

## THE 13th IACIP Annual Workshop: Adaptive Infrastructure under Climate Change

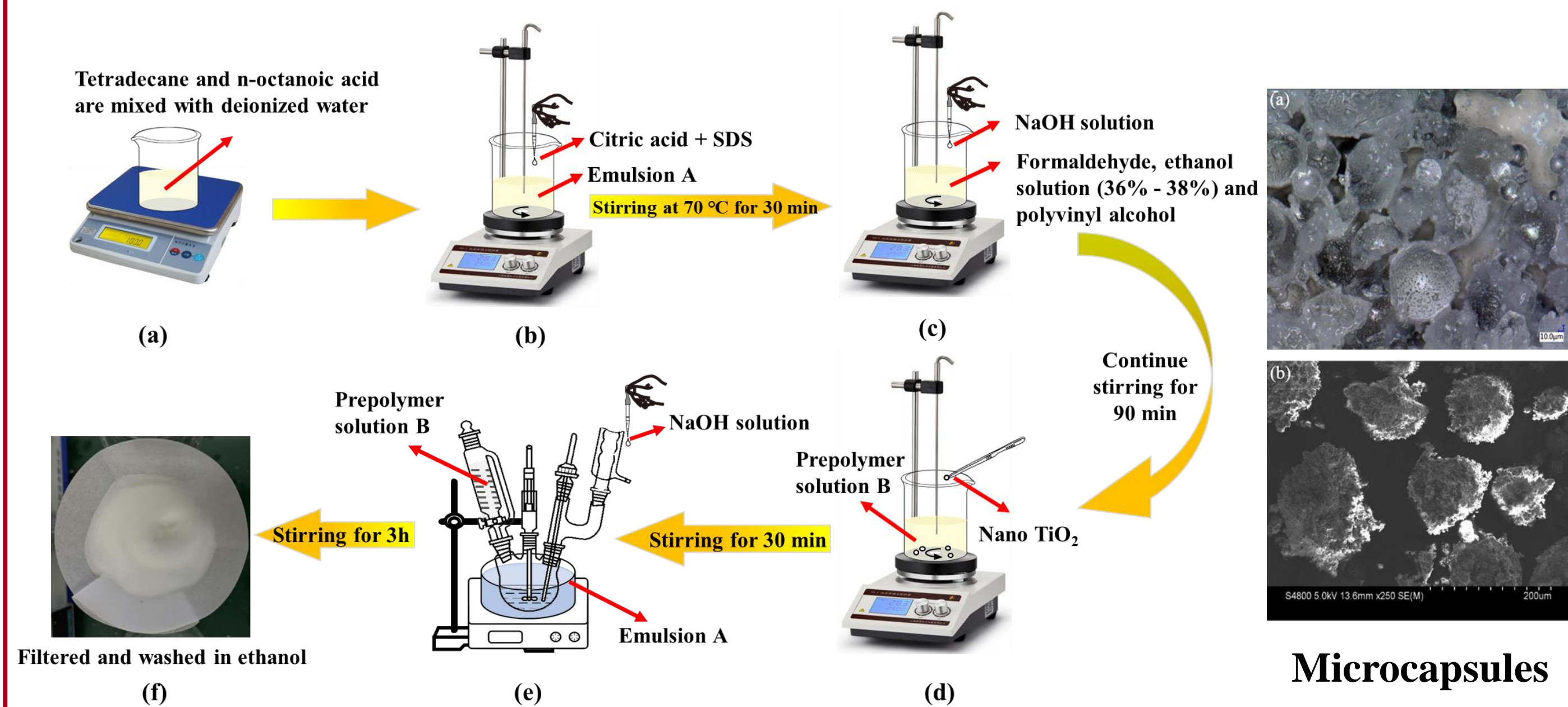
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### Introduction

- Background:** Winter rain and snow weather is often accompanied by a sudden drop in temperature, which is easy to cause asphalt pavement shrinkage cracking and vehicle tire slipping. Some researchers plan to add phase change materials to asphalt pavement to relieve those problem.
- Research gap:** The influence of leakage of different phase change materials on asphalt has not been clarified

