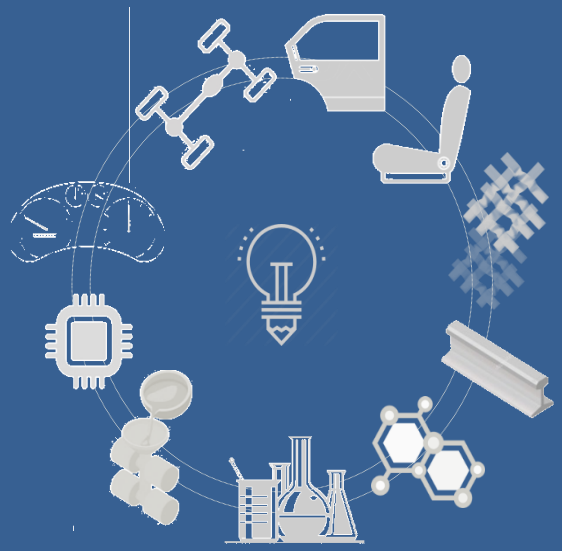
Tyre Abrasion test methods by Internal Drum

Task Force on Tyre Abrasion
10 March 2023

Korea Automotive Technology Institute
(KATECH)



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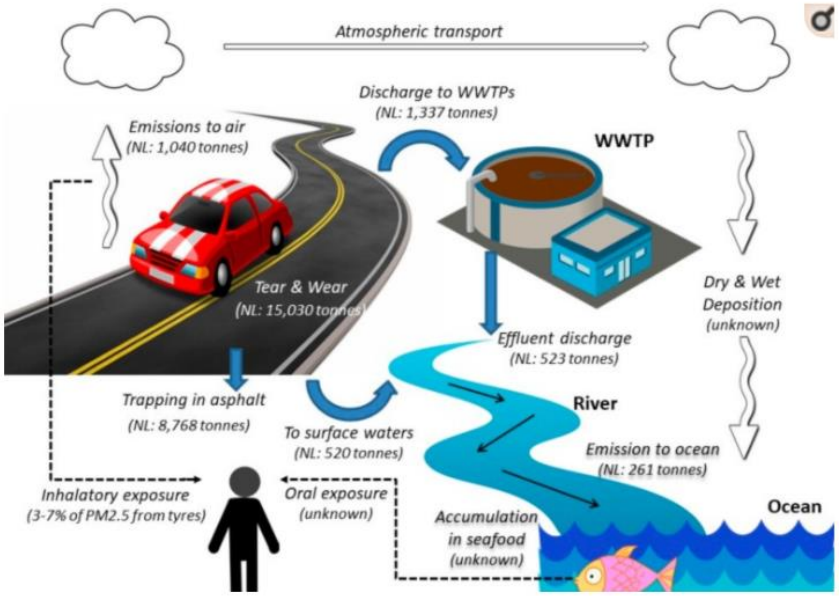
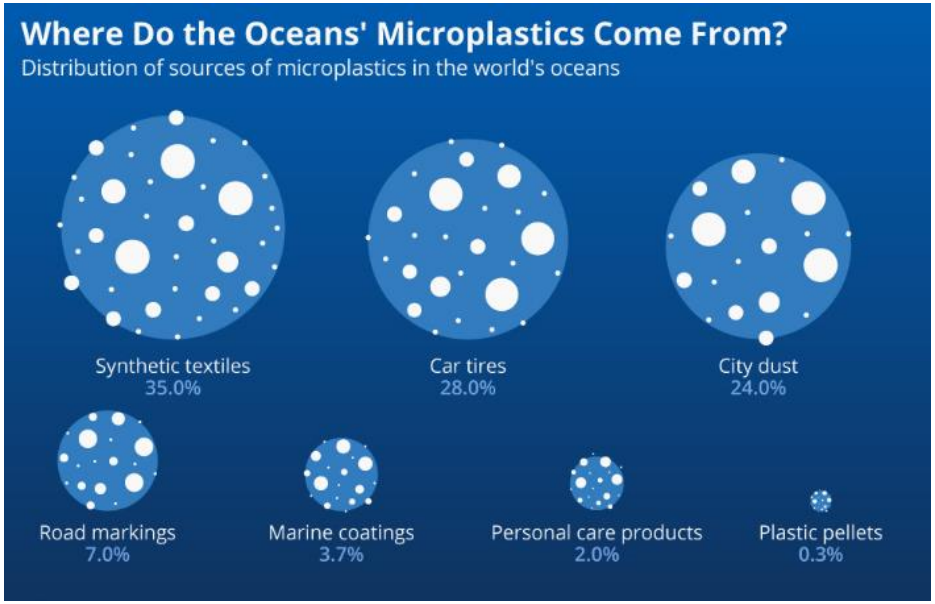
Why should we measure tyre abrasion rate?

