

WORKSHOP ON BITUMEN EMULSION TECHNOLOGY

10TH JUNE 2026
VIENNA, AUSTRIA

EMULSIONS FOR THE CONTRUCTION AND
PRESERVATION OF SUSTAINABLE FLEXIBLE
PAVEMENTS

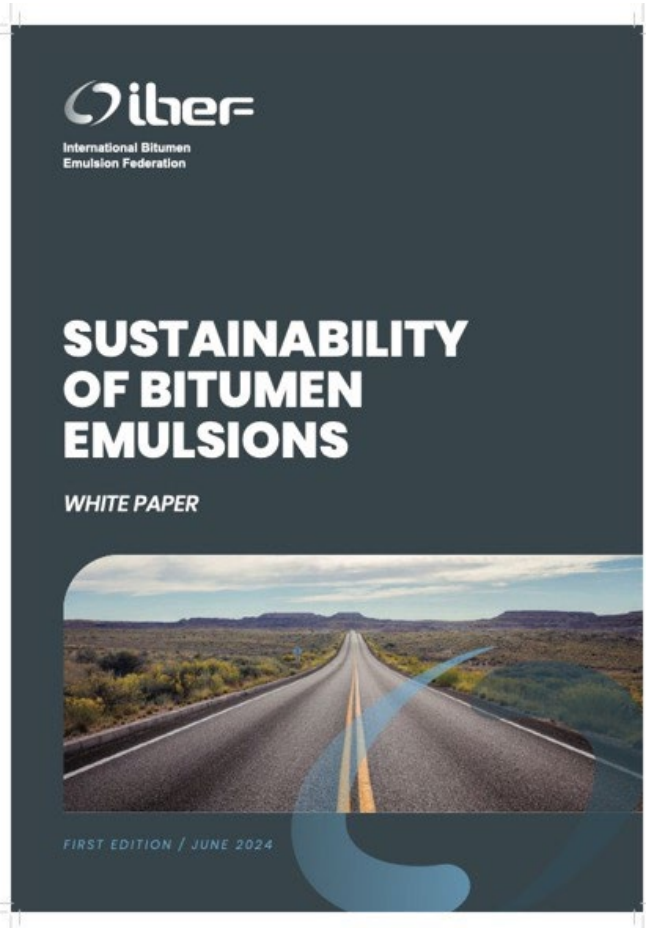
-examples of low-temperature, circular technologies using bio materials-

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The Key Pillars of Bitumen Emulsions in terms of sustainability

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Pillar 1 – Pavement Durability:

- The primary aim is to optimize or maximize pavement durability and lifespan.
- Bitumen emulsion applications and treatments play a crucial role in achieving this goal.
- Sub-pillars further describe the strategies for enhancing pavement durability.

Pillar 2 – Pavement Structural Improvement:

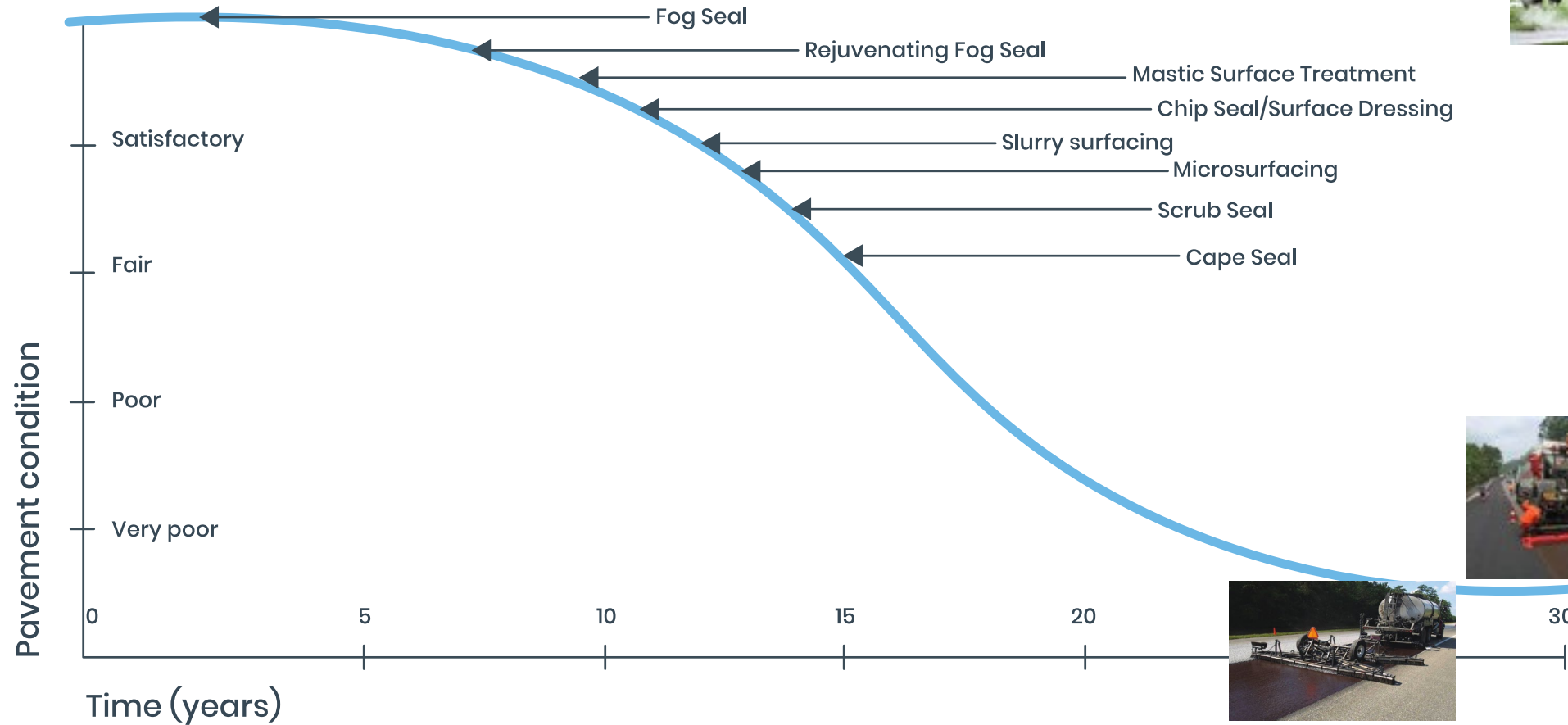
- Rehabilitation focuses on restoring the structural capacity of distressed pavements that go beyond routine maintenance or preservation efforts.

