Advancing Tyre and Road Wear Particles (TRWP) Measurements: Balancing Laboratory Conditions and Real-World Relevance

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Background

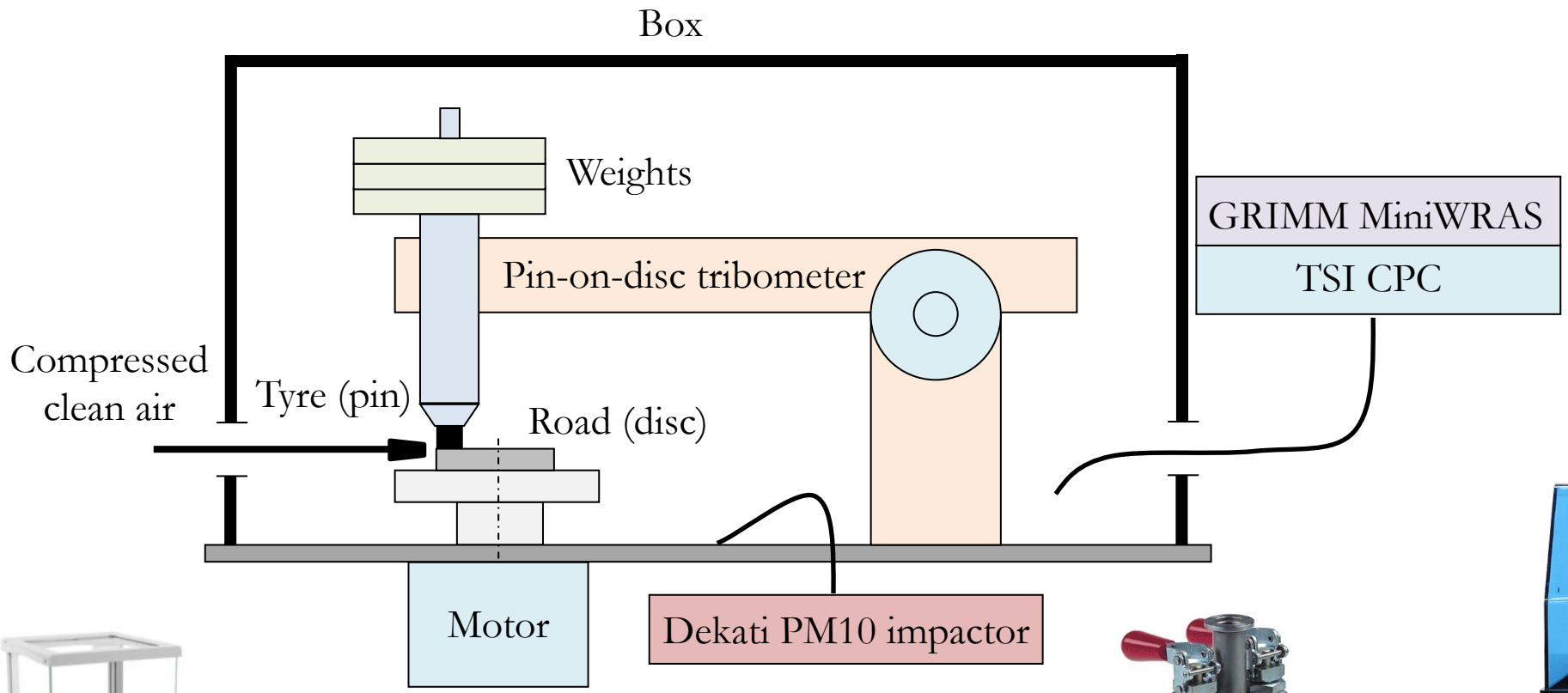
- Few experimental studies reported in the literature includes both ***real tyre*** and ***road materials*** and the ***contact conditions*** (pressure, speeds and temperatures) are “sometimes” a bit extreme