Background

- Tyre and road wear particles(TRWP) run into the ocean, affect aquatic ecosystems.
- Suspended particles among tyre abrasion are inhaled in the process of breathing.
- These points pose a great threat to human health.
  - ➢ **This is the moment when regulations on tire abrasion become necessary.**



[source: Int J Environ Res Public Health. 2017 14(10):1265]



[source: International union for conservation of nature/statista]

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How is it appropriate to evaluate?

Representative

- It should be recognized anywhere in the world.
- It must reflect road requirements and environments around the world.
- Various vehicle drivers and driving environments must be considered.

Reproducible & reliable standardized test methods

- The same results should be obtained when retesting through a test method.
- The same results can be obtained at other locations.

Considering various variables & factors …

Constraints of time and place ….

➢ **In conclusion,**
an indoor test method that simulates the real environment is needed.

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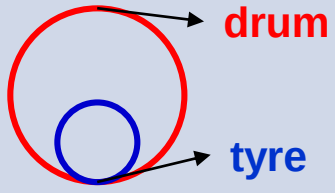
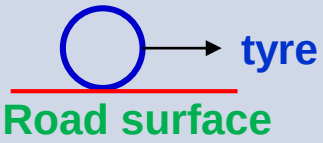
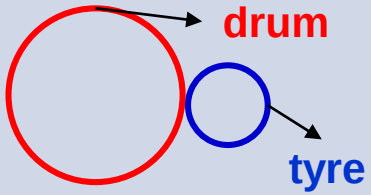
Internal drum vs external drum

Indoor tyre abrasion test method

- **Internal drum** method: the tyre runs along the **inner surface** of the drum.
- **External drum** method: the tyre runs along the **outer surface** of the drum.

Factor	Internal drum	Flat-type	External drum
Tread severity	Low	Middle	High
Real – pavement (asphalt, concrete)	Possible	Impossible	Difficult
TRWP acquisition & sampling	Simple and easy	Tricky	Tricky
Climate control in system	Simple (relatively)	Medium	Difficult
Scheme			

TRWP acquisition & sampling is required for emission analysis of PM2.5 & PM10.

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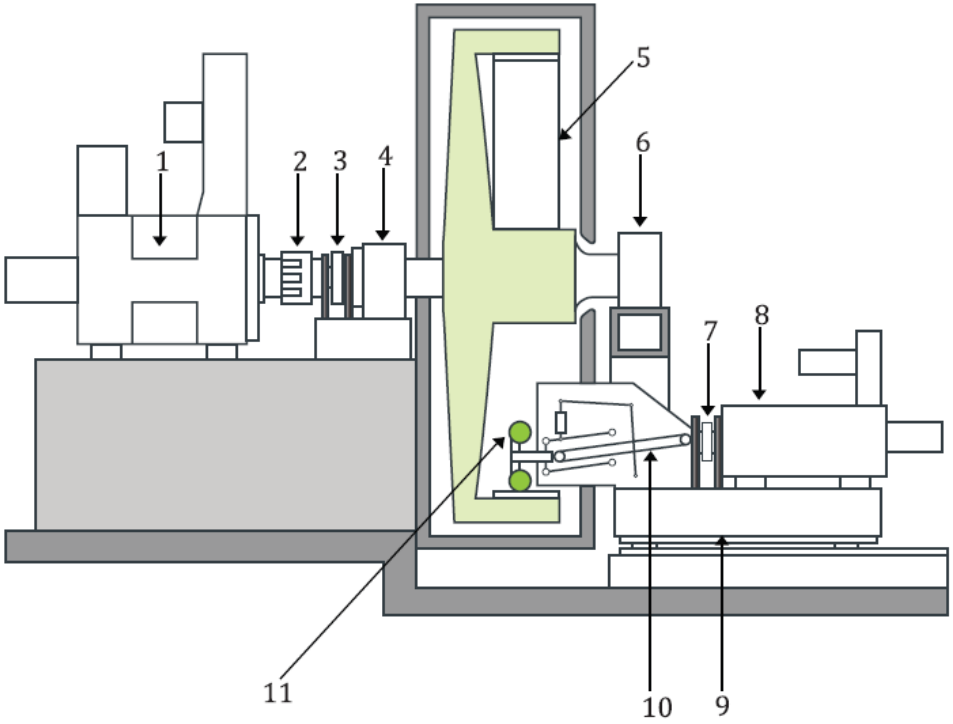
Tyre abrasion test system in ISO/TS 22638