Pillar 3 – Environmental and Social Impact:

- This pillar considers the global environmental and social impact of bitumen emulsion technologies and their applications.

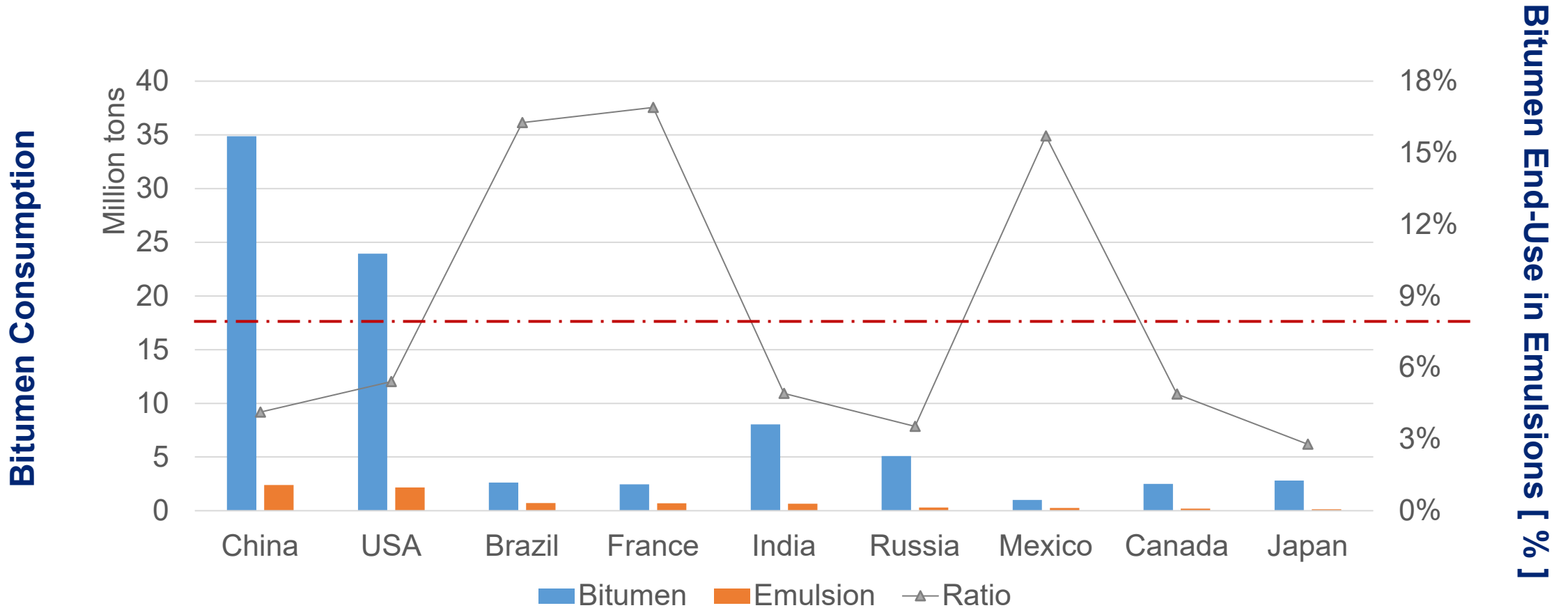


Road Preservation and Maintenance



Treatment matrix, pavement condition over time

Bitumen & Emulsion Volumes Survey



China's Transition towards Preservation and Maintenance



"Integrating long-term durability into preventive maintenance decisions transforms infra-structure management from a reactive cost center into a proactive value strategy. The application in Shanghai demonstrates that timely, data-driven interventions maximize the structural integrity of vital infrastructure, minimize traffic congestion caused by unplanned maintenance, and represent a crucial step forward for the sustainable development of urban transportation networks."

FANG, Yu; SUN, Lijun. *Applied Sciences*, 2026, 16.5: 2583.

>> 90 % of the Chinese network has been completed

So preservation, maintenance, renovation & RECYCLING becomes more and more important in complex cost-driven decision processes.





**25 FTE
6 Int. Experts**

**Cooperation
with 4 renowned
Universities**

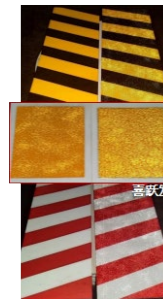
ASPHALT



CONCRETE EMULSIONS



COATINGS



Today's Focus



Up-cycling



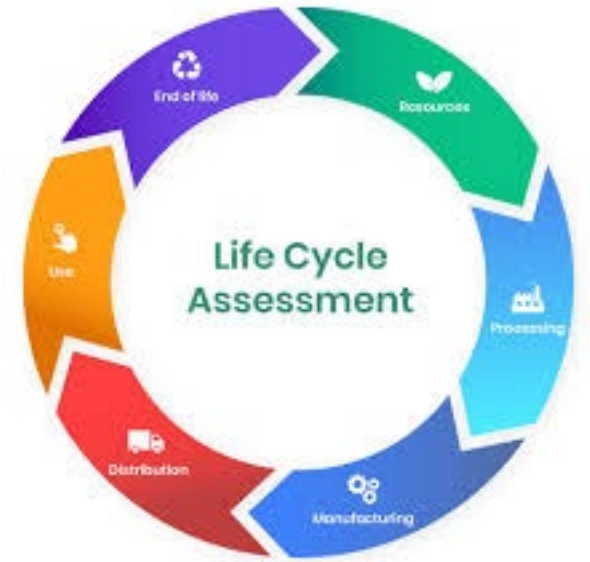
Re-cycling



Down-cycling



Circular
Economy



Bio-Mass Cascading

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High Value Bio-Based Molecules

BIO-BASED REJUVENATORS
(regenerating properties of RAP)

