ORRAP
Optimal recycling of reclaimed asphalt pavement

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„Dépasser les frontières : projet après projet"

# ORRAP

**Optimal recycling of reclaimed asphalt pavement**

Recyclage optimal des agrégats de béton bitumineux dans les chaussées à faible trafic

*Optimales Recycling von Ausbauasphalt auf verkehrsschwachen Straßen*

01/11/2016 - 31/12/2020

## FINAL ANNUAL MEETING

02/12/2020

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES STRASBOURG
ICUBE

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# Synthesis and perspectives

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**ICUBE, UMR 7357, CNRS, INSA, Université de Strasbourg**

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# • Reminder of the objectives

- New RAP recycling strategy
  - To achieve an optimum formulation of the granular mixtures made of RAP which can be used in a **base layer with their own self-binding properties**
  - RAP from recycling centers (homogeneous or non-homogeneous (mixtures), containing PAHs or not)

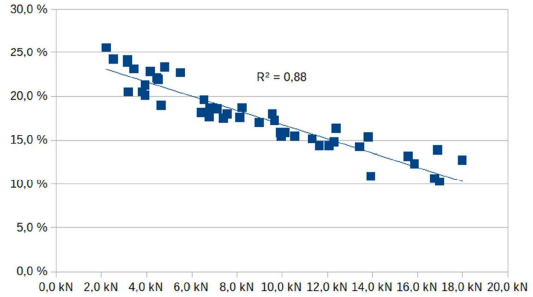
- Assessment of economic and environmental impact
  - The implementation of this technique in our regions will be studied both from an **economic** and **environmental** point of view.
  - A **risk analysis** will be carried out.

- Provision of useful **recommendations** for practitioners with a technical guide.

# Study of the self-binding properties of RAP (design of a granular mixture)

- Compactibility
  - No large influence of the water content (+/- 1.5%) **at OMC**
  - Large influence of the temperature (10°C to 50°C)
  - Influence of the PSD (coarser RAP)
- GSC and ITS tests
  - Large influence of  the temperature
  - Influence of the voids content

Evaluation of the impact of voids on ITS at 20 °C – Stock Germany & France



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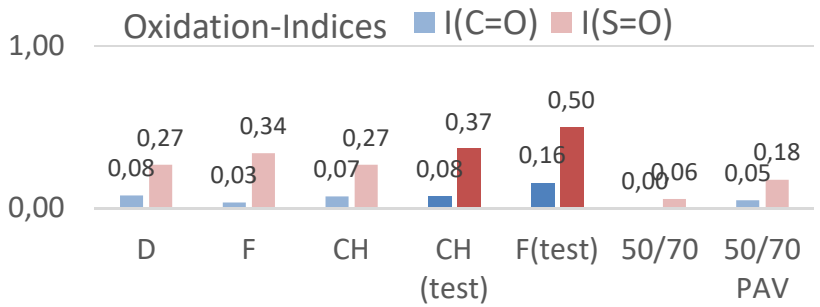
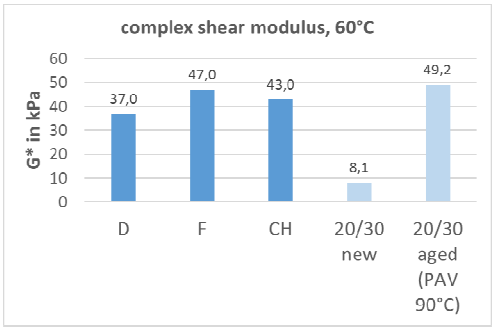
# Study of the self-binding properties of RAP (design of a granular mixture)

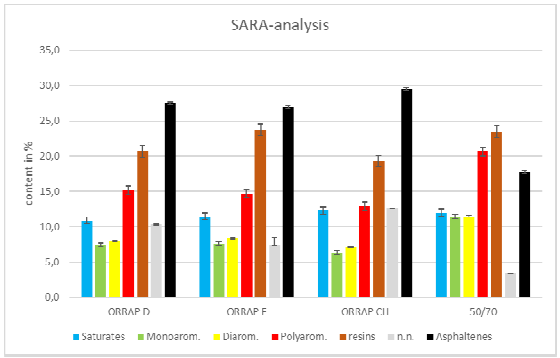
- Bitumen properties
  - Similar characteristics (R&B, pen, SARA, Ico, Iso) and rheological behaviour of the aged bitumen (60°C)




- MOP and CBR tests

  Different dry density and OMC (coarse RAP) from 4.3% to 6%.

