

Microsurfacing with CQS-1hP: An Eco-friendly Modern Approach to Road Maintenance in Vietnam

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- Road Maintenance Challenges in Vietnam
- Microsurfacing Technique
- Production of CQS-1hP Polymer Modified Bitumen Emulsion
- Legal and Regulatory Framework for Microsurfacing in Vietnam
- Eco-efficiency: Environmental and Economic Benefits
- Case Study: CQS-1hP Microsurfacing in Vietnam
- Conclusions



Road Maintenance Challenges in Vietnam

Road Network and Traffic in Vietnam

➤ Extensive and heavily used road network

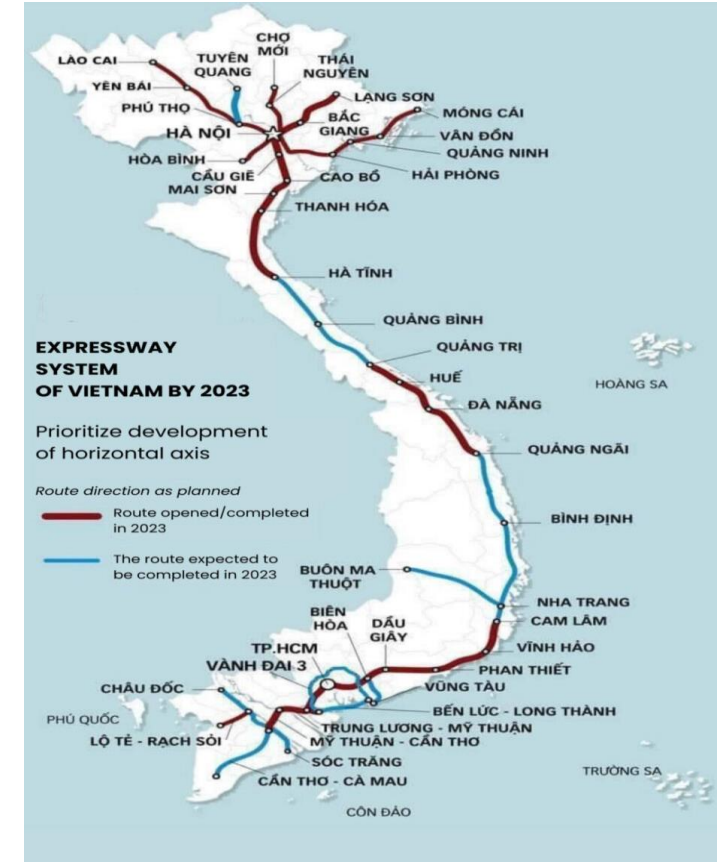
- **595,000 km** roads nationwide (**25,500 km** national roads & expressways)

➤ High and growing traffic volumes

- Strong increase in medium and heavy trucks for construction, industry and logistics.

➤ Concentrated loading on key corridors

- North–South and major radial corridors carry a very high share of total traffic;
- Surface distress often appears long before structural failure.



“Adapted from Viettonkin Consulting,
Expressway System of Vietnam”



Road Maintenance Challenges in Vietnam

Climate, Maintenance Pressure

- Harsh tropical climate and extreme rainfall
(High temperatures, strong UV radiation and very heavy rain, with frequent flooding)
- Accelerated pavement surface deterioration
- Growing maintenance needs
- Vietnam's net-zero 2050 commitment

Road maintenance strategies therefore need more eco-efficient, low-carbon surface treatments, such as **Microsurfacing**.



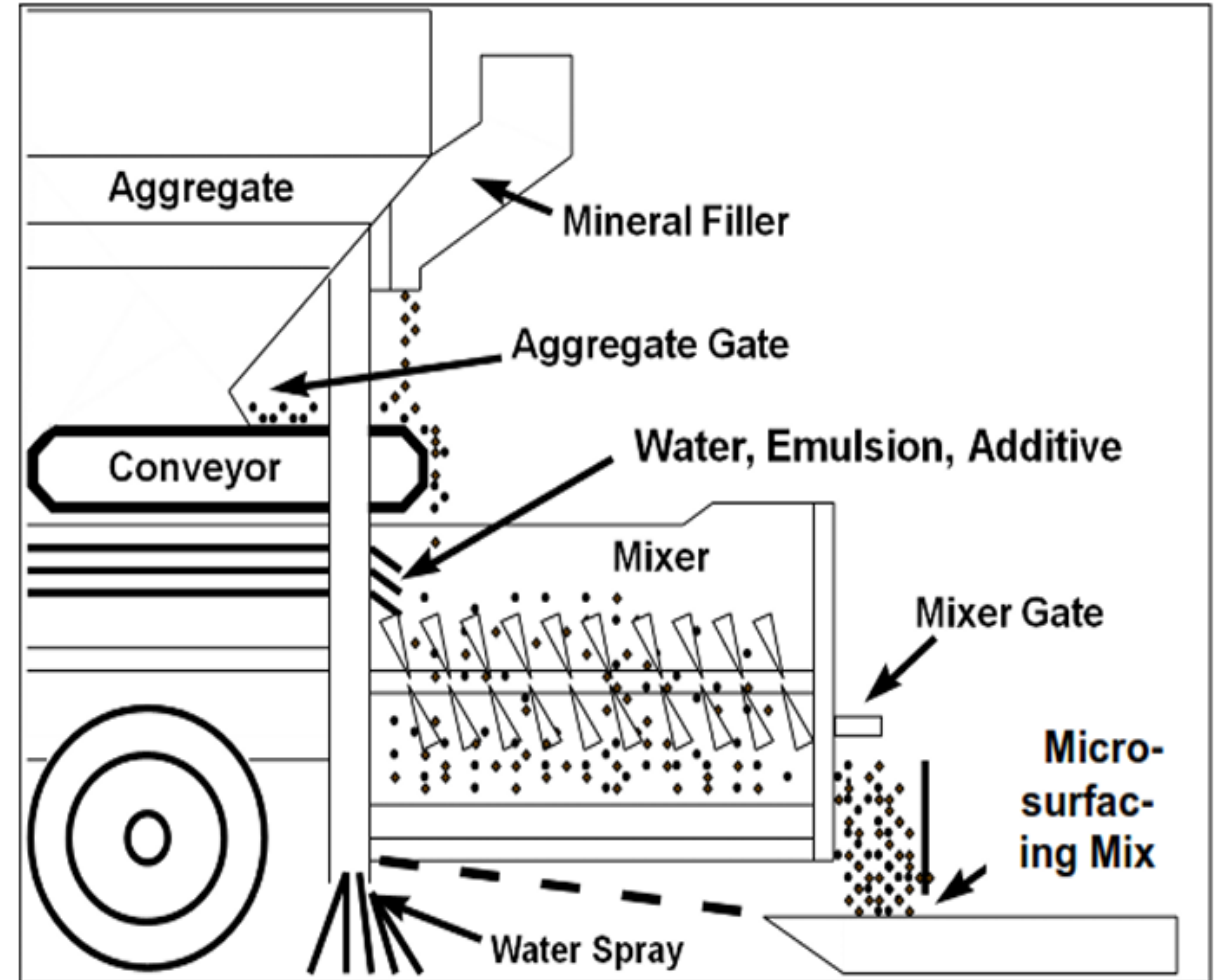
“Frequent flooding in Hanoi after heavy rain (source: VietnamNet)”



Microsurfacing Technique

What is it?