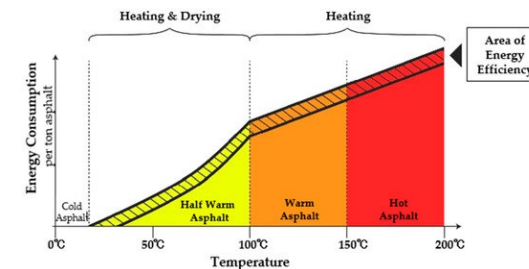
BIO-BASED BITUMEN EMULSION ENHANCERS
(Trackless Tack Coats, PMB-Emulsions,)

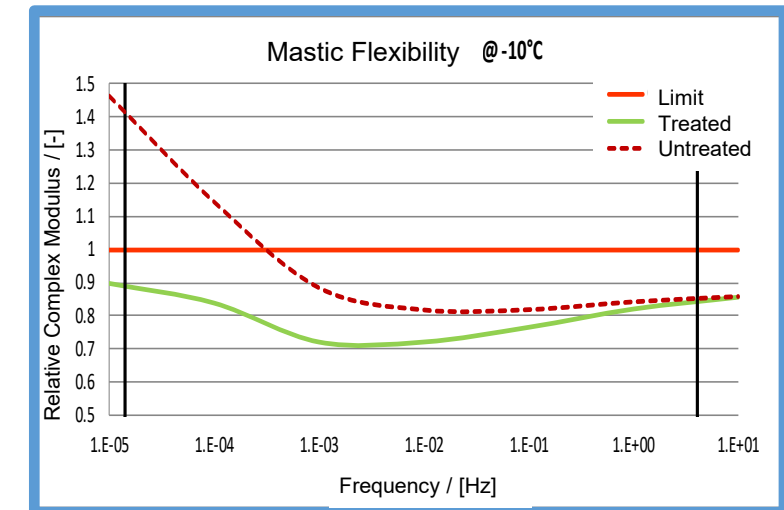
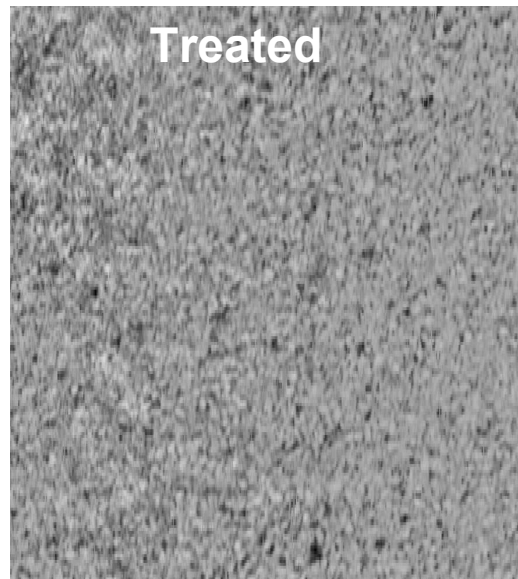
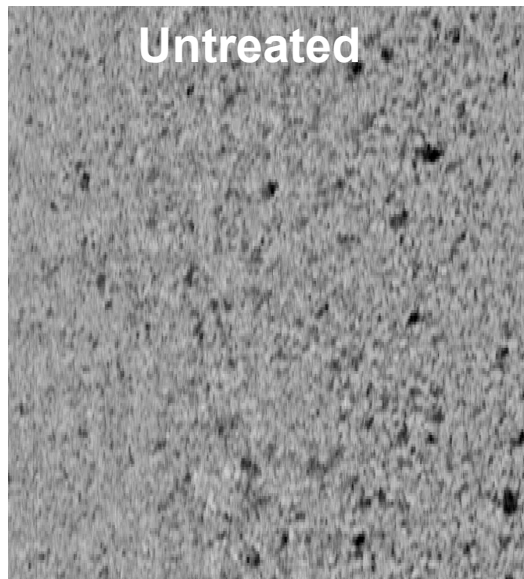
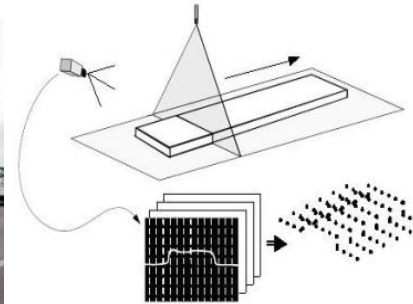
BIO-FLUXES for BITUMEN
(viscosity reduction,)



BIO-BASED WMA
(additives for lower Temperature Asphalt Production)

BIO-BASED DIFFUSION ENHANCERS
(Regeneration of RAP, low T processing of asphalt,)