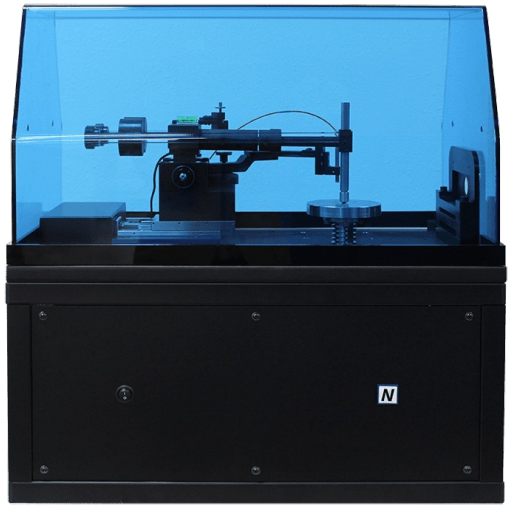
- There is a lack of ***simple experimental methods*** for screening ***friction***, ***wear***, and ***emissions*** across different novel ***tyre*** and ***road materials***

Aim

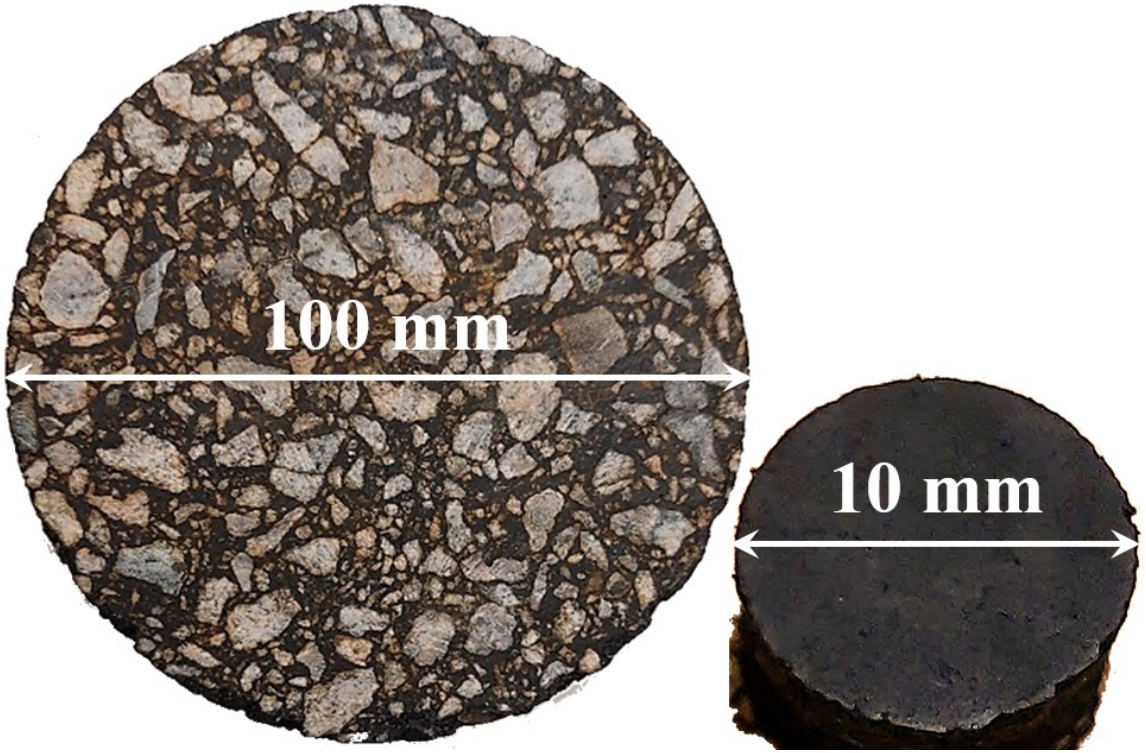
- Therefore, the aim is to propose ***a scaled experimental method*** that includes ***both real tyre and road materials***, while keeping the ***contact conditions*** (contact pressure and sliding speed) unchanged.

