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Assessment of Diesel Exhaust Particulate Exposure and Surface Characteristics in Association with Levels of Oxidative Stress Biomarkers

Exposure to PM_{10} and $PM_{2.5}$ (particulate matter with aerodynamic diameter smaller than 10 μm and 2.5 μm, respectively) is associated with a range of adverse health effects, including cancer, pulmonary and cardiovascular diseases. Surface characteristics (chemical reactivity, surface area) are considered of prime importance to understand the mechanisms which lead to harmful effects. A hypothetical mechanism to explain these adverse effects is the ability of components (organics, metal ions) adsorbed on these particles to generate Reactive Oxygen Species (ROS), and thereby to cause oxidative stress in biological systems (Donaldson et al., 2003). ROS can attack almost any cellular structure, like DNA or cellular membrane, leading to the formation of a wide variety of degradation products which can be used as a biomarker of oxidative stress.
The aim of the present research project is to test whether there is a correlation between the exposure to Diesel Exhaust Particulate (DEP) and the oxidative stress status. For that purpose, a survey has been conducted in real occupational situations where workers were exposed to DEP (bus depots).

Different exposure variables have been considered:
- particulate number, size distribution and surface area (SMPS);
- particulate mass - $PM_{2.5}$ and PM_4 (gravimetry);
- elemental and organic carbon (coulometry);
- total adsorbed heavy metals - iron, copper, manganese (atomic adsorption);
- surface functional groups present on aerosols (Knudsen flow reactor).

Several biomarkers of oxidative stress (8-hydroxy-2'-deoxyguanosine and several aldehydes) have been determined either in urine or serum of volunteers.
Results obtained during the sampling campaign in several bus depots indicated that the occupational exposure to particulates in these places was rather low (40-50 μg/m^3 for PM_4). Bimodal size distributions were generally observed (5 μm and <1 μm). Surface characteristics of PM_4 varied strongly, depending on the bus depot. They were usually characterized by high carbonyl and low acidic sites content.
Among the different biomarkers which have been analyzed within the framework of this study, mean urinary levels of 8-hydroxy-2'-deoxyguanosine increased significantly ($p<0.05$) during two consecutive days of exposure for non-smoker workers. On the other hand, no statistically significant differences were observed for serum levels of hexanal, nonanal and 4-hydroxy-nonenal ($p>0.05$).
Biomarkers levels will be compared to exposure variables to gain a better understanding of the relation between the particulate characteristics and the formation of ROS by-products.
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