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# Study of the self-binding properties of RAP (design of a granular mixture)

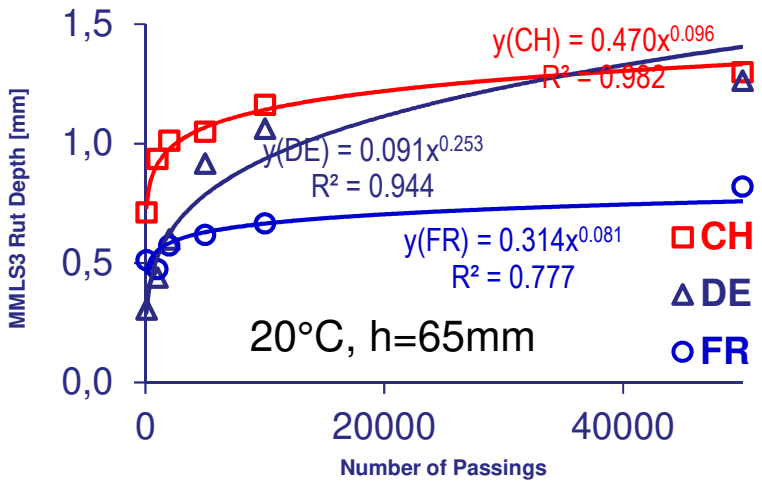
- RLT tests - strains

- Permanent strains increase with water content and with temperature
- RAP : permanent strain criterion not checked for RAP, but positive evolution with the increase of the compaction density

- RLT tests - mechanical properties
  - RAP : characteristic elastic modulus criterion checked
  - RAP can be used instead of UGM, in base and subbase layers in low-traffic roads

# Study of the self-binding properties of RAP (design of a granular mixture)

- Rutting tests with large wheel
  - 60°C is the lowest temperature (compaction effort)
  - Rutting resistance criteria (CH, F, G) are checked at 60°C
- Rutting tests with traffic simulator (MMLS3)
  - Most rutting at the beginning
  - Stable (no evolution) for similar PSD of RAP.



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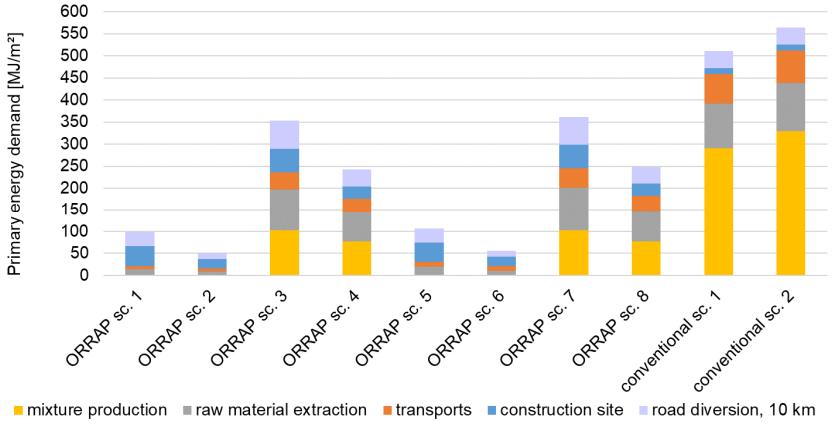
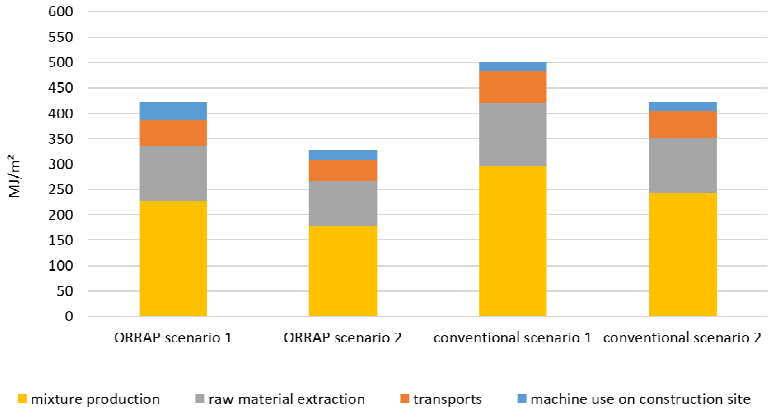
# Environmental studies : estimation of the deployment of this technique at the level of the Upper Rhine region