- Microsurfacing is a cold-applied pavement preservation technique
- a mixture of aggregate + polymer modified bitumen emulsion + mineral filler (cement) + water + chemical additives
- continuously mixed in a microsurfacing machine and immediately spread in a thin, uniform layer over a properly prepared pavement surface



Microsurfacing Technique

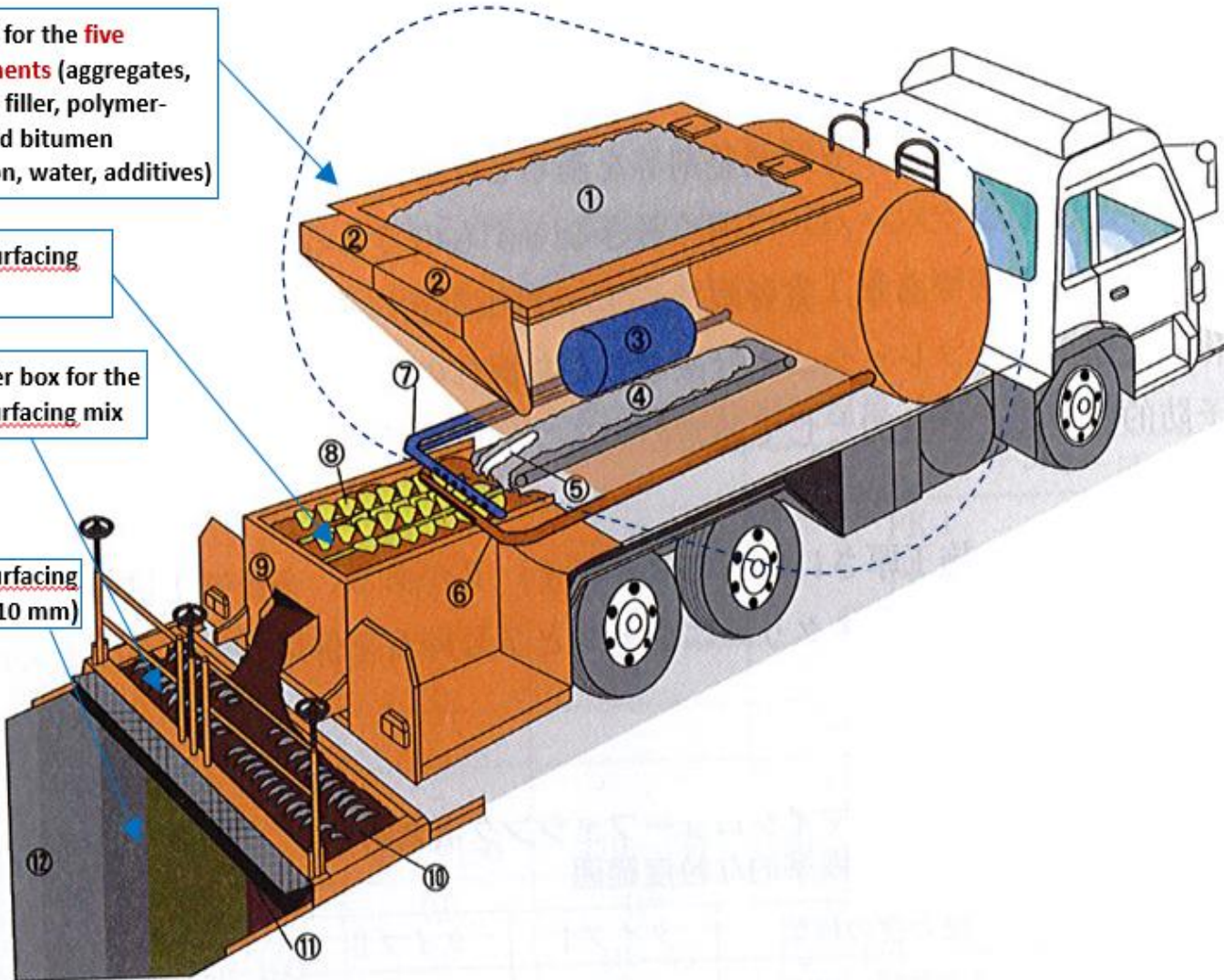
Microsurfacing machine

Storage for the **five components** (aggregates, mineral filler, polymer-modified bitumen emulsion, water, additives)

Microsurfacing mixer

Spreader box for the microsurfacing mix

Microsurfacing layer (~10 mm)



Traffic can be opened after about **1 hour** (no tack coat and no rolling required)



Microsurfacing Technique

Microsurfacing Formulation and Key Functions

Microsurfacing Formulation

- 9.5 mm down aggregate: 100%
- **Polymer Modified Bitumen Emulsion (CQS-1hP) : 12.5%**
- Water: 6-8%
- Cement: 1-2%
- Breaking Control Additive: 0.5-2%



**CQS-1hP is the key component
in the microsurfacing mixture**

Key Functions

- Restore surface texture and skid resistance
- Seal the surface and delay ageing
- Provide preventive maintenance and correction of minor surface distresses
- Renew aged asphalt surfaces
- Act as an interlayer/cushioning layer over cement concrete pavements
- Enable fast, eco-efficient maintenance



Microsurfacing Technique

Microsurfacing Mix Design Requirements

According to TCVN 12316:2018 – Micro-surfacing pavement layer

No.	Property / Test Item	Unit	Requirement	Test Method
1	Mixing time at 25°C	s	≥ 120	ISSA TB 113
2a	Wet cohesion at 30 minutes	kg.cm	≥ 12	ISSA TB 139
2b	Wet cohesion at 60 minutes	kg.cm	≥ 20	ISSA TB 139
3	Wet stripping	%	< 10	ISSA TB 114
4a	Wet track abrasion loss – specimen soaked 1 hour	g/m ²	≤ 538	ISSA TB 100
4b	Wet track abrasion loss – specimen soaked 6 days	g/m ²	≤ 807	ISSA TB 100
5	Residual asphalt content (loaded-wheel sand adhesion check)	g/m ²	≤ 538	ISSA TB 109

Note: TCVN 12316:2018 adopts key performance tests from ISSA TB 100, 109, 113, 114, 139, ensuring compatibility with international microsurfacing practice.



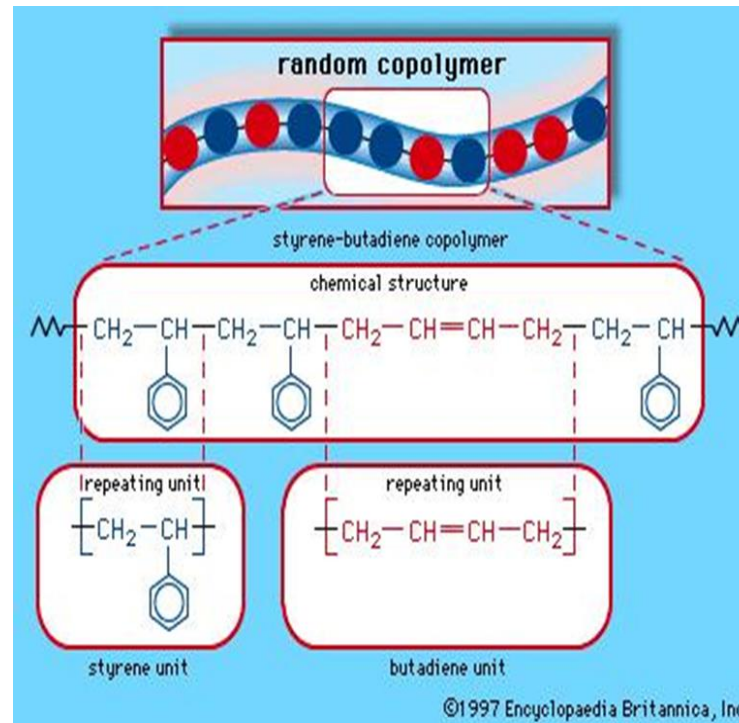
Production of Polymer Modified Bitumen Emulsion: CQS-1hP

