DEFINITION OF EXPERIMENTAL PLAN TO ASSESS THE AGEING RESISTANCE OF MODEL BIOBINDERS

Innovative pavement biobinder development and ageing resistance

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1. Introduction

Bitumen

Petroleum derivative, limited resource.

Production of bitumen has been reduced. Impact on quality.

Negative impacts on the environment.

Biobinders

Asphalt binder alternatives made from plant-based renewable sources, which should not impact on food production, and have environmental and economic benefits [1].

Ageing

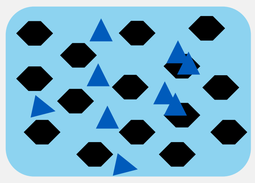
- Limited research of evolution and resistance to ageing.
- Different from bitumen, composition: oxygen content.

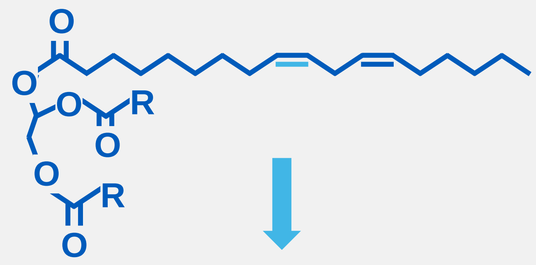
Objective

Determine the main ageing mechanisms of biobinders and the consequences on performance in order to reproduce in the laboratory.

2. Strategy

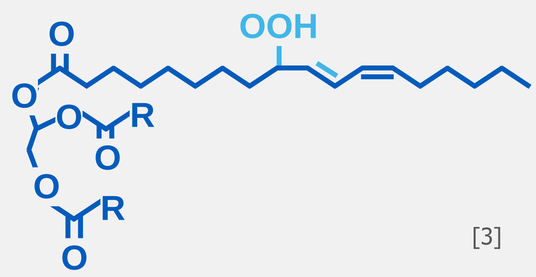
Model biobinder





Oil nature

More unsaturated fatty acids which have double bonds (DB), more susceptible to oxidation, because react with oxygen through free radical chain mechanism [2]. Iodine index (II) is a measure of DB.



[3]

Design of Experiments (DOE)

The process of planning, designing and analyzing of experiments to draw valid and objective conclusions in an effective and efficient method [4].

3. Literature review

Parameters that can affect the ageing resistance of the biobinders

Temperature

Traditional bitumen oxidation is expedited by heat and intensified by time [5]. Additionally, higher temperatures due to the climate crisis can cause increased damage to infrastructure [6].

Humidity

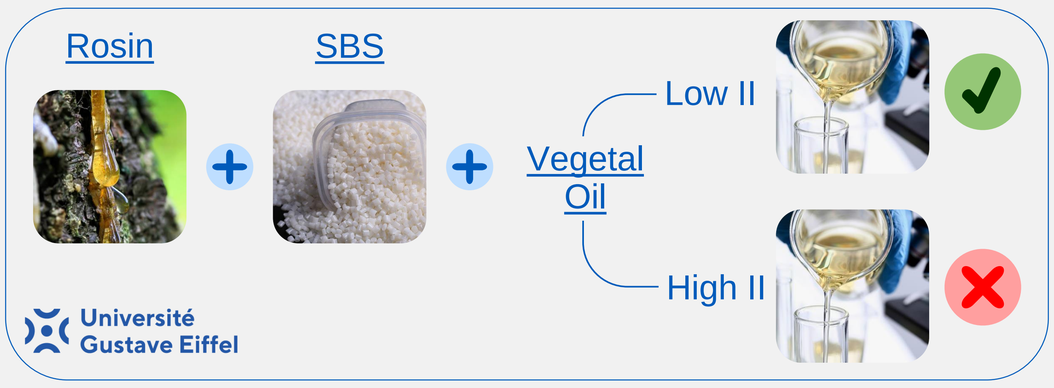
Water generates the loss of the adhesive bond between bitumen and aggregate surface and/or loss of the cohesive resistance within the bitumen [7].

Salinity

Sodium chloride (salt) improves the rutting resistance of asphalt mixture; but salt is harmful to the cracking resistance [8].

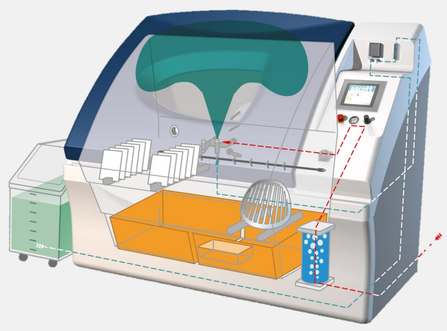
4. Experimental plan

Step 1: Composition of biobinders



Step 2: Ageing parameters

Time
Humidity
Temperature
Salinity



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Tests

Ageing
- RTFO
- PAV

Chemistry
It is necessary to find an appropriate indicator
- FTIR
- DSC
- TGA
- Average Molecular Mass*

Rheology
- Master curve
- Creep
- ΔT_C

Select the biobinders that will be evaluated

Ageing
- Salt Spray Corrosion Test

Binder

Chemistry
- FTIR
- TGA
- DSC
- AMM*

Rheology
- Master curve
- Creep
- ΔT_C

Mixture

Performance
- Modulus

(non destructive tests)

Results

ANOVA: to assess the importance of the materials and their properties in the composition of the biobinder.

Multiple Regression: to define relationships between the behavior of the material (dependent) and its composition (independent).

Design future biobinders

ANOVA: to evaluate the effect of different parameters in the ageing resistance of the biobinder.

Multiple Regression: to describe correlation between the ageing resistance of biobinders (dependent) and different environmental conditions (independent).

Define an ageing protocol for biobinders

5. Conclusions and perspective

Conclusions

- Understand the impact of composition to develop new biobinders that are adapted to the local biomass.
- Develop a biobinders ageing protocol that is close to field evolution and includes the factors that cause the most deterioration.

Perspective

- Produce biobinders in large quantities to build full-scale test sections.
- Evaluate the future reuse and recyclability of biobinders.

6. References

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