- Collection of environmental data related to the pavement construction process.
- Life cycle analysis, for a typical pavement, using the proposed construction method
- **Environmental relevance of this construction process.**
- **Gains on primary energy demand were obtained. They depend on the construction scenarii**



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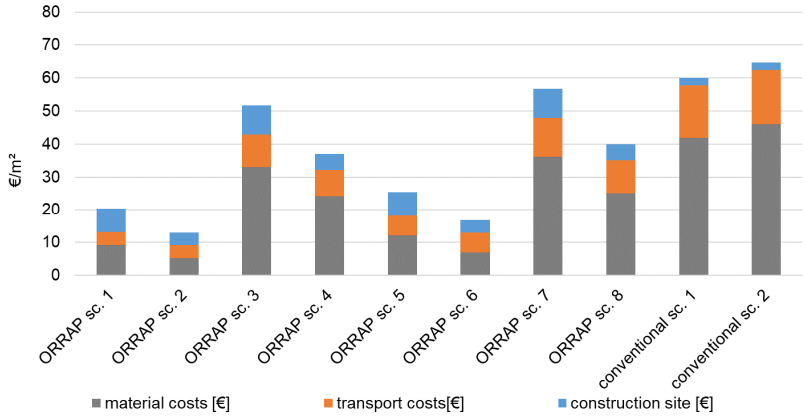
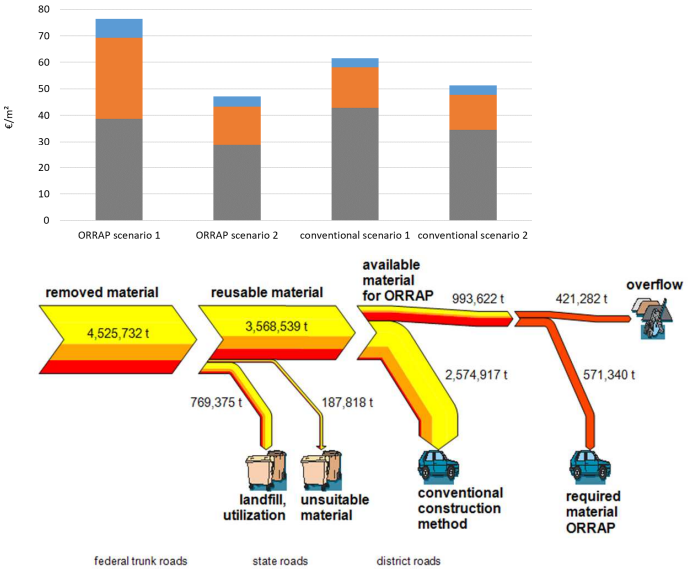
# Economic studies : estimation of the deployment of this technique at the level of the Upper Rhine region

- Economic relevance of this construction process
- **Reduction** of materials to be used for the same structural bearing capacity
- **Reduction** of environmental impact
- **Reduction** in the cost of constructions



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# Test sections

## After a year and a half with traffic :

- The pavements (CH and F) are behaving well
- **Protection** of the ORRAP layer (e.g. surface course or surface dressing) is recommended.
- Two sections in ORRAP technique do not differ from the section in conventional UGM ;
- Keeping **moisture content** at reasonable level improves compactability
- French test section will still be monitored for several years (with the Aigle 3D device).

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# Synthesis

- Constructing low and moderate traffic volume roads with 100% of RAP at low compaction temperature with ORRAP technique appears **doable**

- ORRAP technique in the **off-season** is not recommended as low temperatures are negative for compactability and potential binder re-activation

- High requirements regarding **longitudinal evenness** cannot be met (like unbound gravel layers).

# Technical guide

thanks to Arnaud, Christiane, Hartmut and Delphine

- https://www.orrap.org/
- www.hs-karlsruhe.de/ivi/forschungsprojekte/orrap
- www.cerema.fr/orrap

# Perspectives

- The **follow up of the full scale test sections**, as Cerema and CD67 are planning to continue the performance study at least 3 years.

  This feedback will be organized among all the partners.

- The next step of this project would be to continue studying RAP material and to promote this material for **wider applications as for roads with medium traffic**.

  – A first action would include studying, classifying and **optimizing the RAP material concerning its grading**. As the construction of the test section clearly show, an optimization of RAP material would certainly improve it.

  – A second action to improve the RAP performance and to allow for wider applications, would be to enhance the mechanical properties with the addition of « **rejuvenators** » for cold mixes.