Occupational exposure assessment using miniaturized aerosol instruments in different workplace environments

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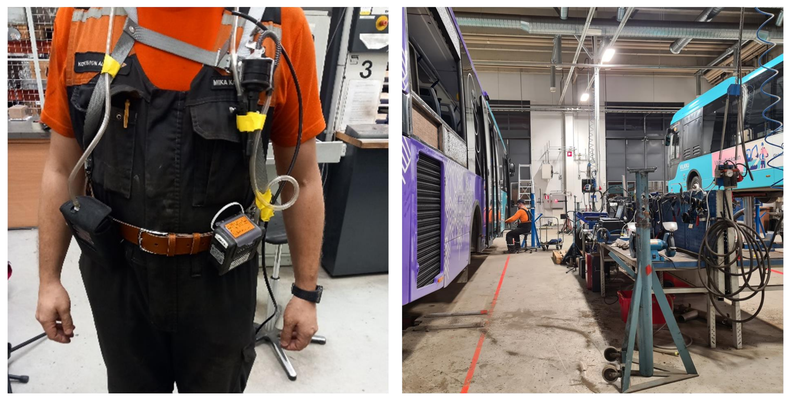

Figure 1. Measurements in inspection station

Introduction

- European Union (Directive 2004/37/EC) regulates occupational exposure to diesel exhaust and other carcinogenic compounds. However, in many sectors diesel exhaust exposure levels are not well quantified.
- In addition, a new information is needed regarding the use of new miniaturized measurement instruments to occupational exposure assessment

Materials and methods

- Occupational exposure of bus drivers, mechanics working in a bus depot, infrastructure construction workers, inspection station workers (Fig. 1) and street maintenance workers was measured, as well as ambient air quality in these workplaces
- Diesel exhaust exposure was measured as elemental carbon (EC; NIOSH5040) and as equivalent black carbon (eBC; MA200, Aethlabs, and AE33 and AE36s, Magee Scientific)
- Alveolar lung deposited surface area (LDSA) was measured using two instruments (Partector 2 Pro, Naneos and NSAM, TSI),
- Ångström exponent (AAE) values were calculated and source apportionment (e.g. Sandradewi et al. 2008) was performed using aethalometer data

Results and discussion

- Diesel exhaust exposure (Fig. 2a) was below the occupational exposure limits in all workplaces
- Source apportionment was used to separate different aerosol sources (example in Fig. 2b)

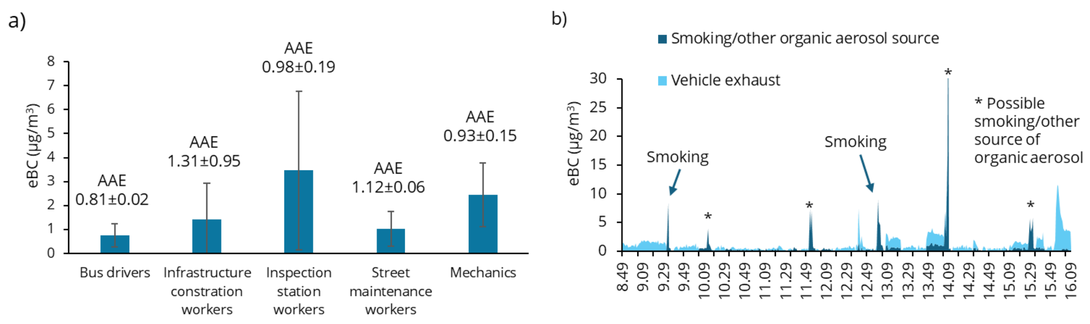

Figure 2. eBC exposure levels and AEE values of workers (a) and separation of eBC to vehicle exhaust and organic-rich aerosol source like tobacco smoke (b). Data in example (b) is from inspection station worker

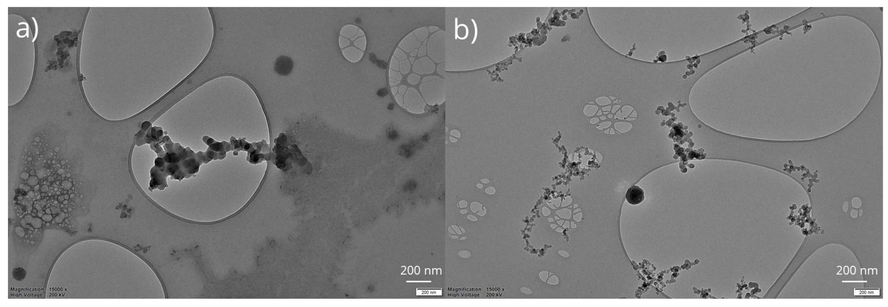

Figure 3. TEM images sampled from infrastructure constration site (a) and inspection station (b)

- AAE values (Fig. 2a) for bus drivers, inspection station workers and mechanics indicates that the source of carbonaceous aerosols is mainly traffic, whereas AAE values of infrastructure construction workers and street maintenance workers refers also to the presence of other light-absorbing aerosols or the organic coating on the surface of diesel soot particles
- TEM images showed also differences between the particles from different workplaces (Fig. 3a and b)
- LDSA and eBC were clearly connected in ambient air of inspection station, bus depot and infrastructure construction sites (Fig. 4a and b)
- Exposure to LDSA and eBC measured from inspection station workers, mechanics and infrastructure construction workers showed a good correlation (Fig. 4c), whereas no correlation was observed for bus drivers and street maintenance workers (Fig. 4d)

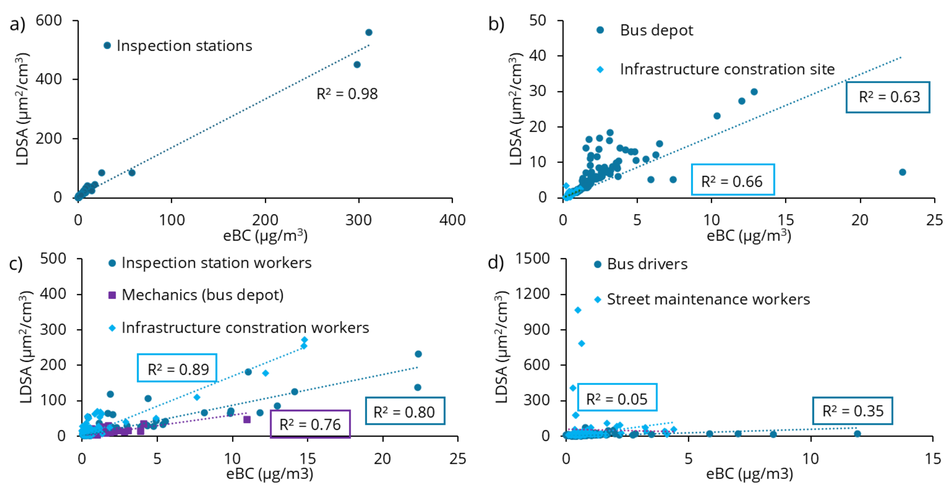

Figure 4. Comparison of eBC and LDSA: ambient air of inspection stations (a), ambient air of bus depot and infrastructure constration sites (b), inspection station workers, mechanics and infrastructure constration workers (c), and bus drivers and street maintenance workers (d)

Conclutions

- Portable aerosol instruments are useful for monitoring occupational exposure
- eBC has a remarkable contribution to LDSA in many studied occupational exposure environments
- AAE values indicates that fossil fuels were the main source of carbonaceous aerosols in many workplaces, but also the presence of other light-absorbing aerosols

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References:
Sandradewi et al. (2008) Environ. Sci. & Technol. 42 (9), 3316-3323

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