

## Overview of French Research Project on Cold Mix Asphalt Recycling for Road Construction / Maintenance

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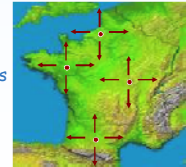
## Cold mix asphalt properties

### ◆ Time-dependent behaviour

- Strong behaviour changes during its life from unbound material to HMA behaviour : curing and cohesion build-up

### ◆ Local competences

- Mix design and manufacture are empirical
- Many difficulties to 'spread' CMA processes over French territory



### ➔ Research program

- Assess pavement layer behaviour versus time
- Develop mix design methodology

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## Experimentation

### ◆ Assess pavement layer behaviour versus time

- Construction and monitoring of experimental sections
  - Departmental Road n°20, October 2006 (with local authority C631)
  - Departmental Road n°44, July 2008 (with local authority C635 and French Union of Road contractors USIRF)



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## Instrumentation installation on RD44 worksite

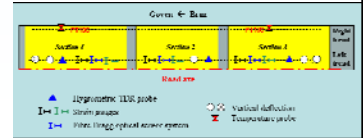
### RD44 experimentation

a single testing zone (12.3 m long) has been instrumented by placing probes and sensors in the new GE (12 cm thick) layer



### Compaction step on testing zone

- GE layer in the probes and gauges zone was **not submitted to vibrating compaction** to preserve probes
- To obtain required in situ voids content, the pneumatic-tyred roller passes number has been increased (32 passes).



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## Internal instrumentation (CMA Layer)

### ◆ CMA internal behaviour

- Gauge responses
- Temperature and moisture evolution

Strain gauge and optical fibres



TDR probe (moisture)

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## External instrumentation (climatic conditions)

### ◆ Climatic conditions (rainfalls, wind, solar UV, atmospheric IR radiations)

### Objective

Globally assess local weather features and correlate them with in situ curing of the GE



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## Additional assessment

- ◆ CMA internal behaviour
  - Cored and sieved samples to check binder characteristics and mixes mechanical performances (EN 12697-26) over time

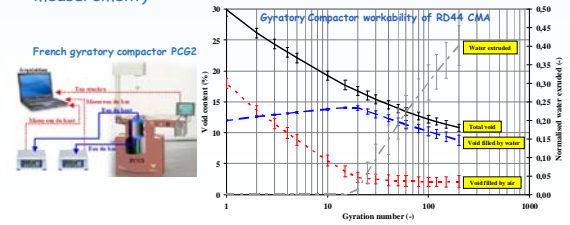


Two-point bending complex modulus test, uniaxial direct tensile test, indirect tensile stiffness test (diametral pulse loads)

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## Methodology used

- ◆ Constituents and worksite control
  - Aggregate and grave-emulsion characteristics
  - On site workability (French gyratory compactor PCG2)
  - Jobsite mix cohesion characterization (workability test and torque measurement)



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A French Experimental Worksite to Assess in situ Cold Bituminous Mixtures Behaviour. Working paper, ECAR/MAGC/FA, 2010

## Methodology used

- ◆ Global pavement behaviour (external auscultation techniques: Deflexion (Deflectograph Flash, Falling Weight Deflectometer), permanent deformations and transverse profile (PALAS) in continuous mode)

Falling weight deflectometer FWD



French Deflectograph FLASH

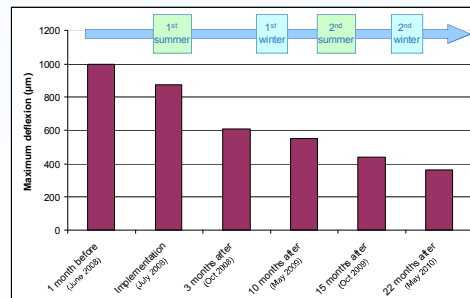


PALAS (laser profilometer)



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## Maximum deflexion measured by FWD



Deflexions decrease with time

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## Research subjects on CMA

- ◆ Monitoring jobsite behaviour
  - Classical in situ behaviour assessment (coring, mechanical perf.)
  - Links with binder ageing (extraction methodology,...)
  - External auscultations and in situ instrumentation
- ◆ Laboratory characterization methodology
  - Correlate materials time-dependent behaviour with climatic conditions
  - Develop lab methodology (especially curing conditions) to achieve CMA characterization

This study is in progress since 2007 (internal works at IFSTTAR and collaborative project with Private Industry)

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## CONCLUSIONS

- ◆ Great interest of Road Companies and French Administration for these environmentally friendly techniques with regard to sustainable development
- ◆ Researches to check cold asphalt mixes properties
  - Very short term : Equivalent to unbound materials
  - Short term : bound materials (GSC, Modulus, Rutting, ...)
  - Long term : Properties durability (Fatigue)
- ◆ Develop a collaborative mix and pavement design methodology (including specific tests – and experimental conditions evaluation dedicated to CMA assessment)
- ◆ Standardization (French and European levels) of cold mixes

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## Outputs

- ◆ 4 MLPC methods as helping tools to design CMA treated with bitumen emulsion (2011 - in French)
  - MLPC 74 : Coating quality and consistency
  - MLPC 75 : Hydrous stability of CMA (manufacturing, transport, storage)
  - MLPC 76 : Cohesion evolution (workability, torque measurement)
  - MLPC 77 : Aggregate reactivity of emulsion/aggregate couple



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## Outputs

- ◆ Collaborative project with the French Union of Road contractors
  - 14 communications in a French journal « RGRA » (2011 to 12)  
→ from manufacturing process in lab to CMA mechanical properties
  - Special issue available for the next congress Eurasphalt and Eurobitume (June 2012 - in English)
- ◆ IDRRIM French working group
  - Guide in progress on « Materials treated by emulsified bitumen and foamed bitumen »

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**Thank you for your  
attention !**

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