

Measurement of ultrafine particles from small non-road engines under real-world operating conditions

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INVESTMENTS IN EDUCATION DEVELOPMENT

The perils of engine exhaust nanoparticles

Internal combustion engines are the dominant source of fine particles in urban air, responsible for an order of magnitude more premature deaths than traffic accidents. Particles are very small and are emitted in the streets in the immediate vicinity of people. Black carbon is also an excellent light absorber, contributing to climate changes.

Real driving vs. Laboratory emissions

During optimization of engine emissions to prescribed type-approval test cycles, emissions under real-world operation are often neglected, and often higher compared to the laboratory tests.

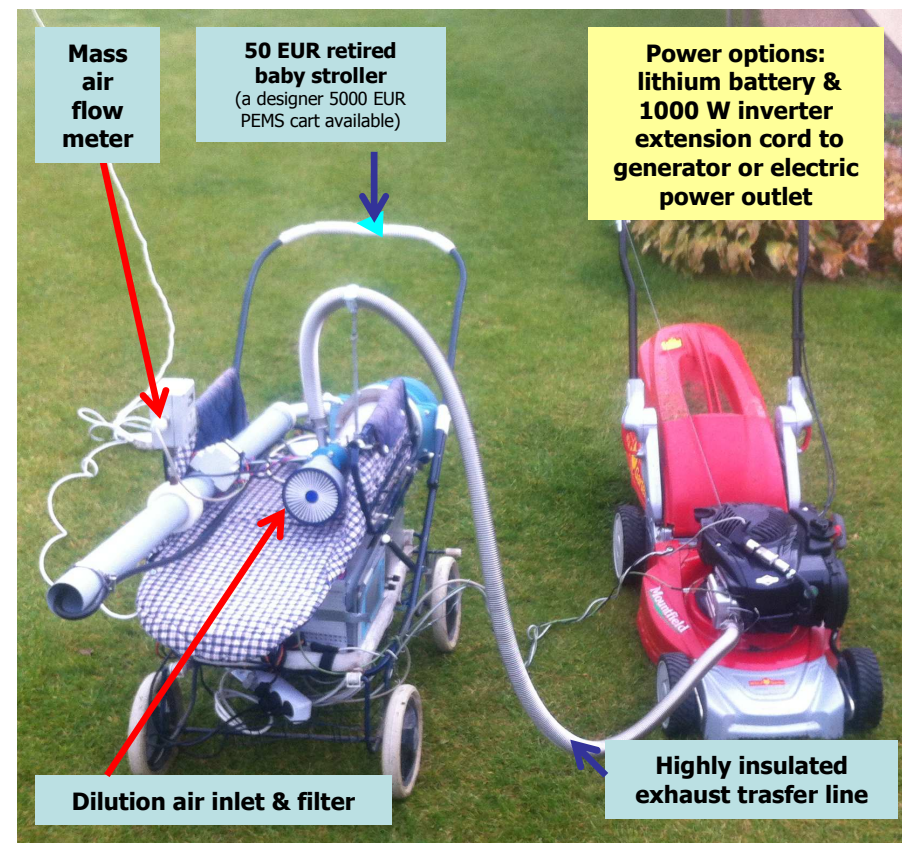
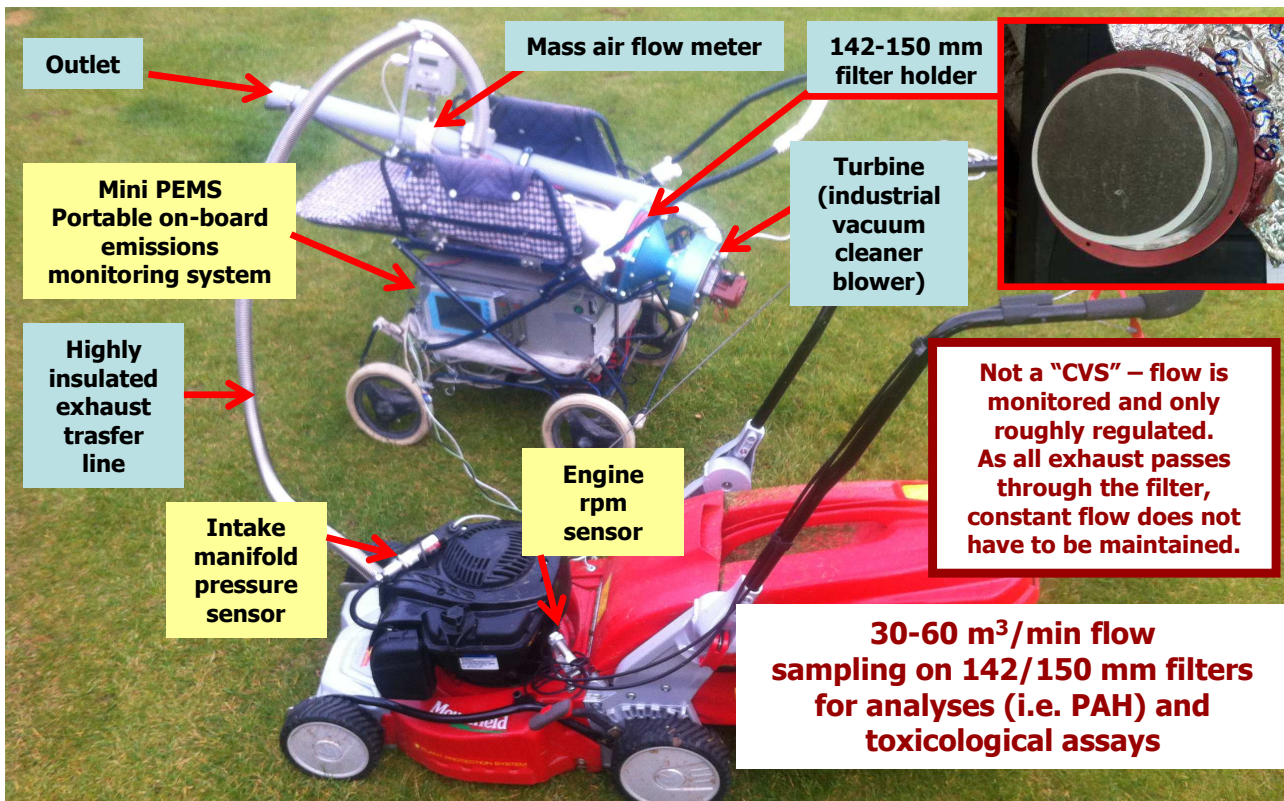
Goal: Assessment of real driving exhaust emissions from small internal combustion engines in non-road machinery.