Experimental setup



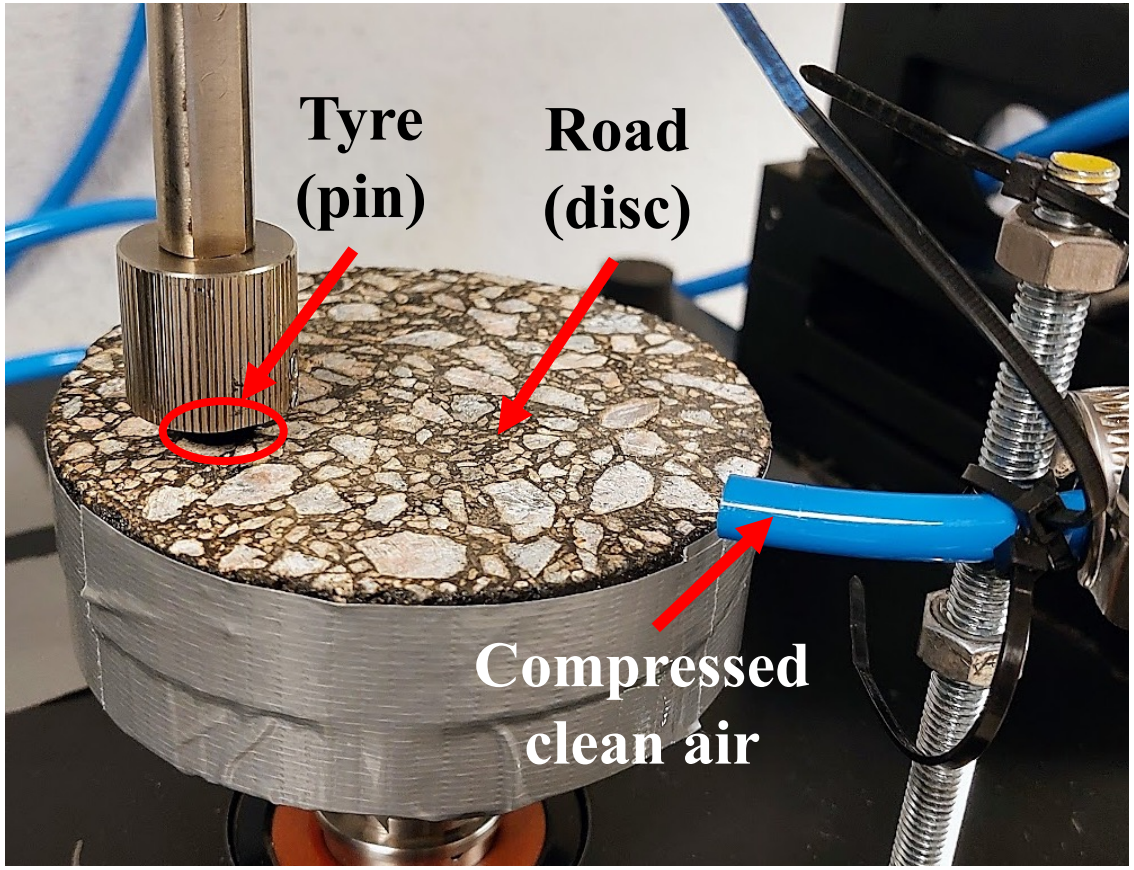


Test specimens



Marshall sample
(SS-EN standard 12697-30:2019)

