Breathe Easy With Wool.

Wool carpets have been proven to clean indoor air.	2025

IWTO

International Wool Textile Organisation

Published by International Wool Textile Organisation

iwto.org

Breathe easy with wool.

Wool carpets have been proven to clean indoor air by scientists at AgResearch.

- We now spend up to 90% of our lives indoors[1] - at home, at work, at school. We are an indoor generation.
- The quality of the air we breathe has an impact on our wellbeing. Poor indoor air quality has been linked to discomfort, ill health and reduced productivity[2].
- Volatile organic compounds (VOCs) – indoor air pollutants released from interior products and household chemicals - pose a significant threat to our overall wellbeing.
- Wool naturally absorbs and neutralises common indoor air pollutants such as formaldehyde, nitrogen dioxide and sulphur dioxide, improving indoor air quality.
- Not only does wool neutralise these contaminants more quickly and completely than synthetic carpet fibres, wool does not re-emit them, even when heated (think underfloor heating) and may continue to purify the air for up to 30 years.
- Choosing thoughtful materials for interior design and furnishings is essential, and wool-based products such as carpets, textiles, insulation, bedding, acoustic surfaces, lighting and air filters present excellent solutions for the health conscious.

WHY DOES INDOOR AIR QUALITY MATTER?

The connection between the quality of indoor air, and human wellbeing is undisputed.

We spend up to 90 percent of our lives indoors; in our homes, our schools and our workplaces. More and more architects and designers consider indoor air quality as a factor in the products they specify. Companies and individuals have a responsibility to provide a healthy indoor environment for their teams and families.

Exposure to indoor air pollutants can have serious health consequences[2 3] , with vulnerable populations, such as children and the elderly, most at risk. Short-term exposure can lead to irritation of the eyes, nose and throat, headaches, dizziness and fatigue[4]. Long-term exposure, however, has been linked to more severe health issues, including respiratory problems, such as asthma, liver and kidney damage, and even an increased risk of cancer.

What causes indoor air pollution?

Many new products have a characteristic odour – that new building smell that comes with fresh paint, new carpet, etc. This odour is due to the release of Volatile Organic Compounds (VOC's).

Gases such as Volatile Organic Compounds (VOCs) or particles such as dust and microplastics (that can be mobilised and inhaled) in the air that are not adequately removed through ventilation are the primary causes of indoor air pollution.

VOCs – chemical elements that easily become vapours or gasses - such as formaldehyde can be a continuous source of indoor air pollution, released from many sources inside a building; from building materials and furnishings, to copy machines and printers, to cleaning agents and air fresheners[5].

Other VOCs such as nitrogen dioxide and sulphur dioxide are released as by-products of combustion processes (e.g., gas stoves and heaters). They can also migrate indoors from outside, where they are generated by industrial activities and transportation.

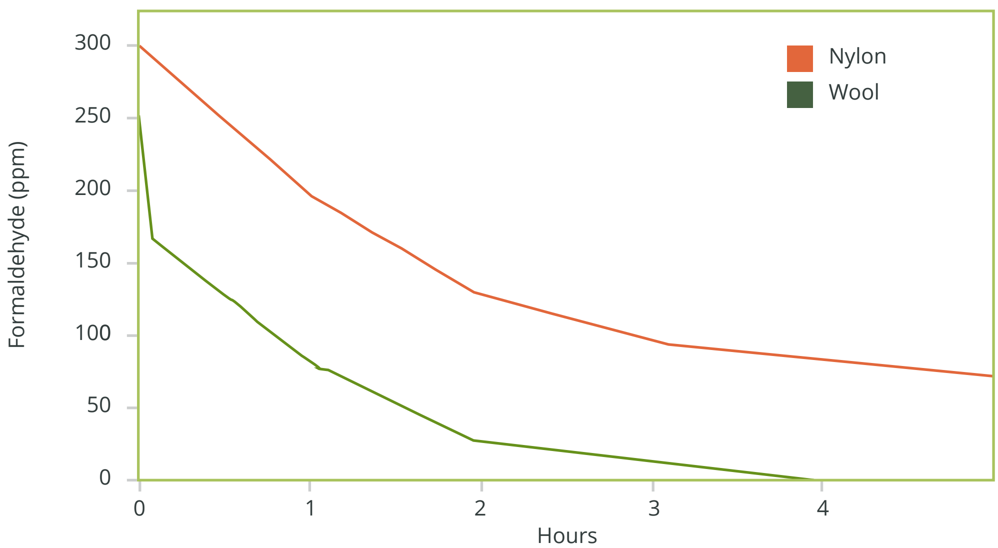
WOOL BINDS VOCS, PURIFYING THE AIR.

