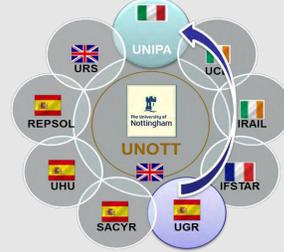


# Characterization of rubberized asphalt for railway sub-ballasts

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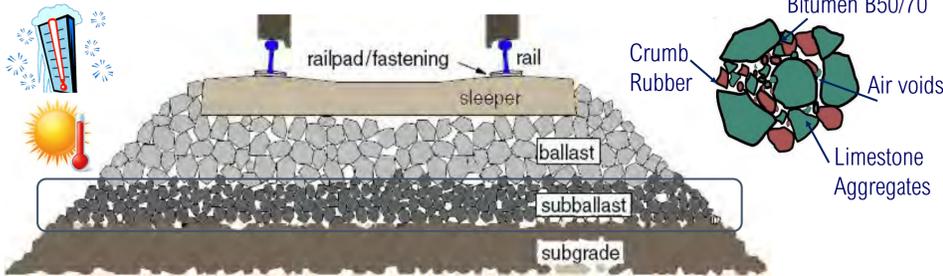
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## Abstract

The use of recycled materials within the road and **railway infrastructures** is now an irreversible trend. In this area the use of **Dry Rubber-modified asphalt concrete mixtures (RUMAC)** in **sub-ballast layer** seems to be a suitable technique to reach high mechanical and environmental performance even if such material should be analysed over a long time horizon.

This project presents the results of experimental research focused on the **resistance to FATIGUE CRACKING** of **Dry Rubber-Modified Asphalt Concrete** in sub-ballast layers; the survey has been carried out using 4-point bending tests.

The results of fatigue in rubberized asphalt in railways, have been compared with the performance of different mixes such as a **standard hot mix asphalt without rubber** according Italian standard, **two Plusride™ mixes** with 1.5-3% crumb rubber modifier (CRM) and a **Generic Hybrid-Dry modified asphalt concrete** with coarse/fine scrap tire rubber.

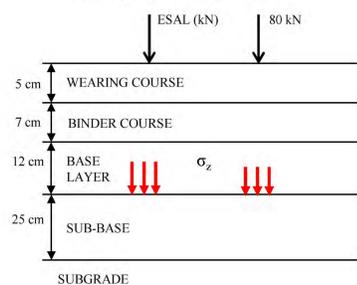


## Objectives

- Use of sustainable methodology to apply ASPHALT RUBBER by dry process (Rubber modified asphalt concrete mixture) to decrease the ground-borne vibrations.
- Laboratory evaluation on the performance of hot mix asphalt (HMA) using crumb rubber.
- Investigate optimal mechanical parameters of "aggregate-rubber" hot asphalt mixes with computer model development (KENTRACK).

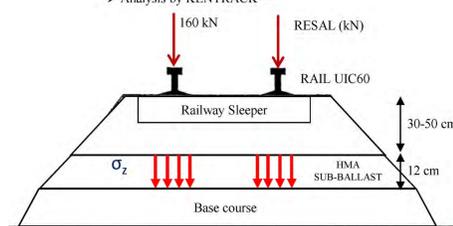
### ROAD SUPERSTRUCTURE

- Typical motorway pavement in Italy
- Multi-layer linear elastic analysis
- Analysis by KENPAVE™

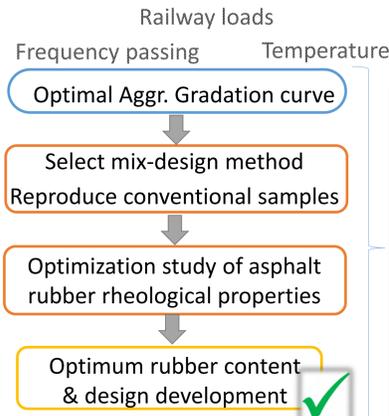


### BALLASTED RAIL TRACK

- Typical Italian-track speed < 250 km/h
- Sleeper spacing = 60 cm
- Analysis by KENTRACK™



## Methodology



## Materials

- Waste tires crumb rubber [recycled materials] used as an additive within railway infrastructures in **sub-ballast layer bituminous mixes** improves characteristics such as **viscosity, fatigue cracking resistance and noise attenuation**.
- Experimental work:
  - Conventional Hot mix asphalt (no rubber);
  - Generic Dry-Hybrid mixture (2%rubber);
  - RUMAC Gap-Graded (1.5-3%rubber) Plusride™ Granulated technology;
- Crumb rubber sizes:
  - Ø0.4-2mm; Ø2-4mm; Ø4-9.5mm.