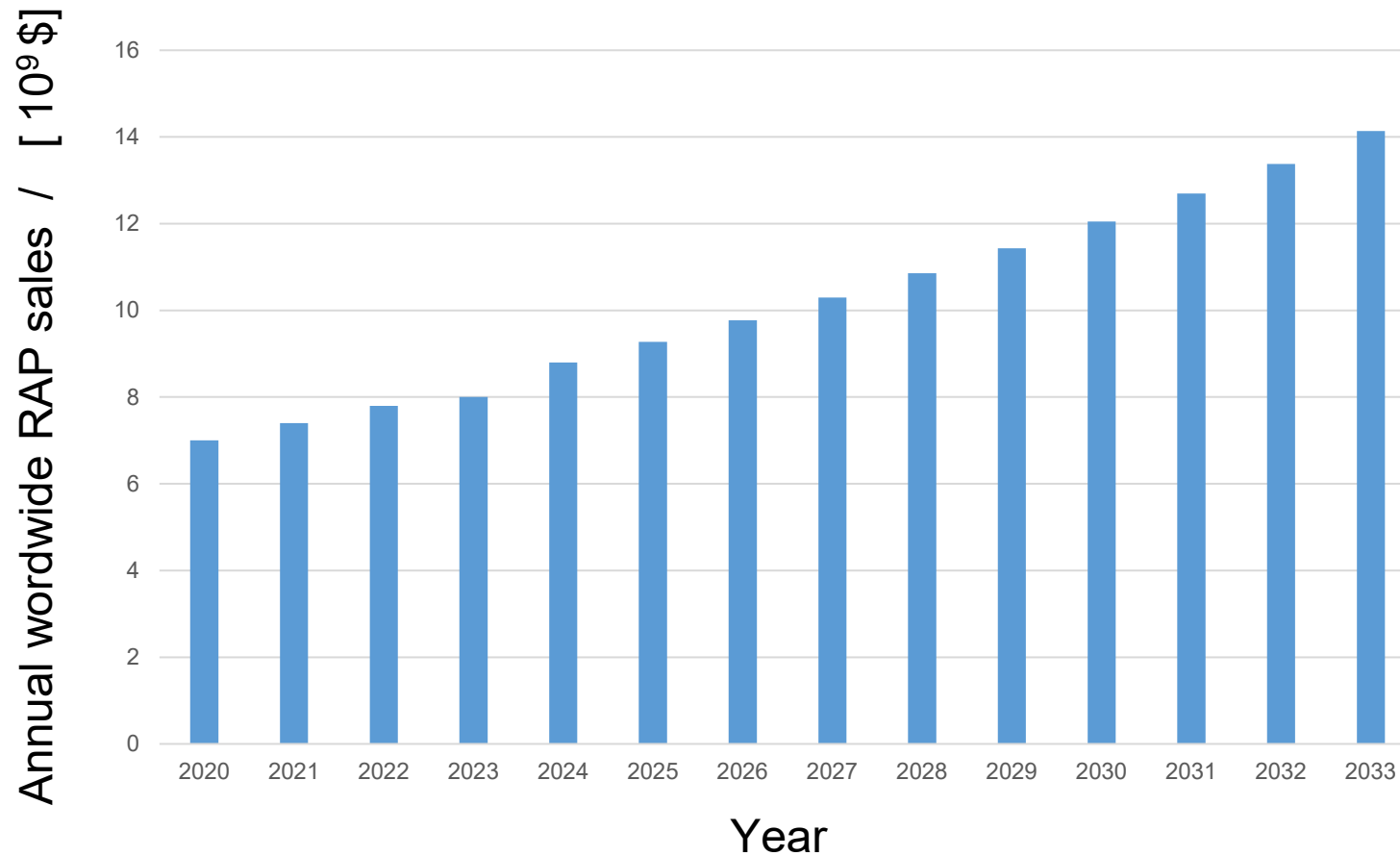


MicroSeal (30-40% Sand-Filled, Sprayable Emulsion)



*Continuously-Stirred
Spray Tanker
(0.4 – 0.9 kg/m²)*

RAP is becoming a new Vital Feedstock

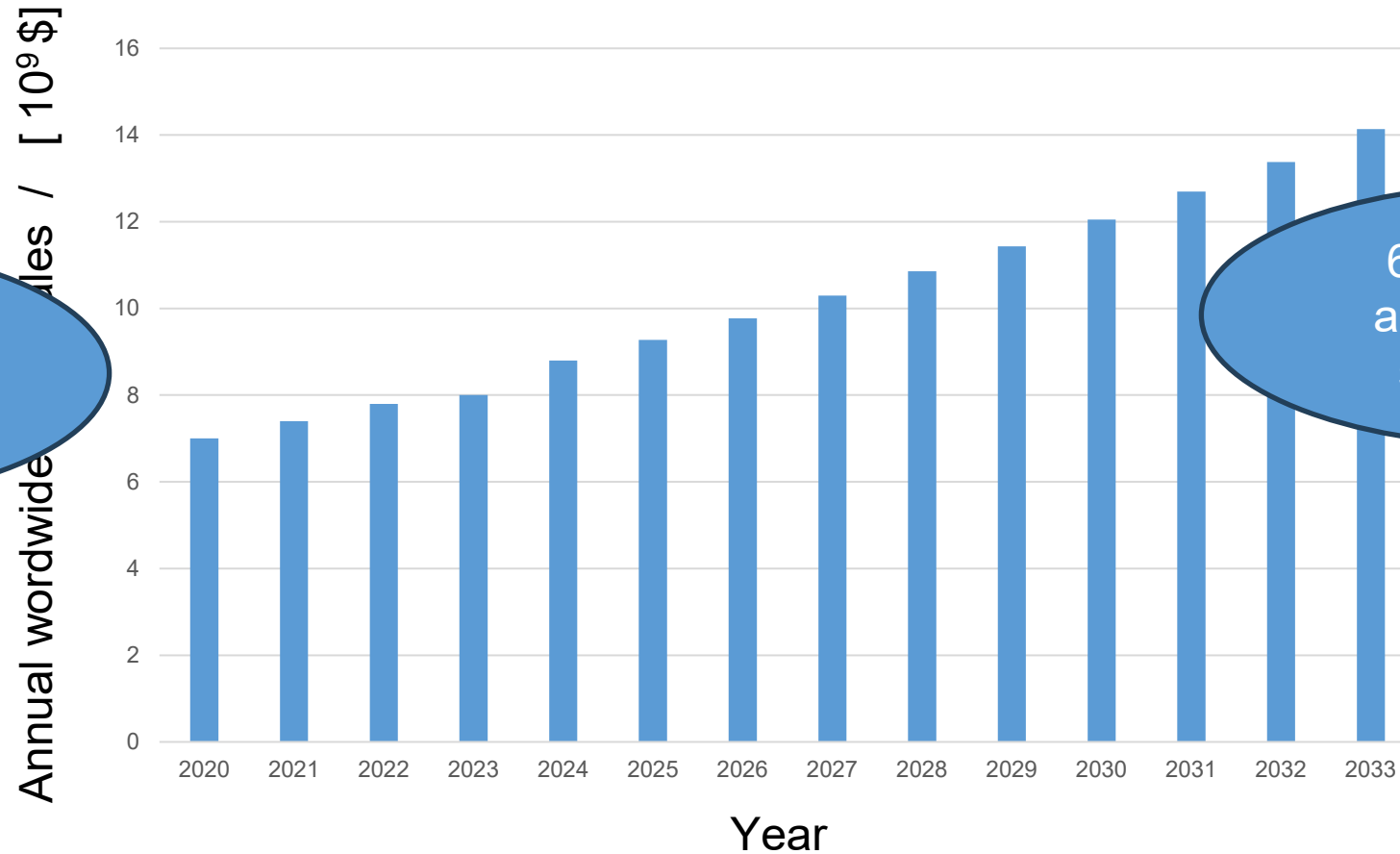


The development of the worldwide RAP sales over the period 2020 – 2033. The data are obtained by taking the average of five reported sales projections:



RAP is becoming a new Vital Feedstock

Average sales price estimated to be \$25 per MT



300 MMT per annum of RAP sales/re-use

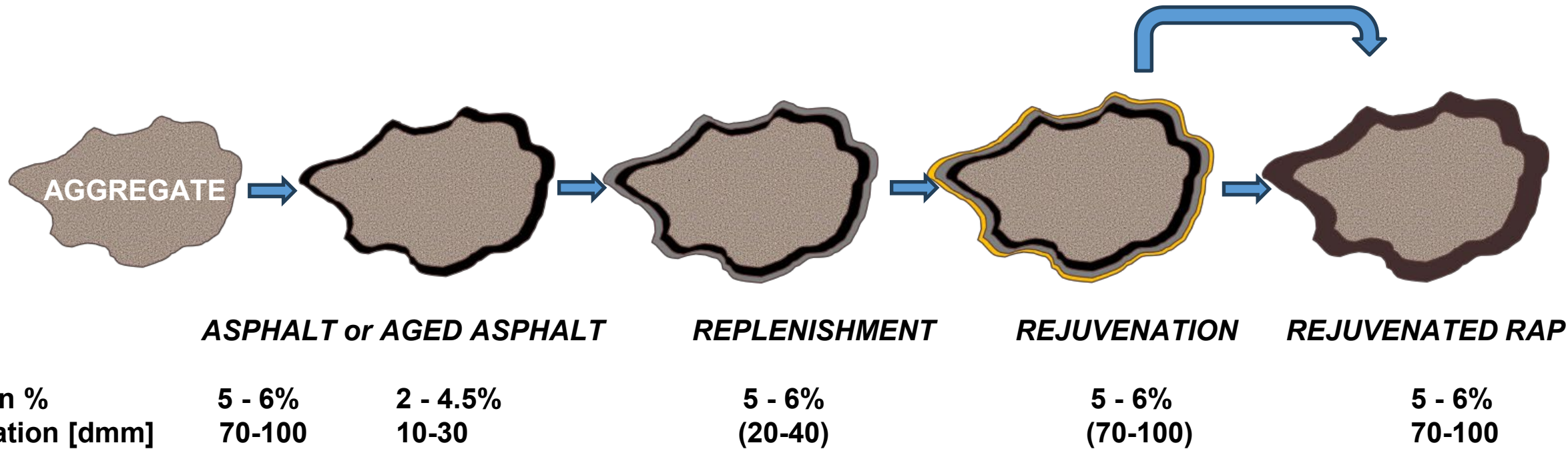
600 MMT per annum of RAP sales/re-use

The development of the worldwide RAP sales over the period 2020 – 2033. The data are obtained by taking the average of five reported sales projections:



Upgrading RAP in cold-mixes at Room Temperature

DIFFUSION AND COMPATIBILITY CONTROLLED



INITIALLY, TEMPERATURE RANGE FOR MIXING/DIFFUSION WAS AIMED AT 10-30 °C



FUNCTIONAL REQUIREMENTS

BITUMEN REPLENISHMENT

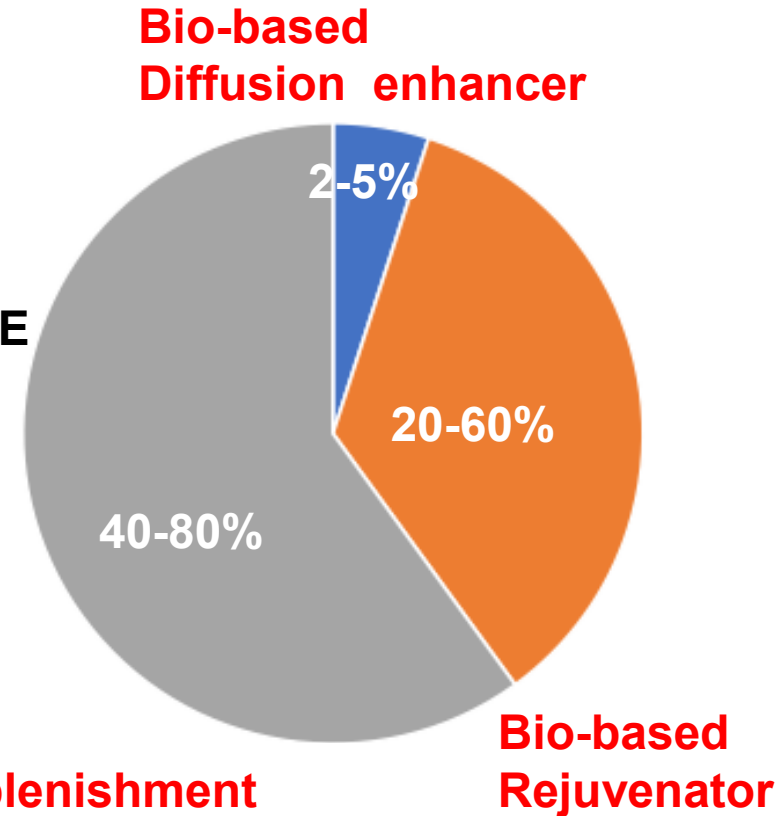
BITUMEN REJUVENATION

MIXING AND DIFFUSION AT ROOM TEMPERATURE

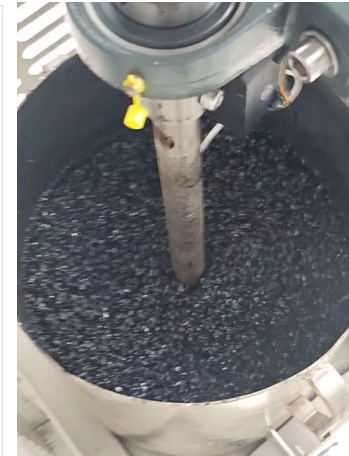
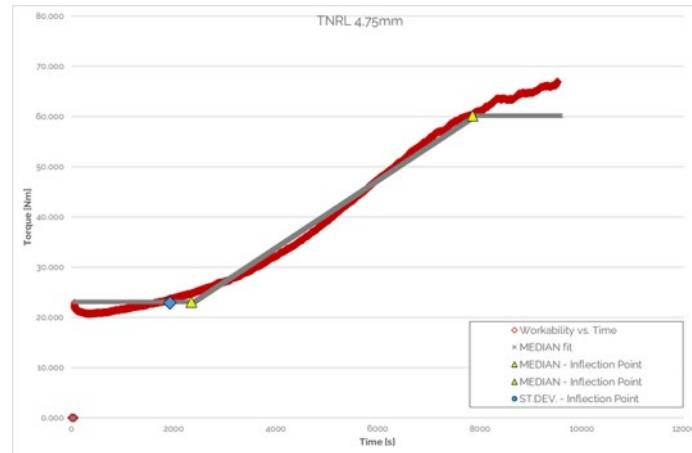
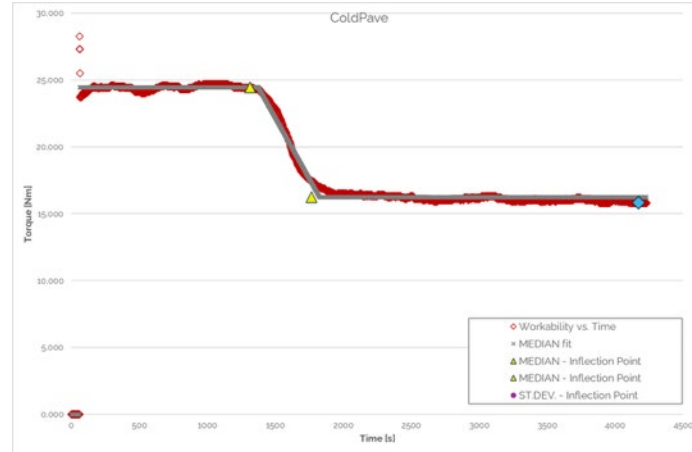
DIFFUSIVITY CONTROL

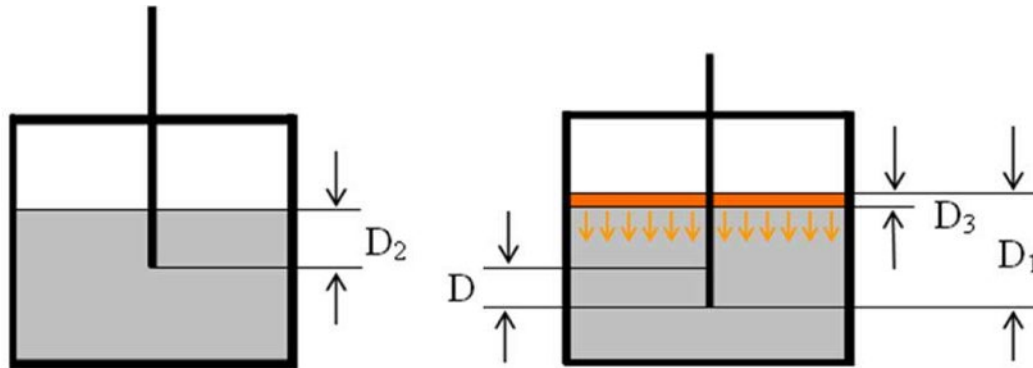
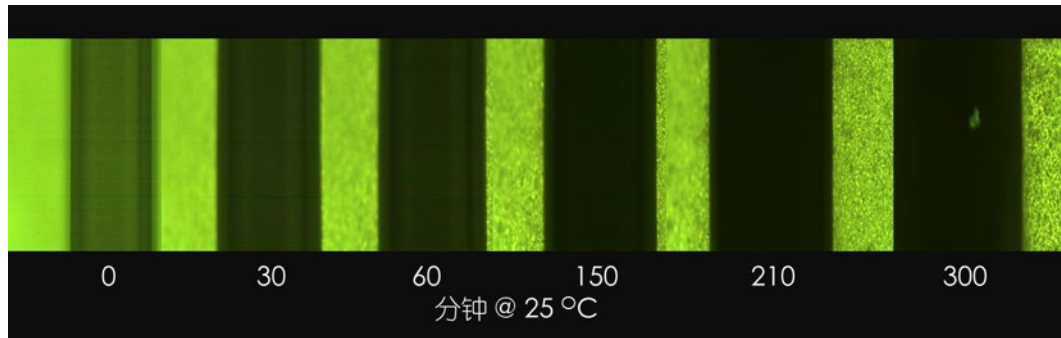
FINAL PERFORMANCE (SOFTNESS/DSR)

BROAD COMPACTION WINDOW



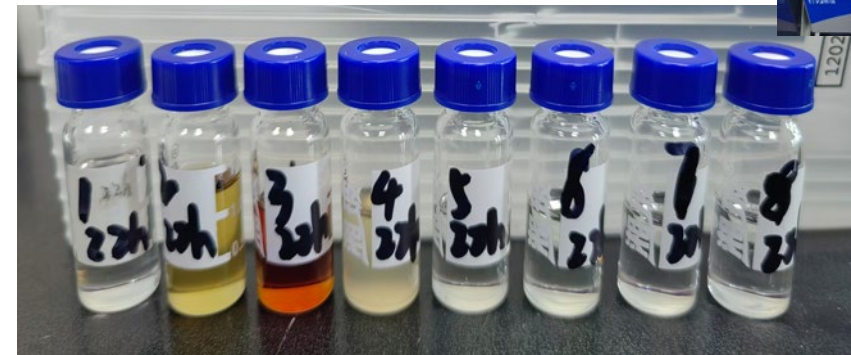
Liquid @ 20 °C
No volatile solvents
High vapor pressure
No fumes
Pleasant to work with





$$I_{CO} = \frac{A_{C=O}}{\sum A_V}$$

MONITORING CURING RATE



Diffusion Enhancement

OPTIMIZATION DIFFUSION ENHANCEMENT

- (Aged) Bitumen Compatibility
- Viscosity
- Molecular Weight
- Polarity
- Component Volume Fractions



First Application Development

POTHOLE AND OTHER SMALL REPAIRS *MIX ON SITE*

**98.5% UPGRADED RAP (Mix of three sieve fractions)
1.5% of the Cold-Mix Oil**



Easy mixing



Good workability



***Adjusted
compaction
scheme***



***Short curing
period after.
compaction***



***Good durability
>> 4 years***

OUTPERFORMS SOLVENT-BASED SYSTEMS, MEETS CHINA STANDARDS !!!