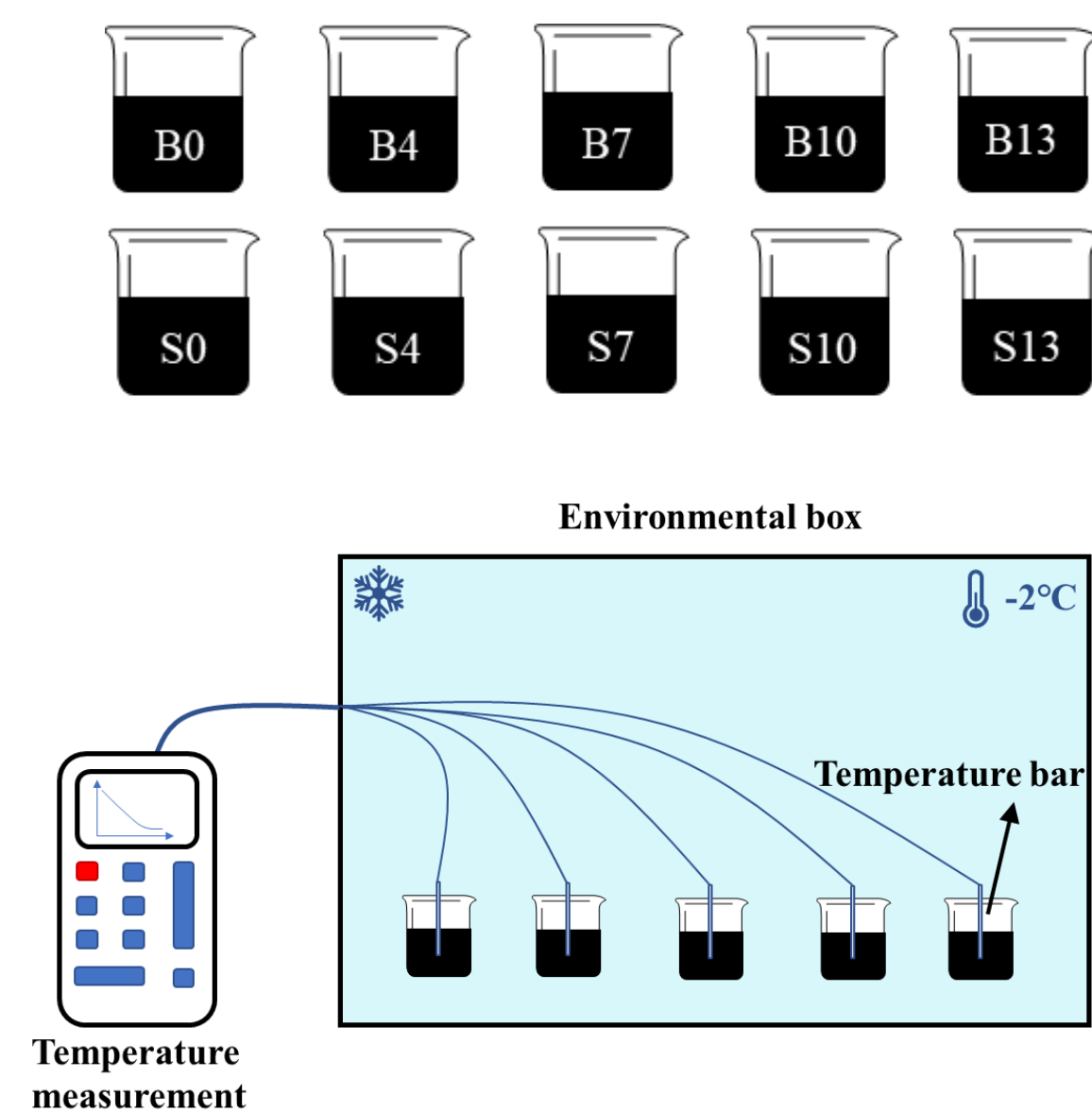


### Microcapsules preparation



### Experiment

- Asphalt sample:** Five contents (0%, 4%, 7%, 10% and 13%) of microcapsules were added to the SK70# and SBS asphalt, respectively.
- Dynamic shear rheometer (DSR):** Temperature sweep, frequency sweep and multiple stress creep and recovery tests
- Bending beam rheometer (BBR):** The S and m values of various samples.
- Self-designed regulation test:** The ability of microcapsules to regulate the temperature of asphalt.