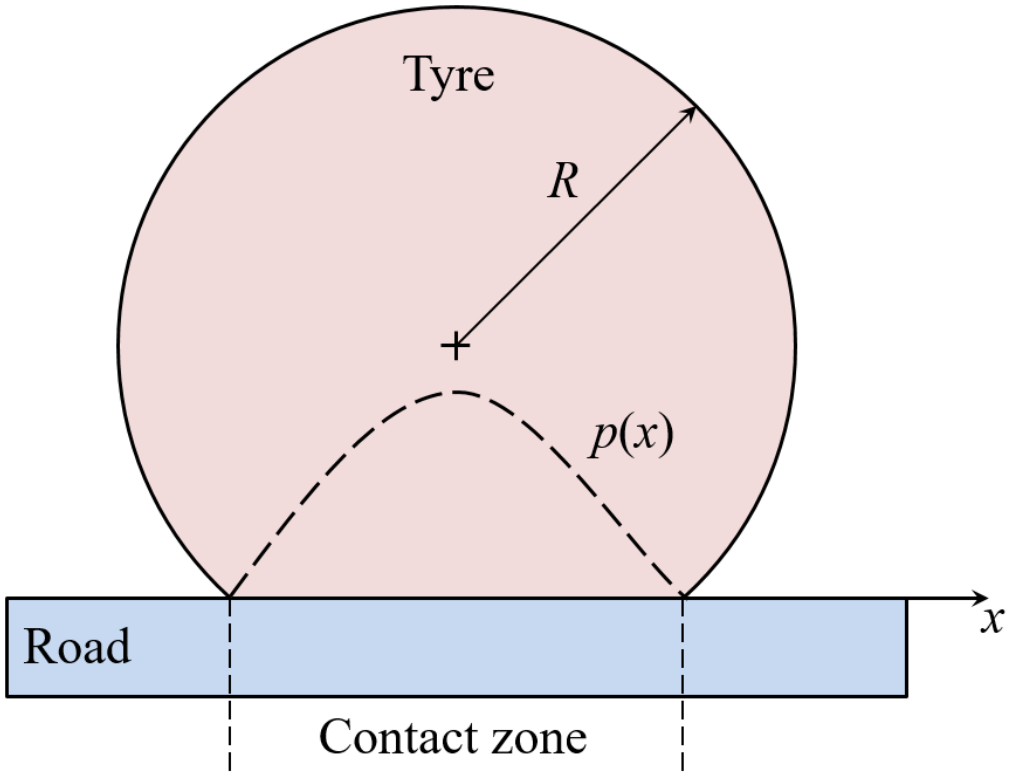
Used Michelin X-Green



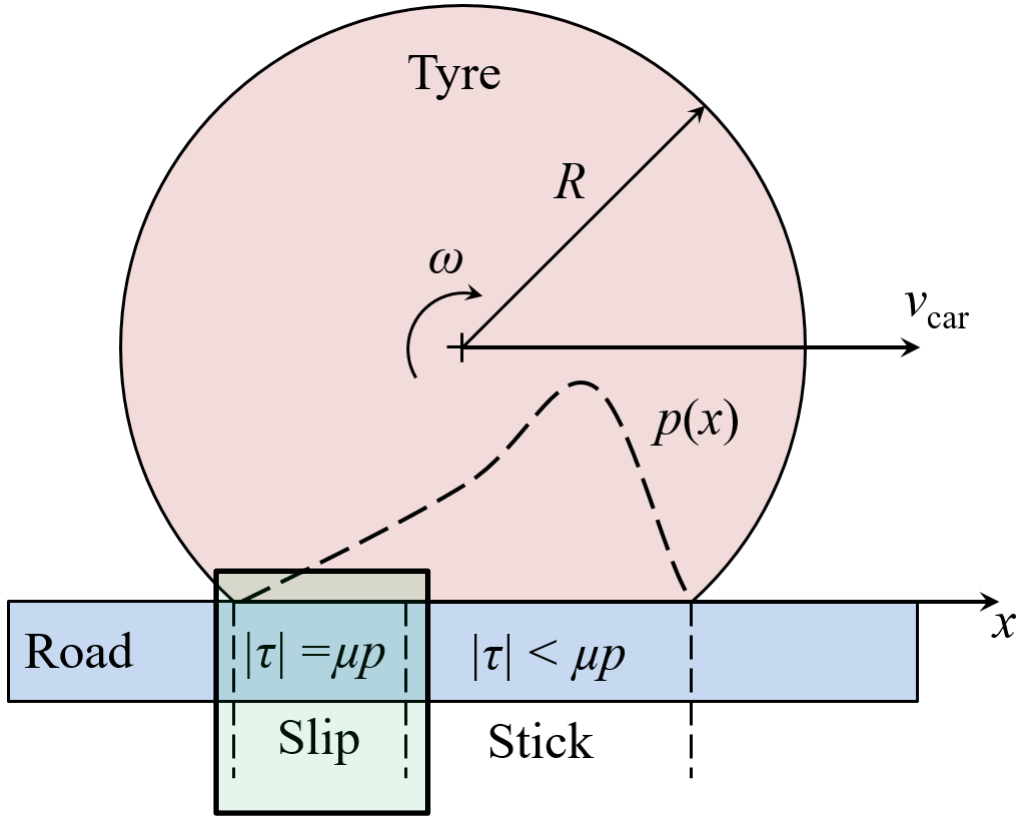
Particle-free air was supplied at a flow rate of 35 L/min, corresponding to a vehicle speed of 100 km/h

