

**KONFERENCJA - Nowoczesne nawierzchnie drogowe**

Recykling w konstrukcjach nawierzchni drogowych

**CONFERENCE - Modern Road Pavements**

Recycling in road pavement structures



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Warsaw, 18 October 2023

**MRP'23**

**Laboratory evaluation of combined effect of jute fibres  
and rejuvenators on some performance characteristics  
of bitumen mixture containing reclaimed asphalt**

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- Introduction to the fibres in bitumen mixtures
- Jute fibres
- Rejuvenators
- **ACP 16+ 30% RA** with reju and/or jute fibres
- Conclusion

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# Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt

# Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt

Fibres can have:

- **Stabilizing effect**



- **Reinforcing effect**



## Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt

### Jute fibres

- Plant-based (*Corchorus*)

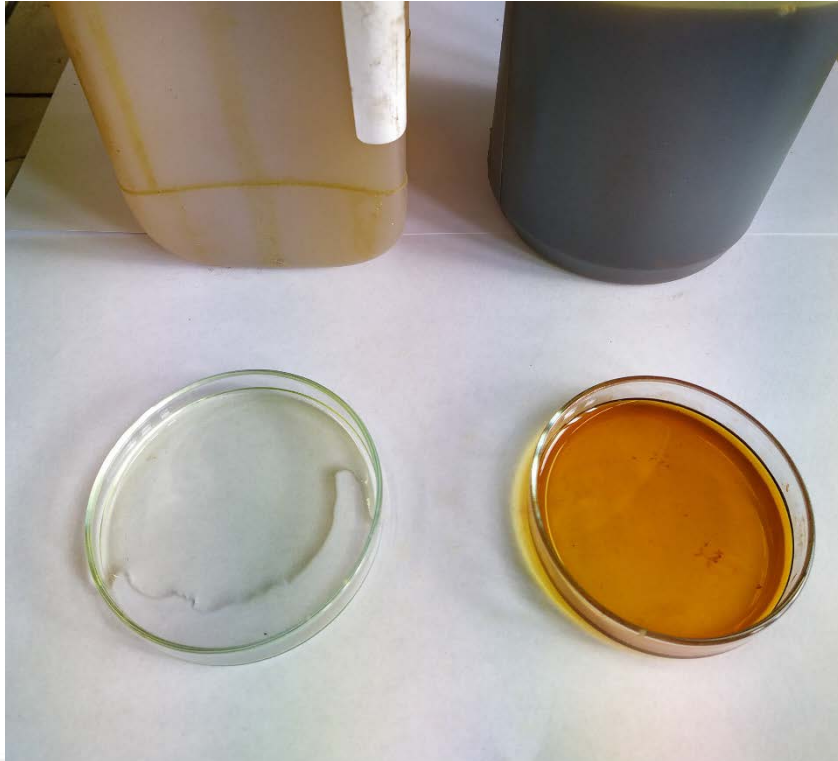
Tensile strength (yarn, 10 mm/min):

- Virgin  $\approx 250$  MPa
- 2 h.  $150$  °C  $\approx 150$  Mpa
- Stabilizing and reinforcing effect
  
- Biodegradable
- From a renewable, sustainable source



## Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt

### Rejuvenators



Two commercialized bio-based rejuvenators:

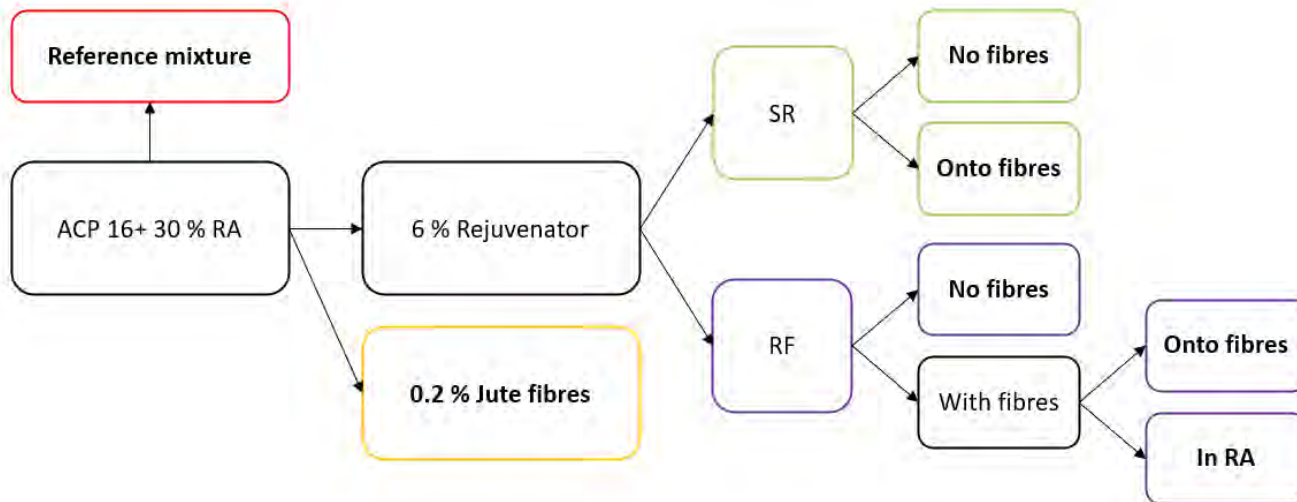
- “SR” (crude tall oil and crude turpentine oil derived additive)
- “RF” (vegetable oil-based additive)

Dosage: by 6 % by mass of the aged binder contained by the reclaimed asphalt.

# Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt

## ACP 16+ 30% RA

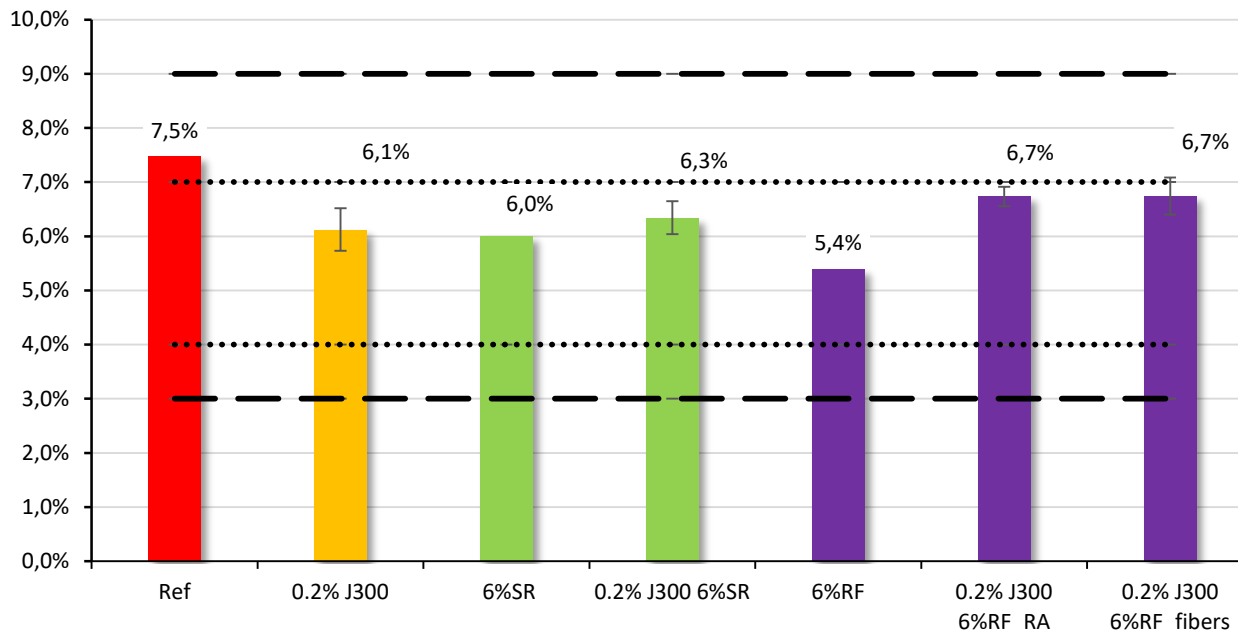
- Standard binder 50/70
- Rejuvenator to the pre-heated RA
- Rejuvenator onto fibres



# Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt

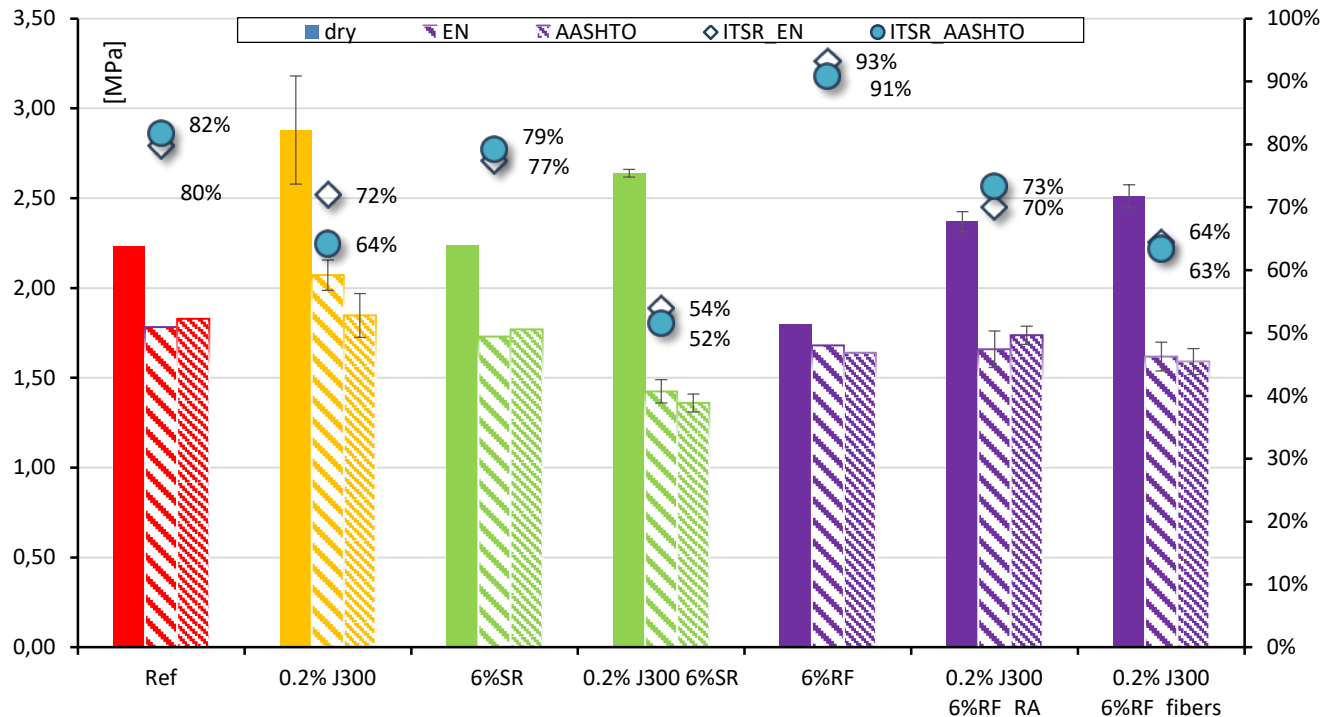


## ACP 16+ 30% RA – Air voids



# Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt

## ACP 16+ 30% RA – Moisture and freeze-thaw susceptibility

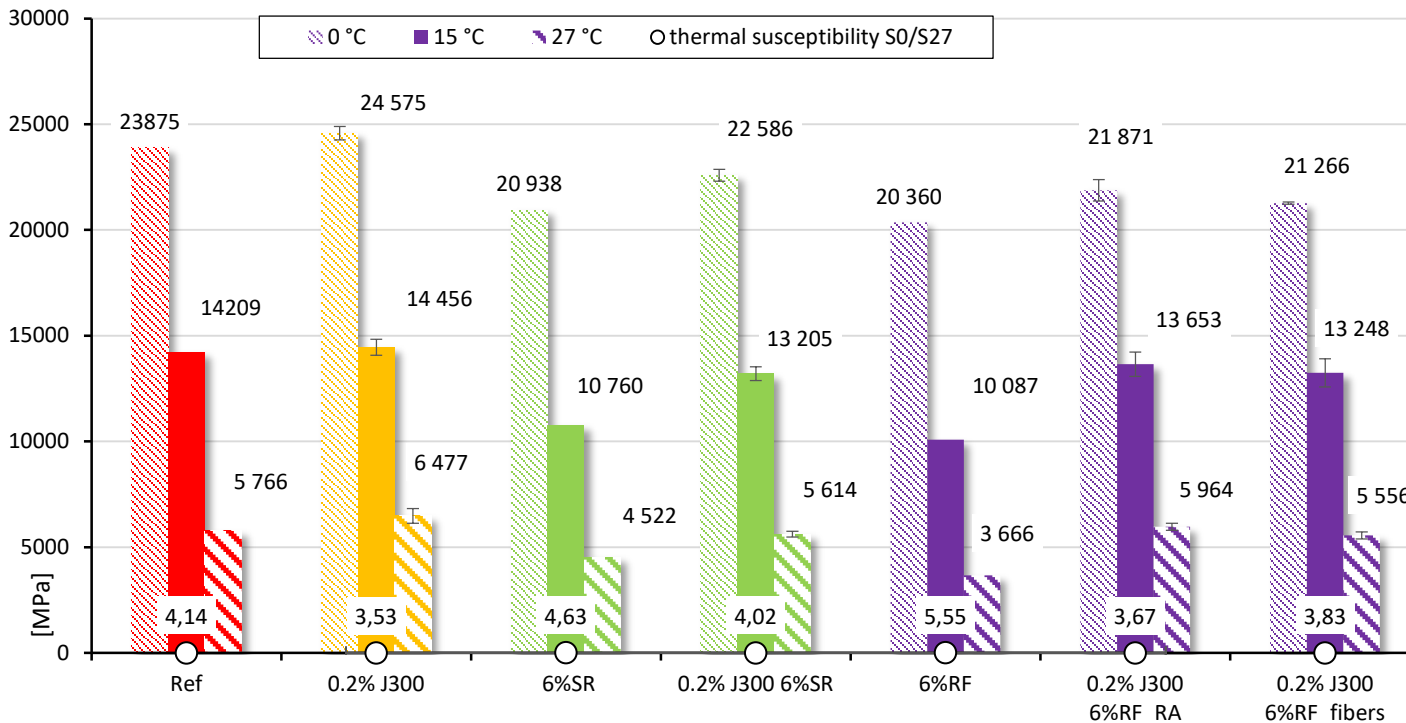




