

## Highlights from the ISAET Congress in Washington Nov. 2016

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**Gaylon Baumgardner, PhD, Paragon Tech. Serv. Inc., ISAET 2016 Program Chairman**

**Bernard Eckmann, Engineer, Eurovia**



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Feb. 28th, 2017 - Paris

# AEMA 2016 ISAET

## ATTENDANCE

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### Attendance Summary –

Total of 168 Attendees Representing 21 Countries Including 25 Speakers

### Attending Countries –

Australia, Brazil, Bulgaria, Burkina Faso, Canada, China, Colombia, Estonia, France, Germany, Ghana, Iran, Ireland, Japan, Mexico, Netherlands, Nigeria, Sweden, Thailand, United Kingdom and USA

### Presenting Countries –

France (6), Japan (1), Netherlands (1), and USA (17)

### Sponsors/Exhibitors –

Heatec, PRI Asphalt Technologies, Inc., and VSS International, Inc.



## PROGRAM

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### **SESSION 1 – Emulsion Issues Worldwide**

Moderator : Archie Reynolds - AEMA President

### **SESSION 2 – Testing & Development**

Moderator : François Chaignon - Colas

### **SESSION 3 – Manufacturing & Applications**

Moderator : Jim Moulthrop - FP2 Inc

### **SESSION 4 – Applications**

Moderator : Codrin Daranga - Ergon Asphalt & Emulsions, Inc.



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### SESSION 1

### Emulsion Issues Worldwide

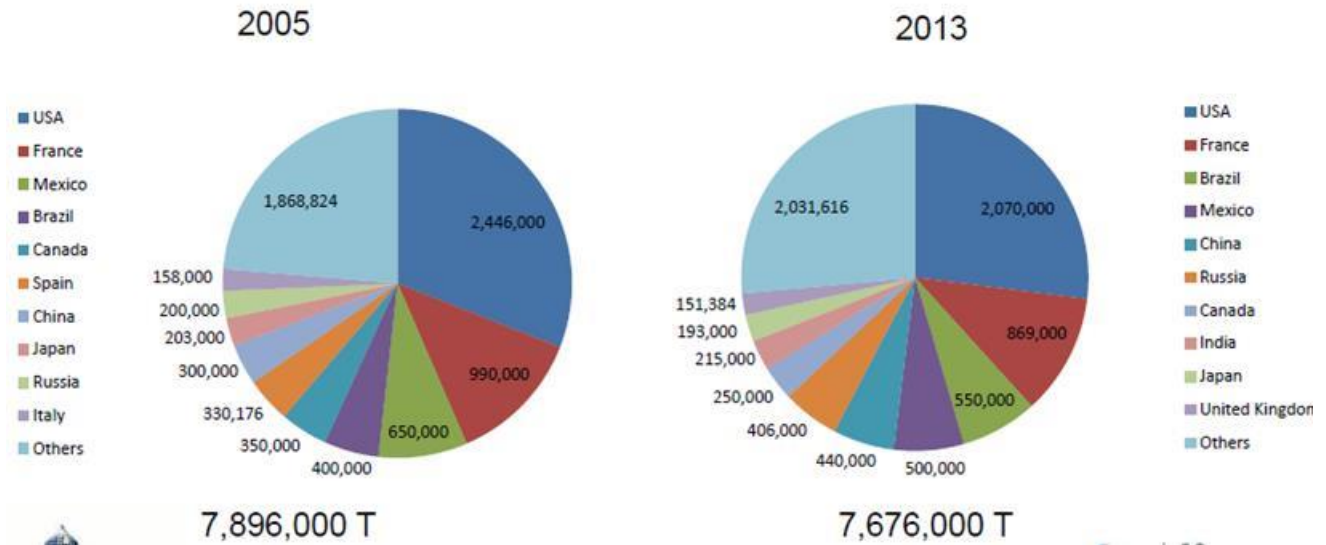


Feb. 28th, 2017 - Paris

# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-1. EMULSION MARKETS AND CHALLENGES – E. Le Bouteiller - IBEF

Trend 2020 v/s forecast in 2008



Production is not improving but the impact of 2008 in industrial countries has been limited