### Results and discussion

#### Temperature sweep

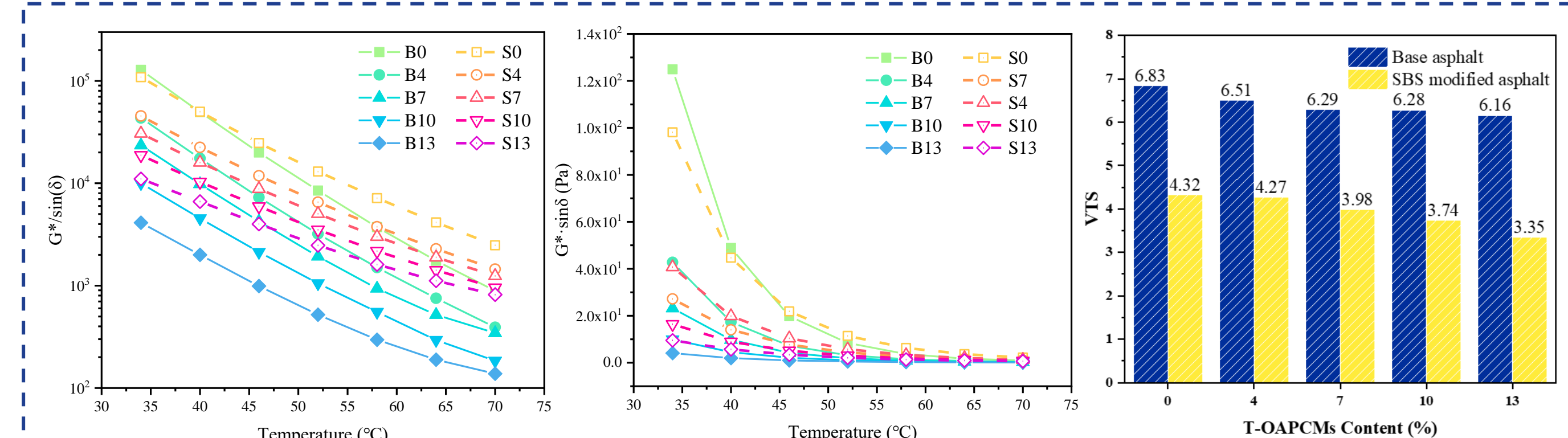


Fig.1 Rutting factor, fatigue factor and VTS

- Microcapsules can reduce the rutting factor and fatigue factor of asphalt, and further reduce with the increase of microcapsules content.
- The addition of microcapsules increases the elasticity of asphalt, decreases its viscosity, increases its deformation resistance and weakens its fatigue performance.
- As the amount of microcapsules increases, the temperature sensitivity of asphalt is reduced, and the effect is more obvious with higher contents.

