Implementation of eco-friendly innovative materials in real road: APSE demo section

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Who we are?
Workshop: Promoting Circular Economy for a Greener Road Construction

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Partners

APSE PROJECT

11 Partners
5 EU Countries
4 SMEs
4 LEs
2 RTD Performers
1 Public Body
Project idea

Use of Eco-friendly materials for a new concept of Asphalt Pavements for a Sustainable Environment
Results

Conventional binder  Alternative binders

Virgin aggregates  RAP

C&D Waste
Results

Lignin modified bitumen

Construction and demolition waste for asphalt mixtures applications

Application of bio-fluxes to increase RAP content

To avoid the “super-heating” of the virgin aggregates when high rates of RAP are incorporated for the preparation of new asphalt mixtures, the addition of a plant-based bio-fluxing agent was studied.

The bio-fluxing agents partially behave as an asphalt rejuvenator, fluidizing the bitumen and recovering its original consistency.

In this study the incorporation of 30% RAP was proven by the addition of the bio-flux.
Fluxing bitumen

Oxidation of RME in room temperature (20-25°C) in presence of cobalt catalyzer and cumene hydroperoxide serving as initiator of polymerization reaction.

- bio-flux agent, technology patented by WUT, partially behaves as asphalt rejuvenator, fluidizing bitumen with possibility to recover its original consistency.
- Flux additive is a plant based product with partially unsaturated bonds with sicative addition.
What did we do to verify the idea?

- Stage I: bio-agent production and testing; special laboratory device was built in WUT (chemical reactor),
- Stage II: bio-fluxed binder production and testing; bio-agent+virgin binder,
- Stage III: HMA with RAP and bio-fluxed binder production and testing.
- Stage IV: field.
Stiffness of asphalt mixture with RAP and bio-agent

Crosslinking and hardening process in time

Stiffness recovery

28 day
Key points of bio-agent

- Vegetable-based additives can be used in production of asphalt mixtures, especially to the mixes containing reclaimed asphalt pavement (RAP).
- Bio-agent causes better capability for quick mixing of asphalt mixture compounds and improves compaction of asphalt mixtures containing RAP.
- Bio-agent supports reaching of the desired air voids content and stiffness level.
- Application of bio-agent allows to eliminate undesired effect of mixtures over-stiffness due to presence of aged bitumen from RAP.

Main goal: to achieve increased RAP content with standard plant technology
Test section

Technology validation: design and construct innovative, eco-friendly roads

- Application to the industrial scale eco-technology of asphalt pavements with bio-origin materials and recycled materials.
- Full-scale complex picture: each layer contains some eco-friendly materials:
  - bioetanol for bitumen binder modification (eco-asfalt): surface layer,
  - higher RAP content for base layer: bio-flux partially rejuvenating bitumen,
  - C&D waste for subbase
Results

Verification of the laboratory results
- Accelerated test section
- Road sections
Results

Field verification:
- Spain
- Poland

Was there easy with an experimental technology in Poland???
- Road authorities
- HMA plant
- Logistics
- Employees
Completed summer 2017

Trial road stretch in Poland.

The trial road stretch was located in Chmielna Street, Makówka in east-central Poland and 53 km south-west of Warsaw.
DESCRIPTION OF THE POLISH TRIAL ROAD

Pomiary do wykonania na ul. Chmielnej, na całym remontowanym odcinku (ok. 800 m), od ok. 100 m na zach. od DW 579.

Odcinek składa się z dwóch sekcji równej długości:
- Wsch. – referencyjna
- Zachodnia – doświadczalna
TESTS:
- HMA tests (standard)
- FWD

Future work:
- Cut the slab from the pavement (all HMA layers) for the lab 4PB on a „sandwich” structure
- Repeat FWD after one year
The trial road stretch will be implemented in the M-607 road as part of the rehabilitation works and construction of new lane in Madrid.
Application method of bio-agent/bio-fluxed binder

- (A) directly to the bitumen (asphalt binder) tank
- (B) through the installation dedicated mainly for the adhesive agent addition.
RAP limitation

- In most cases 20% is the limit for those plants which are not equipped with the dedicated infrastructure, such e.g. double barrel system for RAP heating (so called black drum).
- Proposed technology allows increasing of this limit by 10% (to 30% RAP addition).
Lesson learned from Polish trial section

- Ecological and technical effect was achieved by increasing the percentage of RAP added to Hot Mix Asphalt (HMA) mixtures produced by traditional techniques. Such solution was possible thanks to the integration of ecological (or bio-based) plant-origin fluxes.

- Based on the research and analysis, a method of application of the bio-fluxing agents to the recycled asphalt pavement (RAP) was developed.

- Increased limitation to the RAP content effectively working with bio-fluxing agent was proposed (for up to 30%) when bio-agent content is 2,5-5,0% (by weight, as referred to binder).

- The most ecological aspect of this whole process, based on the sustainability philosophy, is a three stages virgin bitumen reduction, as compared to the traditional HMA mixture produced in a traditional HMA-plant (not equipped with a black-barrel system):
  - Application of RAP in the HMA,
  - Increased amount of RAP,
  - Substitution of part of the virgin bitumen by flux additive.
Summary

- Road sector is one of the main industry sector in terms of the materials demand.

- According to the sustainability philosophy, proportion of the recyclable materials and materials from the renewable sources in total amount of materials used in road construction should increase.

- LCA and LCCA analysis are required for complex assessment of the ecologically friendly road technologies.

- Project APSE supported from the founds of VII Program of EU validated in industrial scale earlier developed materials and technologies allowing for construction of all layers of ecologically friendly roads.
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Thank you for your attention

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