LOWBRASYS OVERVIEW
Brussels, 10 March 2016

39th PMP Meeting

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LOWBRASYS: a LOW environment impact BRAke SYStem
GA 636592 - MG-3.1-2014: Technologies for low emission powertrains

10 members from 6 European countries
Total costs: 9.5 million €
Project Start: 01. September, 2015
Project duration: 36 month
### Background

<table>
<thead>
<tr>
<th>Part affected</th>
<th>Particles dimension</th>
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<tr>
<td>Nose cavity and pharynx</td>
<td>5 – 10 μm</td>
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<tr>
<td>Trachea</td>
<td>3 – 5 μm</td>
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<tr>
<td>Bronchi Bronchioles</td>
<td>2 – 3 μm 1 – 2 μm</td>
</tr>
<tr>
<td>Alveolar ducts and alveoli</td>
<td>0.1 – 1 μm</td>
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Soot particles in human lung
In 2013, tire and brake wear contributed approx. 20-30 % to the total road transport PM emissions (EEA33). The relative contribution to the road transport of these unregulated emissions are expected to rise significantly due to declining exhaust emissions.
## Goals of the project

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<td><strong>1.</strong></td>
<td>To demonstrate a novel and low environmental impact brake system that will reduce micro and nanoparticles emissions by at least 50%;</td>
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<td><strong>2.</strong></td>
<td>To improve the measurement and understanding of micrometre-sized and ultrafine particles and their effects on health and the environment;</td>
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<td><strong>3.</strong></td>
<td>Recommendations to policy makers.</td>
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LOWBRASYS Strategy path

PM (PN) prevention
- Disc material development
- Disc coating development
- Pad material formulation
- Dynamic adaption of brake parameters

PM (PN) reduction
- Eco-informed braking style by smart dashboard (human based)
- Smart braking distribution between front and rear axle (machine controlled)

PM (PN) capturing
- Capturing system at the pad to disc interface

LOWBRASYS Technology Demo

LOWBRASYS Validation and Assessment on i) passenger car; ii) city logistic light trucks

Simulation
- Micro level: MCA
- Meso level: CA
- Macro level: FEM

Testing
- “Pin on disc”, i.e. lab scale
- “Dyno stand set up”, i.e. wheel-scale
- Real vehicle road test

LOWBRASYS Health and Environment assessments

LOWBRASYS Policy and Legislation recommendations
Technology overview

Smart Braking Dashboard
- Braking classifier
- Braking Manager
- Braking Coach (HMI)

Adv. Brake disc
- Ceramic coatings (WC-Co-Cr, Cr₂C₂-Ni-Cr and Al₂O₃-TiO₂) on cast iron and aluminum discs
- Increase of surface hardness through heat treatments, press hardening, nitriding and carbonitriding

Adv. Brake pad
- Goal: Innovative NAO-type friction materials with braking performance of Low-Met friction materials
- Modified formulation (remove Carbonaceous material and reduce Cu (to <0.5%))
- Clay materials (vermiculite and kaolinite) with embedding of nanoparticles (ZnO and TiO₂).

Control strategy
- Brake by wire system
- New brake force sensors to optimize control loops for brake torque

Particle Capturing System
- Combination of technologies based on magnetic, electrostatic, active ventilation
Testing overview

Tribometer testing
- Creation of wear maps
- Rank materials with respect to wear

Dyno Testing (up to roller dyno)
- To assess the impact of these technologies under close-to-real-world in-use conditions

Test track
- Safety, Performance tests & validation
- Comparison to laboratory result

Real-World
- Real world driving tests in 2 EU cities
- 1000 km testing in each city under real conditions

Supported by Simulations
- On different scales to simulate wear and particle emissions

Perricone et al. (2015)
Söderberg et al. (2009)
Health, Environment & Recommendations

Effects on Health and Environment
- PM analysis with state-of-the-art techniques to assess key factors of toxicity of inhalable particles
- Environmental assessment: Investigate impact on soils and aquatic communities including phytotoxicity tests
- Toxicity of PM will be investigated by exposure to selected human cell lines.

Life Cycle assessment
- To assess environmental impact
- Considers entire production chain from raw materials to product disposal
- Life Cycle Cost Analysis comparing new and traditional braking system

Recommendations to policy makers
Defining the following recommendations
i) a solid, reproducible and repeatable measurement procedure for assessing PM emissions from brake wear
ii) Roadmap on the reduction of PM emissions from non-exhaust gases
iii) Results of socio-economic impact including cost-benefit assessment of monetary benefits associated to PM emissions reductions brought by the project.
Expected exploitation and dissemination

**Exploitation**
- Identification of stakeholders
  - Set up of User Group
- Interim Exploitation plan
  - Market potential analysis
- Validation of interim results from User Group
  - Definition of exploitable project results
  - Market potential and full business model
- Validation of final results from User Group
  - Exploitation Agreement
  - Exploitation Plan

**Initial Stage**
- 12 months

**Mid Stage**
- 24 months

**Advanced Stage**
- 30 months

**Final Stage**
- 36 months

**Dissemination**
- Web Site
- Project Communication Material
- e-Brochure, Flyers
- Press Release on project objectives
- Web Site contents update
- Communication at Intl. events
- Awareness campaign (network)
- Press Release on project objectives
- Web Site update with public deliverable
- Presentation at international events
- Publication of Papers and articles
- Web Site updated with public deliverable
- Presentation at international events
- Realisation of final conference
- Publication of Papers and articles
- Press Release for wider public

LOWBRASYS KICK-OFF MEETING 14-15 September 2015
Expected impacts

1. Cleaner, more efficient road transport activities through advances in brake concept.
2. At least a 50% reduction of particle emissions demonstrated.
3. Contribution to improvements of urban air quality in the midterm and strengthening the competitiveness of the EU car industry.