#### Frequency sweep

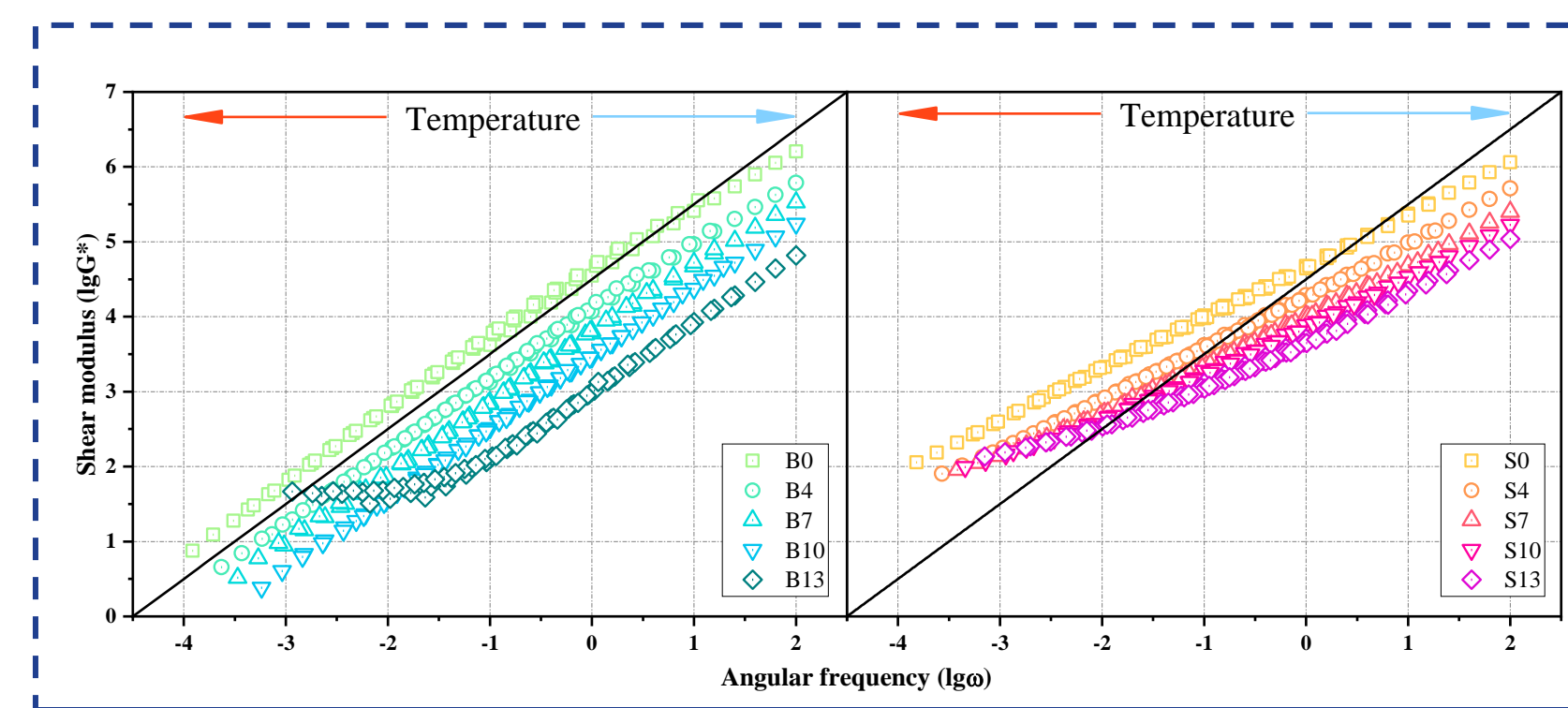


Fig.2 Complex shear modulus master curve

- Microcapsules shifts the master curve downward, and the more you add, the more severe the downward shift.
- B13 appears a plateau in the low-frequency area, and the asphalt has lost its linear viscoelasticity.