Wool is a complex natural fibre. It's diverse range of proteins and lipids give the fibre a unique set of chemical and physical properties, including an ability to absorb and bind a wide range of VOCs and indoor air pollutants.

These benefits of wool are part of the reason the use of wool is extending beyond carpet, upholstery, insulation and clothing, to bedding, acoustic surfaces, lighting and technical products such as air filters and face masks – a natural solution to the problem of accumulating pollutants. In New Zealand, AgResearch scientists studied the potential of wool carpets, fabrics and sheepskins to purify indoor air. They demonstrated that wool carpet can reduce high levels of introduced formaldehyde to virtually zero in 4 hours[6] even when heated, which would occur with underfloor heating. [7 8] Similar results were achieved with nitrogen dioxide, although the absorption rate was slower.

In contrast, nylon carpet had a much more limited ability to absorb these gases, a much slower rate of absorption, and was less able to reduce the final concentrations to the very low levels achieved by wool.

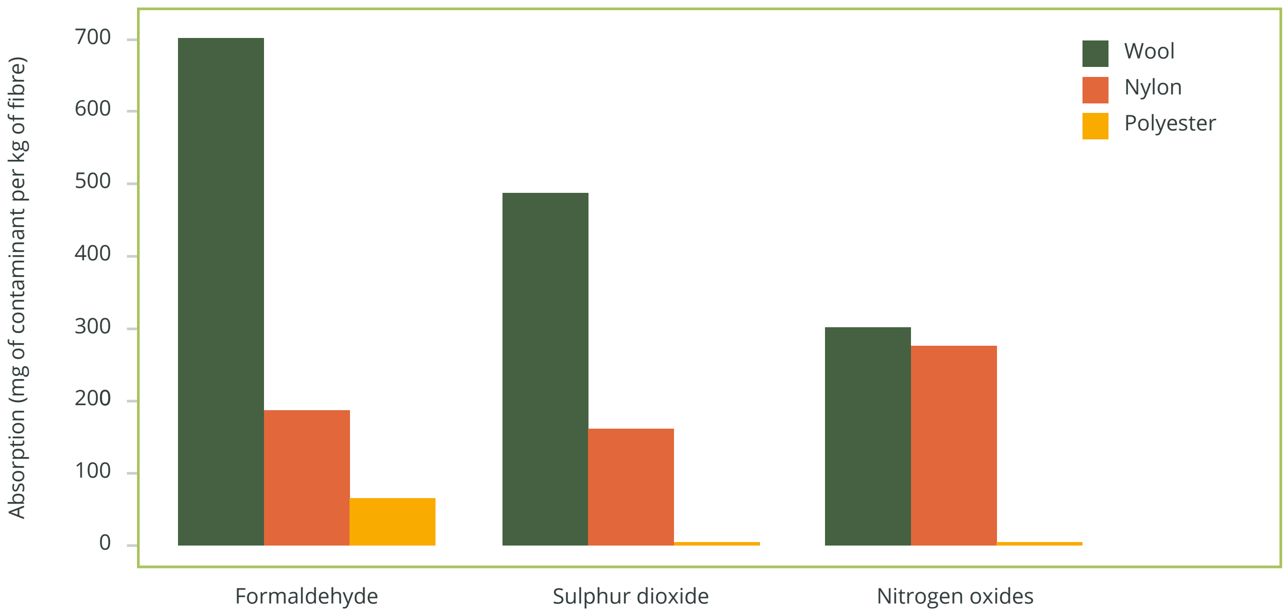
Formaldehyde remaining in a atmosphere after exposure to carpets.