Tyre-to-road contact model

Standing still



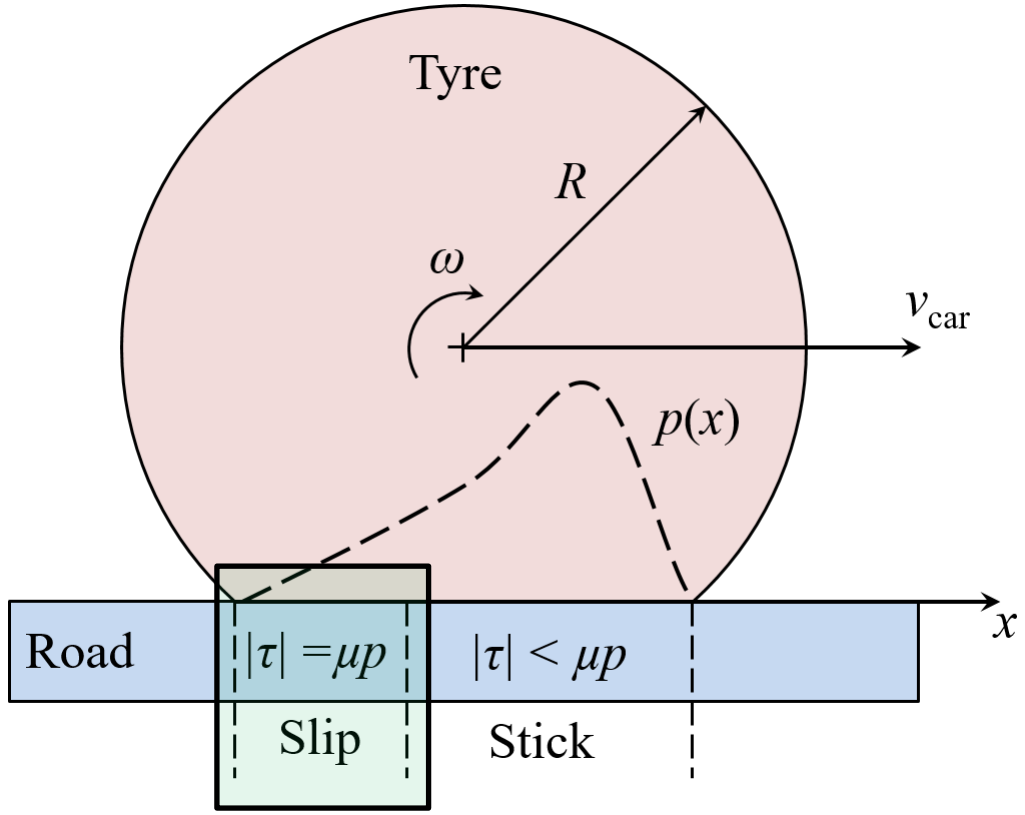
Moving straight



- Slip/sliding occurs at **low contact pressures** in the slip zone
- Slip/**sliding speeds are low** during moderate driving

Test conditions

Test	p [bar]	v_{car} [km/h]	t [min]
T1	0.64	30	120
T2	1.28	30	120
T3	0.64	60	60
T4	1.28	60	60
T5	2.56	60	60
T6*	2.56	120	30



- Only contact pressures and sliding speeds in the slip zone are studied
- Car speed assuming a tyre slip of 1%

