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

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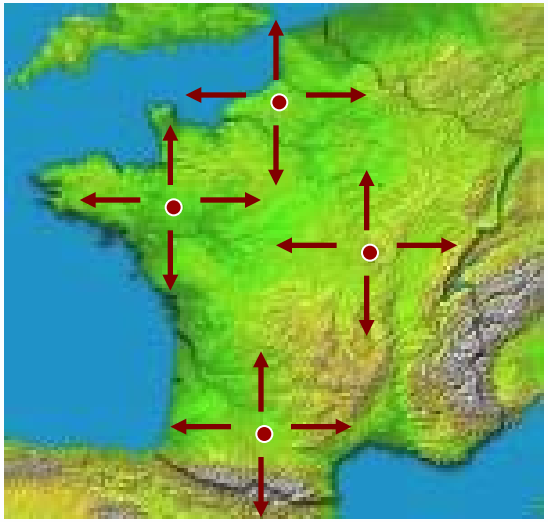
Cold mix asphalt properties

- **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

Experimentation

- Assess pavement layer behaviour versus time
  - Construction and monitoring of experimental sections
    - Departmental Road n°20, October 2006 (with local authority CG31)
    - Departmental Road n°44, July 2008 (with local authority CG35 and French Union of Road contractors USIRF)

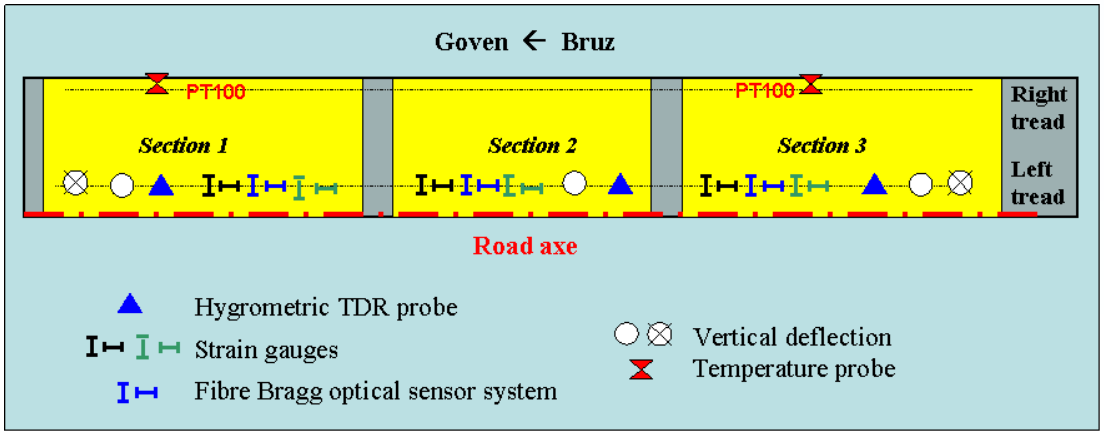
Instrumentation installation on RD44 worksite

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**

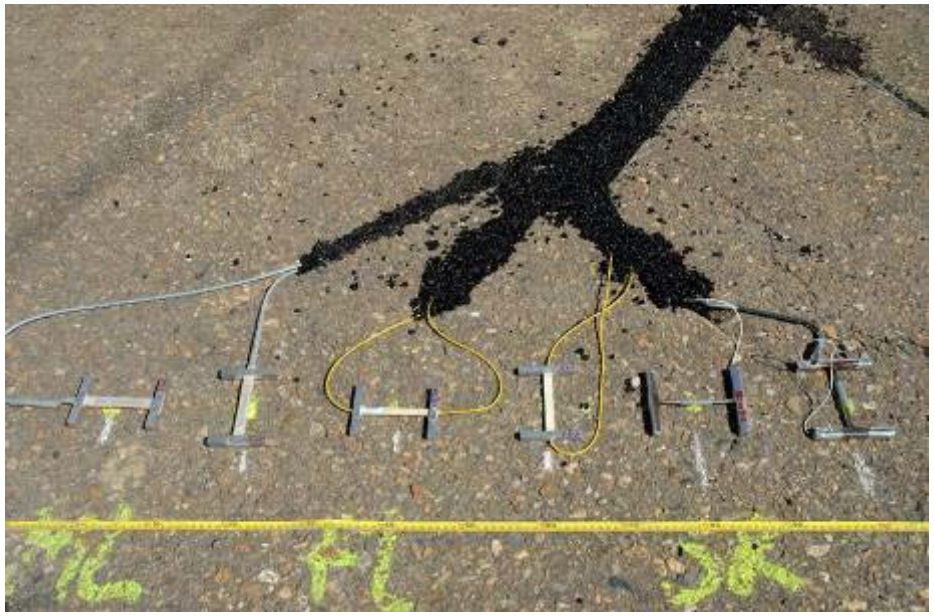
- GE layer in the probes and gauges zone was **not submitted to vibrating compaction** to preserve probes
- To obtain required in situ voids content, the pneumatic-tyred **roller passes number has been increased** (32 passes).