**MARKET OPPORTUNITIES:**

- HSE regulations which should favor cold technologies
- Increasing need for maintenance at low cost

**TECHNICAL CHALLENGES:**

- High traffic roads and limitations of cold mix technology
- Quality and consistency of bitumen



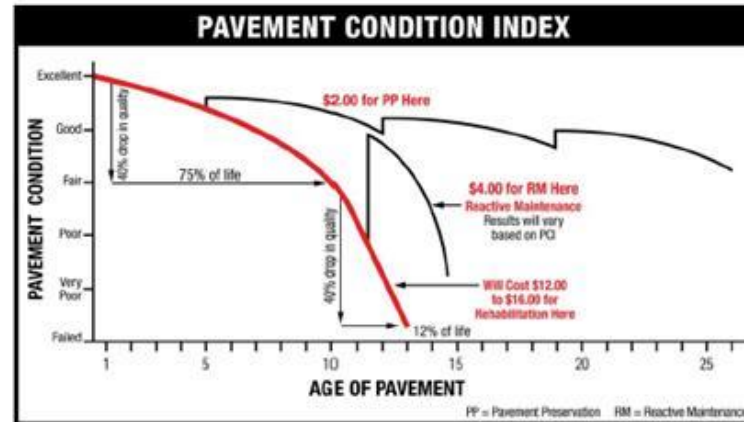
# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-1. EMULSION MARKETS AND CHALLENGES – E. Le Bouteiller - IBEF

### HOW TO MEET THE CHALLENGES

- Continuous work and innovation
- Cross-fertilization and sharing of experience
- Strengthen cooperation with agencies and academics

**Pavement Preservation  
is our first business**



- Don't forget to communicate about successes
- Act local and think global ➔ use IBEF
- Change from product supplier to solution provider



# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-2. EPG (Emuls. Perf. Grades) SPECIFICATIONS FOR SURFACE TREATMENTS – R. Kim - NCSU

### FRAMEWORK

**Fresh emulsion:** Constructability

**Residue:** Performance

**Add 3°C to your current PG grades to obtain the EPG grades for your region!**

○ Climatic considerations

**PG 58- → EPG 61-**

- EPG temperature is measured at the surface while PG is measured at a depth of 20mm
- Should then EPG low temp. not be **3°C lower** ?

○ Low, Medium and High traffic

**Example designation:** CRS – EPG 61-19 M





## 1-2. EPG (Emuls. Perf. Grades) SPECIFICATIONS FOR SURFACE TREATMENTS – R. Kim - NCSU

### FRESH EMULSION

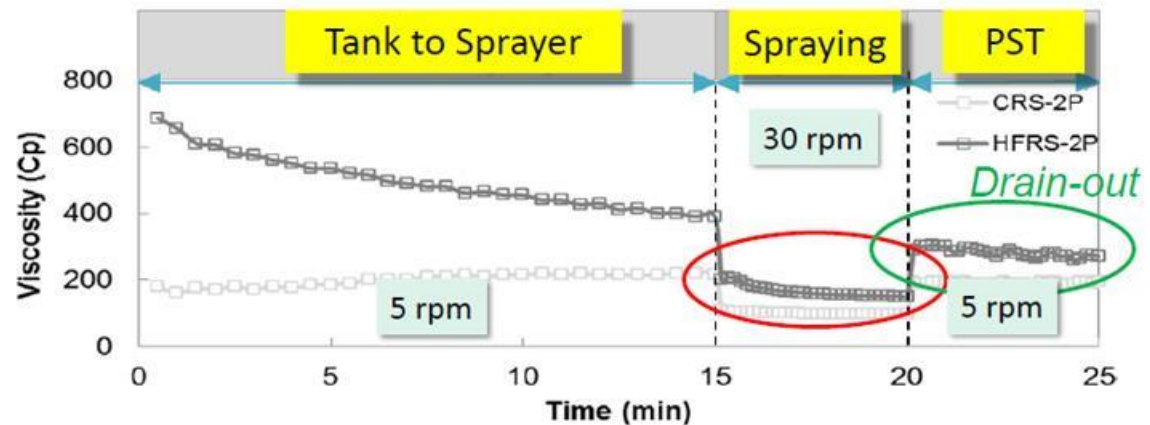


#### Rotational Viscometer to measure:

- Separation Ratio (Rs):  $\eta_{\text{Top}}/\eta_{\text{Bottom}}$ 
  - ✓ Stability under sedimentation, creaming
- Stability Ratio (Rd):  $\eta_{\text{Mixed}}/\eta_{\text{Reference}}$ 
  - ✓ Potential for flocculation, coagulation