CQS-1hP Emulsion

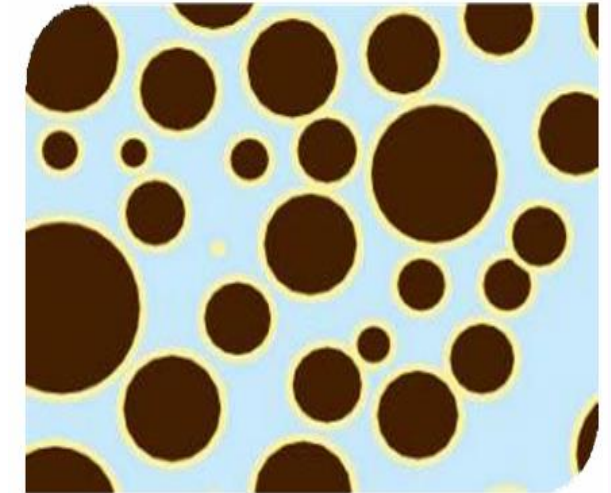
CQS-1hP → Cationic Polymer Modified Bitumen Emulsion

Cationic Quick Polymer

- Bitumen Emulsion = a dispersion system of bitumen droplets (oil phase) in water phase
- Bitumen droplets: stabilized in water phase by **Emulsifier**; droplet size: 0.1 to 20 μm .
- Polymer: most usually **SBR** Latex



SBR structure
 (Styrene content: very important for good quality CQS-1hP) !



Bitumen droplets in water



Emulsion product

Production of Polymer Modified Bitumen Emulsion: CQS-1hP

CQS-1hP Formulation



Laboratory Colloid Mill
(Emulbitume- from France)



Production Line
(Emulbitume-
from France)-
Capacity 15 t/hr.

Component	Content (% by mass)
Bitumen (Grade 60/70)	62-64
Latex (SBR)	5-7
Emulsifier	1.4-1.6
Salt (CaCl_2)	0.1
Acid (HCl 33%)	2.2
Nước	Balance to 100%

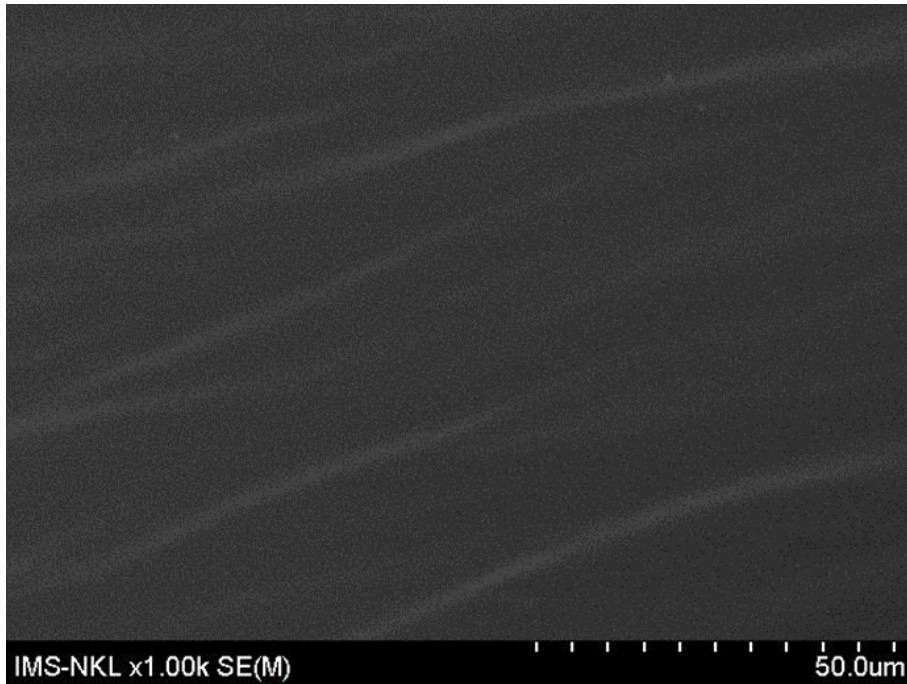
$$T_{\text{soap solution}} = 45 \pm 0,5 \text{ }^{\circ}\text{C}, \text{ pH} = 2,0 \pm 0,2.$$

$$T_{\text{bitumen}} = 140 \pm 0,5 \text{ }^{\circ}\text{C}$$

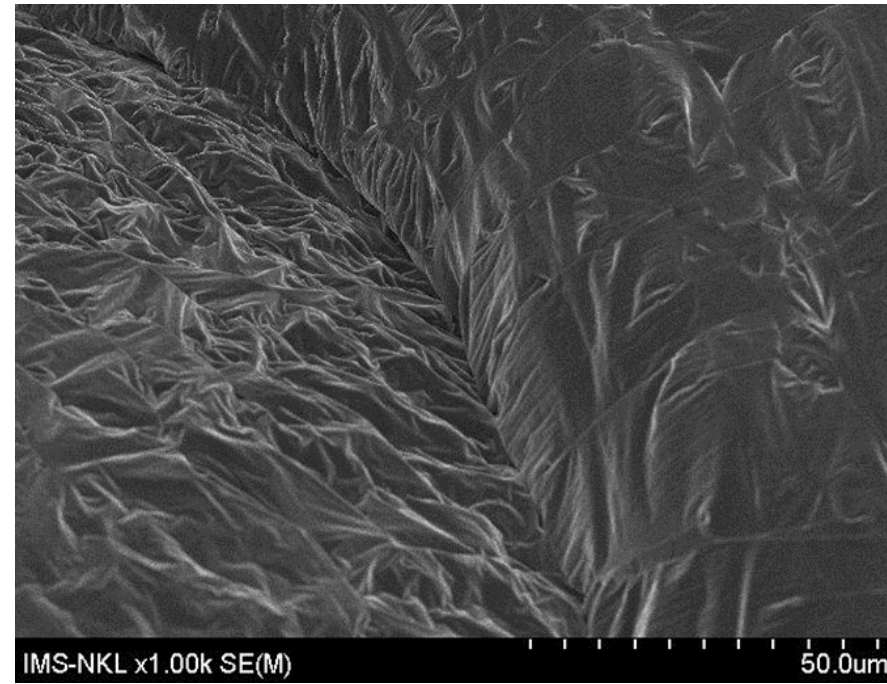


Production of Polymer Modified Bitumen Emulsion: CQS-1hP

Experimental Results: SEM (Scanning Electron Microscope)



