P2-3 Emissions of black carbon in a road tunnel

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A sampling campaign was carried out in the Liberdade Avenue tunnel (Braga, Portugal) to monitor black carbon (eBC-equivalent black carbon) by means of an Aethalometer AE-31, and gaseous pollutants (CO2, CO, NOx). Traffic volume by vehicle category through the tunnel was counted manually. Simultaneous measurements were conducted in an urban background site in the vicinity. Inside the tunnel, the mean eBC mass concentration was 23±11 µg m-3, reaching a maximum hourly value of 50±8 µg m-3. Peak concentrations on weekdays occurred between 1400 and 1900 UTC, during the rush hours, when large numbers of people are travelling to or from work or school. However, on weekends, a peak between 1000 and 1200 UTC was observed, probably due to commuting to shopping and leisure activities. A mean Absorption Ångström Exponent (AAE470-950nm) value of 0.77±0.05 was obtained. Positive significant correlations were observed between eBC and the number of light vehicles ($r=0.47$; $p<0.001$) and between eBC and the gaseous emissions: CO ($r=0.67$; $p<0.001$), CO2 ($r=0.72$; $p<0.001$), NO ($r=0.65$; $p=0.007$) and NO2 ($r=0.73$; $p<0.001$). The contribution from fossil fuel (eBCff) and biomass burning (eBCbb) was estimated through the Aethalometer Model (Sandradewi et al., 2008). eBCff was 23.2±11.4 µg m-3 (about 99% of total eBC), while eBCbb was 0.2±0.5 µg m-3, showing a residual penetration of eBC into the tunnel from residential biomass combustion emissions in the city. The mean black carbon emission factors (EFBC) were estimated to be 0.34±0.08 g (kg fuel)-1 and 0.13±0.08 mg veh-1 km-1, which are higher than those derived in other studies for gasoline and diesel vehicles in road tunnels.

The study of black carbon in road tunnels contributes to better characterise emissions of this pollutant from traffic in real circulation conditions and without influence from other sources, providing information on BC emission factors, which are useful as input data to climate and air quality models, as well as to updated emission inventories.

Sandradewi et al., 2008. Using aerosol light abosrption measurements for the quantitative determination of wood burning and traffic emission contribution to particulate matter. Environ. Sci. Technol. 42, 3316–3323.