#### Rotational Viscometer

- 3-step-shear test: Vary the shear rate to simulate spraying and drain-out potential

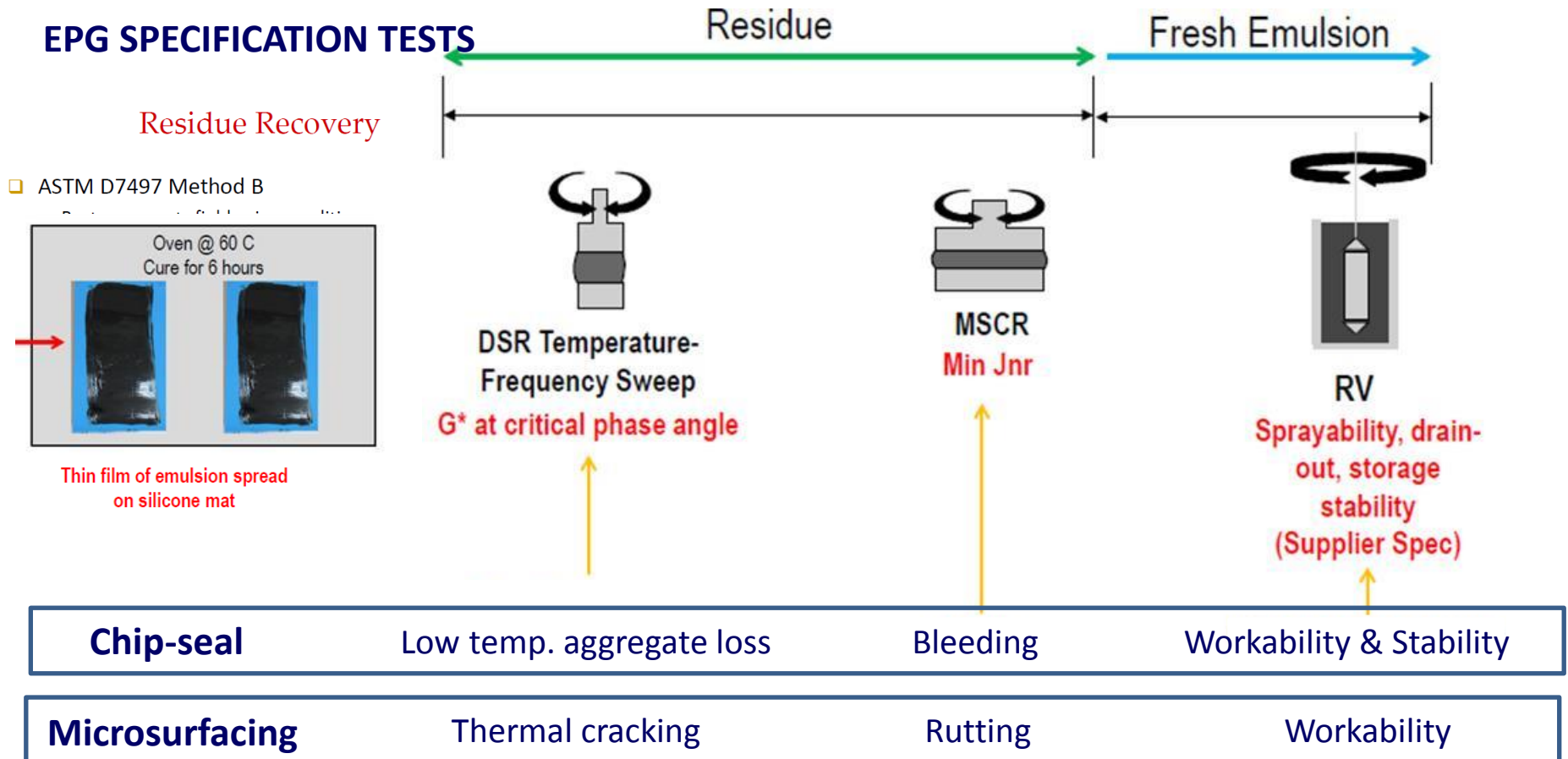




# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-2. EPG (Emuls. Perf. Grades) SPECIFICATIONS FOR SURFACE TREATMENTS – R. Kim - NCSU