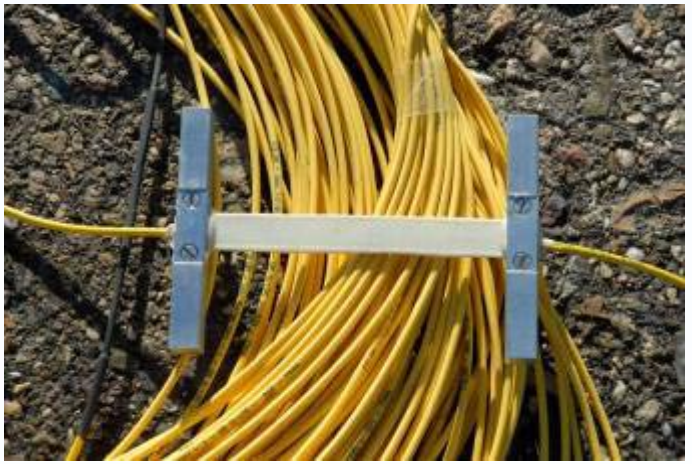
Internal instrumentation (CMA Layer)

- CMA internal behaviour
  - Gauge responses
  - Temperature and moisture evolution

Strain gauge and optical fibres



Optical fibres



TDR probe (moisture)

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

Additional assessment

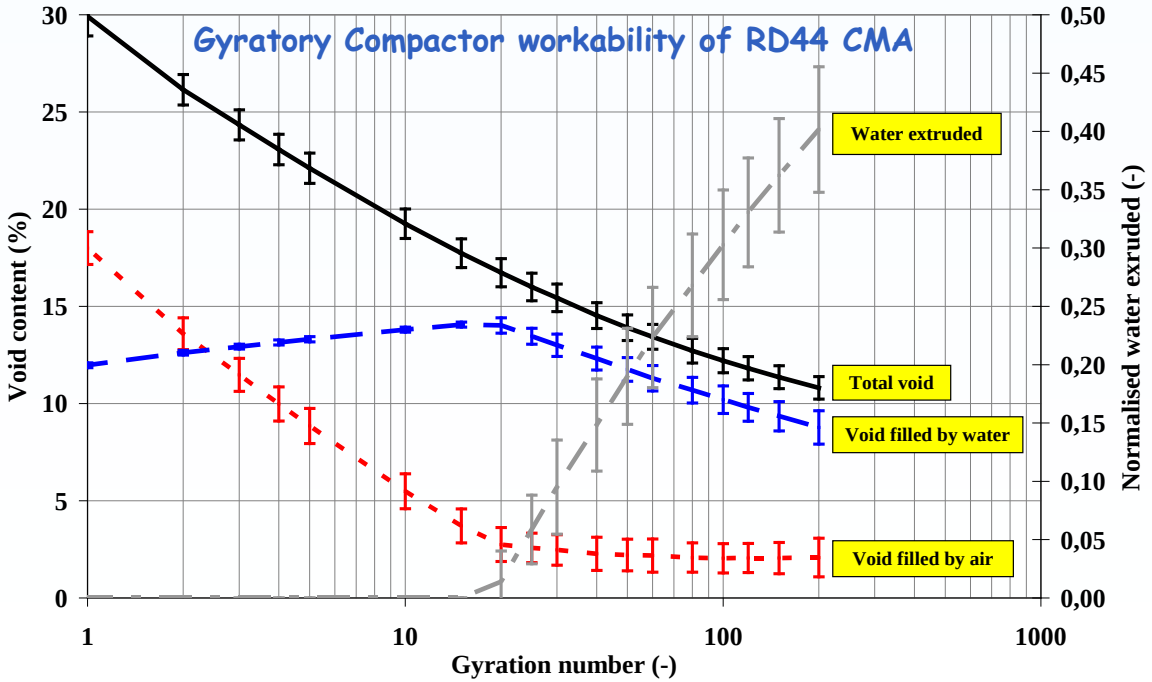
- CMA internal behaviour
  - Cored and sieved samples to check binder characteristics and mixes mechanical performances (EN 12697-26) over time

