PARTICLE EMISSIONS FROM TYRES AND BRAKES WEAR – ON-GOING LITERATURE REVIEW

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On-Going Literature Review

- Approximately 60-70 peer-reviewed papers since 2000
- 10 papers presented in conferences
- 8 intermediate and final research project reports
- Several technical publications from major brake and tyre companies
- Several licentiate and doctoral thesis

PRELIMINARY FINDINGS

Importance of Particles from Brake & Tyre Wear

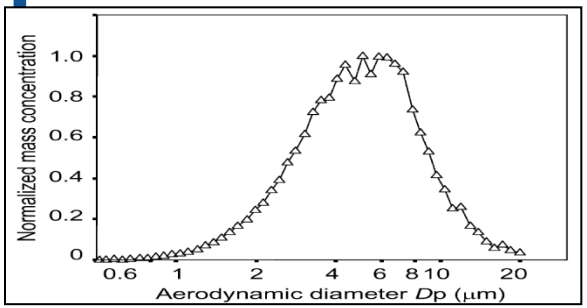
- Non-exhaust emissions is currently estimated to represent ~50% of traffic related PM emissions in urban environments, with a tendency of continuous increase

BRAKE WEAR – Preliminary findings

- Brake wear is considered to be a major source of non-exhaust traffic related emissions particularly in urban locations (16-55%)
- Brake wear debris depends
  - **Bulk friction material of the brake**
  - **Conditions under which braking event occurs**
- It is estimated that ~ 50% of generated brake wear particles become airborne

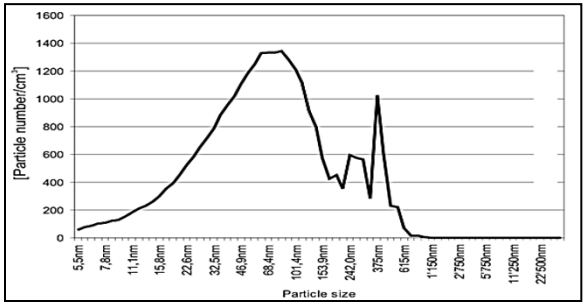
BRAKE WEAR – Main properties

- Mass is mainly distributed in the coarse particle fraction, with a mass-weighted mean diameter of ~ 5-6 µm



Iijima et al., 2007

- Regarding PN most studies report a mode <80 nm together with another mode at 300-500 nm



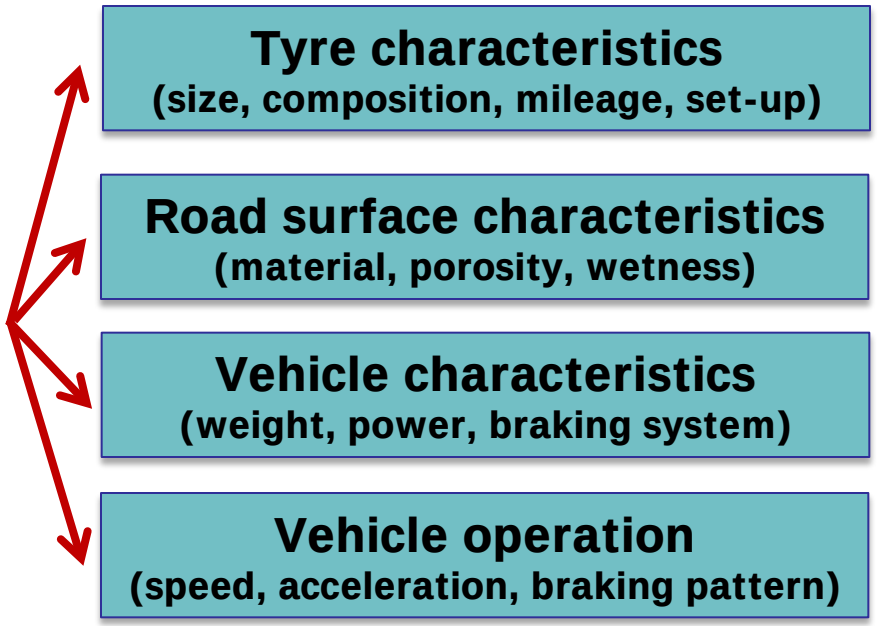
Gasser et al., 2009

- Transition metals (i.e. Fe, Cu), Sb and carbonaceous species have been identified in the fine fraction of airborne brake wear particles
- Field studies and receptor modeling agree in a PM10 brake wear EF of 1-8 mg/km per vehicle for LDVs

TYRE WEAR – Preliminary findings

- Tyre wear is considered an important source of non-exhaust PM10 (~11-20%). Higher contributions have been reported with “studded” tires

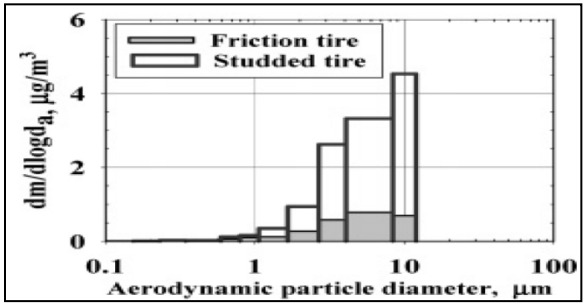
- Tyre wear is a result of the frictional energy developed at the interface tread - road pavement. It depends upon:



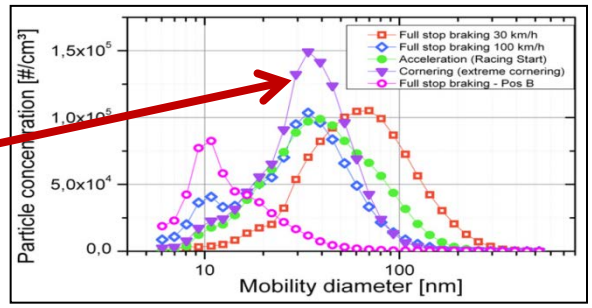
- It is estimated that ~5-30% of generated tyre wear particles are emitted as PM10 depending on the driving conditions

TYRE WEAR – Main properties

- PM10 mass distributions show a maxima at the coarse fraction (>7 µm).
- Regarding PN a mode at 30-60 nm has been reported at non steady-state driving conditions with stops



Kupiainen et al., 2005



Mathissen et al., 2011

- Transition metals (Fe, Cu), Zn (also in organic forms), and organic compounds (PAHs, benzothiazole compounds, n-alkanoic acids, natural resins) have been identified in the tyre wear debris
- Field studies and receptor modeling found a PM10 tyre wear EF of 4-13 mg km-1 vehicle-1 for LDVs and 7.5-200 mg km-1 vehicle-1 for HDVs

BRAKE & TYRE WEAR PARTICLES – MAJOR GAPS

- Definition of standardized operating conditions representative of “real world” operation and standardized sampling methodologies
- Epidemiologic studies addressing the influence of brake and tyre wear particles on human health
- Identification of organic constituents of airborne brake wear particles
- Updated chemical profiles of lining materials (e.g. presence of Sb) and of tyre wear particles (assess the influence of the restriction in the use of PAHs in tyre manufacturing since 2010)