Particles in road and railroad tunnel air - properties, sources and abatement possibilities

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Particulate air pollution in road tunnels is often very high due to high emissions and restricted air exchange (e.g. Gëller *et al.*, 2005). Also subway and railroad sub-terranean environments have been shown to suffer from high particle concentrations (e.g. Gustafsson *et al.*, 2012). The particle sources differ substantially, though. Road traffic particles have both exhaust and non-exhaust sources such as tires, pavement and brakes, while non-exhaust sources totally dominate the rail road particle emissions (e.g. Abbasi *et al.*, 2011).

In an on-going research project, airborne particles in a railroad and a road tunnel are characterized regarding concentrations, size distributions and elemental composition in relation to traffic. The aim is to characterise and identify the main particle sources to be able to suggest abatement measures regarding material and system use as well as measures regarding traffic.

Particle properties were studied during campaigns on the platform of Arlanda Central station (railroad tunnel below Arlanda airport, Stockholm) and in the Söderledstunneln (road tunnel in central Stockholm). At Arlanda C, a new photo cell based system for detecting train arrivals, their deceleration and length was used (Figure 1).

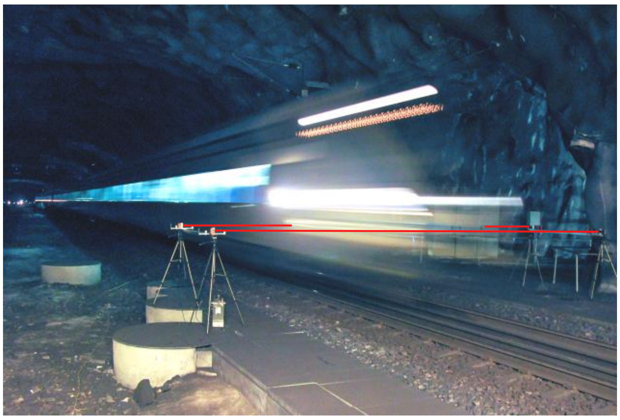

Figure 1. Train detection system at Arlanda Central (red beams illustrating infrared light).

From the measurements at Arlanda C it is clear that certain train types and/or train individuals affect mass and number concentration of particles very differently. While some trains do not seem to contribute to increased concentrations, others result in mass concentration increases and some also to obvious particle number concentration increases, without NO_x concentrations rising (no exhaust contribution) (Figure 2). Previous studies show that the main sources for railroad particles are wear of brakes, wheels and rail and are as such rather coarse (> 0.5 µm). The source(s) of the ultrafine mode (approx. 20 nm) contributing to high particle number are therefore of special interest.

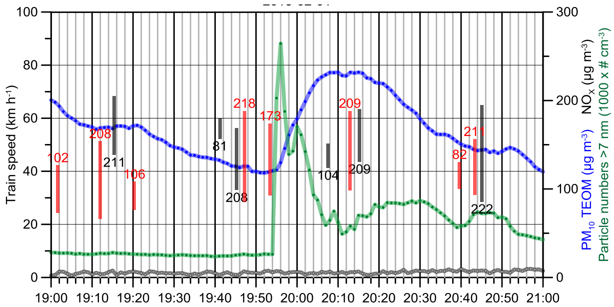

Figure 2. PM_{10} (blue), particle number (green), NO_x (grey), and trains (red = southbound, black = northbound) during two hours on 1st of February, 2013. Note the particle concentration response of the 173 m long train at 19:54.

In Janhäll *et al.* (these proceedings) data from the road tunnel study is presented. Further work will describe differences between road and railroad tunnel particle emissions, size resolved particle composition, source apportionment and abatement strategies.

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