- Testing facility uses two independent driving motors to rotate the drum and tyre, respectively.
- **The test pavement shall be mimic actual road pavement.**

  (ie, asphalt- ISO 10844)



[source: ISO/TS 22638:2018[E]]

1. Drum drive engine(200kW), 200 rpm
2. Clutch
3. Brake (for casket mounting only)
4. Bearing
5. Surface of inner drum (filled caskets)
6. Bearing
7. free-wheeling hub with disk brake
8. Tyre drive engine(200kW)
9. Wheel slide
10. Tyre load
11. Tyre wheel

Tyre abrasion simulator (KATECH)

Introduction of tyre abrasion test system in KATECH

- Construction of temperature and humidity control system inside the drum chamber
- Possible to analyze the status of TRWP emitted from tyre abrasion
- Tyre abrasion test for PCR & TBR*

Specification	KATECH - facility	remark
Inner-diameter of drum	3,800 mm	
Drum-speed	135 km/h over	**Tyre specification:** 275/70R22.5 & 12R22.5
Camber angle variation	-10° ~ +10°	
Slip angle variation	-5° ~ +5°	
Max. Tire radius	500 mm	
Max. Tire Width (Contact-Width)	450 mm	
Max. load for vertical axis	60kN (vertical force)	
Max. acceleration of drum	-1.50 m/s^2 ~ +1.67 m/s^2	
Pavement type	Asphalt/concrete/sand-paper	
Analyzable particle size	0.006 ~ 20 um	Particle size distribution Particle counting, etc
TRWP mass information (PM sampler)	PM10, PM2.5	by filtration of PTFE paper

***There are restrictions on some **commercial vehicle tyre specifications**.

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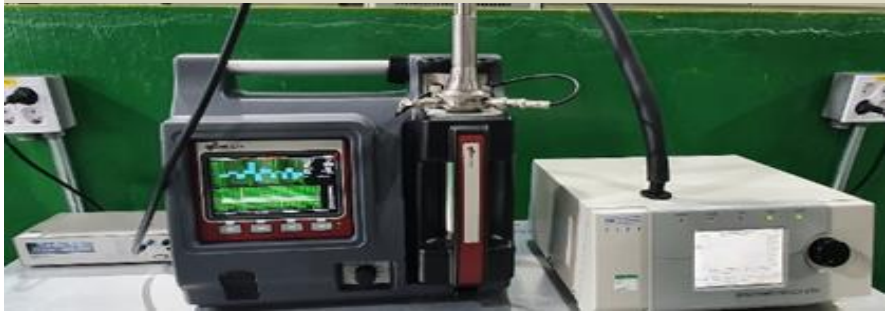
Introduction of tyre abrasion test system in KATECH

- Tyre wear information by tyre type/size/specification
- Tyre wear information by driving condition (acceleration, cornering, slip etc)
- Emission of TRWP & tyre abrasion on actual road-pavement

