PM chemical composition and oxidative potential at a traffic site and in a low emission zone in Milan (Northern Italy)

M.G. Perrone[1], J. Zhou[2], M. Malandrino[3], C. Rizzi[1], G. Sangiorgi[1], L. Ferrero[1], J. Dommen[2], E. Bolzacchini[1]

[1]Department of Earth and Environmental Sciences, University of Milano Bicocca, Milan, 20126, Italy
[2]Paul Scherrer Institut (PSI), Villigen, CH-5232, Switzerland
[3]Department of Chemistry, University of Turin, Turin, 10125, Italy

Keywords: traffic source, low emission zone, chemical composition, reactive oxygen species, health effects
Presenting author email: grazia.perrone@unimib.it

Traffic is the major primary source of PM in the urban area of Milan, Northern Italy (Perrone et al., 2012), and it affects the chemical composition of aerosol particles. The relation between PM chemical composition and various biological effects induced by particles has been investigated in previous studies (Perrone et al., 2013).
In this work we studied the effect of local traffic source on the chemical composition and the oxidative potential (OP) of PM. OP is a measure of the capacity of particles to induce oxidative damage and is considered to be a relevant metric related to adverse health effects induced by PM exposure (Nel, 2005)

PM (total suspended particles) was sampled in the urban area of Milan at two sites: a traffic site (TR, within the Campus of the University of Milano Bicocca) and a limited traffic site (within "Area C" low emission zone, LEZ). The sampling campaign was performed simultaneously at the two sites in October 2013 (1-15 October) during working days, from 8.00 a.m.-18.00 p.m, when traffic limitation inside the LEZ was implemented.

Figure 1. PM sampling at the traffic site (TR) and the limited traffic site (LEZ) in Milan.

The chemical composition of PM (collected on quartz fibre filters, 11.0 cm Ø) was anlaysed in detail including: the carbonaceous fraction (organic carbon, OC, and elemental carbon, EC), inorganic ions, elements, and trace organic compounds, including carboxylic acids, alkylamines, polycyclic aromatic hydrocarbons (PAHs) and alkanes. The OP of PM was assessed by two different chemical assays (a-cellular methods): the dithiothreitol (DTT) assay (which measures the consumption of DTT due to the ability of redox active compounds to transfer an electron from DTT to oxygen); the 2,7 dichlorofluorescein (DCFH) assay (a measure of equivalent H_2O_2 concentration of reactive oxygen species in the PM samples by oxidising DCFH to fluorescent DCF).

The impact of local traffic differed at the two sites (TR and LEZ), and concentrations were lower at the LEZ site for pollutants in PM, such as EC (-36%) and PAHs (-25%), which are directly related to traffic (Rizzi et al., 2015).

Same OP values were measured at the TR and LEZ site (OP-DTT at TR= 0.15 ± 0.02 μM DTT/min/m^3 air; OP-DTT at LEZ =0.15 ± 0.02 μM DTT/min/m^3 air), with daily OP values which varied (Figure 2) but were well correlated between the two sites (OP-DTT R^2=0.89). This could indicate that OP of PM in Milan is more closely associated to other non traffic-related pollutants and meteo variables.

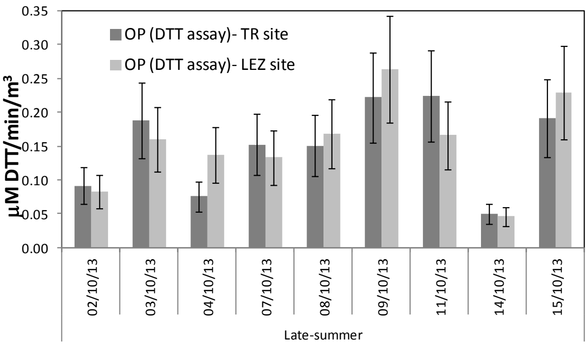

Figure 2. Daily OP values (OP-DTT) of PM sampled at the TR site and the LEZ site in Milan (1-15 Oct 2013).

The relation between PM chemical composition and the OP of PM as obtained from the two different measurement methods of OP was investigated analysing data from both sampling sites. OP-DTT were significantly correlated (Spearman rank correlation; $p<0.05$) with secondary PM components (sulphate and oxalic acid), as well as with global radiation and wind. For OP-DCFH, a significant correlation was observed with the concentration of PM total mass, OC, all major inorganic ions (sulphates, nitrates, ammonium), and relative humidity.

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