#### Multiple stress creep and recovery

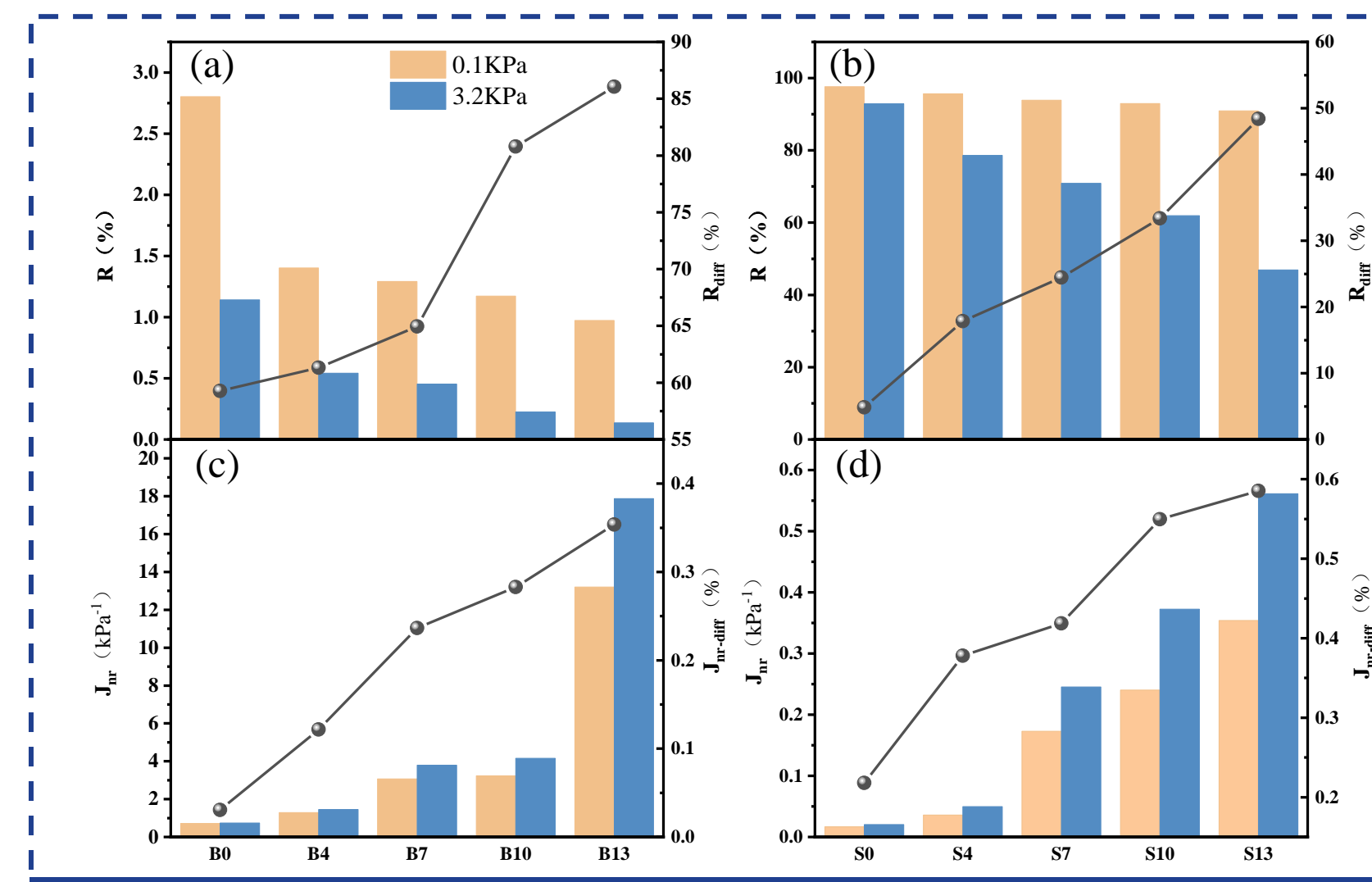


Fig.3 R,  $J_{nr}$ ,  $R_{diff}$ , and  $J_{nr-diff}$  at 0.1kPa and 3.2kPa

- For 0.1kPa and 3.2kPa loading stresses, with the increase of microcapsules content, the base and SBS asphalt binder have similar trends. R decreases, and  $J_{nr}$ ,  $R_{diff}$ , and  $J_{nr-diff}$  increase.
- The incorporation of microcapsules decreases the elastic recovery properties and increases the non-recoverable of the asphalt binder.

#### Low-temperature creep

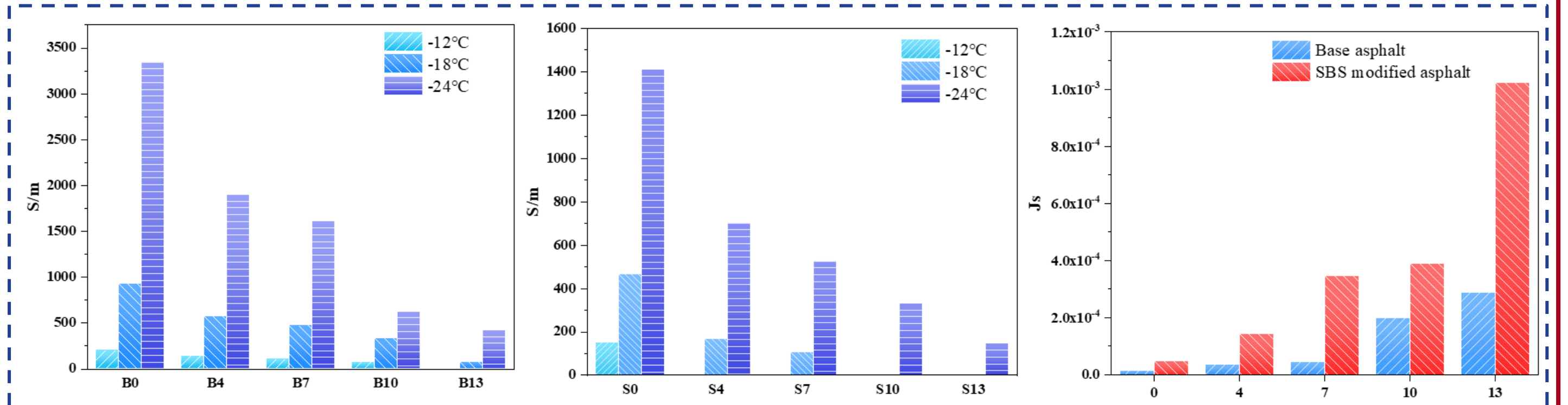


Fig.4 S, m and Js

- Microcapsules can significantly reduce S/m. It can reduce S, enhance m-value and improve the low-temperature rheological properties of asphalt.
- Microcapsules can improve the comprehensive creep compliance Js of asphalt, and improve the viscosity component of asphalt.

