



## 1. Introduction and objective

### Introduction

- Main problem of porous asphalt pavement after long-term service  
Open-graded structure } The **cohesion and adhesion** of HVA get worse  
Accelerated binder aging } **Thus, weak asphalt – aggregate interface**
- It is difficult for ordinary regenerators to recover the adhesion of asphalt

How to solve this problem? Find adhesion recovery mechanisms!

### Objective

- To **develop innovated rejuvenators** for the goal of asphalt adhesion recovery and **reveal the activation mechanism** of optimized regenerants from micro-scale chemical and physical properties.

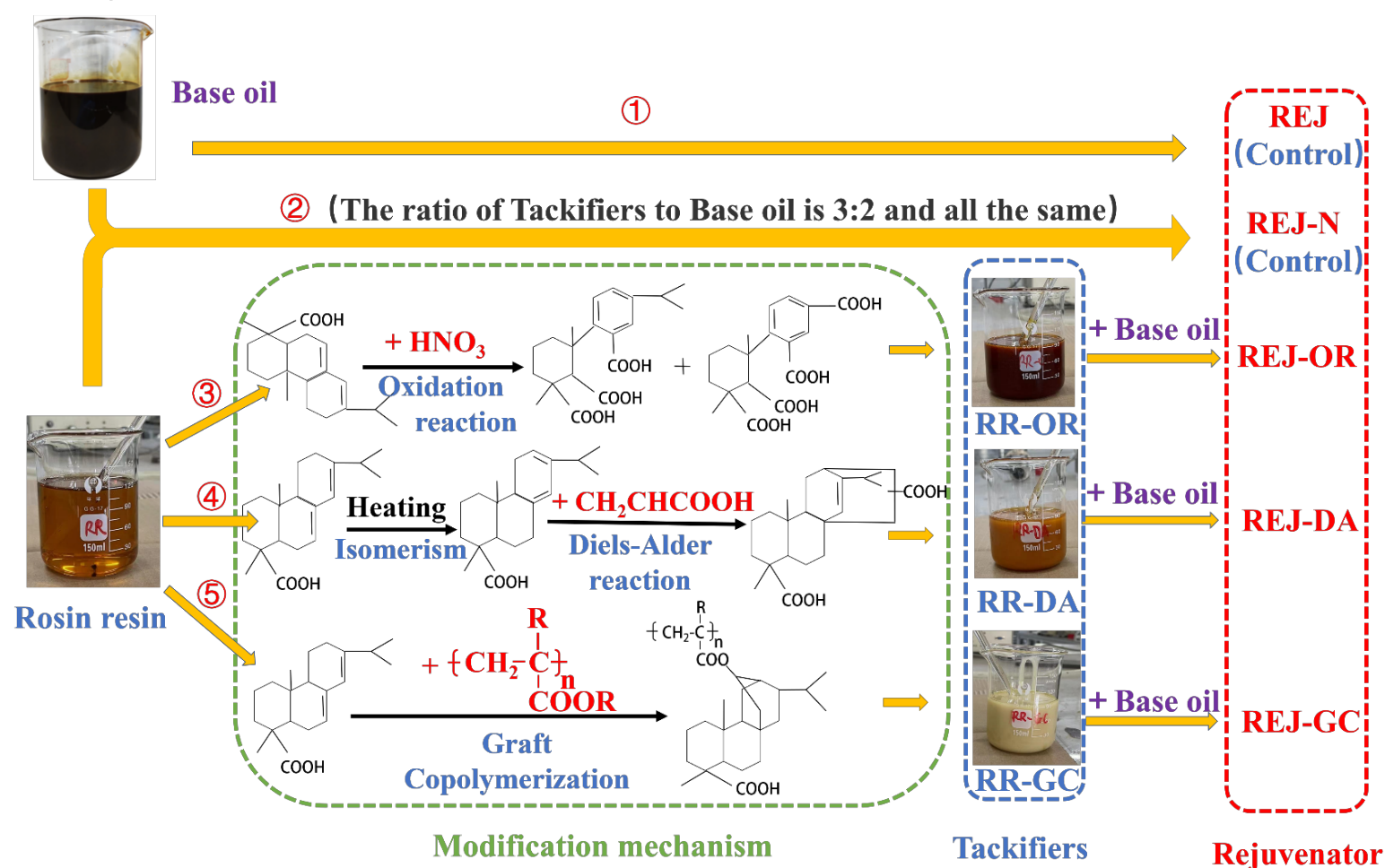
## 2. Materials and Methods

### Raw materials

- Asphalt: Aged HVA (Laboratory simulation)
- Additives and Modifiers:



### Rejuvenators preparation



### Recycling plan

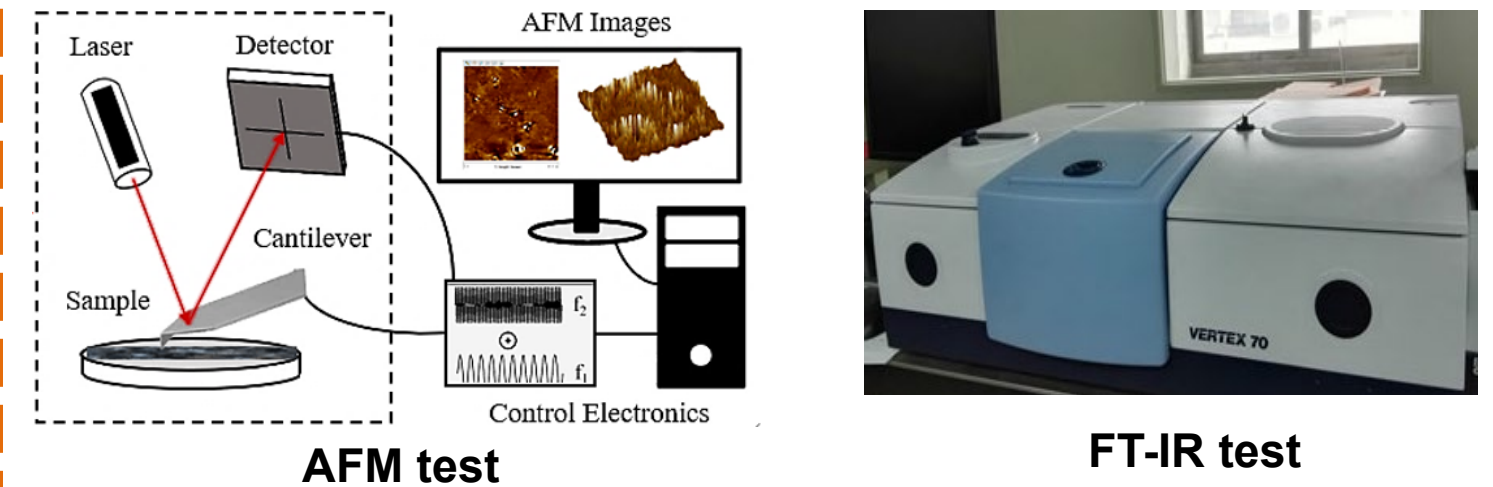
Recycling plan	Rejuvenator type	Dosage
Aged	/	/
Plan A (Control)	REJ	6%
Plan B (Control)	REJ-N	6%
Plan C	REJ-OR	6%、8%、10%
Plan D	REJ-DA	6%、8%、10%
Plan E	REJ-GC	6%、8%、10%