Residue of CQS-1h Emulsion **without** SBR



Residue of CQS-1hP Emulsion **with** SBR

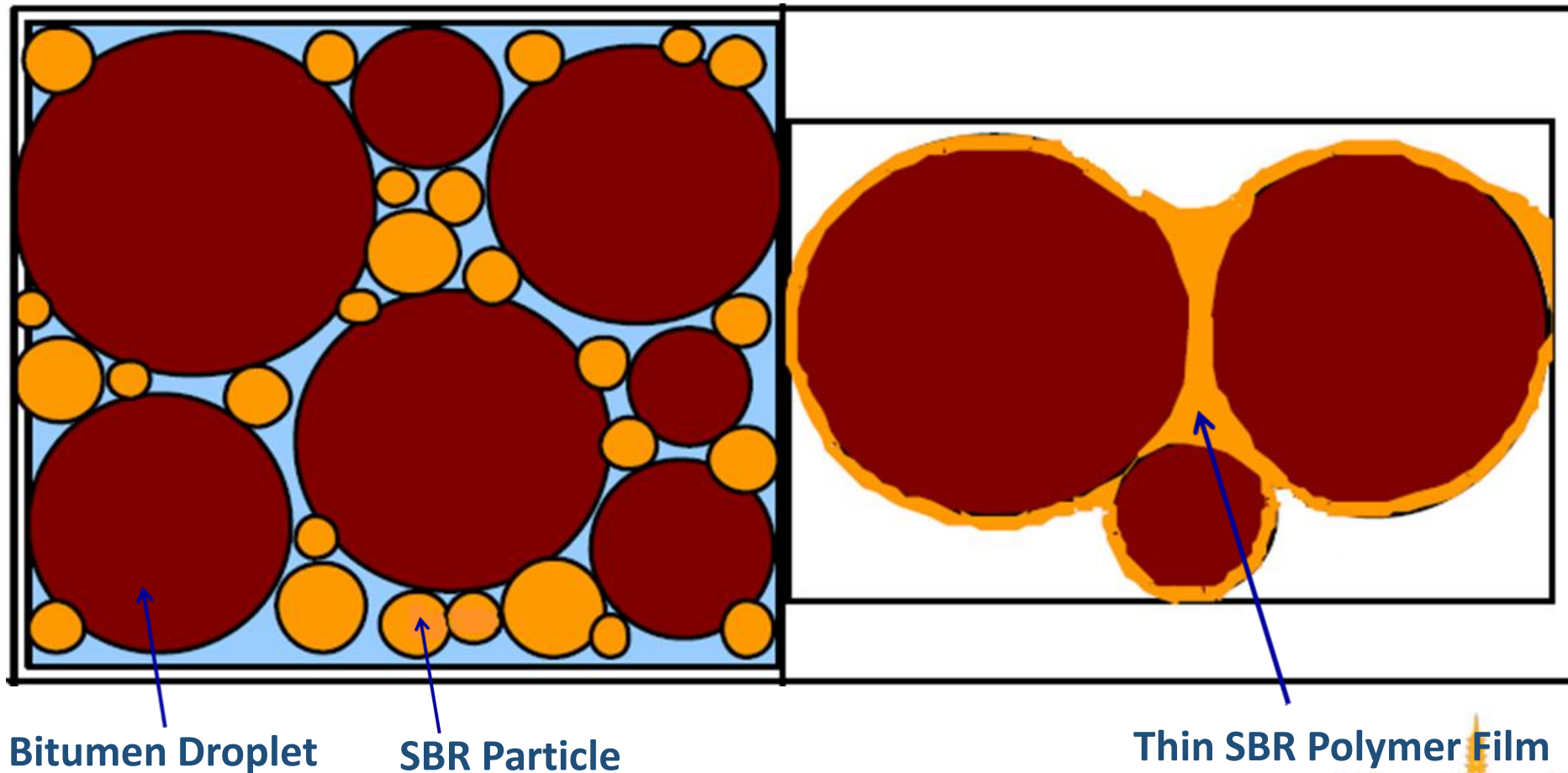
➡ SBR particles tend to exist independently from the bitumen droplets in the CQS-1hP emulsion



Production of Polymer Modified Bitumen Emulsion: CQS-1hP

Experimental Results: **Breaking Mechanism in CQS-1hP**

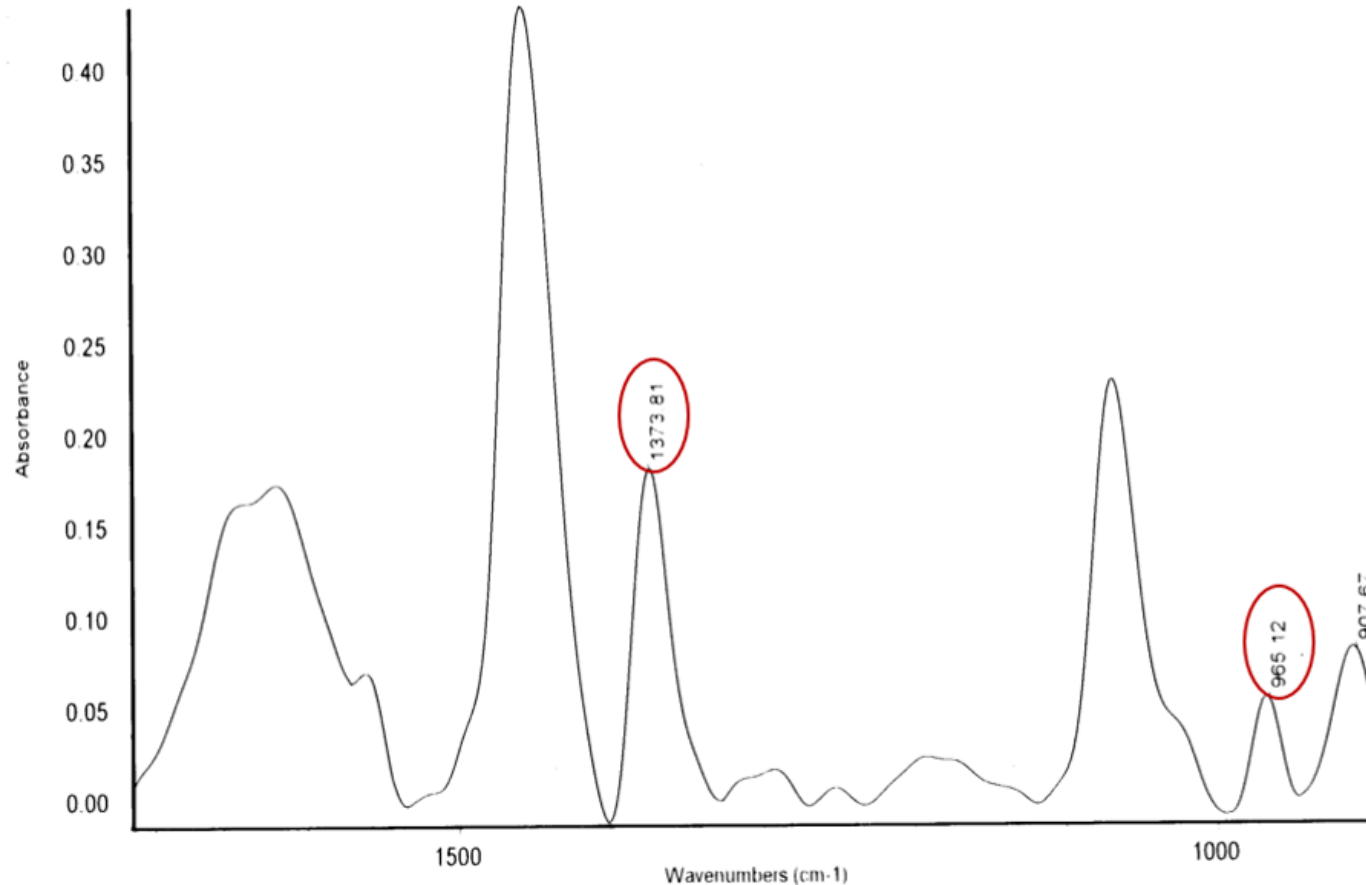
SEM observations support the film-forming mechanism proposed by Dr Koichi Takamura (*)