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

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)

French gyratory compactor PCG2



A French Experimental Worksite to Assess in situ Cold Bituminous Mixtures Behaviour, Wendling et al. ISAP NAGOYA, 2010

Methodology used

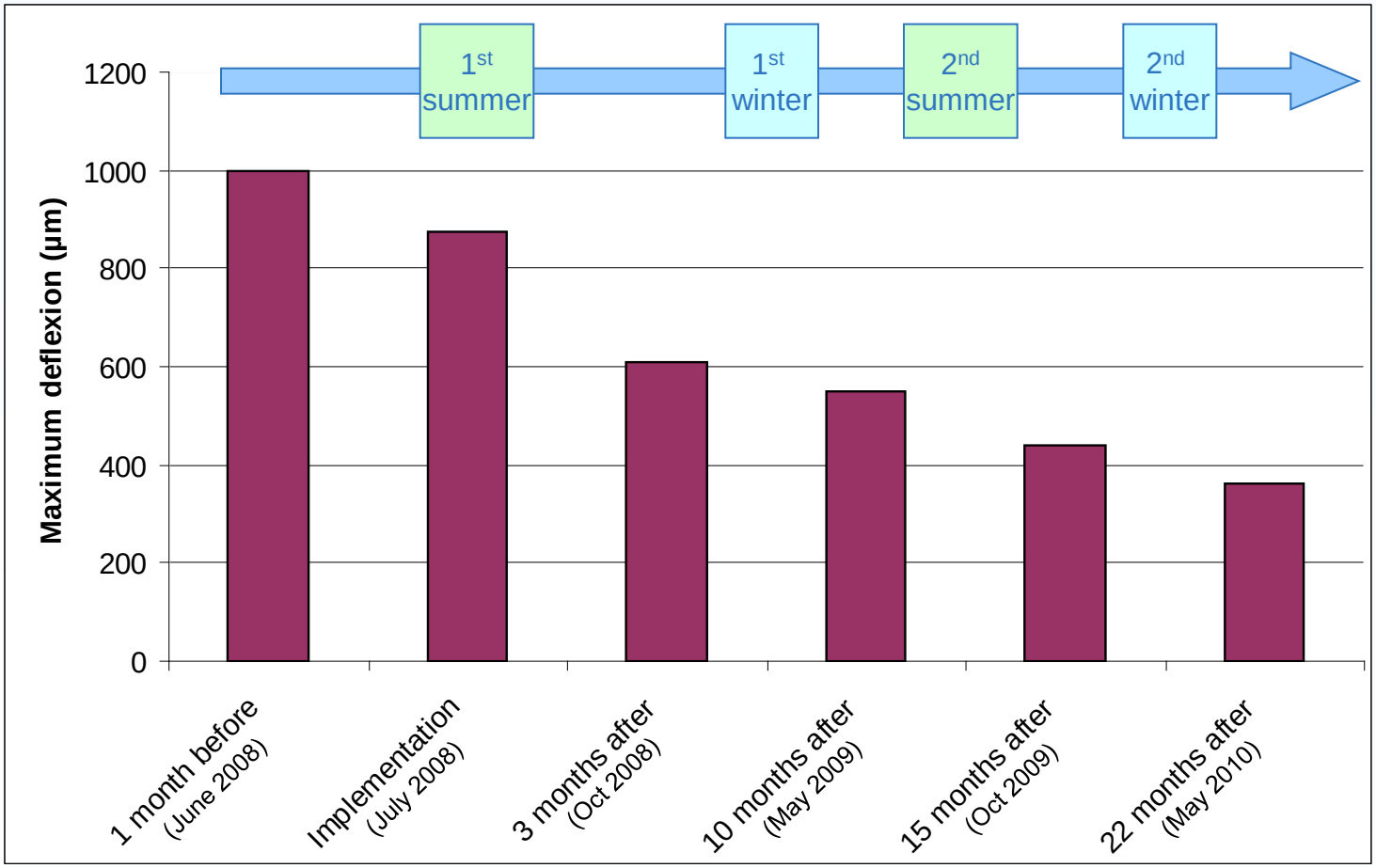
- Global pavement behaviour (external auscultation techniques: Deflexion (Deflectograph Flash, Falling Weight Deflectometer), permanent deformations and transverse profile (PALAS) in continuous mode)

Falling weight deflectometer FWD

French Deflectograph FLASH

PALAS (laser profilemeter)

Maximum deflexion measured by FWD



Deflexions decrease with time

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)

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

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

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 »

Thank you for your attention !

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