French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR)

Pavement LCA: a Comparison of American and European Tools

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Outline

• Introduction
• Objectives
• Compared tools
• Case study
• Results
• Recommendations
Introduction

• Road pavements have considerable environmental burdens associated with their construction, maintenance, and use

• Pavement stakeholders community are congregating efforts to mitigate these negative effects
Introduction

• Collaborative research effort between LCE4ROADS (EU) and NSPC Transportation Pooled Fund (US) was established:

• To improve the current trends in terms of enhancing sustainability in pavements

FIRST JOINT MEETING- Washington. March 2014

SECOND JOINT MEETING- Madrid. September 2015
Objectives

• Provide the pavement stakeholder community with insights on the potential differences in the life cycle impact assessment results of road pavement LCAs resulting from applying American and European LCA tools
Compared tools
## Compared tools

<table>
<thead>
<tr>
<th>Feature</th>
<th>GaBi</th>
<th>Palate</th>
<th>DuboCalc</th>
<th>VTTI</th>
<th>ECORCE</th>
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<tbody>
<tr>
<td>Country</td>
<td>Germany</td>
<td>USA</td>
<td>Netherlands</td>
<td>USA</td>
<td>France</td>
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<td>Primary Data Source</td>
<td>Literature and industrial data; databases</td>
<td>Carnegie Mellon University EIO-LCA software; Transp. Energy Data Book</td>
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<td>Literature data</td>
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<tr>
<td>Photochemical ozone creation</td>
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<td>Y</td>
<td>Y</td>
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<tr>
<td>Acidification</td>
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<td>Y</td>
<td>Y</td>
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<td>Eutrophication</td>
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<td>Y</td>
<td>Y</td>
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<tr>
<td>Chronic toxicity</td>
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<td>Y</td>
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</tbody>
</table>
Case study: general description

• Spanish road № 340
• 1,568 m long, 2 lanes road pavement section
• Analysis period: 20 years
Case study: general description

• Functional unit: 1 km of mainline pavement and year
Case study: system boundaries

- Materials Extraction
- Mixtures Production
- Construction and M&R
- Transportation of materials
- End-of-Life
- Usage
- WZ Traffic Management

Energy Sources Production
Case study: system boundaries

Materials Extraction  ->  Mixtures Production  ->  Construction and M&R

Energy Sources Production

Transportation of materials

Stage 1: demolition of the old pavement and fence
Stage 2: soil excavation and movement
Stage 3: pavement structure construction
Stage 4: road sub-structure construction (i.e. drainage system)
Stage 5: M&R of the top pavement layer
LCIA results: materials level
LCIA results: materials level

- Climate Change Score

![Climate Change Score Chart]

- Palate
- Gabi
- DuboCalc
- VTTI
- Ecorce

- General fill (soil)
- Water
- Graded aggregates
- Bitumen Emulsion
- AC 32 Base G
- AC 22 Bin S
- PG bitumen
- Concrete (brick)
- Glass fibres filaments
- Concrete C20
- Cement
- Formwork
- Prime coat
- Concrete C15
LCIA results per construction stage

- **Climate Change Score**

![Bar chart showing climate change results per construction stage]

- **Stage 1**: demolition of the old pavement and fence
- **Stage 2**: soil excavation and movement
- **Stage 3**: pavement structure construction
- **Stage 4**: road sub-structure construction (i.e. drainage system)
- **Stage 5**: M&R of the top pavement layer
Relative impacts per construction stage

- Climate change impact category

Relative contribution to Climate Change impact category

<table>
<thead>
<tr>
<th>LCA Tool</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
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<tr>
<td>GaBi</td>
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<tr>
<td>PaLATE V2.2</td>
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<td>ECORCE-M</td>
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</table>

Stage 1: demolition of the old pavement and fence
Stage 2: soil excavation and movement
Stage 3: pavement structure construction
Stage 4: road sub-structure construction (i.e. drainage system)
Stage 5: M&R of the top pavement layer
LCIA results: explaining the differences

1. Database comprehensiveness
2. Level of detail of inventory data
3. LCA approach: economic input-output vs. process-based data
4. Temporal, technical, & geographical representativeness
5. System boundaries & allocation methods
6. Process modelling approach
Recommendations

• To develop a consensual framework and Product Category Rules (PCR) for pavements
• To develop local databases that comply with (inter)national standards. They should be built by international cooperation of diverse parties
• To tailor datasets to the impact assessment methods and flows intended to be tracked
• To perform sensitivity and uncertainty analyses
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Thank you for your attention

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