(*): Dr. Koichi Takamura "BSR Synthetic Latex in Paving Applications", Bitumen Asia 2000, June 20-21, Singapore

Production of Polymer Modified Bitumen Emulsion: CQS-1hP

Experimental Results: **SRB content by FTIR**



SBR content: **3,75 %**

(TCVN 12316: 2018: min 3,0 %)

Infrared absorption spectrum of the bitumen residue after evaporation



Production of Polymer Modified Bitumen Emulsion: CQS-1hP

Typical Ex. Results for CQS-1hP, Standard: TCVN 12316:2018

No.	Quality Property	CQS-1hP Emulsion	Requirement	Test method
I	Tests on polymer emulsion sample			
1	Saybolt viscosity, 25 °C (s)	32.5	20 – 100	TCVN 8817-2:2011
2	Oversize particles, sieve test (%)	9.1×10^{-5}	max. 0.1	TCVN 8817-3:2011
3	Storage stability, 24 h (%)	0.3	max. 1	TCVN 8817-4:2011
4	Particle charge	Positive	Positive	TCVN 8817-5:2011
5	Residue after evaporation test (%)	68.48	min. 62	TCVN 8817-10:2011
II	Tests on residue after evaporation test			
6	Penetration at 25 °C, 5 s (0.1 mm)	54	40 – 90	TCVN 7495:2005
7	Softening point (ring-and-ball), °C	63.5	min. 57	TCVN 7495:2005
8	Elastic recovery at 25 °C, ex. 20 cm, rate 5 cm/min, waiting time 5 min (%)	77.5	min. 50	AASHTO T301
9	Ductility at 25 °C, rate 5 cm/min (cm)	85	min. 40	TCVN 7496:2005
10	Solubility in trichloroethylene (%)	99.87	min. 97.5	TCVN 7500:2005
11	Polymer content (% by mass, SBR)	3.75	min. 3	AASHTO T302

➔ **CQS-1hP** consistently satisfies the **TCVN 12316:2018**, demonstrating excellent quality and performance for microsurfacing applications.



Legal and Regulatory Framework for Microsurfacing in Vietnam

National Technical Standard: TCVN 12316:2018

TCVN TIÊU CHUẨN QUỐC GIA

TCVN 12316: 2018

Xuất bản lần 1

LỚP PHỦ MẶT ĐƯỜNG MICRO-SURFACING –
THIẾT KẾ HỖN HỢP, THI CÔNG VÀ NGHIỆM THU

Micro-surfacing – Standard Practice for Mix Design, Construction and Acceptance

HÀ NỘI – 2018

TCVN 12316:2018 – “Micro-surfacing pavement layer – Mix design, construction & acceptance”

- Defines full technical requirements: materials, CQS-1hP, aggregate gradation, mix design, QC, acceptance.
- Provides full national legitimacy for microsurfacing in preventive maintenance.
- Harmonized with ISSA/AASHTO test procedures → easy alignment with international practice.

Source: TCVN 12316:2018– Ministry of
Science and Technology



Legal and Regulatory Framework for Microsurfacing in Vietnam

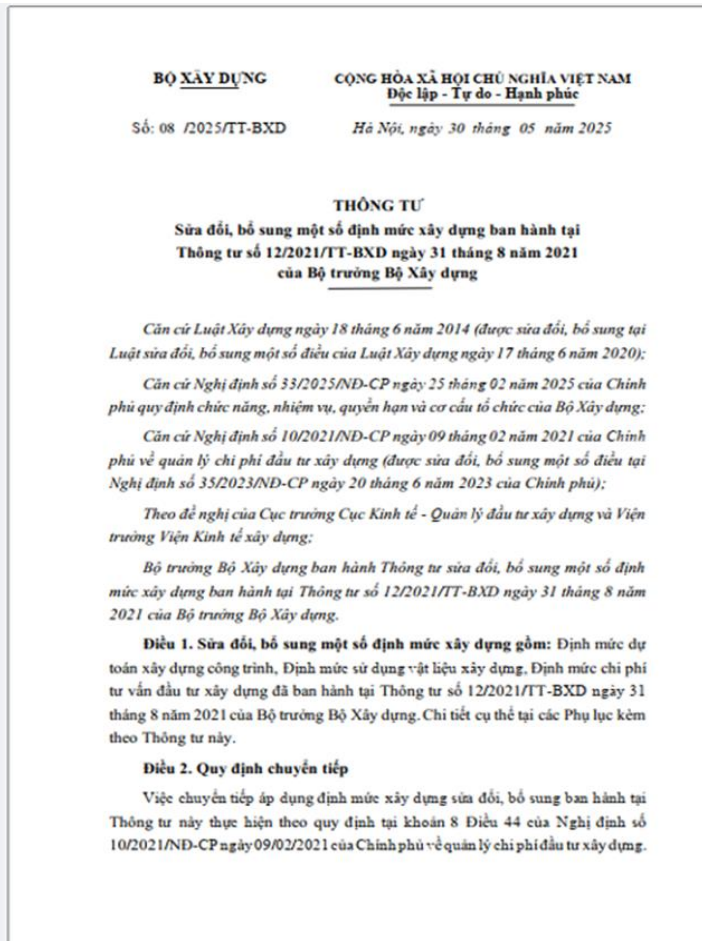
National Cost Norms: Circular 08/2025/TT-BXD

Circular 08/2025/TT-BXD – Construction Cost Norm System

- Officially includes unit cost norms for microsurfacing.
- Allows accurate estimation, tendering, budgeting, and payment settlement.
- Places microsurfacing on equal footing with hot-mix overlays in project appraisal.



“Microsurfacing is fully standardized and economically recognized in Vietnam – ready for mainstream implementation”



