Executive Summary

EcoLanes' main objectives are to develop, test and validate steel fibre reinforced concrete (SFRC) pavements that will contribute towards the strategic objectives of the thematic priority area of Sustainable Surface Transport. EcoLanes aims to use roller-compaction techniques (based on existing asphalt laying equipment) as well as recycled materials to reduce construction costs in the range of 10-20%, construction time by 15% and energy consumption by up to 40%.

The project, which started in October 2006, comprises 9 work packages: 4 RTD, 3 demonstration, 1 dissemination and 1 management. The project draws expertise from six European countries and its consortium (shown below) comprises four universities, three industrial partners, a Recycling Association and three end-users.

- The University of Sheffield, UK *(Coordinator: Prof. Kypros Pilakoutas, Department of Civil and Structural Engineering, The University of Sheffield, Sir Frederick Mappin Building, Mappin Street, Sheffield S1 3JD, United Kingdom. k.pilakoutas@sheffield.ac.uk).*
- Akdeniz University, Turkey.
- Technical University 'Gheorghe Asachi', Romania.
- European Tyre Recycling Association, France.
- Aggregate Industries UK Ltd, United Kingdom.
- Antalya Municipality, Turkey.
- Compania Nationala de Autostrazi si Drumuri Nationale din Romania, prin DRDP Iasi, Romania.
- Adriatica Riciclaggio e Ambiente s.r.l., Italy.
- Public Works Department, Ministry of Communications and Works, Cyprus.
- Cyprus University of Technology, Cyprus.
- Scott Wilson Ltd, United Kingdom.

In addition to the management and administration of the consortium, the following were the other main objectives for the second reporting period.

- Optimisation of the techniques and equipment developed (during the 1st reporting period) for post-processing steel tyre-cord fibres, produced from the mechanical treatment of post-consumer tyres.
- Supply of suitable steel tyre-cord fibres to the technical and demonstration work packages.
- Experimental and theoretical investigation of wet and dry SFRC mixes, which have reduced energy requirements and use recycled materials.
- Experimental and theoretical validation of the concept of the long-lasting rigid pavements (LLRP) made with wet and dry SFRC.
- Development of methodologies for the environmental and cost life cycle assessment of LLRP and site processes.
- Development of equipment for fibre dispersion and site processes.

- Problem investigation and design of demonstrations.

The consortium had two management meetings during the period as well as several technical meetings and dissemination activities. In addition to maintaining clear communication channels and coordinating the technical work, the project steering and management committee took very robust action to deal with some delays in the work progress of some contractors. These issues have by now been resolved and two new partners joined the project.

On the RTD side, the main strategy was to tackle very quickly the areas that presented the highest technological risks, i.e. whether the fibres can be sorted and classified on the medium scale and whether they can be included in sufficient quantities in wet and dry concrete mixes. The results until now are positive, and that means that the overall project technological risks are considerably reduced. However, there is still a low level risk on not supplying recycled steel fibres to the project specification and, hence, it may be necessary to purchase steel fibres from external sources. The performed work and main outcomes of the 4 main RTD work packages are as follows.

Work Package 1 – Fibre Sorting

The fibre cleaning and sorting techniques, developed during the 1st reporting period (Figure 1), were improved to increase the yield of useful recycled steel tyre-cord fibres. This included refinement of the process and hardware used for the mechanical treatment of post-consumer tyres. A procedure was also developed for determining fibre length distributions for Q&A purposes. By the end of the 2nd reporting period, the cleaning and sorting techniques could produce tens of kilograms of recycled steel tyre-cord fibres per hour. Around 15 tonnes of recycled steel tyre-cord fibres were supplied for the pre-demonstration trials

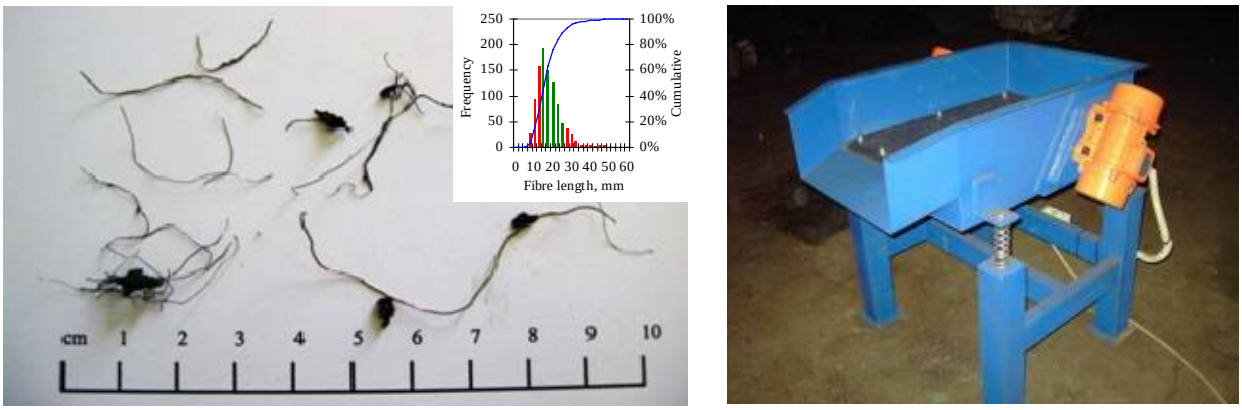

Figure 1 Steel tyre-cord fibres recycled from the mechanical treatment of post-consumer tyres (left), and hardware prototype used for their sorting (right)

