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Biological Effects of Exhaust Aerosol from a DI Gasoline Passenger Car with/without Gasoline Particle Filter

6th VERT Forum

20.03.2015

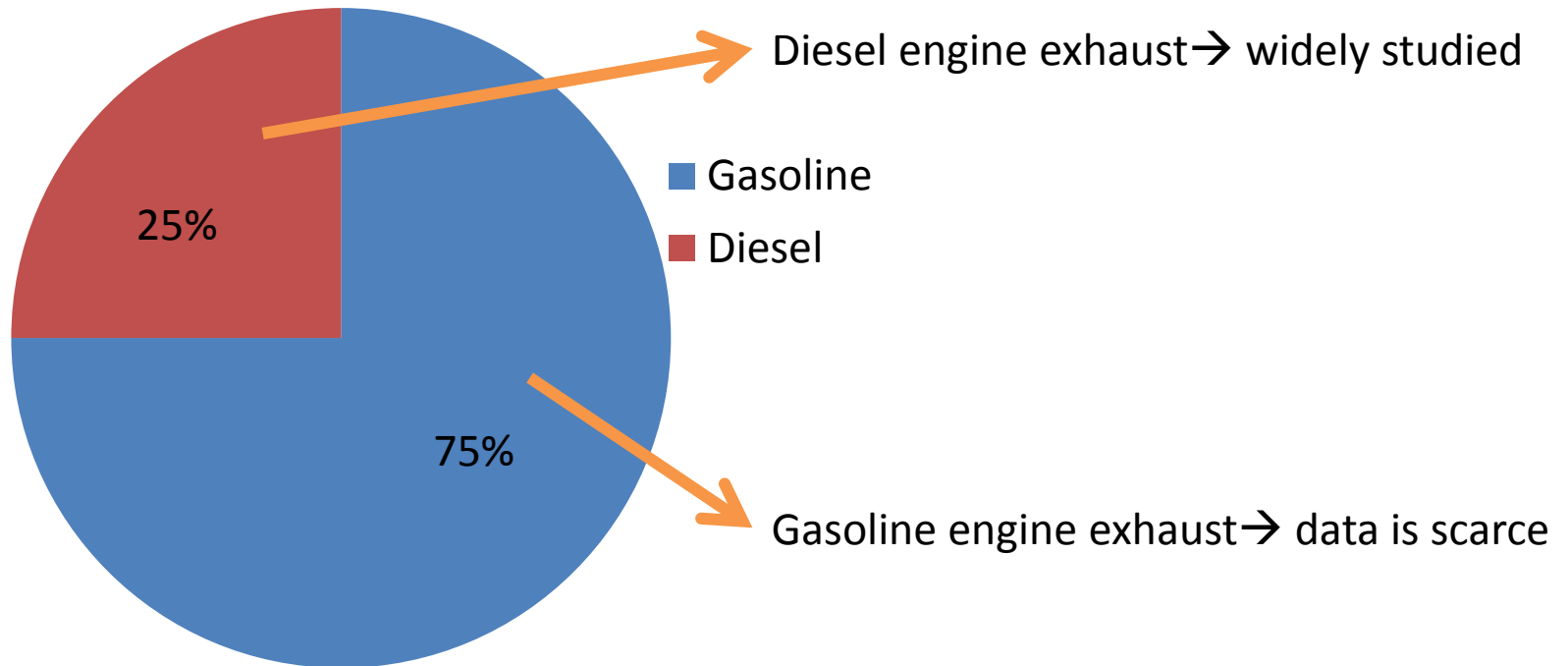
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Why study toxicology of gasoline engine exhaust?

