Oxidative potential of fine aerosols from a Portuguese urban-industrial area

N. Canha[1,*], C. Gamelas[1,2], S. Mendez[1], S.C. Verde[1], S.M. Almeida[1], A.R. Bartolomeo[3], M.R. Guascito[3,4], D. Contini[4]

[1] Centro de Ciências e Tecnologias Nucleares (C[2]TN), Instituto Superior Técnico, Universidade de Lisboa, Estrada Nacional 10, Km 139.7, 2695-066 Bobadela LRS, Portugal

[2] ESTSetúbal/IPS and CINEA, Polytechnic Institute of Setúbal, 2914-508 Setúbal, Portugal

[3] Department of Environmental and Biological Sciences and Technologies (DISTEBA), University of Salento, 73100 Lecce, Italy

[4] Institute of Atmospheric Sciences and Climate, ISAC-CNR, 73100 Lecce, Italy

* nunocanha@ctn.tecnico.ulisboa.pt

Oxidative potential (OP) of aerosols is considered as a highly relevant indicator to characterize the toxicity of particulate matter (PM), with recent studies associating OP measurements to adverse health effects. The dithiothreitol method (OP^{DTT}) has been widely used to assess OP of particles and it has been linked to airway inflammation markers, cellular oxidative stress markers, cellular cytotoxicity and cardiorespiratory health endpoints in epidemiological studies. These results support OP as a highly health relevant air quality parameter. However, specific chemical species, aerosol sources and processes that affect the OP of PM are still not well established. Currently, no studies are available for Portugal.

Fine aerosols (PM2.5) were sampled during one year (Dec 2019-Nov 2020, total of 128 sampling days) in an urban-industrial area of the Metropolitan Area of Lisbon (Seixal, Portugal) and their chemical composition was assessed to perform a source apportionment study using Positive Matrix Factorisation. A total of 7 different sources were identified: soil, secondary sulphate, fuel-oil combustion, sea, vehicle non-exhaust, vehicle exhaust and industry. Thirty samples were chosen considering the highest load for each source (both massic or %), which could eventually allow to understand the impact of each source regarding its associated OP, assessed by the dithiothreitol (DTT) method. The final DTT activity of samples was normalised in terms of sampled air volume and in terms of collected aerosol mass.

Samples presented mean levels of DDT activity (normalized to the mass) of 11.9 ± 6.8 pmol/min*µg, ranging from 2.6 to 26.1 pmol/min*µg. The DDT activity (normalized to the sampled volume) showed to have an association with the PM2.5 levels, as shown by Figure 1.

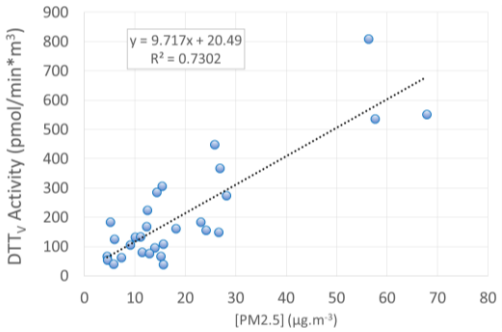

Figure 1. Correlation between PM2.5 concentrations and their DTTv activity.

Considering that the contribution in mass of the different sources was known to the PM2.5 levels, Spearman correlations were conducted and it was found significant correlations between DTTv and two different sources: vehicle exhaust (R2= 0.651, p-value = 0.001) and fuel-oil combustion (R2 = 0.510, p-value = 0.016). Future work will assess the OP of the remaining samples to evaluate the contribution of the different sources for the OP of fine aerosols in the study area.

Acknowledgements

This work was supported by the Portuguese Foundation for Science and Technology (FCT, Portugal) through the project HypnosAir (PTDC/CTA-AMB/3263/2021), the contract 2021.00088.CEECIND (N. Canha) and the financial support to C2TN/IST (UIDB/04349/2020+UIDP/04349/2020). The COST Action CA17136 – Indoor Air Pollution Network is also acknowledged for supporting the Short Term Scientific Mission of N. Canha at DISTEBA (Lecce, Italy).

Keywords: fine aerosols; oxidative potential; urban areas; source apportionment; air pollution