Further Application Development

MACHINE PAVING AT ROOM TEMPERATURE (*MIX IN FACTORY*)



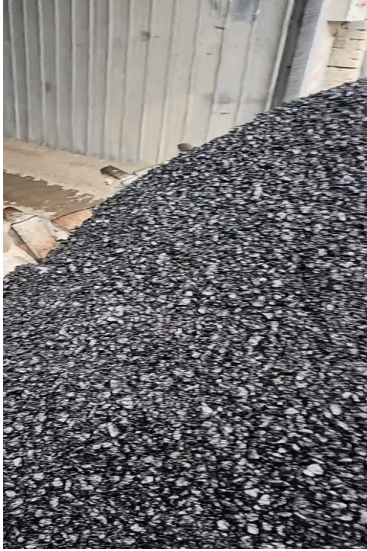
MACHINE PAVING BELOW FREEZING POINT (*MIX IN FACTORY*) PAVING AT ULTRA LOW TEMPERATURES

> 3 years service life



**PAVING & COMPACTION
Pavement @ -10 - -12 °C**





GOOD WORKABILITY, EXCELLENT CONCRETE PENETRATION



Pavement Properties vs Chinese Standard

Property	JT/T 972-2015 Cold Patching Materials	Cold Patching	Cold Paving	Semi- Flexible
Initial Strength (kN)	(not defined)	≥2	≥2.5	≥2 (Main Mixture)
Void Content (%)	--	4~8	3~6	> 20
Marshall Strength 25°C (kN)	≥3	≥10	≥14	--
Residual Strength water immersion 25°C (%)	≥85	≥85	≥90	--
Marshall Strength 60°C (kN)	--	≥3	≥5	≥8 (1d)
Residual Strength water immersion 60°C (%)	--	≥85	≥85	≥80 (1d)
Adhesion rating (level)	5	5	5	5
Residual Strength Freeze-Thaw (%)	--	≥80	≥85	≥85 (1d)
Dynamic Stability (cycles/mm)	--	> 600 (60°C)	> 800 (60°C)	> 7000 (70°C)



The Value of different RAP materials

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Fine RAP Fractions are more Complicated with regard to Emissions

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Fine RAP Fractions are more Complicated with regard to Agglomeration



The Final Objective: Nearly 100% RAP Microsurfacing

Nearly 100% RAP MICROSURFACING

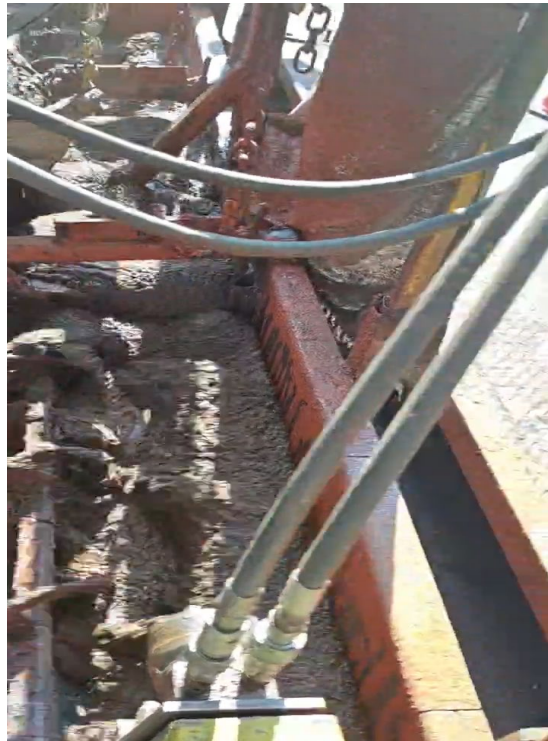
MIX IN MACHINE @ room temperature

FLOWABLE MORTAR, GOOD BREAKING/SETTING TIME

98.5% UPGRADED RAP (fine fraction)

1.5 – 2.0 % of the Cold-Mix Oil (Emulsified)

Optimized RAP grading 0-5 mm for MicroSurfacing



Bitumen – Bio-Oil Bimodal Emulsion

Detection indicators	Aged bitumen (Extraction)	+5% Cold mixing oil	SK 90 bitumen
Dosage (Based on a 6:100 ratio of oil to stone)	3.9		2.1
Softening point °C	62	48	46
Needle penetration 0.1mm	18	86	83
15°C ductility cm	10	68	100

Emulsified bitumen	unit	Emulsified bitumen
Screening residue	%	0
pH		2.36
Solid content	%	60.51
Standard viscosity (3mm25°C)	s	22
Particle size distribution	µm	6.18
Mixing experiment 200:2:10:14	s	60
Molding time (20°C)	min	30



**Bio-based
Diffusion enhancer**

**Bio-based
Rejuvenator**

Bitumen Replenishment

Cationic Emulsifier Interactions with Virgin Aggregates and RAP

Virgin

RAP



Effect of an Adjusted Emulsifier System





100% RAP MicroSurfacing: Effect of Rolling During Trials



**COMPACTION IS REQUIRED TO INITIATE
QUICK DIFFUSION/PENETRATION OF THE OIL
Shear, increasing contact surfaces,**

100% RAP MicroSurfacing: ISSA Evaluation

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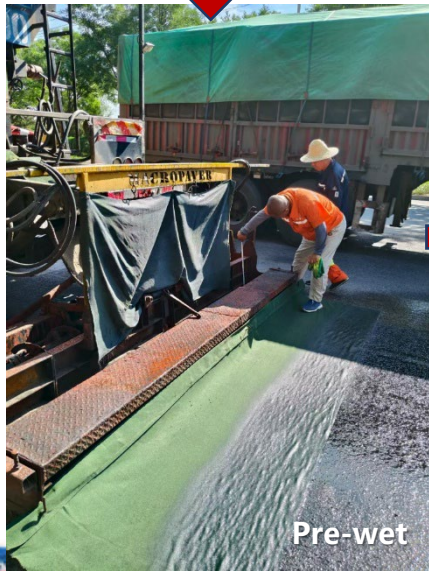