### EPG SPECIFICATION TESTS



# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-2. EPG (Emuls. Perf. Grades) SPECIFICATIONS FOR SURFACE TREATMENTS – R. Kim - NCSU

### VALIDATION OF EPG TESTS AND SPECIFICATION LIMITS THROUGH PERFORMANCE SIMULATION TESTS (PST)

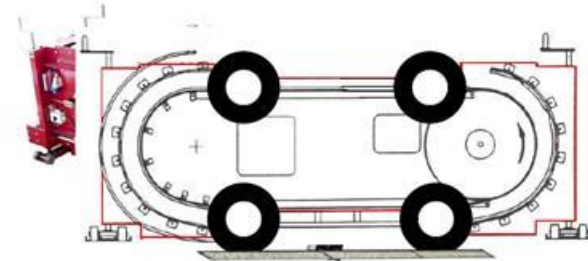
#### Chip seals

- MMLS3 test - Bleeding/Rutting
- VIALIT test – Low temperature aggregate loss

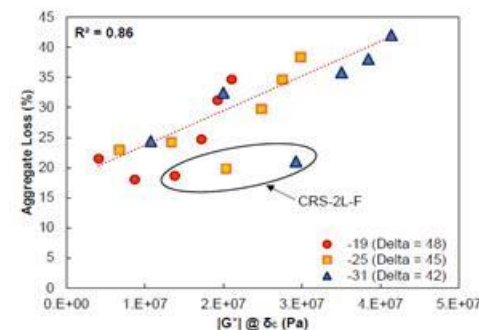
#### Microsurfacing

- MMLS3 test - Rutting
- Single-Edge Notched Bending test – Low temperature cracking

One Third Scale Model Mobile Loading Simulator (MMLS3)



$|G^*|$  at Critical  $\delta$  vs. Aggregate Loss  
Chip Seals



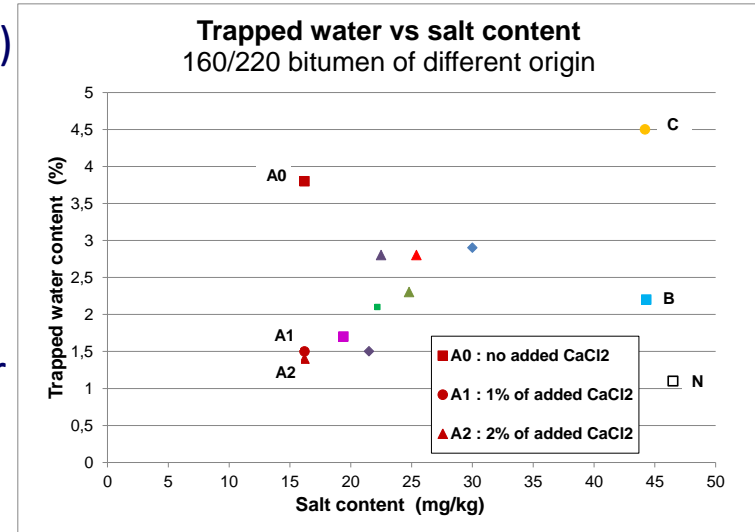
| Low-Temperature Emulsion PG (°C) | $\delta_c$ (°) |
|----------------------------------|----------------|
| -7                               | 54             |
| -13                              | 51             |
| -19                              | 48             |
| -25                              | 45             |
| -31                              | 42             |
| -37                              | 39             |