The small engine issue

- Cheap simple engines
- No electronic controls
- No aftertreatment (most engines)
- No limit on PM emissions
- Immediate proximity of the operator from the tailpipe

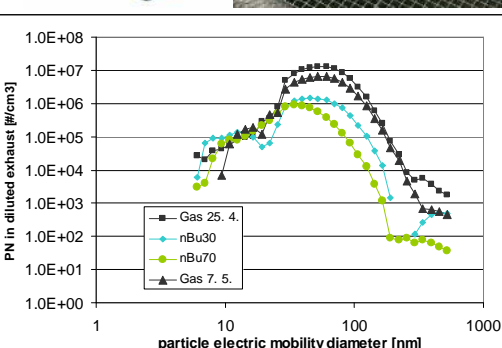
Approaches investigated during proof-of-concept runs

- Miniature Portable on-board monitoring system (Mini-PEMS)
- Off-board PEMS system mounted on accompanying vehicle
- PM sampling for off-line analysis including toxicity assays

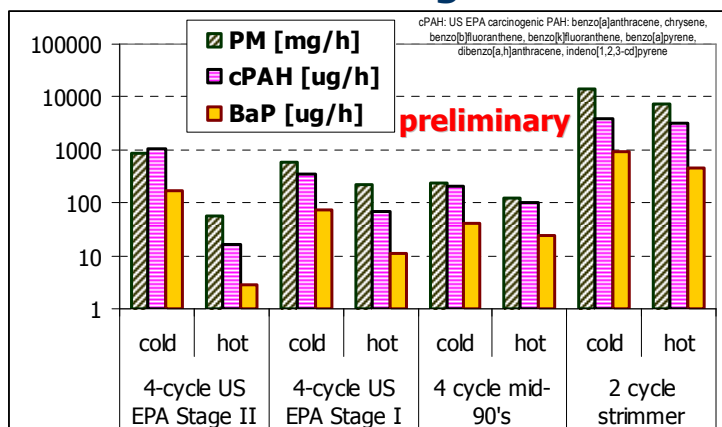


Particle size distributions

2 kW 4-cycle generator, 75% load
 Gasoline, 30% and 70% n-butanol

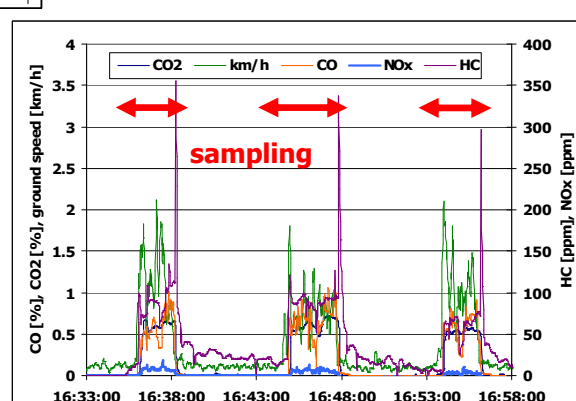


Real-world mowing emissions



Conclusions

- First insight into real-world grass cutting emissions
- Measurement possible with PEMS & off-board systems
- Full-flow dilution tunnel used for PM sampling
- Results preliminary, focus on measurement methods
- Hundreds of mg per hour PM mass from 4-cycle engines correspond to a Euro 5 urban bus at 5 mg/kWh...
- Emissions of PM and carcinogenic PAH are far from negligible, of a concern & to be addressed.



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