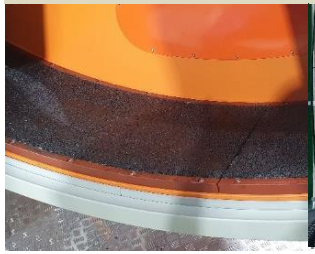
Driving control

Internal-drum type test bench

Analysis of real-time TRWP emission information



Asphalt-pavement



Concrete-pavement

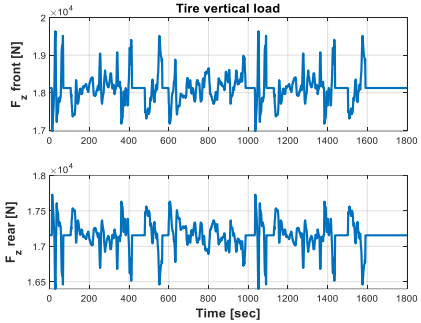
Interchangeable pavement

PM10 & PM2.5 sampler

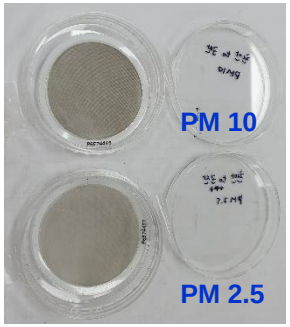
Research with tyre abrasion simulator

Ongoing research topics in KATECH

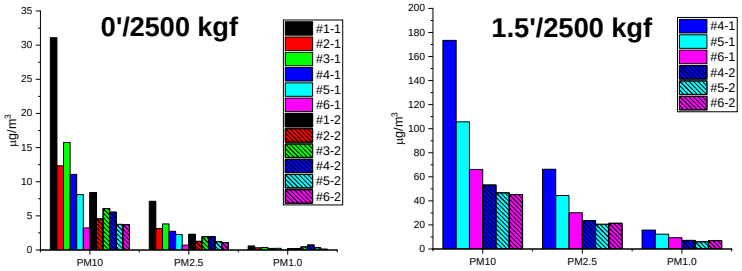
- Trends of tyre abrasion rate & TRWP emission (vs pavement type, tread compound)
- Development of drum running mode with ‘WLTC’ & ‘cornering conditions’
- For TRWP (particle size distribution & number, ingredient ratio, shape, etc)



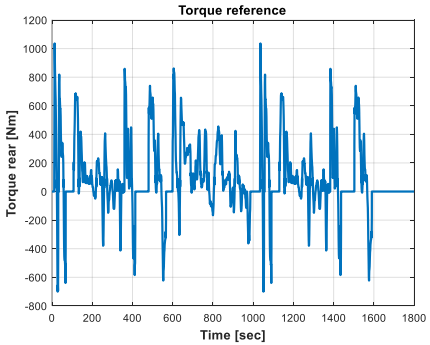
Vertical load data for ‘WLTC mode’



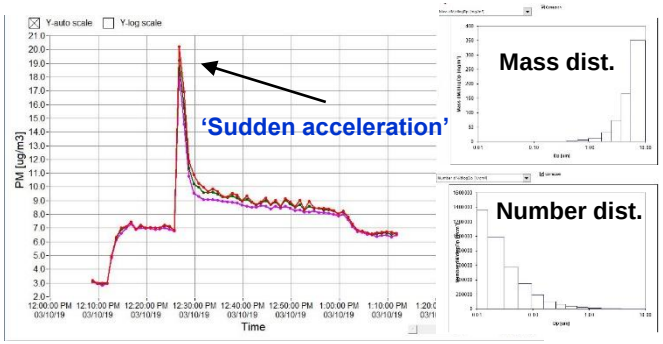
Filter paper from TRWP emission



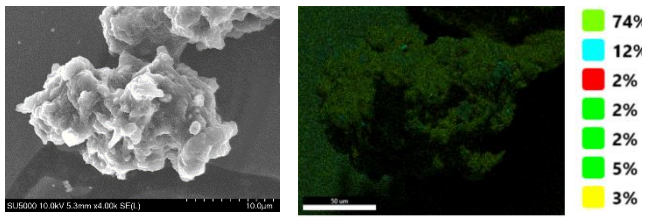
TRWP emission data vs specific running mode



Torque ref. data for ‘WLTC mode’



TRWP emission information by specific situation



Morphological & elemental information of TRWP

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Closing remarks

- There are many unique advantages of the internal drum method that can be mounted on real road surfaces.
- Therefore, in establishing a standard test method for tyre abrasion rate, rather than limiting it to the external drum method.
- We hope you also consider the “internal drum method.”

Thank you for your attention

- We really appreciate your works -

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