## NETWORK WIDE TRAINING PROGRAMME

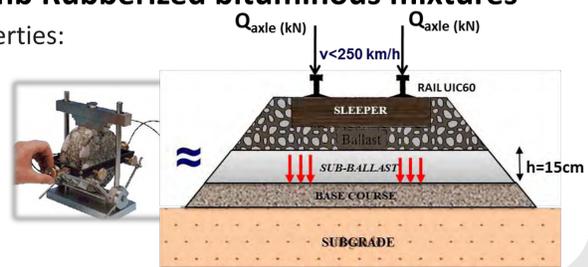
**Principal materials on sub-ballast**

Aggregates, Tyre Rubber, Bitumen, Additive, Gravel (ballast)

Testing, Lifecycle Assessment, Industrial links, Environment, Social Media CRM, Social impact, Rail technology, SKILLS

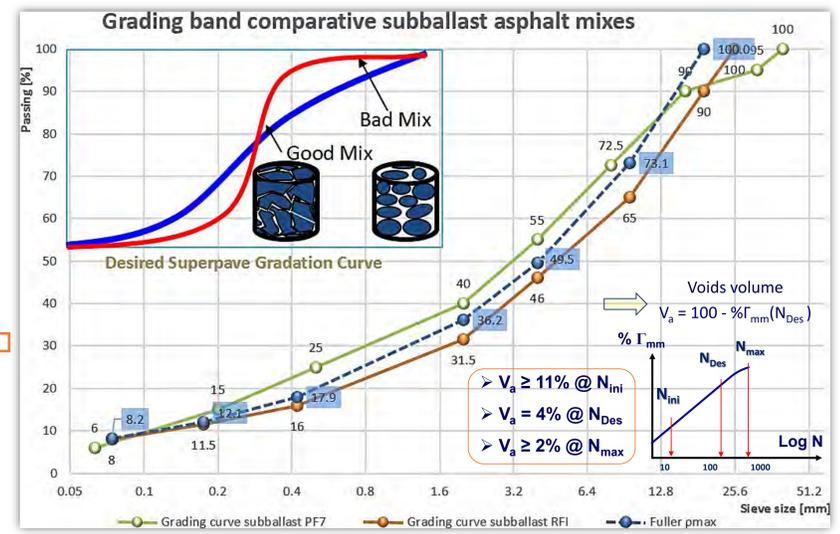
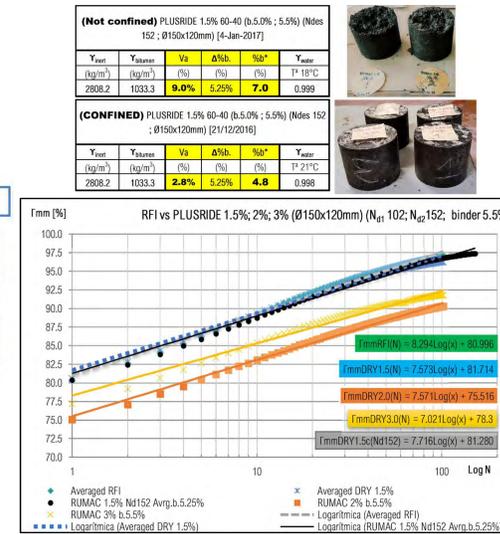
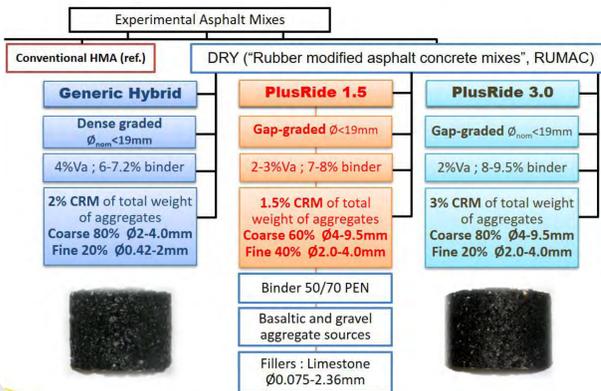
## Laboratory tests on Crumb Rubberized bituminous mixtures

- Evaluation of mechanical properties:
  - Marshall Stability & Flow;
  - Indirect tensile fatigue test;
  - Dynamic complex modulus;
  - Fatigue damage-cracking (4PDBT; UGR-FACT devices);



## Experimental research

- SUPERPAVE Mix design ↔ KENTRACK



## Results & Future expectations >> \*\*A new benchmark criteria for defining a first Superpave mix design system for railways!!!\*\*

RUBBERIZED bituminous mixtures could be effective in DAMPING factor & high vibration ATTENUATION in railways. The scope is achieved with the evaluation of CRM-mixes as Plusride dry-gap-graded and dense-graded Generic-Hybrid technologies. Mechanical parameters to develop a computer modelling in railway track sub-ballast.