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The Removal of Indoor Air Contaminants by Wool Textiles

Steve McNeil

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- Indoor air pollutants can lead to discomfort, reduced productivity of employees and even ill health.
- Research by AgResearch scientists has revealed that wool carpets significantly improve indoor air quality by rapidly absorbing the common pollutants formaldehyde, sulphur dioxide and nitrogen oxides.
- Not only does wool neutralise these contaminants more quickly and completely than synthetic carpet fibres, wool does not re-emit them, even when heated. Wool carpet may continue purifying the air for up to 30 years.

Introduction

Indoor air pollution is the primary cause of Sick Building Syndrome and the associated discomfort, ill health, and reduced productivity [1]. Indoor air quality is a public health concern that is receiving increasing attention, in part, because people are spending a higher proportion of their time indoors. The problem is exacerbated by the tendency for new buildings to have air conditioning, which requires a semi-sealed environment to operate efficiently. This, in effect, traps the pollutants inside. Common indoor air pollutants associated with health hazards include formaldehyde, sulphur dioxide, and various oxides of nitrogen. Formaldehyde can be introduced to indoor air by emissions from certain building materials and furniture, while sulphur and nitrogen oxides are by-products of combustion processes (e.g. gas stoves and heaters).

Wool is composed of a diverse range of proteins and lipids [2,3], which impart a unique set of chemical and physical properties, including an ability to absorb indoor air pollutants. In addition to the established use of wool in carpet, clothing and upholstery, the properties of wool mean that it is increasingly being utilised in technical products such as wool-based oil spill containment materials, filters for waste-streams containing heavy metals and air filters [4-6].

Absorption of air contaminants by wool

AgResearch and its predecessors the Wool Research Organisation of New Zealand (WRONZ) and Canesis have studied the potential of wool carpets, fabrics, and sheepskins to purify indoor air using specialised equipment and procedures [7]. This information has been used by textile companies and grower organisations to support their promotional and product development strategies.

A comparison of different fibres is given in Figure 1 showing that wool has better absorption than nylon, and that polyester has the least absorption. Wool carpet was found to reduce high levels (300 parts per million) of formaldehyde to virtually zero in four hours, whereas absorption was slower and less complete

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with nylon carpet, Figure 2. A low level of formaldehyde (5 parts per million) was reduced to near zero in 30 minutes by wool carpet, whereas even after an hour, nylon carpet had absorbed only 50%.

In a typical experiment, hanks of wool carpet yarn suspended in a test chamber for 24 hours reduced the level of nitrogen oxides from 300 to 5 parts per million, while nylon yarn only reduced it to 60 parts per million. The wool yarn also absorbed the gases appreciably faster, especially in the first 30 minutes, suggesting wool carpet may provide an effective means for ameliorating sudden increases in levels of indoor contaminants. 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 [8].

Figure 1. Comparison of the absorption of indoor air contaminants by carpet pile fibres.

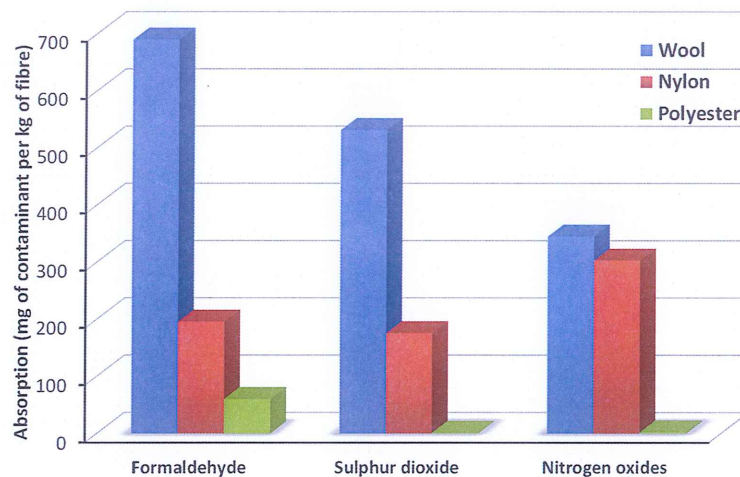
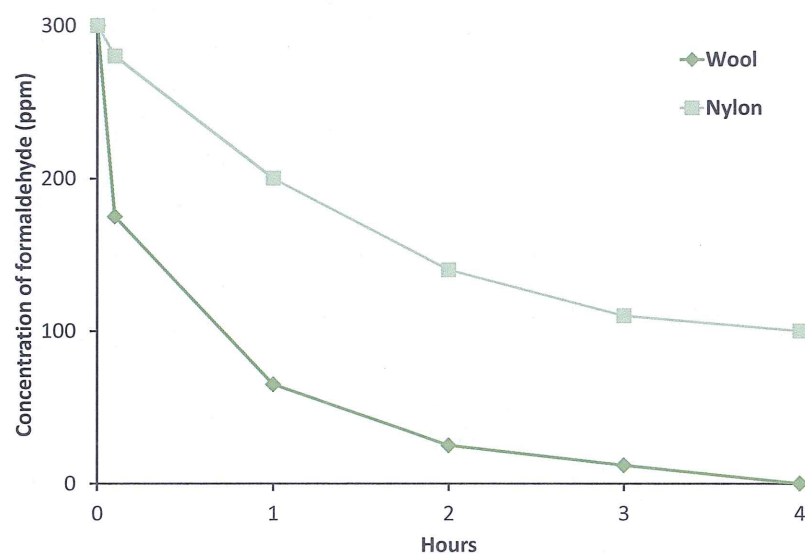


Figure 2. Formaldehyde absorption by different carpets.



Re-emission and long-term performance

Wool carpets that had absorbed formaldehyde did not re-emit the formaldehyde, even when heated. Under similar conditions, re-emission from wool carpet that had absorbed high levels of nitrogen oxides was also 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. This is particularly the case for acidic gases (sulphur dioxide and nitrogen oxides) because of the high acid-combining potential of wool [8].

Benefits of wool in the built environment

Combining an ability to actively buffer moisture changes in the indoor environment [6], with a considerable capacity for absorbing and retaining indoor air pollutants, wool carpets provide a 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.

Other important benefits of wool carpets are that they have greater resistance to burning than most other types of carpet [6,9] and they are biodegradable [10]. Wool carpets also have other benefits which are common to all types of carpet including; excellent acoustic properties [11], maintenance requirements that have a low environmental impact [12], excellent thermal insulation [13] and reducing the frequency and severity of falls [13-15].

Apart from being used in carpets and upholstery, wool is increasing finding other uses in buildings, including insulation for walls and ceilings [6, 16], and bedding [17], providing more opportunities to improve indoor air quality. Recently, the concept of artistic wool passive absorbers has been proposed, and some very attractive prototypes have been made [18,19].

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