## 1-3. BITUMEN VARIABILITY-THE IMPORTANCE OF TEST METHODS – B. Eckmann - Eurovia

### EMULSION VISCOSITY – IMPACT OF BITUMEN ORIGIN

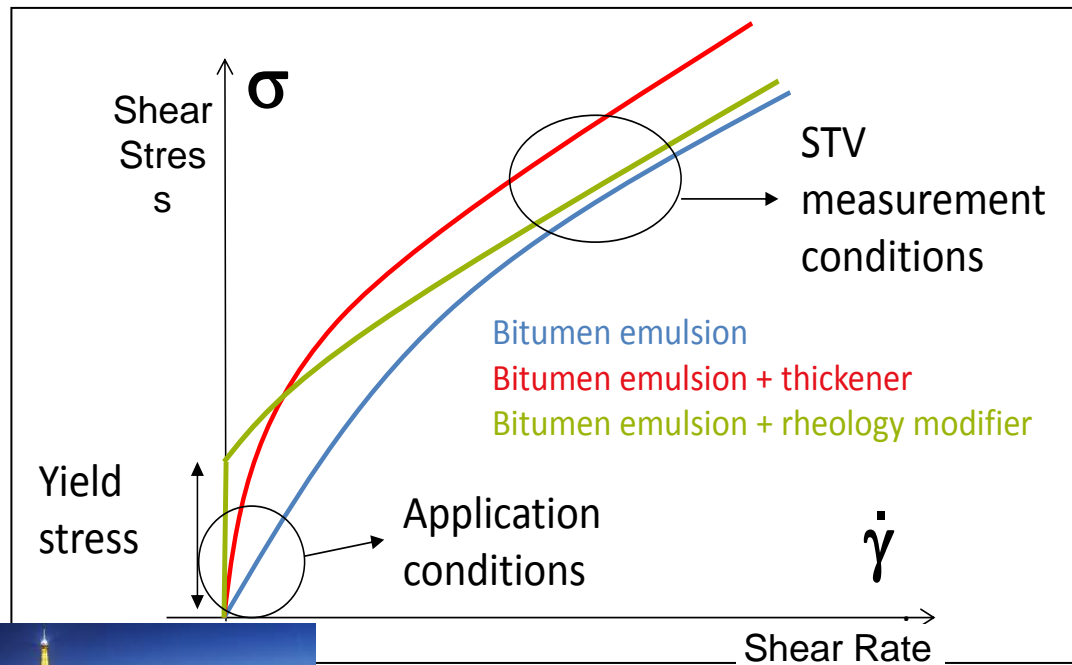
- Trapped water is often (but not necessarily always) at the origin of high viscosity
- Salt content is often (but not necessarily always) at the origin of the phenomenon
- But the tendency of a bitumen (or a bitumen/emulsifier association) to trap water can be easily detected via **DSC analysis on a laboratory made emulsion**
- Addition of salt (e.g.  $\text{CaCl}_2$ ) into the aqueous phase allows to prevent the trapping of water and thus to diminish viscosity
  - ✓ In the cases where this is the origin of high viscosity
  - ✓ Seems to work even if salt content is not at the origin of the phenomenon



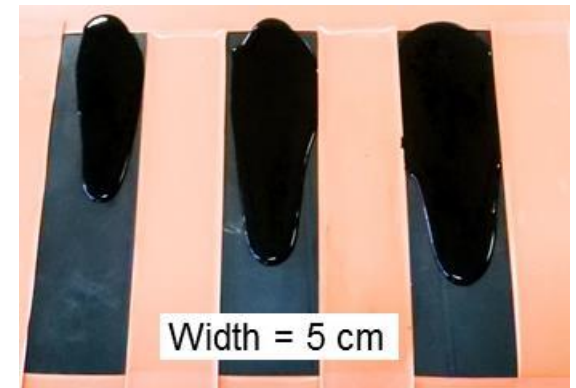
## 1-3. BITUMEN VARIABILITY-THE IMPORTANCE OF TEST METHODS – B. Eckmann - Eurovia

### EMULSION VISCOSITY – IMPACT OF ADDITIVES

- Viscosity at low shear rates is not seen by STV Efflux Time measurements
- Dynamic viscosity at low and high shear rates would be a much better fundamental test
- But dynamic viscosity is sensitive to shear rate history of the sample



