Removal of indoor air contaminants by wool carpet

- Polluted indoor air can lead to discomfort, reduced efficiency and even ill health amongst employees and residents in modern buildings.
- Wool carpet has been shown to rapidly neutralize formaldehyde, nitrogen dioxide and sulphur dioxide, common contaminants in today's indoor environment.
- Not only does wool neutralize these contaminants more quickly and completely than synthetic carpet fibers, it does not re-emit them, even when heated.
- Wool carpet may continue purifying the air for up to 30 years.

Research by Canesis (recently merged with leading New Zealand research institute - AgResearch) scientists has revealed that wool carpets play a significant role in reducing the levels of common indoor air contaminants in buildings.

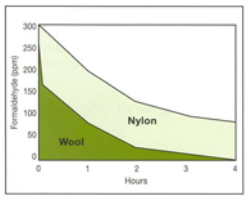
Indoor air pollution is seen as the primary cause of Sick Building Syndrome (SBS), resulting in reduced efficiency and increased instances of ill health amongst employees and other building occupants. The issue of indoor air quality is receiving increasing attention as a public health concern because people spend a much higher proportion of their time indoors. The problem is exacerbated by the tendency for modern buildings to have air conditioning, which requires a semi-sealed environment to operate efficiently. This, in effect, traps the pollutants inside.

Common air pollutants associated with health hazards include formaldehyde, nitrogen dioxide and sulphur dioxide. Formaldehyde can be introduced by emissions from certain building materials and furniture; nitrogen dioxide and sulphur dioxide are by-products of combustion processes (eg, gas stoves and heaters).

Formaldehyde and Nitrogen Dioxide

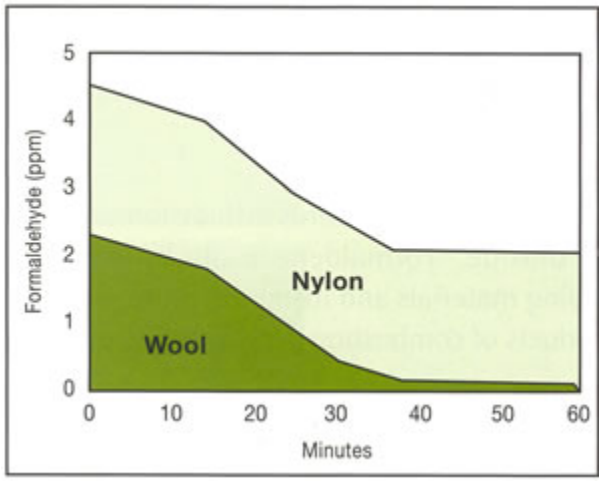
An experimental chamber has been used at AgResearch to compare the influence of wool and nylon carpets in purifying air contaminated with formaldehyde and nitrogen dioxide [1, 2].

Wool carpet was found to reduce high levels (300 parts per million) of introduced formaldehyde to virtually zero in four hours, whereas absorption was slower and less complete with nylon carpets.



Formaldehyde remaining in the atmosphere after 4 hours exposure to carpets.

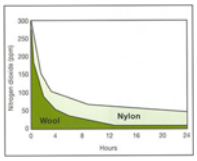
Nitrogen dioxide introduced at the same level was also almost completely absorbed by the wool carpet, although a little more slowly than was found for formaldehyde.



Formaldehyde remaining in the atmosphere after 1 hour exposure of carpets to very low levels.

When formaldehyde was introduced at only 5 parts per million, it was reduced to near zero in 30 minutes by wool carpet, whereas even after an hour, the nylon carpet had only absorbed just over 50%. In addition, the wool carpet absorbed the formaldehyde more rapidly, so that the gas level in the chamber peaked at just over half of that reached with the nylon carpet.

Hanks of wool carpet yarn suspended in the chamber for 24 hours, reduced levels of nitrogen dioxide from 300 to 5 parts per million, while nylon yarn reduced them to 60. The wool yarn also absorbed the gas appreciably faster, especially in the first 30 minutes, which suggests that wool carpet may provide an effective means for ameliorating sudden increases in levels of indoor contaminants.

