

Ageing and Degrading Asbestos- Containing Materials



Victorian Asbestos
Eradication Agency

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Executive summary

The binding materials in asbestos-containing products are degrading at the macro-molecular level. Many of these products have already reached, or are approaching, a dilapidated state. It is commonly assumed that asbestos-containing materials (ACMs) remain stable and low-risk – that they're safe if left alone – but material science suggests they are actively degrading. This paper explains the chemical processes driving that degradation and their implications for how we assess ACMs.

Introduction

Asbestos-containing materials (ACMs) are often assumed to be exceptionally durable. However, this reputation primarily applies to the asbestos fibres themselves. These fibres can withstand extreme temperatures, pH ranges, high-voltage arcs, and direct flame. The matrices used to bind these fibres – such as cement, vinyl and bituminous resins – have significantly shorter product lifespans and degrade rapidly under routine environmental exposure.

The assumption that ACMs remain stable or in 'good' condition decades after installation is, therefore, fundamentally flawed. This paper examines three common product types, their binding materials and the specific mechanisms that drive their degradation.

Cement (corrugated roof sheeting)

As a cornerstone of the construction industry, the functions and limitations of cement are well-documented. However, when used in roofing and external cladding, cement sheets face a significantly reduced lifespan due to environmental pressures and the physical profile of the product.

Carbonation and brittleness

Cement products undergo a continuous chemical process known as carbonation, which progressively reverses the initial reaction that formed the cement. While the carbonation process increases static load-bearing capacity, it simultaneously reduces impact resistance, making the material increasingly brittle. External forces like hailstones, wind-borne debris and vibration eventually compromise the structural integrity of the rigid sheet.

Factors from nature

Unsealed cement sheets can act as a soilless growth medium for mosses. The ingress of moss rhizoids (root-like structures) physically fractures the cement matrix, creating voids. When the moss dies, these voids facilitate further water ingress and the 'flushing' of soluble components and small particulate matter. This is compounded by freeze–thaw cycles: ice crystals form within the matrix, physically breaking apart the material structure, then melt leaving voids and fractures on a macro-molecular level. Rain and UV radiation break down the material over time.

Leaching and thinning

The physical profile of thin, flat sheets further accelerates this decay. A high surface-area-to-volume ratio means that a large proportion of the binder is perpetually exposed to the elements. Regular rainfall creates a constant 'flushing' effect, leaching soluble material and carrying away solid particles of the matrix, gradually thinning the material from the outside in.

Carbonation, leaching and weathering affect all cementitious materials to some degree, but they are most pronounced in corrugated cement roofing. Its thin profile, high surface exposure and direct contact with the elements mean corrugated roofing transitions from stable to compromised.

In summary, the chemical makeup, physical geometry and environmental exposure of cement sheet roofing converge to make it highly susceptible to progressive macro-molecular degradation. This poses a significant – and, often, invisible – risk of asbestos fibre release.

Vinyl (floor tiles)

Following the Second World War, asbestos and vinyl (PVC¹) saw a concurrent surge in popularity due to their durability and low cost. This led to the widespread production of asbestos-containing vinyl floor tiles, which became a standard alternative to linoleum or hardwood in mid-century construction and renovations.

Plasticity loss

PVC is inherently rigid; during manufacture, plasticisers (chemical softening agents) are added, which give it its characteristic flexibility and resilience. Over several decades, these additives evaporate, 'off-gas'² or break down. The tiles lose their malleability and become rigid. This transition from a flexible polymer to a brittle one is the primary driver of macro-molecular degradation in vinyl floor tiles.

Cracking and UV damage

Once brittle, the material can no longer accommodate the physical stress of thermal expansion and contraction. Temperature and humidity fluctuations lead to cracking, particularly at stress concentration points such as corners and seams. Exposure to UV radiation further breaks down the polymer chains within the PVC, leading to surface deterioration and accelerated structural failure.

¹ polyvinyl chloride, the world's third-most widely produced synthetic plastic polymer

² the release or evaporation of volatile chemicals and vapours within materials like furniture, carpets or paints

Maintenance

When used as flooring, vinyl is uniquely vulnerable to chemical and mechanical wear. In high-traffic environments such as hospitals and schools, the frequent use of harsh cleaners (including ammonia and chlorine-based disinfectants) weakens the vinyl structure over time. Mechanical abrasion from rotary buffing machines directly degrades the surface, releasing asbestos fibres from the compromised vinyl matrix.

While vinyl is often categorised as a lower-risk material, the inevitable loss of plasticisers and the impact of aggressive maintenance regimes mean that older tiles are frequently in a far more degraded state than their appearance suggests. A tile that looks worn but intact may already be releasing fibres during routine use.

