EcoLanes - “Economical and sustainable pavement infrastructure for surface transport”

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ETRA, European Tyre Recycling Association
Outline

• Concrete road pavements and fibres from tyre-steel cord
• EcoLanes overview
• Benefits from EcoLanes
Surface transport infrastructure

• EU infrastructure: €600bn up to 2010 for maintenance and extension of network
  - respond needs of enlarged EU
  - benefit single market

• Road pavements main element of infrastructure
  - Flexible: Asphalt concrete
  - Rigid: Portland cement concrete
Road pavements

Flexible pavements:
- Deep foundations / multi layer construction
- Energy consumption due to transportation of materials
- Increasing cost of asphalt due to high oil prices

Rigid pavements
- Single layer
- Generally last longer
- May require asphalt topping due to noise / comfort issues

Conventional rigid pavements more expensive than flexible
Rigid pavements

- Use steel reinforcement to
  - improve mechanical properties
  - reduce pavement depth

- Steel fibres reduce costs associated with rebar placement

- Concrete mixes
  - wet / slip forming (laborious - require side formwork)
  - dry / roller compaction (fast – cost effective)

- Difficult to add fibres in roller-compacted concrete
EcoLanes background:

- University of Sheffield research on tyre recycling ([http://www.shef.ac.uk/tyre-recycling](http://www.shef.ac.uk/tyre-recycling))

Tyre shredding: SRSF

Microwave induced pyrolysis of whole tyres: PRSF
UoS research proved that tyre-fibres (e.g. PRSF) can be as effective as industrially-produced fibres (ISF).
EcoLanes background

- Aggregate Industries Ltd UK (AI) / Holcim
  - Precast concrete products
  - Contractors for all types of pavement surfacing and construction
  - Major supplier of aggregate / asphalt / cement
  - But interested in concrete road pavements
    - future competitiveness (uncertain future of asphalt)
    - environmental issues (CO$_2$ trading scheme)
EcoLanes background

• AI’s interest in road pavements

  - research collaboration between AI and UoS
  - funded a year’s Fellowship for further research & preparation of proposals on concrete roads
EcoLanes Development

Transportation Engineering

Environmental Engineering

End-Users

Steel-Fibre-Reinforced Roller-Compacted-Concrete Road Pavements

Tyre Recycling
<table>
<thead>
<tr>
<th>No.</th>
<th>Participant organisation name</th>
<th>Country</th>
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<tbody>
<tr>
<td>1</td>
<td>The University of Sheffield (concrete)</td>
<td>United Kingdom</td>
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<tr>
<td>2</td>
<td>Akdeniz University (environmental)</td>
<td>Turkey</td>
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<tr>
<td>3</td>
<td>Technical University “Gheorghe Asachi” Iasi (transportation)</td>
<td>Romania</td>
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<td>4</td>
<td>European Tyre Recycling Association (environmental policy)</td>
<td>France</td>
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<td>5</td>
<td>Aggregates Industries UK Ltd (concrete materials &amp; pilot demonstration)</td>
<td>United Kingdom</td>
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<tr>
<td>6</td>
<td>Antalya Municipality (demonstration)</td>
<td>Turkey</td>
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<td>7</td>
<td>Romanian National Road Authority (demonstration)</td>
<td>Romania</td>
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<tr>
<td>8</td>
<td>Adriatica Riciclaggio e Ambiente s.r.l.* (tyre recycler)</td>
<td>Italy</td>
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<tr>
<td>9</td>
<td>Public Works Department (demonstration)</td>
<td>Cyprus</td>
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EcoLanes Outline

Call: FP6-2005-Transport-4

Type of instrument: Specific Targeted Research Project (STREP)

9 partners, 9 work packages, 633 man-months total cost ~€2.5m

Reference Number: 031530

Submitted: 1 September 2005

Evaluated: October 2005

Contract Negotiations: March – August 2006

Start of contract: 1 October 2006

End of contract: 30 September 2009
EcoLanes Objectives

Develop infrastructure for surface transport using:

• Roller-compacted techniques based on existing asphalt laying equipment
• Steel fibre reinforced concrete
• Concept of long-lasting-rigid-road-pavements