Other studies have shown that large amounts of sulphur dioxide are also readily absorbed and securely bound by wool carpets[9] and in a study comparing 35 building and furnishing materials, wool carpets had one of the highest removal rates of nitrogen dioxide[10].

Wool carpets, because of their construction, present a much larger surface for gas absorption. One square metre of carpet containing 1 kg of wool in the pile represents a fibre surface of at least $100m^2$, whereas the same area of painted wall surface will still only provide about $1m^2$ for absorption.

Comparison of the absorption of indoor contaminants by carpet pile fibres.



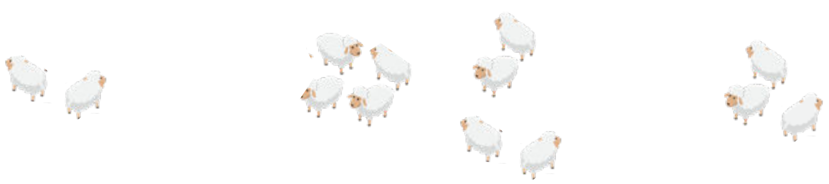
Most recently, the absorption by wool of these and a wide variety of other VOCs has also been demonstrated[11] for different types of wool and the fibre in different material formats,[12] including as powder.

RE-EMISSION AND LONG-TERM PERFORMANCE.

It has been shown that wool carpets that absorb VOCs do not re-emit them in time; formaldehyde irreversibly chemically bonds to proteins such as the keratin that makes up the wool fibre[13] and, under similar conditions, re-emission from wool carpet that had absorbed high levels of nitrogen oxides was negligible, while nylon carpet re-emitted it more readily. Wool carpets are likely to be able to purify indoor air for up to 30 years.

EFFECTIVE HUMIDITY MANAGEMENT.

Wool is also an effective humidity buffer, reducing the high indoor humidities which can give rise to condensation and mould growth. The moisture buffering behaviour of wool has also been demonstrated for wool building insulation in conditions typical of real world scenarios[14 15].



PARTICULATE AIR POLLUTION.

Dust, or other particulates that can be disturbed during life indoors are also a source of indoor air quality issues as they can contain allergens, pollens, moulds, etc that contribute to respiratory problems such as asthma, and allergies. Carpeting has a much-reduced propensity for particulate disturbance compared to hard flooring.

If the particles don't become airborne, they are less likely to cause health effects. Both wool and synthetic carpets act as sinks for particulate pollutants which can easily be removed by vacuuming[16].

MICROPLASTIC POLLUTION INDOORS.

Plastic has become fundamental for daily life however the tiny microplastic and nanoplastic particles that escape from commercial product development, use and care, and from the breakdown of plastic waste are permeating our atmosphere, soils, eco-systems and bodies.

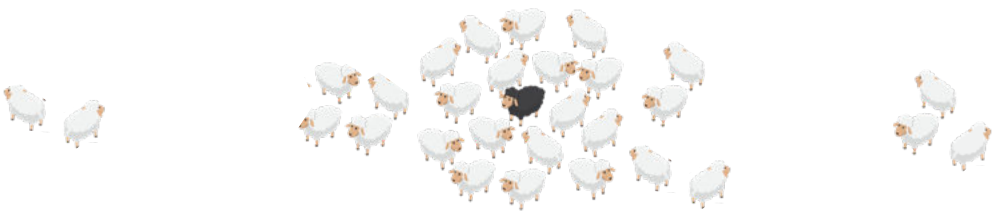
Microplastics have been found in human lungs[17], blood[18], placenta[19] and in breast milk[20] and the body of literature detailing the impact of microplastics and nanoplastics on human health is growing.

It has been estimated that the presence of a carpet in an indoor space can almost double the number of microplastics fibres in the home[21].

The majority of carpet companies are heavily promoting a shift to recycled plastics as a more environmental and sustainable solution, but are not yet considering the impacts of microplastics[22].

Further work is required to fully understand the connection between interior products composed of different fibre types, microplastics that may be released during use, particle size and potential health impacts. However, research has shown that wool particulates are broken down in the lung by biological processes, so are unlikely to persist and cause adverse health effects[23].

The situation for synthetic fibres is unknown, but they are known to be much less susceptible to decomposition.



