

Assessment of airborne titanium particulate matter from the wearing of a photocatalytic bituminous pavement in an urban area

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Applying TiO₂-modified coatings onto the external covering of roads might be a supplement to conventional technologies for mitigating NO_x air pollution. In the framework of the LIFE MINOX-STREET European project, co-financed by the EU, a commercial photocatalytic coating designed for use in bituminous mixtures, has been selected among a range of commercial products after been subjected to rigorous essays. This product has been implemented in a real urban scenario in order to evaluate its effect on the degradation of atmospheric NO_x. The wearing of the photocatalytic pavement by road traffic produces titanium (Ti) particles that could be resuspended on air with potential harmful effects on public health. In this work the assessment of this influence on the ambient and ground deposited Ti particle concentration levels is presented.

An area of 1000 m² of bituminous pavement of a street in the municipality of Alcobendas (Madrid) was covered with the photocatalytic coating and an air quality monitoring program was carried out from September to November 2015. A micro-orifice uniform deposit impactor (MOUDI M110R) was placed in the median stripe of the road at 1 m high to collect size resolved atmospheric aerosol samples (eleven 50% cut-off diameters from 18 to 0.056 μm -uncoated aluminium foils- and a backup stage <0.056 μm-quartz fibre filter). Samples were taken on a 3.5 h time basis around 7 UTC. Deposited dust on the road was sucked on several 1 m² areas. The suction device consisted of a vacuum pump operating at 20 m³h⁻¹ during 15 minutes, a flow controller fixed at 20 lm⁻¹ and a holder device containing a quartz fibre filter located at the beginning of the sampling line. Both types of samples were analysed for Ti content by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and for determination of crystal structures by X-ray Diffraction spectroscopy (XRD).

The bituminous pavement was coated with the photocatalytic product on 25/09/2015. Measurements were done before the implementation of this coating and also several days later (4, 12, 21, 27 days). Figure shows the results of ICP-MS analysis corresponding to

on-road deposited dust. The percentage of mass of Ti per mass of particles collected on the filters during the samplings is represented.

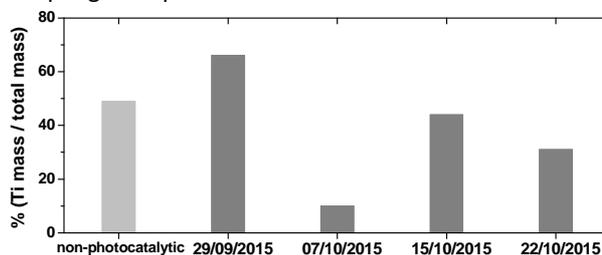


Fig. Percentage of Ti content for on-road deposited dust

Titanium is typically a crustal origin element and likely to arise from soil or dust resuspension. It has been observed on the deposited particles over the non-treated pavement (49 %). A decrease of the deposited Ti over the photocatalytic road pavement occurs as a consequence of the wearing of the coating due to road traffic. The minimum value was obtained on the second sampling day when the pavement was washed by rainfalls of previous days. XRD patterns of the samples of 29/09/2015 showed the presence of TiO₂ in the anatase-type phase as it was expected due to the massive presence of photocatalytic coating wastes produced by erosion. No crystalline phase could be identified in the remaining samples. Airborne Ti was only determined in the filters of the backup stage of the MOUDI and their XRD analysis could not detect crystalline phases. These two facts indicate that the source of ambient Ti aerosol is not the wearing of the photocatalytic coating as it comprises anatase-TiO₂ with a particle size of about 1 μm. The presence of ultrafine Ti particles in ambient air could be attributed to wearing of car brakes (Nosko, 2015).

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Nosko O, Olofsson U, Alemani M. (2015) Temperature effect on emission of airborne wear particles from car brakes. In: *Proceedings of Europe's Braking Conference and Exhibition*, May 2015, Dresden, Germany.