PARTICLE EMISSIONS FROM BUSHFIRES EXTENDING INTO THE RURAL-URBAN INTERFACE

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BACKGROUND

Bushfires can release substantial quantities of particles into the air environments of communities, both nearby and distant. When bushfires extend into the rural-urban interface, the fuel type will change. In addition to vegetation, combustible materials from house structures, house contents, vehicles, sheds and other objects around a house will burn and release additional toxic chemicals into the air which may cause an increased health risk.

SMALL-SCALE FIRE TESTS

Small-scale fire tests have been conducted on 11 selected building and furnishing materials under well-ventilated conditions at two irradiance levels (25 and 50 kW m^{-2}) (Figure 1). The aim was to assess particle emissions and composition. 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 ($PM_{2.5}$).

Figure 1. Cone calorimeter experimental setup

MAJOR FINDINGS

- Polymeric materials emitted more particles (9-20 fold) than wood-based materials (Figure 2).
- Most of the particle mass (>70%) was carbonaceous, with a larger fraction of EC, except for combustion of plasterboard and polystyrene (PS). The presence of glues and resins in manufactured wood products also increased the organic fraction of particles.
- PAH emissions were only measured at the higher irradiance level, with highest yields measured for polyester, PS and carpet and lowest yields for wood-based products (Figure 3).
  - Naphthalene, a possible human carcinogen, made up the majority of the total PAH yields (37-90%).
  - Benzo(a)pyrene, a known human carcinogen contributed 0.6 - 4.2% to the total PAH yields, with the highest contribution from the combustion of polyester insulation.

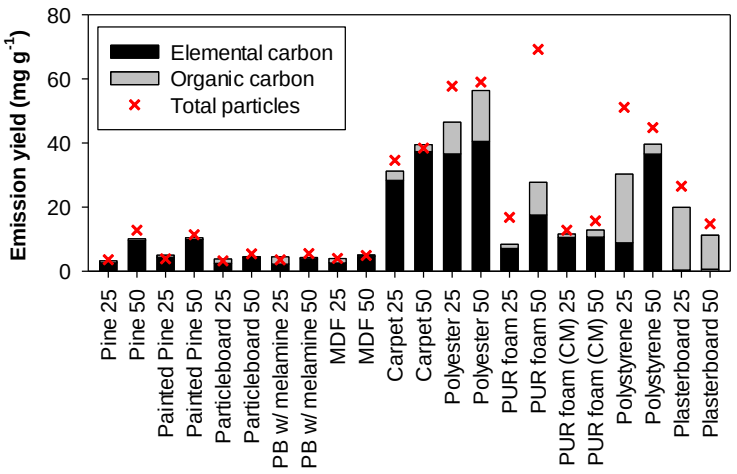

Figure 2. Emission yields of particles, EC and OC.

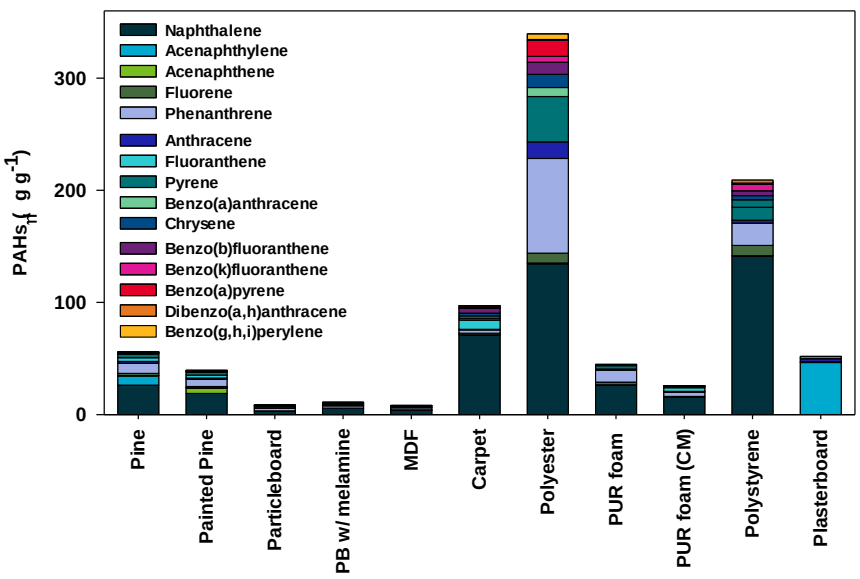

Figure 3. Emission yields of individual PAHs.

OUTCOMES

Among the 11 materials that were tested, combustion of a wool/nylon carpet and polyester insulation ranked highest in terms of emissions of CO, particles and PAHs. Previous studies have also shown high emissions of hydrogen cyanide, an asphyxiant gas, from the combustion of polyester, wool and nylon. Burning these materials may present an increased health risk.

However, wood-based products make up the majority of mass in structures, and therefore their emissions may contribute more significantly to total emissions and hence to exposures.

END USER STATEMENT

The research being undertaken into smoke toxins in the rural/urban interface sets a sound foundation for the future, helping to inform both firefighting practices and equipment. Once fire agencies have information about the actual exposures and their likely spread at rural/urban interface fires, agencies will be better placed to deploy people safely, as well as provide advice to the community, enabling them to better protect themselves from the hazards of smoke.

Robyn Pearce, Director Human Services, Tasmania Fire Service