Source: Circular 08/2025/TT-BXD - Ministry of Construction



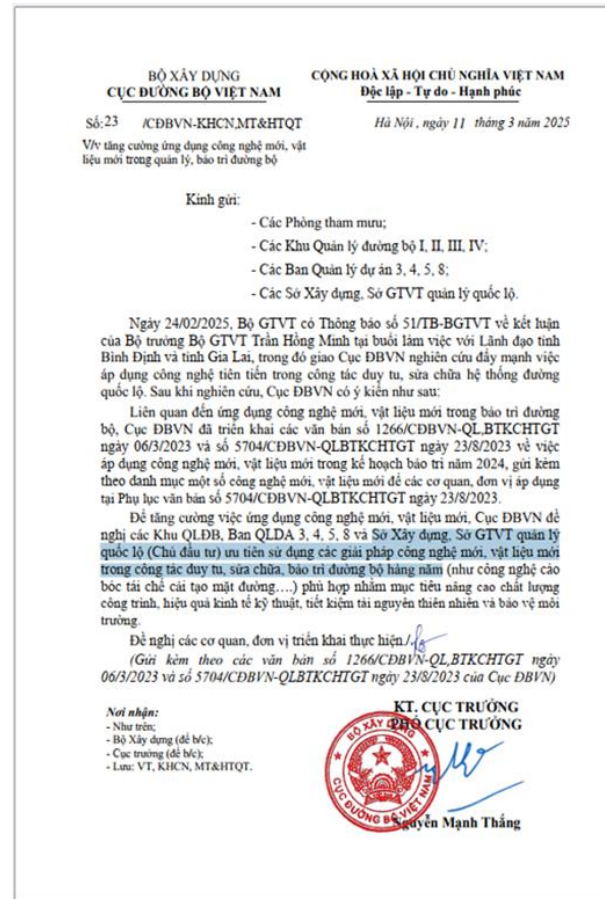
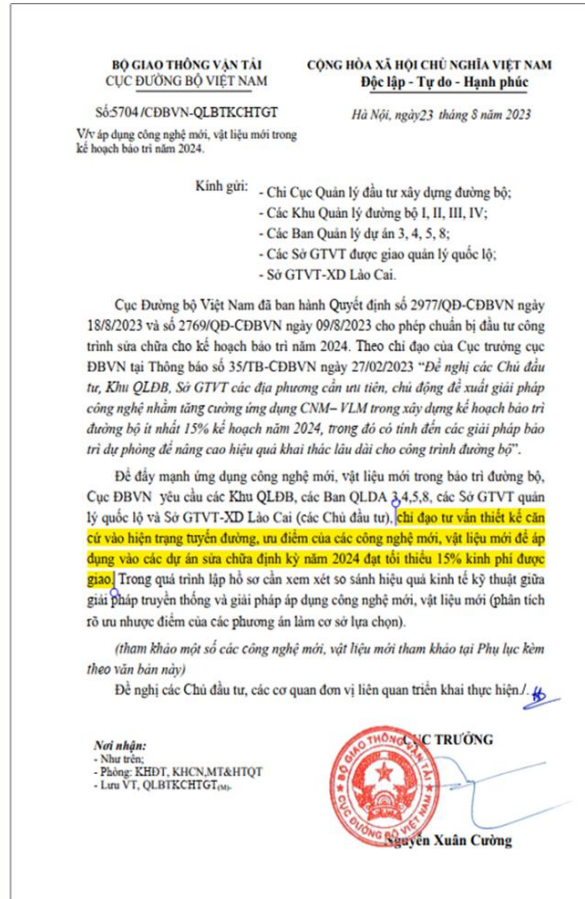
Vietnamese Legal and Standards Framework for Microsurfacing

Policy Support from Vietnam Road Administration

VRA Official Letters (2023 & 2025)

- **Encourage** applying new eco-efficient pavement preservation technologies
- Microsurfacing explicitly listed as recommended thin wearing course.
- Allow using maintenance budgets for pilots, trials, and wider adoption.

➔ **Microsurfacing is no longer experimental — VRA officially supports nationwide expansion**



Source: VRA Official Letter 5704/2023 & 23/2025-Vietnam Road Administration

Eco-efficiency: Environmental and Economic Benefits

Why?

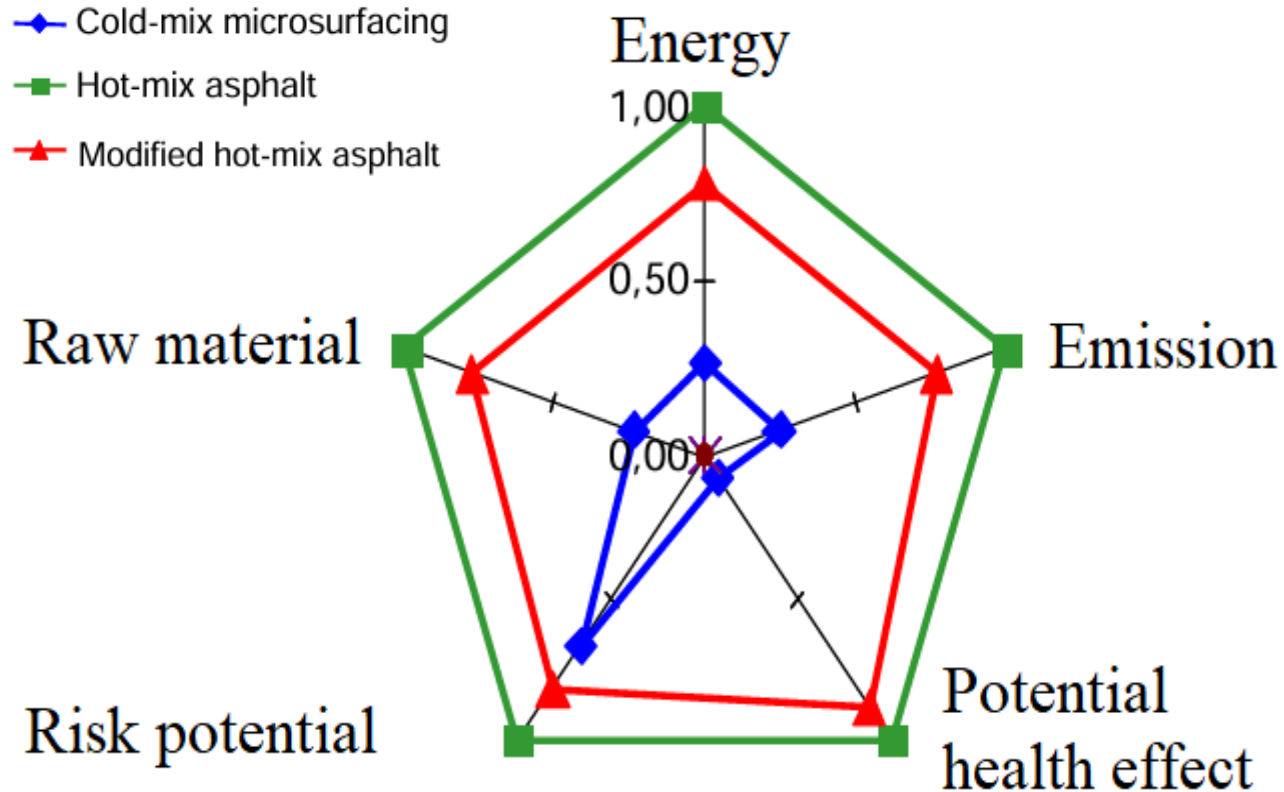
Compared to conventional Hot-Mix Asphalt overlays, microsurfacing delivers substantially lower environmental impacts:

- Cold-applied, zero-heating process
- Very thin 8–12 mm treatment
- Lower life-cycle energy demand
- Reduced transport and handling emissions
- Shorter work zones and construction times