Work Package 2 – Fibre Reinforced Concrete

Trials mixes were developed for wet and dry consistency SFRC and key parameters were investigated. The fresh and hardened properties of these mixes were experimentally investigated by undertaking standard laboratory tests. These included bending tests of SFRC prisms, which were undertaken to characterise the

flexural toughness of the developed SFRC mixes. The bending tests showed that recycled steel fibres can be as efficient as industrially produced steel fibres, if they are used at higher fibre contents. Bending tests were also carried out on prisms, which were initially exposed to corrosive environments (e.g. freeze-thaw cycles). No reduction in the mechanical properties was observed due to the durability issues (e.g. Figure 2). Work was also carried out on the theoretical evaluation of the properties of the wet and dry SFRC mixes.

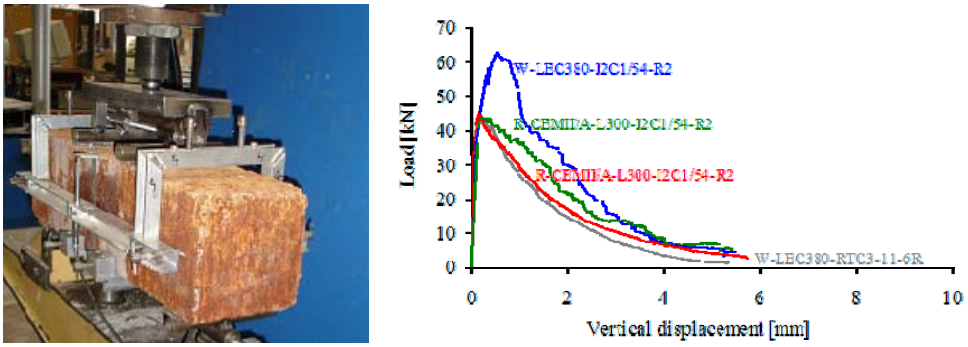

Figure 2 Bending test results of SFRC prisms tested by WP2; the prisms initially sustained 5 months of wet-dry corrosion cycles

Work Package 3 - Pavement testing, analysis and design

The trial SFRC pavement (Figure 3), which will be tested under accelerated load testing, was constructed and instrumented at the ALT LIRA facility. Extensive analytical and numerical (elastic and inelastic finite element) analyses of plain-concrete and SFRC pavements were undertaken aiming to develop appropriate design tools for wet and dry SFRC pavements. Existing design methods for concrete pavements are being examined. In addition, it is being investigated to find out if LLRP can be designed using the UK method for industrial concrete floors.

Figure 3 Construction of the trial LLRP (a and b) at ALT LIRA facility (c)

Work Package 4 - Environmental studies and site processes

Methodologies were developed for the life cycle assessment of the environmental impact and cost of LLRP and data collection was initiated for each demonstration pavement. The industrial dispersion of fibres in concrete was examined as well as the processes and equipment currently used for roller-compacted concrete. Successful dry SFRC trials were also carried out in the United Kingdom and Romania to assess these equipment and processes (Figure 4).

(a) Pre-demonstration trial held in London (UK), June 2008.

(b) Pre-demonstration trial held in Gura Humorului (Romania), September 2008.

Figure 4 WP4 trials of site processes

Work was also carried out for the demonstration work packages. Site investigations were undertaken for the sites selected for the construction of the four demonstration pavements and SFRC mixes were developed by using locally available construction materials. In addition, two pre-demonstration trials were undertaken to assess SFRC and roller-compacted concrete technology.

The consortium also undertook dissemination activities, such as publication of 30 press releases and 19 technical papers. Two industrial seminars were held so far (May 2007 in Rome, Italy, and October 2008 in Iasi Romania).

Expected Outcome

A number of results are expected from the work of the EcoLanes project.

- The project has developed small to medium scale industrial processes and machinery for sorting the steel tyre-cord fibres. It is expected that during the 3rd reporting period, 120 tonnes of recycled steel tyre-cord fibres will be produced, required for the construction of the four demonstration pavements.
- The project is expected to develop SFRC mixtures, which use materials with low energy requirements (such as low energy cement and recycled steel fibres and aggregates).
- Analysis and design software are also expected to be developed for the concept of LLRP.

These results should provide: a) a sustainable market for the steel fibres recycled from post consumer tyres and, thus, encourage the material recovery of large amounts of tyres, b) open the way for the construction of LLRP, which are more economic and environmentally friendly.

The EcoLanes consortium has developed an exploitation strategy of the project and several streams of protectable IP is expected.

Further information on the EcoLanes' activities and dissemination material may be obtained from http://ecolanes.shef.ac.uk.