Passenger cars in Switzerland



Toxicological studies with a lung model are needed

Reference: Bundesamt für Statistik. «Mobilität und Verkehr 2013»



Methods- Exposure system

Exhaust generation

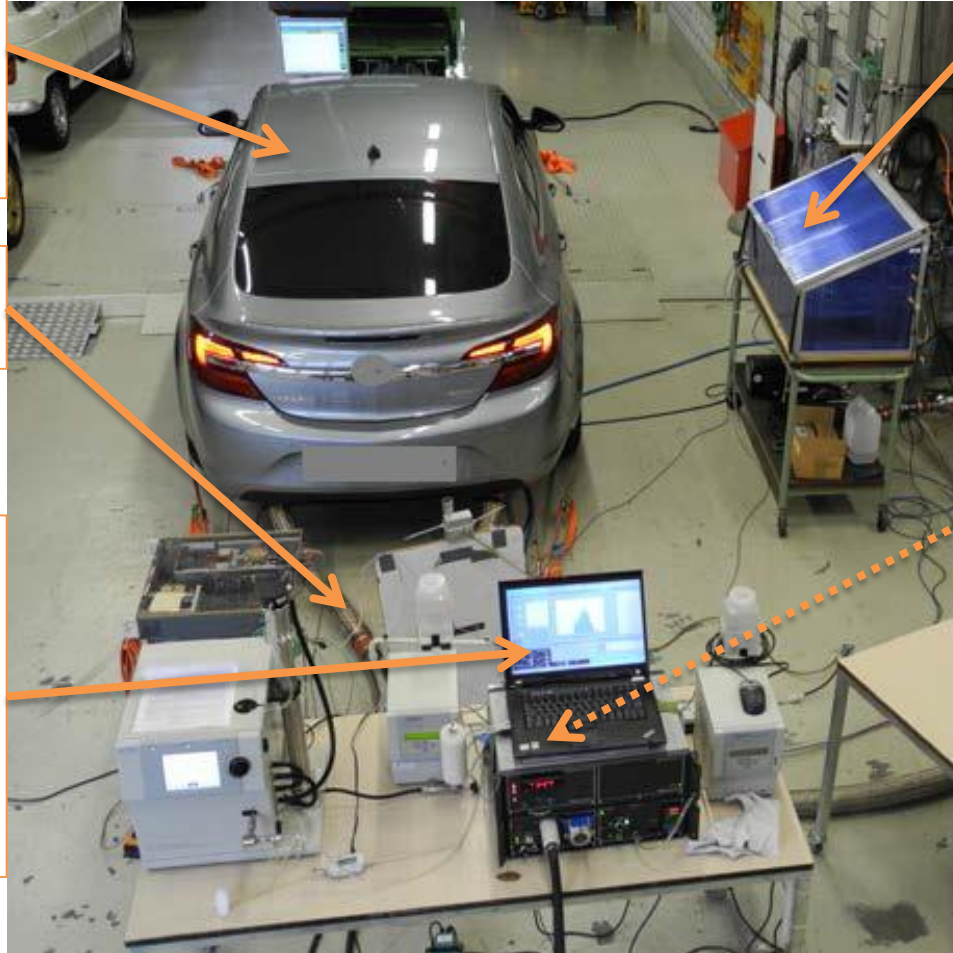
- Gasoline DI car, 95 ROZ
- New European driving cycle (NEDC)
- With or without a gasoline particle filter

Exhaust collection

- At tailpipe

Exhaust characterization

- On-line
- Particles (condensation particle counter)
- Gases (NO_x, CO, CO₂, T.HC)



Exhaust application

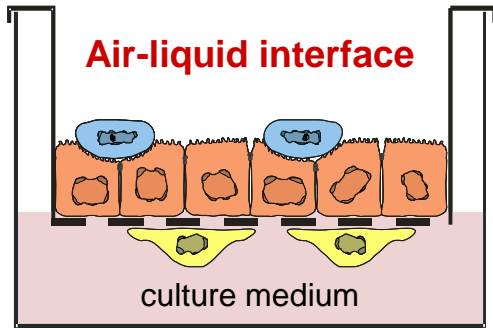
- T = 37 °C
- CO₂ conc = 5 %
- rH = 70-90 %
- Flow = 2 L/min