Tire specimens wear scars

T1

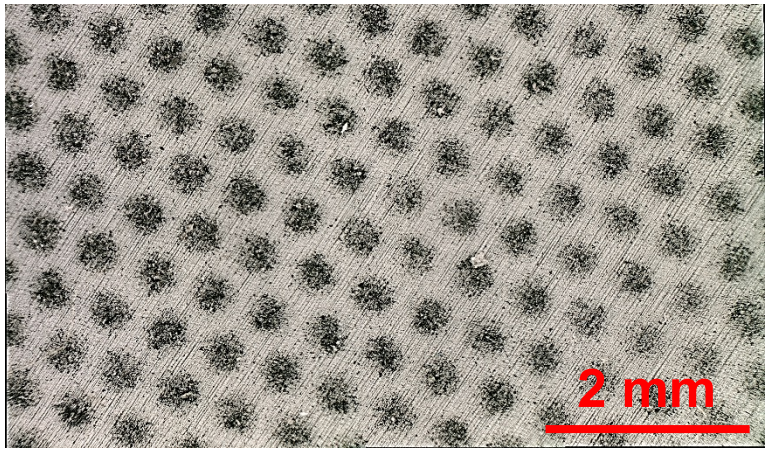
T2

T3

T4

T5

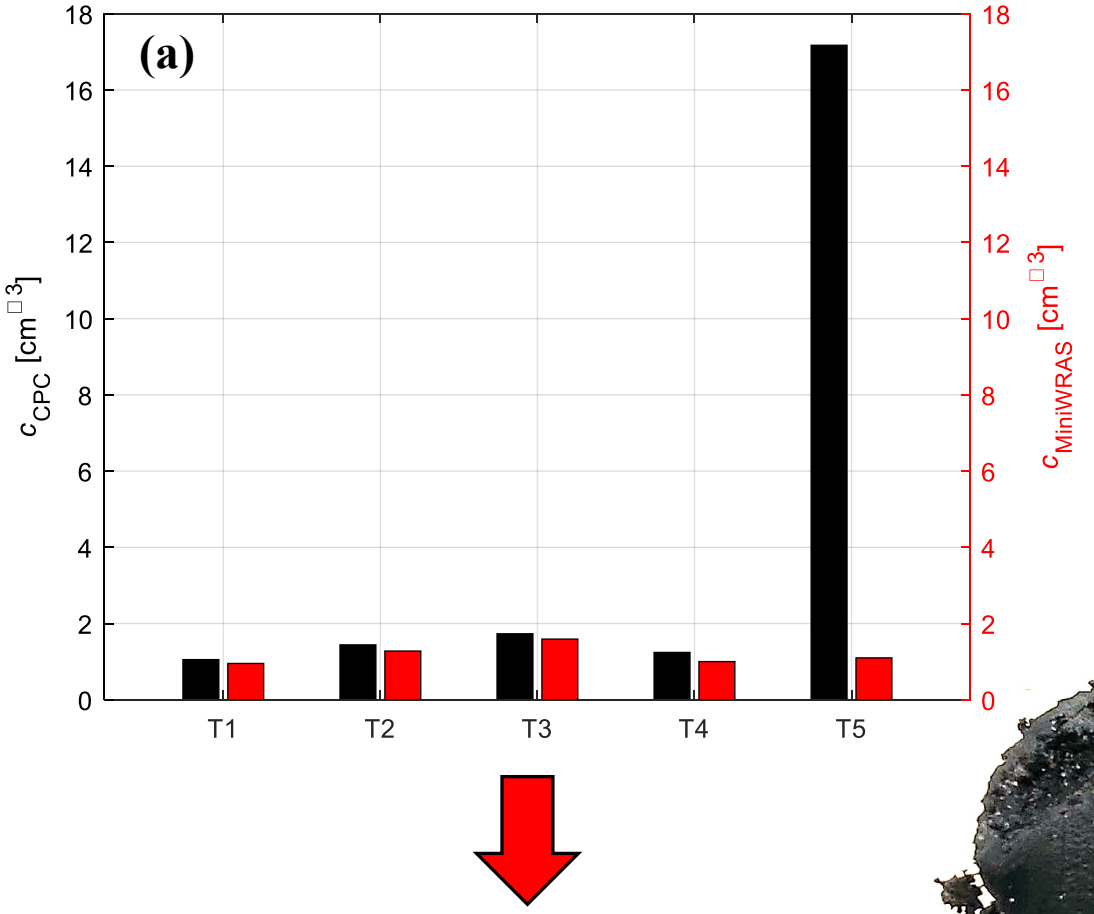
T6*

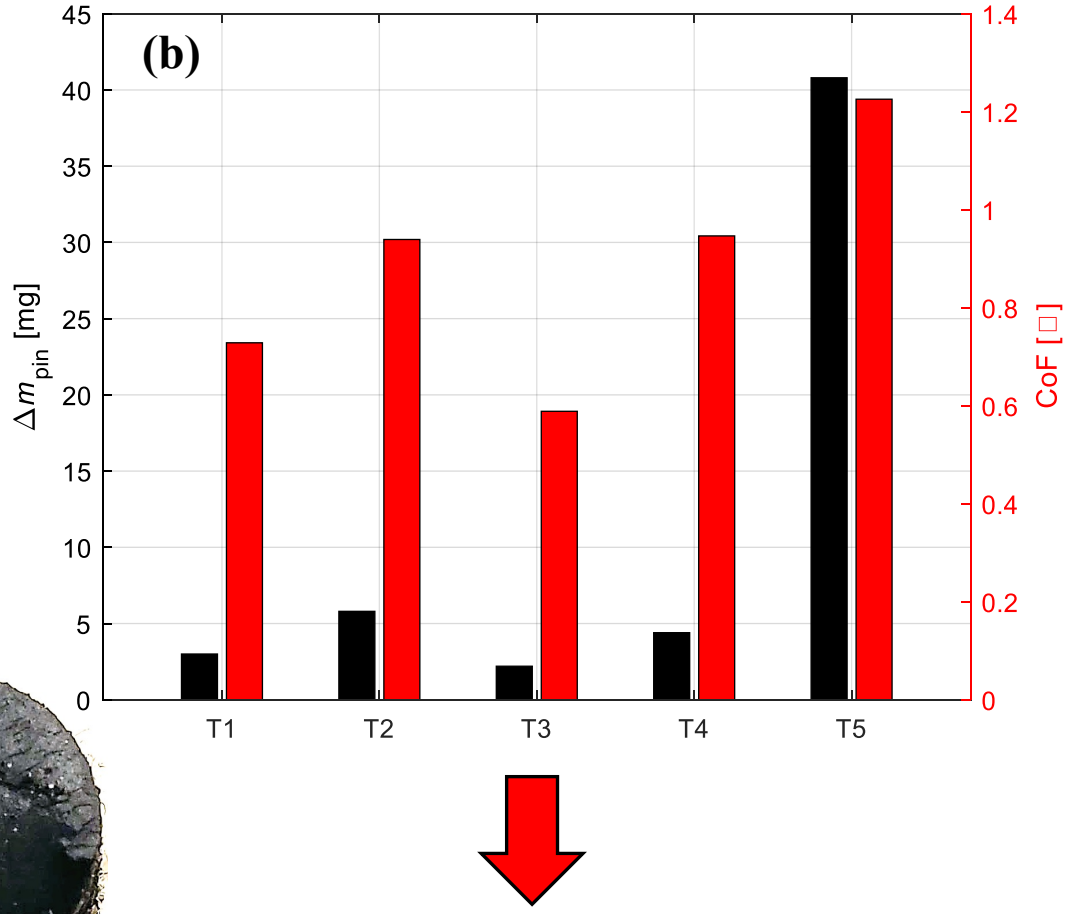


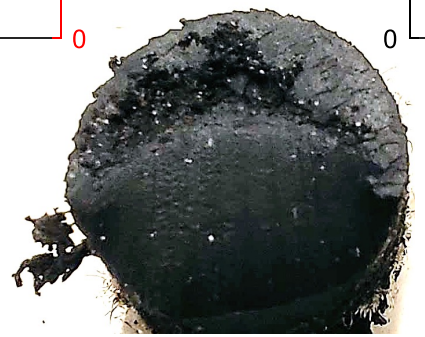
T1

T5

Mean friction, wear and airborne particles







T5

Airborne TRWPs:
- Very low under moderate conditions
- Could be observed under harsh conditions

Non-airborne EFs and CoFs:
Moderate conditions: 50 - 100 mg/km/vehicle, 0.6 - 1.0
Harsh conditions: > 700 mg/km/vehicle, up to 1.5

Concluding remarks

This study highlights the importance of using representative test conditions in future experiments to better simulate real-world driving:

- ***Under moderate conditions***, ***airborne TRWP concentrations remained very low*** (about 100 times lower than for corresponding brake conditions) and resulted in expected surface wear, CoF and non-airborne EFs per vehicle.
- ***Airborne TRWPs were observed under harsh conditions***, where friction and the non-airborne EF increased sharply, leading to the significant detachment of tyre and road materials. *However, such worn contact surfaces are not representative of those found on road used car tyres.*

Further investigation is needed to assess the robustness of the setup.

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Thanks for listening!

Sten K JOHNSONS STIFTELSE

For more detailed information about the study, please check:

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