
- area is being redeveloped for other potential uses and will be excavated - ie. there is an opportunity to remove all contamination.

Disadvantages:

- increased risk to persons removing material – ohs management plan and monitoring required
- potential for elevated exposure to public during removal work
- high cost
- relocation of contaminant.

3.4 SURFACE CONTAMINATION

The main sources of surface contamination have been from buildings containing asbestos (eg. from breakage of products, demolition) and from dumping of asbestos waste. The presence of asbestos cement fragments on some soil surfaces may cause concern. However, if the asbestos fibre is reasonably well fixed into the cement matrix and unless it is mechanically disintegrated into dust, it does not present a significant dust hazard. To alleviate the concern, visible asbestos fragments should be physically removed and disposed of in an appropriate manner.

4 CONCLUSION

Containment on site is the preferred asbestos management option provided that there is sufficient management control, transfer of information and other safeguards to ensure that material is not disturbed, particularly in a residential setting.

Risk management strategies to prevent exposure to airborne asbestos fibres would need to be considered for sites where asbestos is detected using the NATA analytical method or Draft Australian Standard. There may be a need to quantify trace levels of asbestos to ≥0.001% for health risk assessment or validation of site clean up. The Davies *et al*. (1996) and further developed Schneider *et al*. (1997) methods may be considered as a basis for a quantitative method in Australia.

There are not sufficient data to establish an ambient and/or indoor air level. The paraoccupational limit of 0.01 f/mL in air has been used to monitor control measures used in asbestos removal work and there does not seem to be a need to have a reduced limit during site redevelopment/remediation. However, a detection limit of 0.002 asbestos structures/mL can be achieved using electron microscopy (eg. ISO 10312) and is recommended for use in more comprehensive health risk assessments. However, until such time that electron microscopy is used routinely in Australia, this air level is not able to be routinely applied or enforced.

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