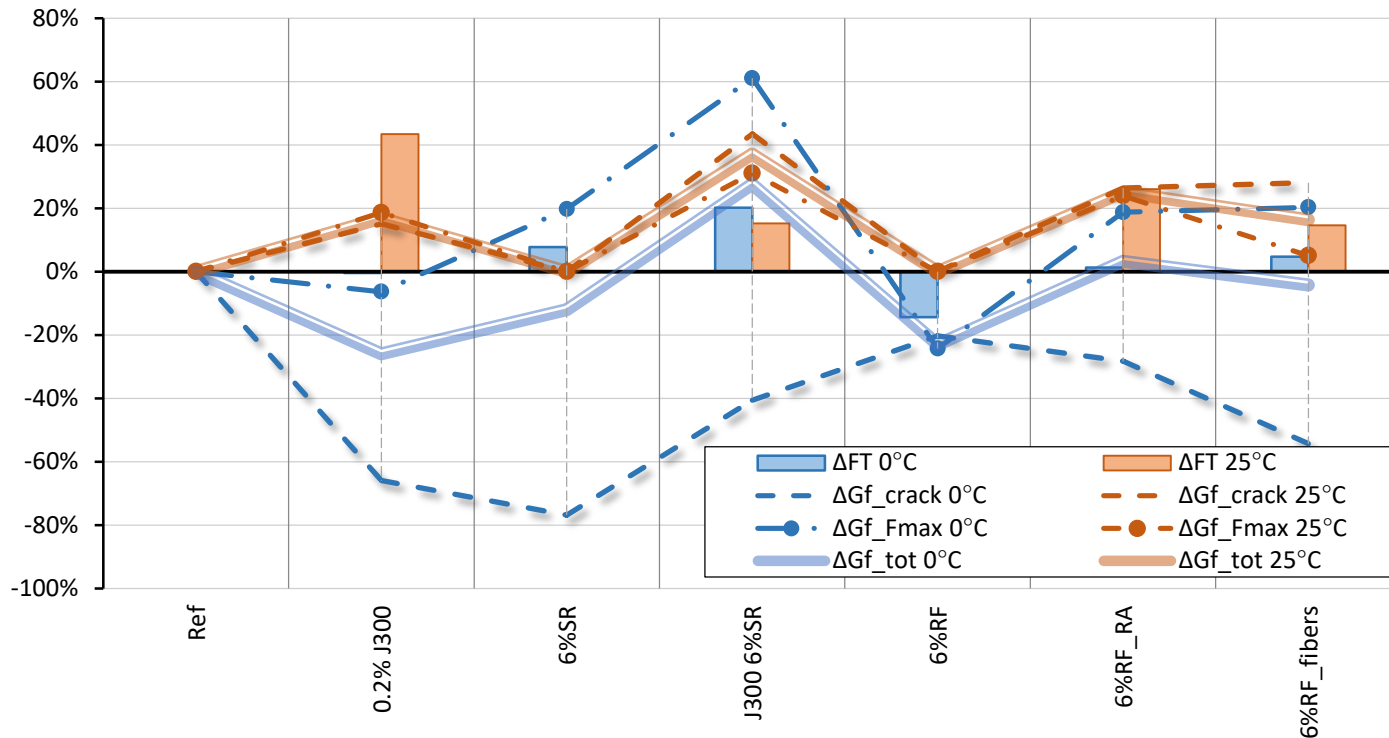
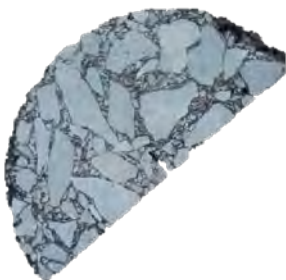
# Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt



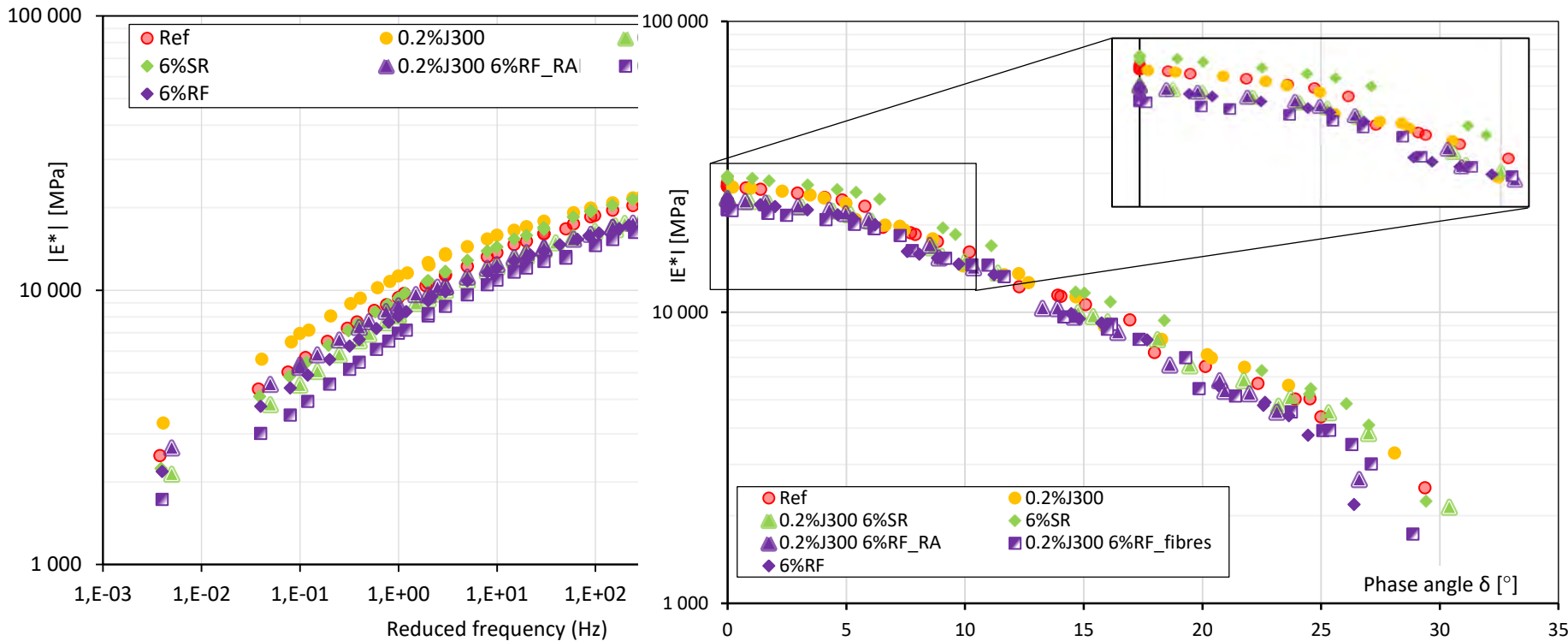
## ACP 16+ 30% RA – Stiffness – IT-CY



## ACP 16+ 30% RA – Resistance to crack propagation



## ACP 16+ 30% RA – Dynamic modulus – 4PB-PR



## Jute fibres and rejuvenators in bitumen mixture containing reclaimed asphalt



### Conclusion

- Rejuvenators have positive influence on the compactability
- Lower ITSr in mixtures with jute fibres
- A decrease in the stiffness of mixtures with rejuvenator, an increase of stiffness and decline of thermal susceptibility with jute fibres
- Best crack propagation results: mixture with jute fibres and rejuvenator “SR”
- The addition of rejuvenator and jute fibres showed lower dynamic modulus along the whole range of frequency comparing to the control mixture.
- Desirable behaviour: mixture with jute fibres only, mixture with jute fibres and rejuvenator applied to the RA
- The addition of the rejuvenators with the RA or with the fibres showed a negligible difference in the influence of the different properties, except dynamic stiffness and ageing index. Mixtures with the rejuvenators dosed onto the fibres showed worse ageing results.

## Sources:

**Characteristics of aggregate gradation, drain down and stabilizing agents in stone matrix asphalt mixtures: A state of art review**, DOI: 10.1016/j.jtte.2021.10.007

**State of art review on the incorporation of fibres in asphalt pavements**, DOI: 10.1080/14680629.2022.2092022

**A Review on the Durability of Recycled Asphalt Mixtures Embraced with Rejuvenators**, DOI: 10.3390/su13168970



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Thank you for your attention!