Bituminous material (compressed electrical panels)

Compressed electrical panels are constructed from asbestos fibres (sometimes combined with organic fibres) and a bituminous resin or coal tar pitch (CTP³).

Volatility and brittleness

Like vinyl, these panels are highly susceptible to degradation through off-gassing of volatile components. The CTP or bituminous resin contains a variety of hydrocarbons which evaporate over time. This process leaves a hardened, brittle product containing asbestos fibres, organic fibres and the non-volatile remnants of the original binder.

Flexible to fragile

When manufactured, these panels contained a high percentage of volatile hydrocarbons, which kept the binding tar ductile and flexible.

³ a heavy, tar-like substance derived from the distillation of coal

After decades of off-gassing, particularly in the warm, enclosed environments typical of electrical switchboards and service risers, the panels become prone to fractures and crumbling upon disturbance.

Compounding factors

Unlike roofing or flooring, electrical panels are often located in concealed or rarely accessed areas. This means they can degrade unobserved for extended periods. When panels are disturbed during maintenance or renovation, they may be far more fragile than expected, creating an acute risk of fibre release.

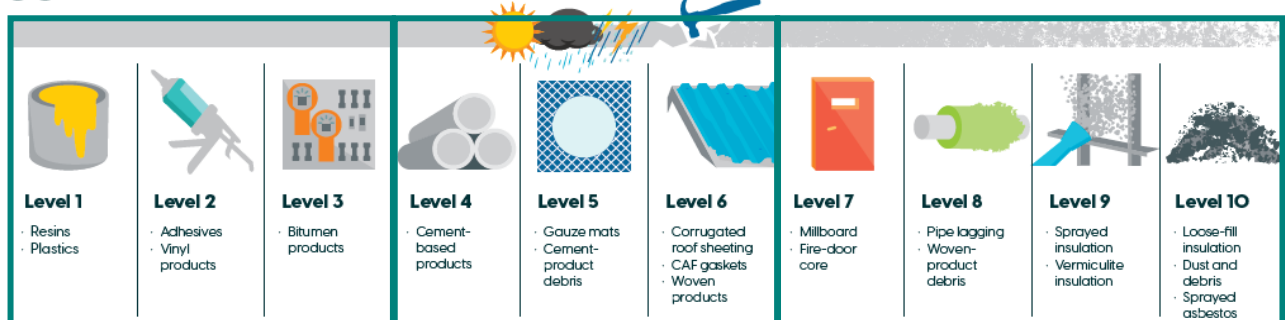
The practical consequence is that electrical panels which have remained undisturbed for decades should not be assumed to be in the same condition as when installed. Their matrix has been steadily depleting, and any physical interaction carries a heightened risk of fibre release.

Discussion

The binding matrix is what holds asbestos fibres in place. As it degrades, fibres loosen and, eventually, separate from the material entirely. Across all three product types examined, the same fundamental pattern emerges: the binder degrades progressively and inevitably through well-understood chemical and physical mechanisms, while the asbestos fibres remain ready for release once the matrix can no longer contain them.

Ease of fibre release

35%



Polymer matrices

Cementitious matrices

Low or no matrix

The VAEA's risk model includes an ease-of-fibre-release scale which reflects this understanding. It is a 10-point scale indicating a product's potential to release asbestos fibres into the atmosphere, replacing the binary friable/non-friable categorisation with a more granular and precise assessment.

The scale is divided into three sections based on matrix types:

- **polymer matrices** (for example, vinyl floor tiles, bituminous panels): degradation driven primarily by plasticiser or volatile loss
- **cementitious matrices** (for example, flat sheeting, moulded products): degradation driven by carbonation, leaching and environmental weathering. Notably, corrugated cement roofing is the only cementitious material categorised at Level 6, a tier otherwise consisting of low- and no-matrix materials, reflecting its unique susceptibility to accelerated degradation
- **low- or no-matrix products** (for example, loose-fill insulation, asbestos rope, millboard): high-percentage asbestos fibres with minimal binding agents, often combined with gypsum-based fillers. This lack of binding agent means they do not need to degrade to become dangerous; they are friable from the moment they are installed.

Conclusion

The evidence presented in this paper supports a clear conclusion: ACMs installed in Australian buildings are not stable, timeless products. Their matrices are degrading at the macro-molecular level through processes that are continuous, inevitable and largely invisible. Many products have passed the point at which visual inspection alone can reliably determine their condition or risk profile.

This has implications for risk assessments. Products that appear intact already may have undergone significant internal matrix loss due to chemical breakdown and degradation, making fibre release far more likely than their surface condition suggests.

Sources

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