## Experimental methods

- Binder bond strength(BBS) test

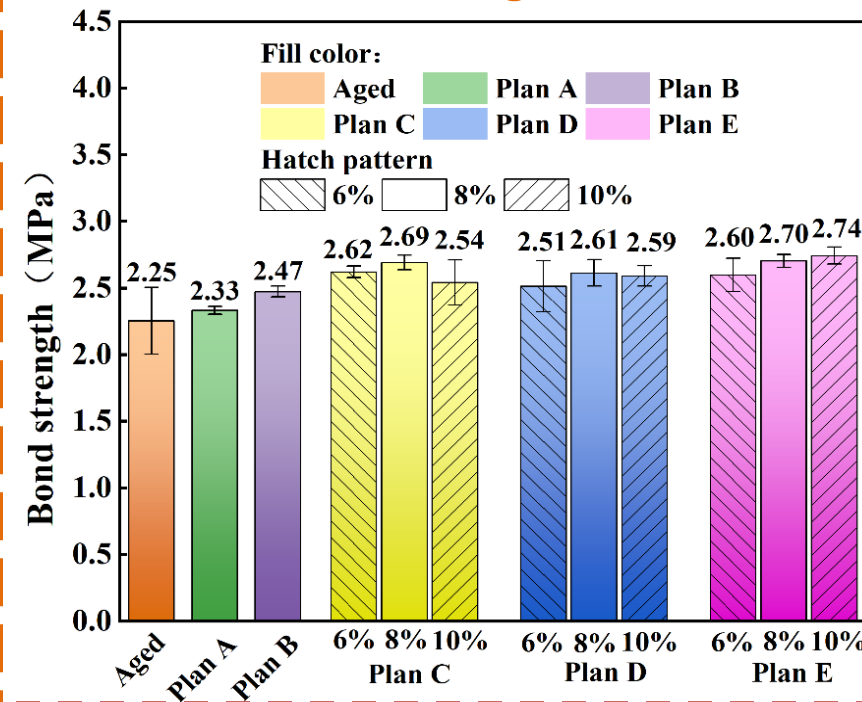


- Chemical and physical tests



## 3. Testing results

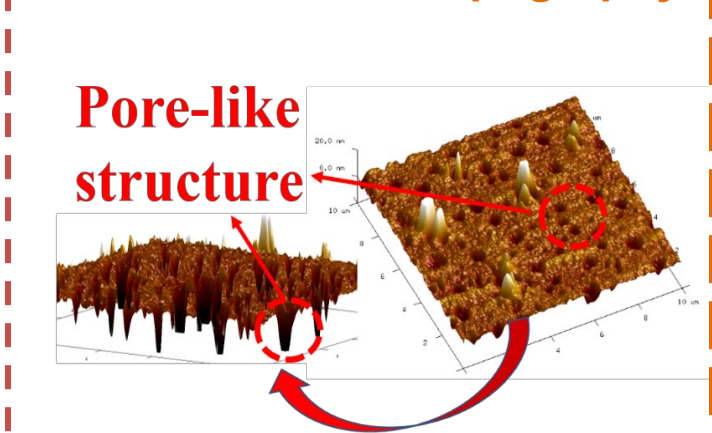
### Binder bond strength



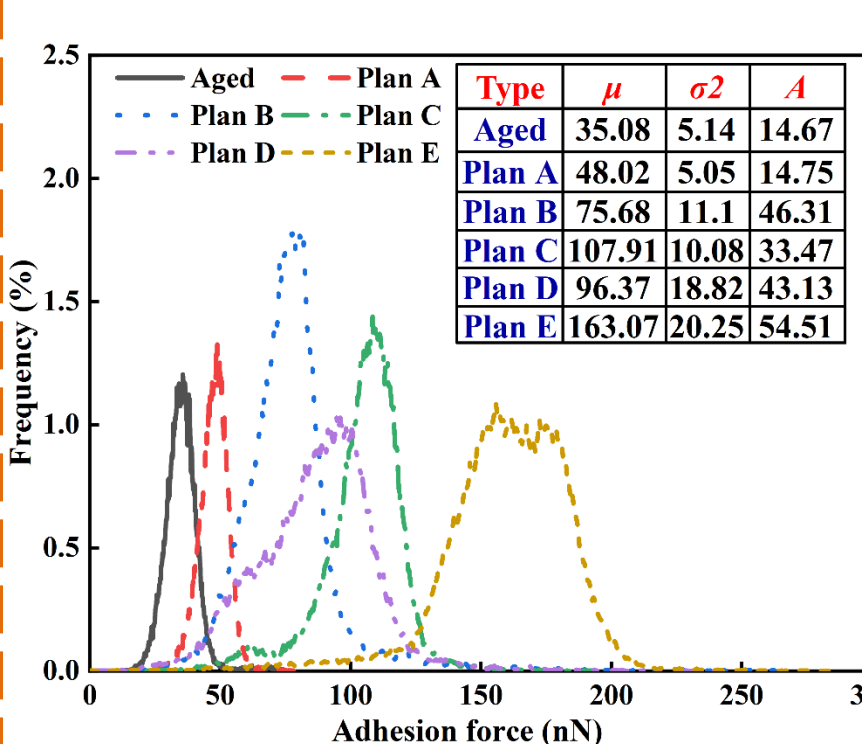
### Functional group change

Type	I <sub>Ar</sub>	I <sub>C=O</sub>	I <sub>S=O</sub>	I <sub>C-O</sub>
Aged	0.122	0.022	0.077	0.001
Plan A	0.246	0.016	0.039	0.006
Plan B	0.248	0.020	0.042	0.014
Plan C	0.292	0.033	0.046	0.038
Plan D	0.240	0.022	0.056	0.030
Plan E	0.243	0.037	0.044	0.045

### Nanoscale 3D topography



### Adhesion force distribution



## 4. Conclusions

- BBS results show that innovated regenerators are effective and 10% REJ-GC has best adhesion recovery effect.
- The change of functional group index (I<sub>S=O</sub>, I<sub>Ar</sub>) show regenerators has recovery effect on aged asphalt. I<sub>C-O</sub> is significantly correlated with BBS and may be the main reason for adhesion recovery.
- Pore-like structure, which appears on the surface of recycled asphalt, increased asphalt surface roughness to improve adhesion.
- 10% REJ-GC shows the largest and most evenly distributed nano adhesion force, which has a significant correlation with BBS results.