Measurement of the effectiveness of fiber reinforced micro surfacing mixtures

Evaluation technique de l’apport des fibres pour les enrobés coulés à froid

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Outline

› Micro surfacing background information
› Re-inforcement considerations
› Measurement of the fiber effectiveness in the laboratory and in the field
› Closing remarks
MICRO SURFACING
BACKGROUND
INFORMATION
What is Micro Surfacing?

› A designed mixture of:
  - Polymer modified emulsified asphalt
  - Mineral aggregate
  - Mineral filler
  - Water
  - Other additives

› Quick cure - Quick traffic
  - Traffic ready in about 1 hour
  - Can be done at night

› Uniformly spread over a properly prepared surface
  - ISSA A-143
  - ASTM D-6372
Micro Surfacing - Machine Schematic

- Crushed aggregate
- Cement additive
- Water
- Polymer Modified Emulsion

Spreader box

Mixing time 15 to 45 seconds

Mixture Brown & Homogeneous

Breaking Time 60 to 120 seconds

Traffic in Approximately One Hour

Water Flows

Mixture Black

Direction
Micro Surfacing Has A Global Track Record

› Economical product:
  ▪ Maintenance treatment less than 1 cm thickness
  ▪ Can fill ruts as repair treatment

› Environmentally Efficient
RE-INFORCEMENT CONSIDERATIONS
What Additional Micro Surfacing Values are Desired?

› Improved flexibility and resistance to cracking
› Greater durability
› Low noise

The Use of Fiber as Micro Surfacing Re-inforcement Could be a Viable Option

› Fiber can be reliably added in the field
Ability to Deliver Fiber into the Micro Paver Pugmill
FIBER EFFECTIVENESS IN THE LABORATORY

Introduction of a flexural cracking test to quantify fiber effect
Proposed Flexural Beam Test
Proposed Flexural Beam Test

› Vertical loading rate of 1 mm/minute
› Conditioning of 2 - 16 hours
› AREA under the load displacement curve as energy estimation

Beam width (after compaction): $b = 30\, \text{mm}$
Height (after compaction) $h = 18 \pm 2\, \text{mm}$
Span length, $L = 100\, \text{mm}$
Primary Sample Preparation Steps

› Combine JMF components and mix thoroughly to quickly fill the beam mold
› Cure filled beams
› Compact specimens to simulate early traffic densification
› Demold and condition to test temperature
Flexural Beam Results

![Graph showing the comparison of force (N) vs. displacement (mm) for beams with and without fiber.](image)
FIBER MICRO-SURFACING PROJECTS
China Experience
Recent Fiber Micro Surfacing China Projects

- 08/2012: Shaaxi Shangluo G40 Expressway Demo 5,000 m²
- 09/2012: Xi'an X316 County Road 10,000 m²  <- Detailed Case Study
- 10/2012: Changji Z900 County Road 95,000 m²
- 10/2012: G2501 Hangzhou Belt Expressway Novaseal, 55,000 m²
- 06/2013: Beijing Pinggu Xiayu Road Cape Seal, 119,000 m²
- 09/2013: Ninglian expressway 130,000 m²
- 10/2013: Sichuan Suining Tongde Bridge 30,000 m²
- 04/2014: Nanjing airport expressway 50,000 m²
FIBER EFFECTIVENESS IN THE FIELD

X316 Fiber Microsurfacing Case Study
Xi’An (Shaanxi) China Case Study

› A fiber test section was constructed by Shaanxi Guolin Highway Engineering on September 22-23, 2013

› Xian Dao County Road 316

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<th>Side Road Section Marking</th>
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Project Start: 0 km  Project End: 3.8 km
Xi’An (Shaanxi) China Case Study

› Type III micro surfacing reinforced with glass fiber was applied at 1 cm thickness

› 0.2% glass fiber BWA had minimal impact on workability or early strength gain
Xi’An Project Flexural Beam Results

Field materials used for testing with and without fiber at 0°C and 10°C

- Area under the curve ("energy"): 18% improvement from fiber at 0°C and 73% improvement from fiber at 10°C
- Temperature and fiber loading significant at 95% level
### Xi’An Project Field Performance

#### Distress Evaluation Survey and Crack Map

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(*) From the best performing section
CONCLUSION

- Micro surfacing has global track record as an effective pavement preservation technique
- Micro surfacing is continuously being improved including with fiber
- Sample preparation and flexural testing methods were developed to quantify the effect of fiber reinforcement in the laboratory
  - The area under the flexural load-vertical displacement curve as “energy measurement” can be used to quantify improvement from fiber reinforcement and optimize the system
  - Test temperature and fiber loading were shown to be statistically significant
CONCLUSION (cont.)

› Fiber reinforced micro surfacing is gaining popularity in China
› Xi'an X316 2012 case study findings:
  ▪ Flexural fracture energy tested using field representative material was improved from fiber when tested at 0°C and 10°C
  ▪ Fiber glass at a target rate of 0.2% by weight of aggregate could be easily added in the field
  ▪ The addition of fiber resulted in an improvement in terms of longitudinal and cracking resistance compared to conventional micro surfacing when checked after 8 and 25 months
› Other potential benefits from fiber usage:
  ▪ Modified gradation and improved texture
  ▪ Low noise
Thank you
Questions?

August 2012 Shaanxi Guolin Shangluo G40 Expressway Fiber micro surfacing
October 2012 Hangzhou Belt Expressway (G2501) Ningbo Novaseal Fiber Project
March 2014 - Wuxi SHENGTONG Nanjing Airport Expressway Fiber micro surfacing

June 2013 Focus Beijing Pinggu Xiayu Road Cape Seal with Fiber micro surfacing

September 2013: Ninglian expressway low noise fiber micro surfacing
October 2013 Sichuan Suining Tongde Bridge Fiber micro surfacing