#### Temperature regulation capacity

- The greater the amount of microcapsules, the higher the asphalt temperature curve and the greater the temperature difference between the asphalt and the original asphalt, indicating the slower the rate of temperature decline.

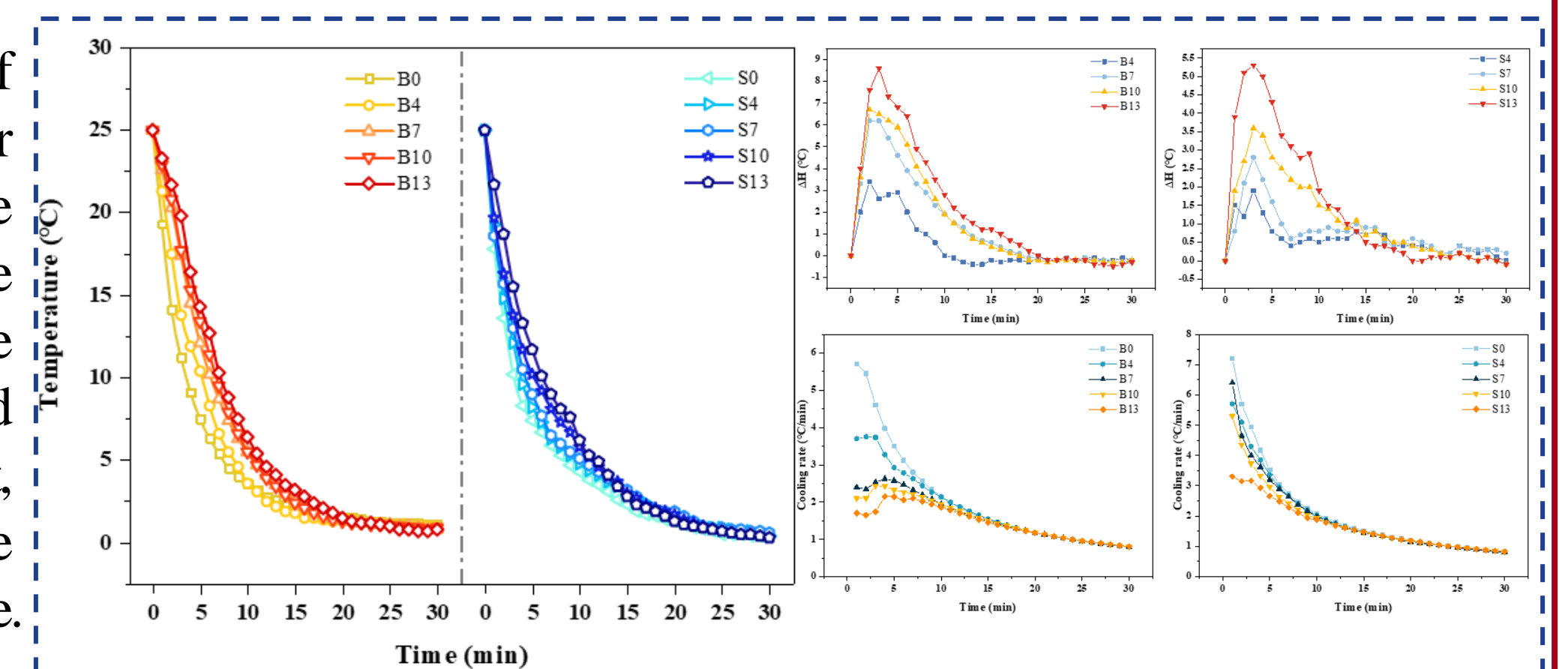


Fig.5 Temperature regulation test

- The maximum temperature difference is 8.6 °C in about 4min. The temperature difference curves of base asphalt and SBS asphalt converge at about 20 minutes and 15 minutes, respectively.

### Conclusion

- Microcapsules can make asphalt develop from elasticity to viscosity, improve fatigue performance and weaken high-temperature deformation resistance.
- The recoverable performance of asphalt under load is gradually reduced by the influence of microcapsules. The greater the amount of microcapsules, the more obvious the decline.
- The low temperature creep property of asphalt is improved by microcapsules, and it is more obvious with the increase of the content of microencapsulation.
- The addition of microcapsules can play the role of temperature regulation, reduce the rate of asphalt temperature decline, and extend the time of temperature decline.