The project aims to reduce:

• Construction costs by 10-20%
• Construction time by 15%
• Energy consumption in road construction by 40%
• Maintenance

And to

• Use waste materials
• Make tyre recycling more economically attractive
EcoLanes work plan

Tasks

Project Steering and Management Committee

- Exploitation Manager
  - WP8 Dissemination & Exploitation

Technical Management Group

- WP1 Fibre sorting
- WP2 FRC
- WP3 Pavement Testing, Analysis, Design
- WP4 Environ. Studies & Site Processes

Coordination Team

- WP9 Project Management

Demonstration Management Group

- WP5 Demonstration in W. Europe
- WP6 Demonstration in E. Europe
- WP7 Demonstration in E. Mediterranean
WP 1: Fibre Sorting
Leader: AD.RI.A (Italian Tyre Recycler)

Develop techniques and equipment:
• Post-processing steel fibres extracted from tyres
• Arrive at fibres suitable for incorporation in concrete
WP 2: Fibre-reinforced Concrete
Leader: The University of Sheffield (United Kingdom)

Develop steel fibre-reinforced concrete mixes:
• Suitable for slip forming and roller compaction
• Use recycled materials, low energy cements
WP 3: Pavement testing, analysis and design

Leader: Technical University of Iasi (Romania)

Develop long-lasting-rigid-road-pavement concept:

- Accelerated load tests (facility ALT-LIRA)
  1.5 million cycles: 30 years (600 trucks /day)
- Durability (climate) tests
- Develop design guidelines for LLRRPs
WP 4: Environmental studies & site processes

Leader: Akdeniz University (Turkey)

Develop life-cycle cost tool to assess environmental impact:
• Site construction processes
• Long-last-rigid pavements (LLRRP)

Develop optimised processes for constructing LLRRPs:
• Use of existing asphalt equipment
WP 5 - 7: Demonstrations

Leaders: Aggregate Industries (UK), DRDPIASI (RO), Antalya Municipality (TR)

• Construct four concrete roads in rural and urban European environments

• Eliminate the problem of road deterioration due to cold and wet environments

• Eliminate the problem of asphalt displacement due to hot weather
WP 8: Dissemination and Exploitation

Leaders: European Tyre Recycling Association (France), Sheffield University Enterprises Ltd (UK)

• Focus the project on developing solutions needed for transport infrastructure

• Develop technology implementation plan (IPR)

• Disseminate research findings:
  - website (http://ecolanes.shef.ac.uk)
  - 2 industrial seminars
WP 9: Project Management

Leader: The University of Sheffield (United Kingdom)

- Optimise application of technical resources
- Ensure compliance with the project objectives
- Ensure efficient communication within the project
- Ensure that all aspects of the EC requirements for communication and reporting are met
EcoLanes expected output

**Tyre-recycled steel fibres:**
- Processes & machinery to sort and clean shredded fibres

**Steel-fibre-reinforced RCC rigid pavements**
- Processes and machinery to disperse steel fibres in RCC
- Use of waste materials
- Analysis and design software for concept of LLRRPs

**Surface transport infrastructure**
- Reduction of construction time and cost
- Reduction of energy consumption during construction
Benefits for tyre recyclers

• Price of industrial fibres: €650 ~ €14000 per tonne

• Initial market value of RSF: €150 ~ €300 per tonne

• Economic benefits for tyre recycling industry
Benefits for tyre recyclers

Use of recycled tyre-cord in concrete construction

• Provide sustainable market for recycled tyre-cord
• Encourage material recovery of large amounts of tyres
• Facilitate implementation of EC directives
Benefits for construction industry

• Low-cost steel-fibre reinforcement
• Economic method for road construction
• Reduction of industry’s CO$_2$ emissions
• Access to construction innovation
The presentation is available online:
http://ecolanes.shef.ac.uk/diss.htm

Thank You
Background Notes
Placing of RCC in truck

Placing of RCC in paver

Placing of RCC pavement

Layers: 100-200mm, up to 250mm (with high density paver)

Rolling of RCC pavement

From mixing to rolling ~ ½ hour