# Particle emissions from bushfires extending into the rural-urban interface

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Bushfires extending into the rural urban interface (RUI) have become more common, particularly in Southern Australia, California and southern Europe and have resulted in losses of life and properties. Climate change is predicted to increase both fire severity and fire season duration while a forecasted population growth in the RUI will expose more residents and homes to an increased bushfire risk.

Bushfires can release substantial quantities of particulate matter into the air environments of communities, both nearby and distant. When bushfires extend into the RUI, vegetation fuels but also structural fuels will burn and release additional chemicals into the air which may cause an increased health risk. Currently information on the composition of emissions and smoke plumes from fires at the RUI is scarce.

In order to assess the particle emissions from fires in the RUI, small-scale fire tests using a cone calorimeter were conducted on 11 selected building and furnishing materials. Samples were collected for analysis of gravimetric mass, organic (OC) and elemental (EC) carbon and polycyclic aromatic hydrocarbons (PAHs) along with continuous measurements of CO, $CO_2$ and fine particles ($PM_{2.5}$).

The time series analysis of $PM_{2.5}$ showed highest emissions during combustion of polyester insulation and a wool/nylon carpet. Maximum $PM_{2.5}$ concentrations were approximately 5-8 times higher than those measured during combustion of pine. Among wood-based products, combustion of medium-density fibreboard (MDF) resulted in highest peak $PM_{2.5}$ concentrations.

Emission yields expressed as mass of compound generated per mass of material combusted were calculated for CO, $CO_2$, $PM_{2.5}$, EC, OC and PAHs. Highest emission yields of $PM_{2.5}$ were measured for polyester and polystyrene, both materials emitting about 20 times more particles compared to wood. Wood-based products had the lowest $PM_{2.5}$ yields.

Wood-based materials had the lowest carbon emission yields while polyester, carpet and polystyrene had the highest carbon emission yields (approximately 10 times higher). In general there was a larger fraction of EC compared to OC, with the exception of plasterboard and polystyrene where we observed a significant OC fraction (70-98%). The presence of glues and resins in manufactured wood products also increased the organic fraction of particles.

Highest PAH yields were observed for polyester, followed by polystyrene and carpet. The wood-based products had the lowest PAH yields (Figure 1). Naphthalene made up the majority of the total PAH yields (37-90%). Other PAHs with significant contributions included phenanthrene, fluoranthene and pyrene. Benzo(a)pyrene, a known human carcinogen contributed between 0.6 and 4.2% to the total PAH yields, with the highest contribution from the combustion of polyester.

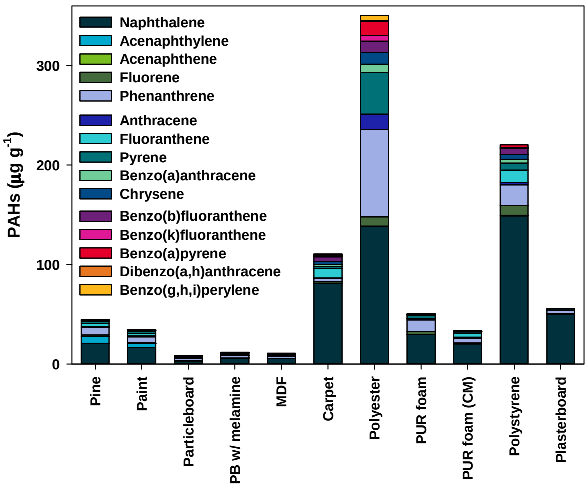


Figure 1. Distribution of individual PAHs emitted during combustion of selected materials

The study revealed that among the 11 materials that were tested, the most pollution resulted from the combustion of a wool/nylon carpet and polyester insulation. These materials ranked high in emissions of CO, particles, EC, OC and PAHs. However, as wood-based products make up the majority of mass in structures, the emissions from those materials may contribute more significantly to total emissions and hence to exposures. The emissions characterized in the small-scale fire tests will serve as input into a high time-resolution dispersion model that will enable to determine short-term modelled ground concentrations and provide an estimate of potentially hazardous exposures.

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