MicroSurfacing: Trials (Bitumen Emulsion new + Emulsified Oil)

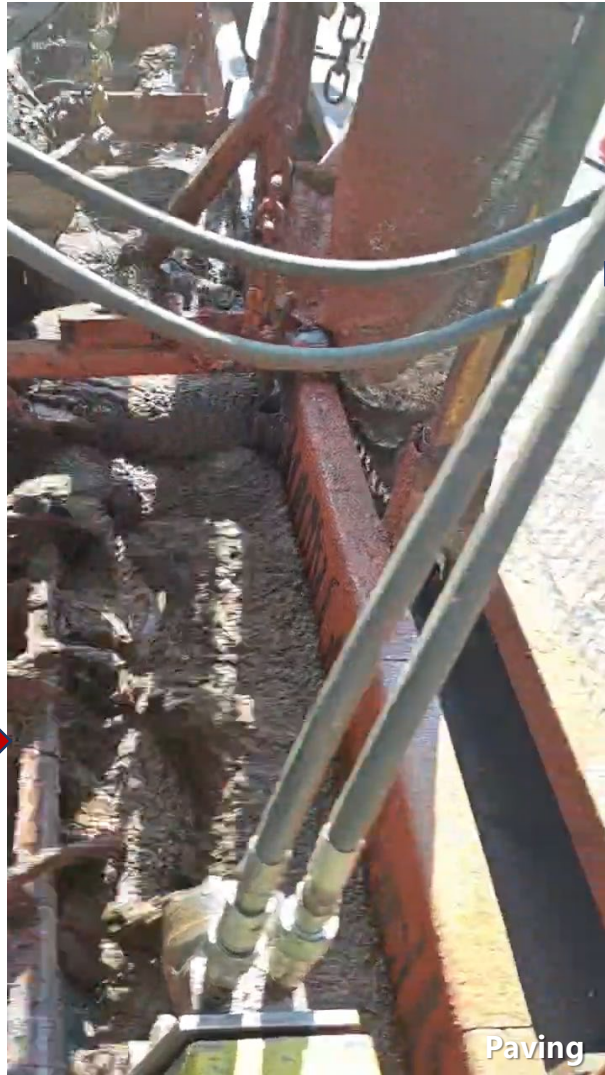
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Clean



Pre-wet



Paving



After 1h



Rolling



Open traffic after 2h

Designed BE%

7.0

Solid content%

45

Designed New B%

3.1

RAP B%

4.3

Mixture B%

7.4

Actual BE%

7.36

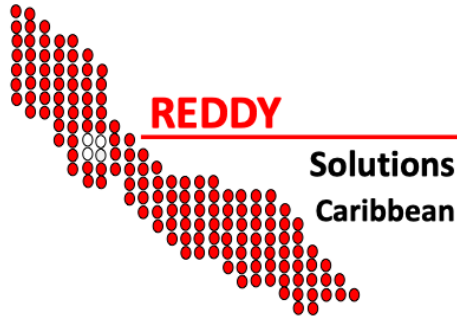
Actual B%

7.32

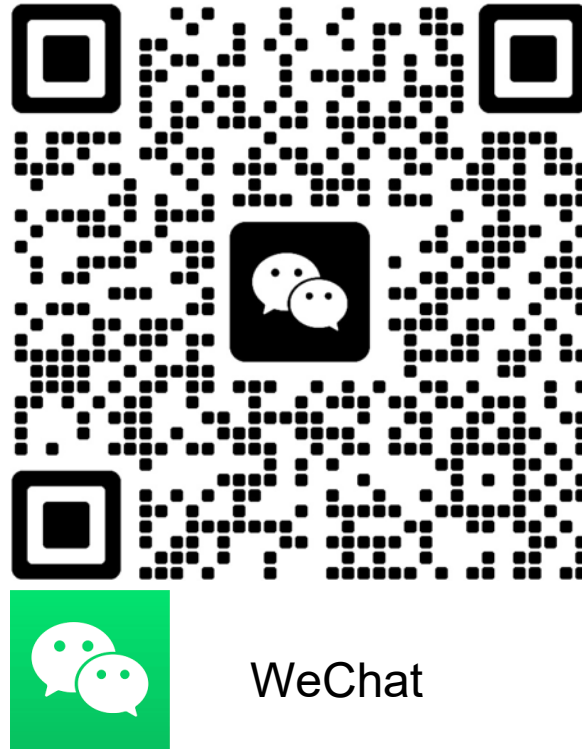
Comparison Virgin vs RAP MicroSurfacing

***Extra water addition required for mixture workability
With the new emulsification system, breaking is still meeting requirements***

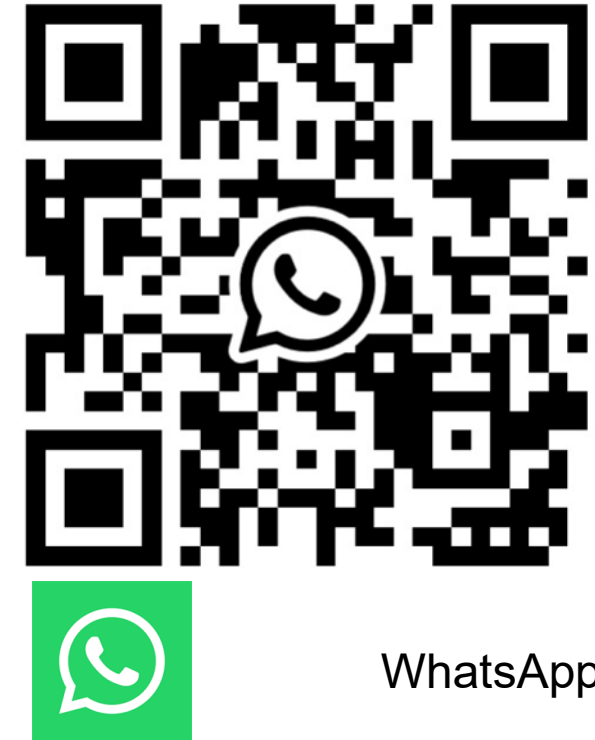




***“Your Consulting Partner for Circular
and Protective Construction
Materials”***



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THANKS FOR YOUR ATTENTION



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