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Editorial

Special Issue Editorial: Study of Brake Wear Particle Emissions

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This *Atmosphere* Special Issue "Study of Brake Wear Particle Emissions" comprises six original papers and one review paper. The papers deal with experimental methods used for studies of airborne brake wear emissions. The motivation of this Special Issue is that more than half of the traffic-generated airborne emissions originates from non-exhaust sources [1], that is, from the wear of tyres, roads, clutches and brakes. It has been reported [2] that airborne brake wear particle emissions account for about 50% of the total non-exhaust emissions. There are still gaps in the current state of knowledge about transport generated airborne brake wear emissions.

This Special Issue is made up of two groups of papers. The first group discusses how to design laboratory tests that can be used for standardized testing of airborne brake wear emissions. The second group discusses how novel design of brake components could decrease the generation of airborne brake wear emissions.

It is difficult to measure airborne brake wear emissions directly on the vehicle since the surroundings cannot be controlled, and therefore, laboratory test setups are used. There are several challenges with these test setups. One challenge is to define a test cycle that can represent real driving conditions. It is known that the temperature of the brake components strongly affects the level of generated airborne brake wear emissions. With this in mind, Grigoratos et al. [3] conducted a temperature study on test data obtained at eight locations in Europe and the United States. The Worldwide Harmonised Light-Duty Vehicles Test Procedure (WLTP) brake cycle was used in all laboratories. It was found that several parameters such as the properties of the cooling air and implementation of dyno-bench test protocol considerably influence the output of tests. Moreover, Gramstat et al. [4] used a dyno-bench with the WLTP brake cycle to investigate how different aspects, such as pad type and bedding-in, affect the level of airborne brake wear emissions. They concluded that the level of emissions depends on the bedding-in time and that off-brake emissions can play an important role for the total vehicle emissions. Another challenge regarding testing is how to characterize the sampled wear particles. Therefore, Sinha et al. [5] performed a literature review of the experimental characterization protocols used for brake wear particles. They concluded that reliable results require investigating the composition, structural and microstructural properties of fine and ultrafine particles, and therefore, recommended that multi-analytical protocols should be used. The above-mentioned studies are important inputs when formulating future legislation for non-exhaust emissions from brake systems.

One approach to decrease the generated amount of airborne brake wear emissions is to change the materials and surfaces of the brake components (pad and disc) in contact. Wahlström et al. [6] investigated how surface scorching of the pad influences the level of airborne particle emissions by analysing tribometer and dyno-bench tests. They concluded that the level of pad scorching has an adverse influence on both the tribological performance and level of airborne emissions. Gomes Nogueira et al. [7] investigated the tribological and airborne emission behaviour of three novel copper-free automotive pad friction materials with tribometer testing. The results indicate that the measured emissions do not correlate with the level of friction and wear, which could be explained by the fact that the wear mechanisms influence the tribological and emission behaviour of the studied materials differently. Matějka et al. [8] investigated the level of airborne emissions released during the dyno-bench tests with brake pads consisting of alkali-activated slag as an abrasive. They concluded that maximum disc temperature has the largest influence on the level of airborne emissions together with the duration of the brake event. Dizdar et al. [9] investigated discs laser cladded with Nickel–Tungsten Carbide with a tribometer and concluded that both wear and particle emission performance are improved.

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