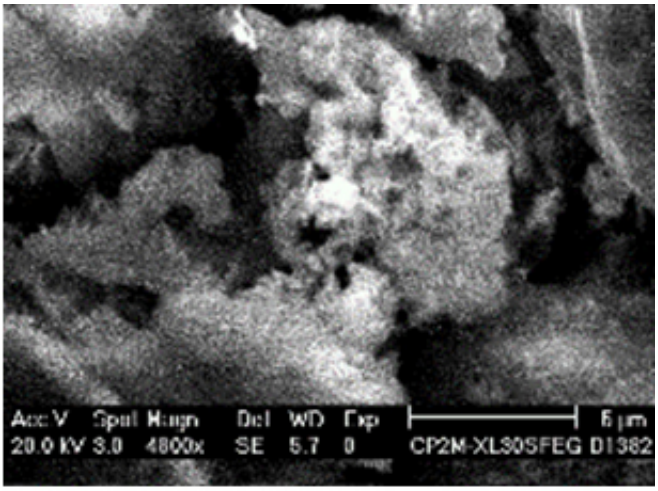
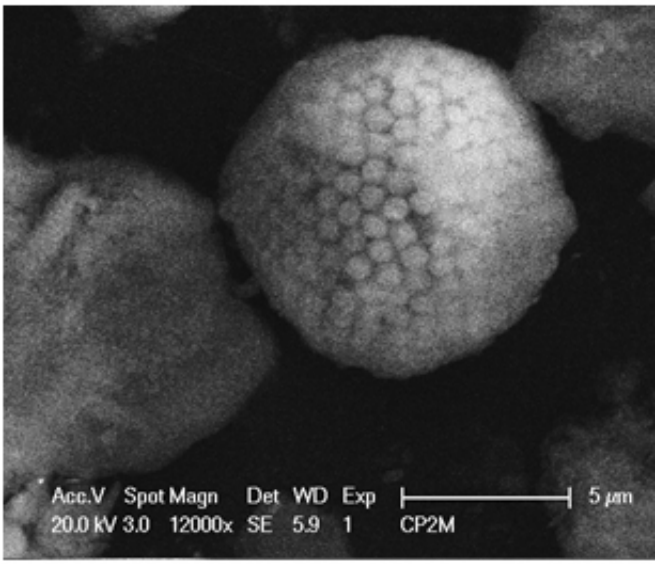
Assessment of the influence of traffic-related particles in dust

Dust particles present in our daily lives consist of a mixture of materials from different sources, such as soils, traffic-related particles, pavement particles, etc. Due to their low particle size, dust particles can be easily re-suspended and greatly contribute to the atmospheric pollution of big cities. These particles have tendency to act as carriers of metals and carcinogenic components, which can result from the vehicle/brake wear.

There are significant gaps of knowledge on the potential adverse effects caused by the exposure and subsequent absorption of such metal particles or compounds through the main routes (oral—ingestion, dermal—skin contact and/or inhalation) on human health. In general, previous studies identified oral ingestion as the most critical exposure route to coarse dust particles for humans, compared with inhalation and skin contact.



Cu rich particle (> 50%) in dust



Fe-S spherical particle in dust

Fig.1.

Oral bioaccessibility is defined as the fraction of a soil/dust contaminant that is solubilized, if ingested, by the digestive fluids. Generally, only a small fraction of the metals released from these dust particles are bioavailable (the fraction that reaches the blood compartment), which greatly depends on the type of these metals, the size and form of particles, and the environmental conditions. Evaluation of metal bioaccessibility can provide valuable information related to the potential hazard of urban particles for humans following ingestion.

The dust particles composition analysis showed typical minerals with soil origin, but also unidentified amorphous material (a mixture of organic matter with a natural source and carbon particles with an anthropogenic source). The brake dust showed high portion of low-crystallinity materials, as graphite, and iron oxides as the most important constituents, and the traffic paint was basically composed by carbonates.A previous study showed significant differences on bioaccessibility concentrations between dust samples from Estarreja (Portugal) attributing this to site-specific constraints. The presence of particles with origin in human activities could be responsible for the modification of the metal behaviour of the dusts due to their mixed composition and manufacture processes. Thus, in order to interpret differences of bioaccessibility among the different elements, determining and understanding the intrinsic properties and influence of anthropogenic particles in dust is crucial. Considering that some of the most relevant anthropogenic particles that constitute urban dusts are traffic related particles, the present study focused on the copper (Cu) and iron (Fe) behaviour, since these metals are widely associated with a traffic-related source. Dust particles (mixture of materials) and single type traffic-related particles as brake dust (for two different car brands) and white traffic paint were collected and studied.

Considering the studied traffic-related particles, only brake dust samples seem to have an expressive contribution to urban dusts. The brake wear samples showed high amounts of metals. The composition of brake dust samples varies considerably among range-type car brands, which may be related not only to the original composition of the constituent materials but also to the braking system.

The same behaviour of different brake dust samples was found in urban particles regarding their spatial distribution. Considering these results, it is possible to conclude that oral bioaccessibility is highly site specific.

The particle size fraction seems to be one of the most important factors affecting the oral bioaccessibility. As fine particles are easily re-suspended and more easily ingested. This fact, in association with greater bioaccessible fraction values found for these particles, particularly for potentially harmful elements (e.g. Cu), could pose a risk factor to the populations living in cities with a high-volume traffic.

Publication

Assessment of the influence of traffic-related particles in urban dust using sequential selective extraction and oral bioaccessibility tests.
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