Exhaust dosing

- 1:10 dilution
- 6 hrs



Methods- biological test system

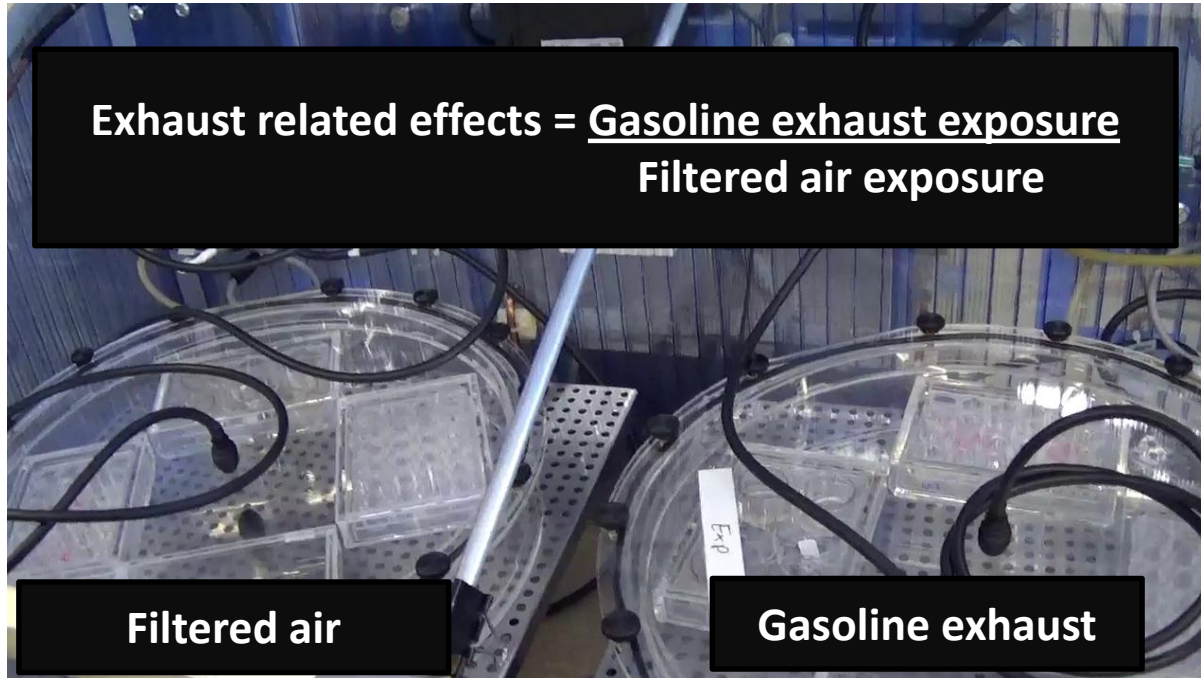


3D cell model

- Macrophages
- Bronchial epithelial cells (human lung cells)
- Dendritic cells

Additional (AMES test)

Salmonella typhimurium (TA100, TA98)



Exhaust related effects = Gasoline exhaust exposure
Filtered air exposure

Filtered air

Gasoline exhaust

Incubator controls
Quality control of
the cell culture



- 6 hours exposure to gasoline exhaust, plus 6 hours post-exposure in incubator
- Non coated gasoline particle filter (GPF) vs unfiltered exhaust (no GPF) in comparison with Diesel particle filter
- Biological endpoints
 - Oxidative stress
 - Pro-inflammation
 - Cytotoxicity
 - Mutagenicity (AMES test)
 - And more



Summary- Results GPF vs no GPF

	Unfiltered	Filtered (GPF)	Diesel unfiltered	Diesel filtered (DPF)
Oxidative stress	↑	↑	↑	↑
Pro-inflammation	no effect	↑	↑	no effect
Cytotoxicity	no effect	no effect	no effect	no effect
Mutagenicity (Ames test)	↑	no effect	↑	↑

- Removal of the particles alone is not sufficient for exhaust toxicity elimination.
- A coated GPF will also eliminate secondary emissions, these tests are planned.

Bisig et al. 2015. Manuscript submitted
Steiner et al. 2013
Steiner et al. 2014



Thank you very much

Foundation:



Schweizerische Eidgenossenschaft
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