Sources

1. Klepis, N.E., Nelson, W.C., Ott, W., Robinson, J.P. The national Human Activity Pattern Survey (NHAPS): A resource for assessing exposure to environmental pollutants. Journal of Exposure Analysis and Environmental Epidemiology, 2001. 11(3): 231-52.
2. Brooks, B.O., Understanding Indoor Air Quality. 1991: Taylor & Francis (Chapter 1, pp 10-11).
3. Viegi G., Simoni M., Scognamiglio A., Baldacci S., Pistelli F., Carrozzi L., Annesi-Maesano I. Indoor air pollution and airway disease (2004) International Journal of Tuberculosis and Lung Disease, 8 (12), pp. 1401 – 1415.
4. Introduction to Indoor Air Quality, 2024. www.epa.gov/indoor-air-quality-iaq.
5. United States Environmental Protection Agency, 2024. www.epa.gov/indoor-air-quality-iaq
6. Causer, S.M.M., R. C.; Bryson, W. G., The Role of Wool Carpets in Controlling Indoor Air Pollution, in 9th International Wool Textile Research Conference. 1995: Biella, Italy. p. 155-161.
7. Causer, S.M. and R.C. McMillan, Control of indoor air pollution with wool carpeting. Australasian Textiles, 1994. 14(3): p. 48.
8. Ingham, P.E., The Role of Wool Carpets in Controlling Indoor Air Pollution, in TIFCON. 1994, The Textile Institute: Blackpool, UK.
9. Walsh, M., et al., Sorption of SO2 by typical indoor surfaces including wool carpets, wallpaper and paint. Atmospheric Environment, 1977. 11(11): p. 1107-1111
10. Spicer, C.W., et al., Rates and mechanisms of NO2 removal from indoor air by residential materials. Environment International, 1989. 15(1-6): p. 643-654.
11. Mansour, E., Curling, S., Stéphan, A., Ormondroyd, G., Absorption of volatile organic compounds by different wool types. Green Materials. 2016. 4(1): p. 1-7.
12. McNeil S.J., Zaitseva L.I. The development of wool-based passive filters to improve indoor air quality (2016) Key Engineering Materials, 671, pp. 219 - 224 DOI: 10.4028/www.scientific.net/KEM.671.219
13. Maclaren, J. A., Milligan, B. (1981). Wool Science: The Chemical Reactivity of the Wool Fibre. Australia: Science Press.
14. Romano, A., et al., Dynamic behaviour of bio-based and recycled materials for indoor environmental comfort. Construction and Building Materials, 2019. 211: p. 730-743.
15. Tucker, S., E. Latif, and D.C. Wijeyesekera, An experimental study of moisture buffering of bio-insulations in lofts. Structural Survey, 2014. 32(5): p. 434-448.
16. Klingenberger. J, and Elixmann J.H. 1990. Distribution of dust mites in home textiles in German households. Proceedings of the 8th International Wool Textile Research Conference, Volume IV, 1990 Feb 7-14, Christchurch, New Zealand, Wool Research Organisation of New Zealand, Christchurch, New Zealand, P 635 - 42.
17. Jenner, L.C., et al., Detection of microplastics in human lung tissue using μFTIR spectroscopy. Science of The Total Environment, 2022. 831: p. 154907.
18. Leslie, H.A., et al., Discovery and quantification of plastic particle pollution in human blood. Environment International, 2022. 163: p. 107199.
19. Ragusa, A., et al., Plasticenta: First evidence of microplastics in human placenta. Environ Int, 2021. 146: p. 106274.
20. Ragusa, A., et al., Raman Microspectroscopy Detection and Characterisation of Microplastics in Human Breastmilk. Polymers, 2022. 14(13): p. 2700.
21. N Soltani, M Taylor & S Wilson, Quantification and exposure assessment of microplastics in Australian indoor house dust (Environmental Pollution, v 283, 2021).
22. https://www.port.ac.uk/news-events-and-blogs/news/new-report-highlights-need-for-carpet-industry-to-roll-out-microplastic-guidance
23. V Schmitz, K Schäfer, H Höcker (1999), Characterization of airborne dusts generated in the wool processing industry – biostability of wool. Melliand English, 10, E212-E213