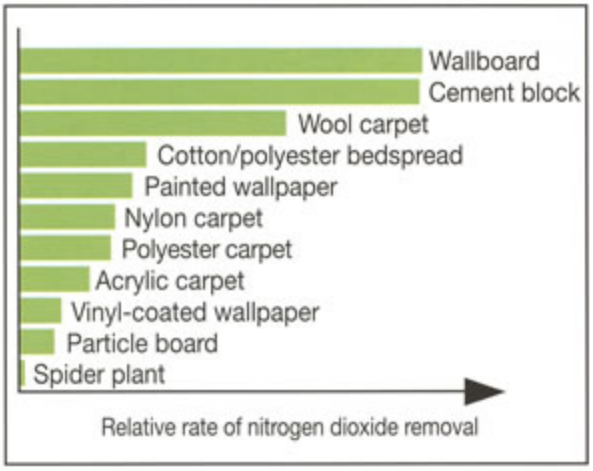


Nitrogen dioxide remaining in the atmosphere after 24 hours exposure to carpet yarns.

The importance of wool pile in both increasing and hastening the absorption of indoor air contaminants was also suggested by experiments exposing just the jute secondary backing from the carpets to 300 parts per million nitrogen dioxide. Although the backing was able to absorb significant amounts, after 24 hours there was still three times more gas in the chamber than there had been with the wool carpet under similar conditions.

When wool carpets that had been used to absorb formaldehyde were laid on the floor of the test chamber, they did not re-emit the pollutant, even when placed on an under floor heating pad. Under similar conditions, re-emission from wool carpet that had absorbed high levels of nitrogen dioxide was negligible. In contrast, nylon carpet, which absorbed nitrogen dioxide to a lesser extent, also re-emitted it more readily.

Studies by the US Gas Research Institute [3], comparing 35 building and furnishing materials, showed that wool carpets have one of the highest removal rates of nitrogen dioxide. In contrast, the removal rate of synthetic fiber carpets was less than half that of wool.



Comparative rate of nitrogen dioxide removed by selected interior furnishings (Data Source: US Gas Research Institute Survey [3]).

Although wallboard and cement blocks had higher removal rates, wool carpets, because of their construction, present a much larger surface for gas absorption. For example, 1 m^2 of carpet containing 1 kg of wool in the pile actually represents a fiber surface of at least 100 m^2, whereas the same area of painted wall surface will still only provide about 1 m^2 for absorption.

Sulphur Dioxide

Similar studies by the Environmental and Medical Sciences Division of the UK Atomic Energy Research Establishment have shown that large amounts of sulphur dioxide are also irreversibly absorbed by wool carpets [4]. They concluded that sulphur dioxide levels inside buildings are reduced by sorption on interior surfaces, and that the most effective absorbing materials are natural and regenerated products such as cellulosic wallpaper, cotton and rayon furnishing fabrics and wool carpets.

Radio labeling of sulphur dioxide showed that after absorption the majority of the sulphur dioxide was present in the pile. This was particularly apparent in foam-backed carpets,

with just traces being found in the upper surface of the backing, compared to more even penetration in hessian backing.

Benefits of Wool Carpet

It has been estimated that wool carpets may continue purifying indoor air for up to 30 years. This is especially true for nitrogen and sulphur dioxide because of the high acid-combining potential of wool. Formaldehyde is also known to react irreversibly with wool.

With their considerable capacity for absorbing and retaining formaldehyde, nitrogen dioxide and sulphur dioxide, wool carpets provide natural means of improving and maintaining indoor air quality. This may, in turn, be reflected in the improved health and comfort of those living and working indoors, and has wider implications for the control of Sick Building Syndrome.

References

1. S M Causer. Absorption of Nitrogen Dioxide by Carpets. WRONZ Report R204, 1993.
2. S M Causer, R C McMillan and W G Bryson. The role of wool carpets in controlling indoor air pollution. Proceedings of the 9th International Wool Textile Research Conference, Biella, Italy, 1995.
3. C W Spicer, R W Coutant, G F Ward, D W Joseph, A J Gaynor and I H Billick. Rates and mechanisms of NO2 removal from indoor air by residential materials. Environment International, 1989, 15, 643 - 654.
4. M Walsh, A Black, A Morgan and G H Crawshaw. Sorption of SO2 by typical indoor surfaces including wool carpets, wallpaper and paint. Atmospheric Environment, 1977, 11, 1107 - 1111.