Eco-efficiency: Environmental and Economic Benefits

Evidence from the Literature



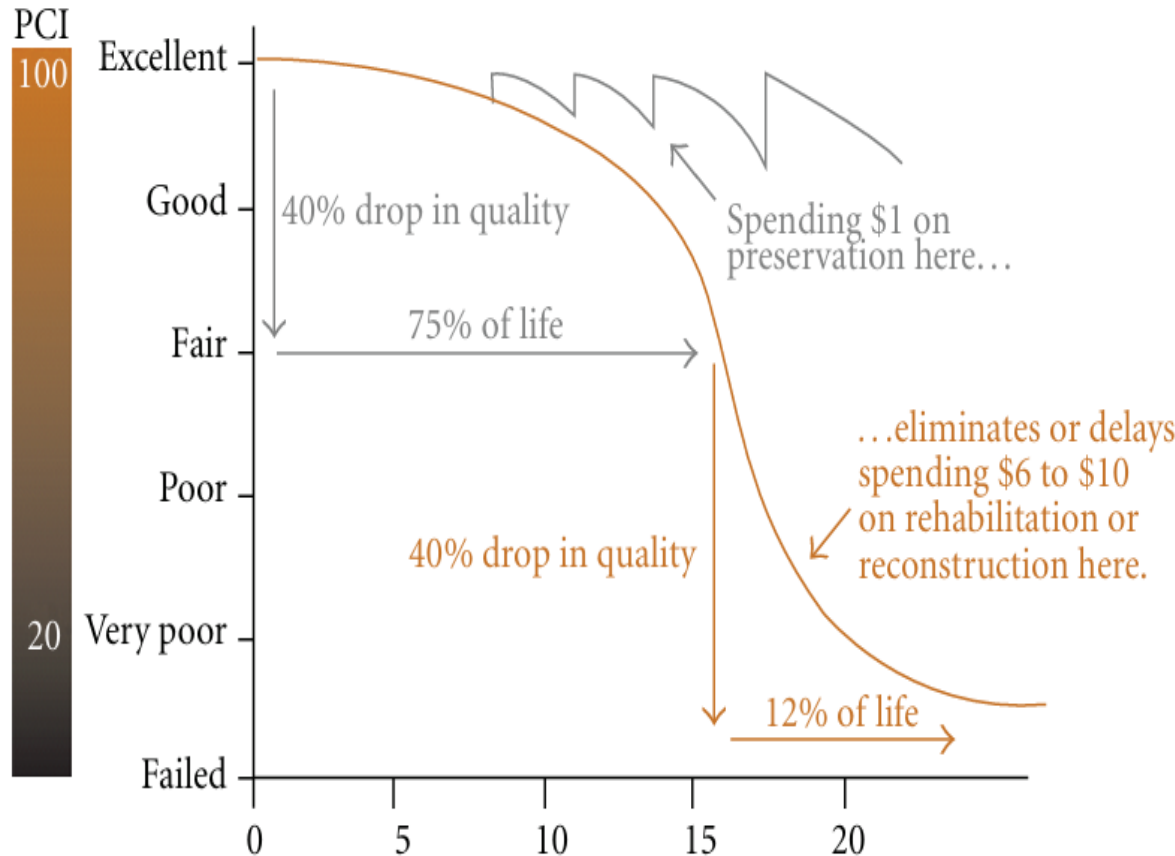
- Eco-efficiency analysis compares Microsurfacing with Hot-mix overlays
- Microsurfacing shows **lowest impact** in: raw materials, energy, emissions, safety → **smallest** environmental footprint

Source: K. Takamura et al., "Microsurfacing–Eco-Efficient Strategy," in Eco-Efficient Pavement Preservation Strategy, BASF, 2011.



Eco-efficiency: Environmental and Economic Benefits

Evidence from the Literature

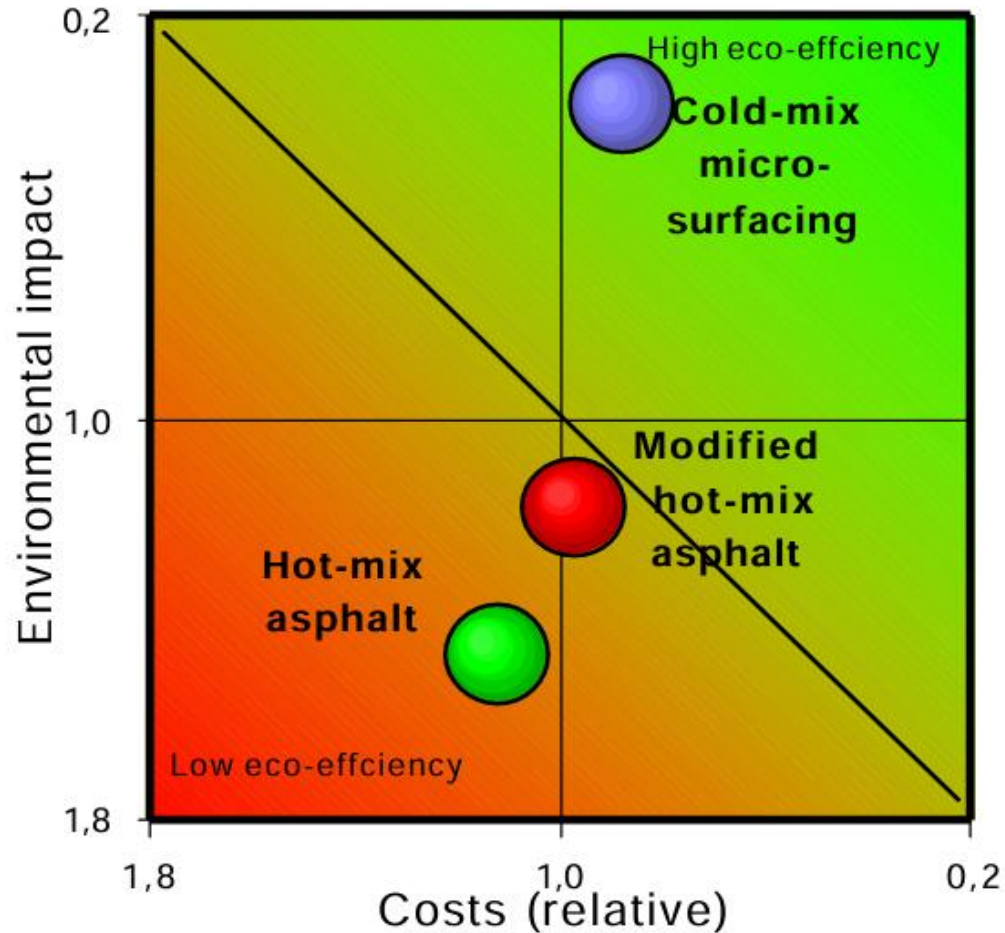


- PCI: pavement condition index; x-axis is in years
- Source: B. Broughton *et al.*, “30 Years of Microsurfacing: A Review,” 2012.

- Applying preventive maintenance such as microsurfacing delivers exceptional value — every \$1 spent today can save \$6–\$10 in future rehabilitation or reconstruction costs.
- The ISSA reports: for treating rutted and polished pavement, **microsurfacing** costs **\$17,600** per lane mile, while **milling and HMA** cost **\$50,000** per lane mile. (Source: International Slurry Surfacing Association (ISSA). *High Performance Slurry Systems*. Annapolis, MD, USA, n.d.)



Eco-efficiency: Environmental and Economic Benefits Evidence from the Literature



Microsurfacing positions itself in the **High Eco-efficiency quadrant**, outperforming both hot-mix and modified hot-mix asphalt.

Source: K. Takamura et al., "Microsurfacing–Eco-Efficient Strategy," in Eco-Efficient Pavement Preservation Strategy, BASF, 2011.



