Biological response in lung cells by brake dust from a novel set-up to generate one source wear particles

S. Abbasi[1], B. Ekstrand-Hammarström[2], U. Bergström[2], A. Bucht[2,3], U. Olofsson[1], U. Sellgren[1], A. Jansson[4]

[1]Department of Machine design, Royal Institute of technology (KTH), Stockholm, 100 44, Sweden
[2]Division of CBRN Defence and Security, Swedish Defence Research Agency (FOI), Umeå, 901 82, Sweden
[3]Deptartment of Public Health and Clinical Medicine, Umeå University Hospital, Umeå, 901 89, Sweden
[4]Department of Applied Environmental Science, Stockholm University, Stockholm, 106 91, Sweden

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Recent legislation has resulted in reduced emission of combustion particles from vehicles and therefore the relative contribution of wear particles on the PM levels has increased. Although scientific research on airborne wear-based particles started in 1909, there is neither legislation that controls the generation of wear-based particles nor approved method to study one source-based wear particles (Abbasi *et al*, 2012). The chemical composition of brake pads differs in different vehicles and in addition, the PM generated from these will differ depending on operational conditions (*e.g.* speed, brake pressure and temperature.) Here the aim was to generate PM from a cast iron brake disc and low metallic (LM) brake pad using different cycles/temperatures and study if their potential to induce inflammatory response in a lung epithelial cell line.

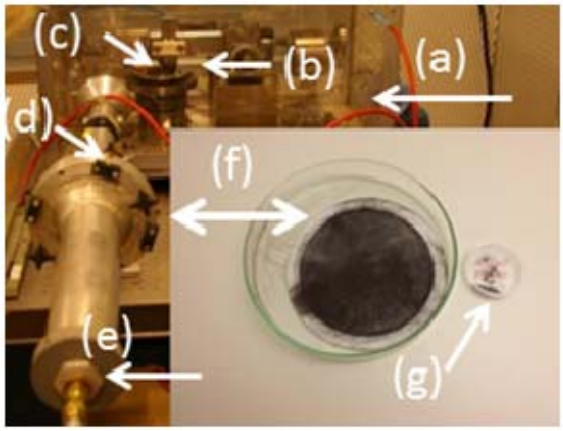

Fig. 1. The experimental set-up to generate particles from braking material, (a) a tribometer in a sealed chamber, (b) square shaped pin from car brake pad, (c) rotating disc from brake disc, (d) filter holder, (e) connection to vacuum pump, (f) filters with deposited particles, (g) collected particles.

Particle generation: Fig. 1 shows the set-up used in this study to generate wear particles from brake pads. In this set-up, the mechanism to blow clean air into an enclosed tribometer (a) monitoring the particle characteristics was akin to work of Olofsson *et al.* to study particles from bearing (2009). However, the 60-mm-diameter discs (c) from cast iron brake disc and the 20-mm-squared shape pins (b) from LM brake pad were used in this study. The dead weight was 100 N and the rotational speed was 3000 rpm. Particles deposited on filter surface (f) were mechanically removed and kept in a glass container (g). *Inflammatory response*: To investigate how cells in respiratory epithelium react to PM from cast iron brake disc and LM brake pads human alveolar type II cells (A549) were exposed to increasing levels of PM. After 24 hours of exposure of PM extracted from the filters, a significant and dose-dependent increase of production of reactive oxygen species and interleukin-8 was observed in the A549 cells. The data indicate that PM from filter 101may be more potent in inducing the biological response.

Here we have demonstrated that the conditions during generation of PM from braking materials have an impact on the response on oxidative stress and inflammatory response in lung epithelial cells.

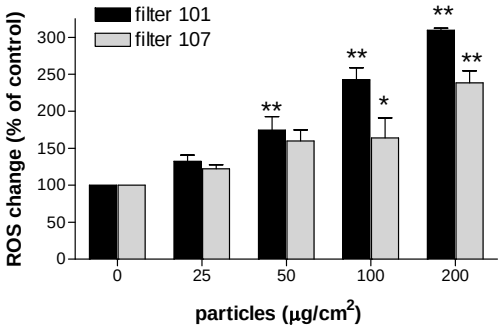

Fig. 2. Production of reactive oxygen species (ROS) in the human lung epithelial A549 after 24 hours of exposure to particles generated from car brake pads. Particles from both filters induce a dose dependent increase of ROS as compared to control.

Altogether, our novel set up for generating single source particles can be used to generate PM under realistic. conditions. These PM can then be used to elucidate the relationship between choice of material, and driving behaviour, for the detrimental health effects of PM from individual sources.

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