Study of brake wear particle emissions of a minivan on a chassis dynamometer

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There are several studies reporting that the contribution of exhaust and non-exhaust traffic related sources to total traffic related PM_{10} emissions is almost equal. The current study aimed at investigating the physicochemical characteristics of brake wear particles generated by a whole vehicle on a chassis dynamometer under different initial speeds and deceleration rates. The selection of driving conditions was made in such way to better represent driving conditions met in urban environments due to the fact that the contribution of brake wear is more significant in big cities and urban sites.

Regardless the driving conditions a single brake event reveals a clear two peak PN concentration curve, the first at acceleration phase and the second during brake application. Higher initial speeds result in a higher number of total brake wear particles. However, at higher initial speeds more particles are released during the acceleration phase rather than the application of the brake. On the other hand, braking with lower deceleration rates result in a higher number of particles released at the application of the brake compared to braking with high acceleration rates.

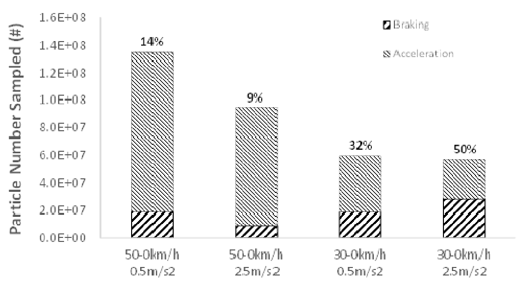

Figure 1: Braking Particles partition over total PN sampled

Regarding the PN distribution higher temperatures of the pad result in a bimodal distribution with the first peak being at approximately 1.0 μm and the second falling at the nanometer scale (~200 nm).

Even if high nanoparticles production has been linked with temperatures of the brake system higher than 180°C, the current study demonstrates that also in temperatures of the pad higher than 140°C a clear second peak at the nanoparticle size range appears

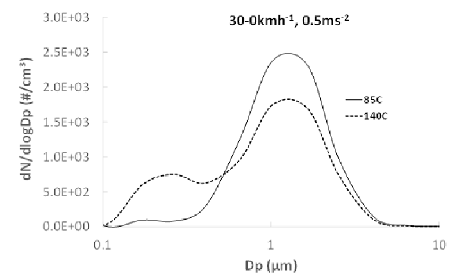

Figure 2: Particle Number distributions at low and higher brake pad temperature

Initial brake pad employed for this study seems to be a mixture of iron, copper, silicon, carbon, zinc, barium and magnesium. After braking procedure no major changes on elements composition occurred for the worn pad material.

Airborne particle collected consist of large irregularly shaped grains (>100 nm). These grains constitute either of C, O, Si or amorphous areas with carbon (>90%) as the main constituent.

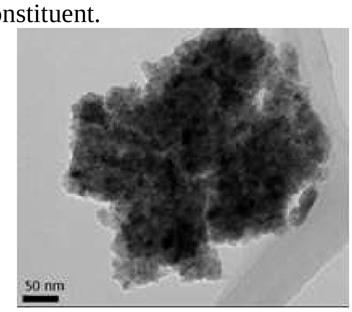

Image 1. TEM images of particles taken from the collection plate of the ELPI.

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