Case Study: CQS-1hP Microsurfacing in Vietnam

Microsurfacing on Ly Thai To Street, Vinh Phuc, Vietnam

Completion year: 2018

Contractor: Elsamex Vietnam JSC

Dimensions: Length 97 m; Width 14 m;

Area: $\approx 1,358 \text{ m}^2$

Mix design:

- Aggregate 100%
- CQS-1hP asphalt emulsion 12.5%
- Cement 2%
- Additive 2%
- Water 8%

Treatment: 9 mm **CQS-1hP** microsurfacing

After 6 years (2024):

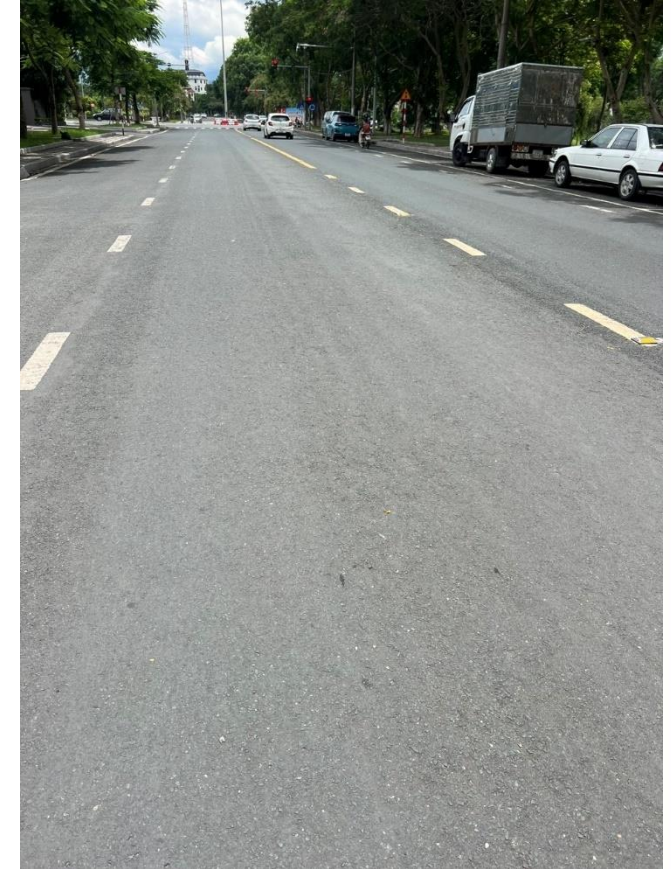
- Excellent surface condition
- No raveling, no stripping
- Good macrotexture and skid resistance
- Stable ride quality

→ Demonstrate strong compatibility of **CQS-1hP** with Vietnamese climate and local aggregates

Before →



During →



After 6 years



Case Study: CQS-1hP Microsurfacing in Vietnam

Recent Microsurfacing Project in Vietnam

Provincial Road **DT 704, Ninh Thuan, Vietnam** (length 4 km; width: 6 m to 8.5 m; treated area: $\approx 29,000 \text{ m}^2$), completed June, 2024 by Elsamex Vietnam JSC



Before Microsurfacing



3 days after Microsurfacing



1 year after Microsurfacing



Conclusions

- CQS-1hP is a high-performance polymer-modified cationic emulsion, fully compliant with TCVN 12316:2018, providing **fast breaking, high cohesion, strong moisture resistance** and **durable adhesion** for microsurfacing.
- CQS-1hP breaks via a **film-forming mechanism**, in which SBR forms a thin polymer film that bridges and facilitates the coalescence of bitumen droplets.
- As an **eco-efficient, low-carbon** technology—cold-applied, thin, and resource-saving—microsurfacing helps **reduce life-cycle energy use, emissions, and costs**, in line with Vietnam's **net-zero 2050** pathway.
- Supported by a comprehensive **legal and regulatory framework**, microsurfacing is now a **standardized and economically recognized** technology in Vietnam.
- Proven in multiple projects nationwide, microsurfacing shows **strong long-term performance**. With rising preventive maintenance needs, the **market potential is large and expanding**, offering **attractive opportunities for technology partners and investors**.



Thank you very much for your attention.

Dr. Thanh Hai Ngo
Hanoi University of Mining and Geology





AGENDA

26 November, Hanoi, L7 West Lake Lotte Hotel

Time	Title
9:30 - 10:00	Registration
10:00 - 10:30	Opening Ceremoney and Remarks
10:30 - 10:50	Dr. Dao Phuc Lam In-plant Hot Recycled Asphalt Concrete with 25-50% RAP used in Vietnam road construction.
10:50 - 11:20	Coffee Break
11:20 - 11:40	Dr. Bert Jan Lommerts Recycling of Reclaimed Asphalt materials into High Value Maintenance Solutions
11:40 - 12:00	Mr. Mai Trieu Quang Full Depth Recycling (FDR) Technology
12:00 - 13:00	Lunch Break
13:00 - 13:30	Networking
14:00 - 14:20	Eng. Klajdi Kulla Warm Mix Asphalt (WMA) - Technologies and case studies
14:20 - 14:40	Ms. Sarah He China's Bitumen Demand & One-Stop Supplier for Road Construction Materials and Equipment
14:40 - 15:10	Coffee Break
15:10 - 15:30	Ms. Rahimi Strategic Preservation Treatments and Smart Material Selection
15:30 - 16:00	Networking
16:00 - 16:20	Closing



AGENDA

27 November, Hanoi, L7 West Lake Lotte Hotel

Time	Title
10:00 - 10:30	Opening
10:30 - 10:50	Dr. Thanh Hai Ngo Microsurfacing with CQS-1hP: An Eco-friendly Road Maintenance Solution in Vietnam
10:50 - 11:10	Eng. Luca Baccellieri Polymer modified mixture (Dry method Technologies and case studies
11:10 - 11:40	Coffee Break
11:40 - 12:00	Networking
12:00 - 12:20	Mr. Xu Quanxin RBBA Emulsion Enhancers for Producing High-Performance Bitumen Emulsions
12:20 - 13:30	Lunch Break
13:30 - 13:50	Mr. Sathya Narayanan Bridging the Middle East and Asia: Overview of Trade Flows, Price Trends, and Arbitrage
13:50 - 14:10	Mr. DaQiang Zhaozhua Creating a New Model of Environment Friendly Logistics
14:10 - 14:40	Coffee Break
14:40 - 15:00	Mr. Foeke Elzinga From reuse to 'Green Label': Developments in the Dutch asphalt industry
15:00 - 15:30	Networking
15:30 - 16:30	Closing Ceremony Award giving and the group picture



Who's Speaking?



Ms. Samane Rahimi
Marketing manager
BACCO LTD



Eng. Luca Baccellieri
Engineer, Iterchimica



Ms. Sarah He
General Manager



Eng. Klajdi Kulla
Area manager Europe



Dr. Bert Jan Lommerts

XiYueFa Group



Mr. Quanxin Xu

Deputy Director of R&D Center



Dr. Dao Phuc Lam

Head of Innovation Department



Foeke Elzinga

Business Development Manager



Sathya Narayanan

Associate editor, bitumen



Dr. Thanh Hai Ngo

University Lecturer at
Hanoi University of Mining and Geology



Who made #Bituroad2025 Possible:



BlackGold



HORMOZAN OIL



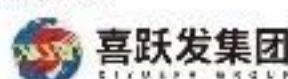
路管家
ROAD KEEPER



RADIANT



roads towards sustainability



喜跃发集团
XIYUEFA GROUP



BACCO
Chemicals and Coatings Co.



HIGHWAYS
TODAY



WORLD
CONSTRUCTION
EQUIPMENT



WFE



argus



argus

PLANT & EQUIPMENT



Rue



Dr. Thanh Hai Ngo

**University Lecturer at
Hanoi University of Mining and Geology**

Keynote Speaker



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