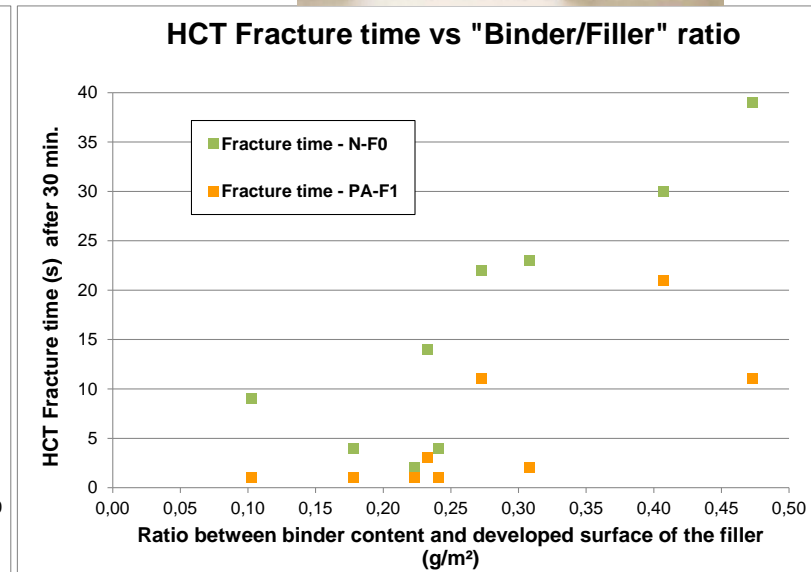
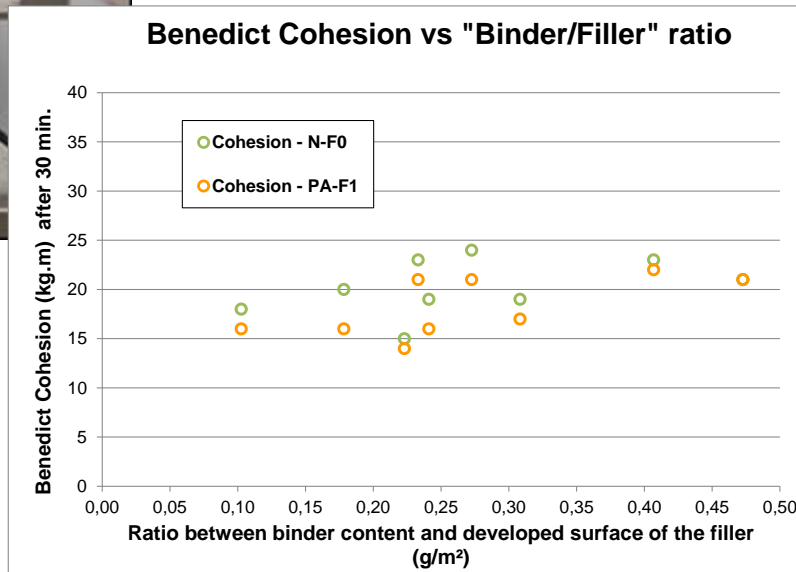
Why not also trying simple  
“flow simulation tests” ?



## 1-3. BITUMEN VARIABILITY-THE IMPORTANCE OF TEST METHODS – B. Eckmann - Eurovia

### MICROSURFACING – BUILD-UP OF COHESION

- HCT fracture test seems to be more sensitive than Benedict Cohesion test
- Binder/Filler ratio appears as an important design parameter



# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-4. STATE OF THE ART OF COLD MIXES IN FRANCE – F. Chaignon - Colas

### FRENCH EMULSION MARKET

**High ratio of use of  
bitumen for emulsions**

SFERB (French AEMA)

- 770 000 metric tons of asphalt emulsion
- French asphalt cement consumption 2,4 M t
- High ratio of use of asphalt for emulsion



**High degree of  
diversification**

Presentation of the French Market

- Micro-surfacing : 50+ M m<sup>2</sup>
- Chip seals : 200+ M m<sup>2</sup>
- Cold mix : 1,5M t (compared to 31 M t of HMA)
  - Cold mix plants
  - Base and Top layers
  - Use of RAP





# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-4. STATE OF THE ART OF COLD MIXES IN FRANCE – F. Chaignon - Colas

### EVOLUTION OF FRENCH SPECIFICATIONS

- Structural Gravel-Emulsions for Base Courses
- Introduction of specification limits on Stiffness Modulus after a standard curing procedure

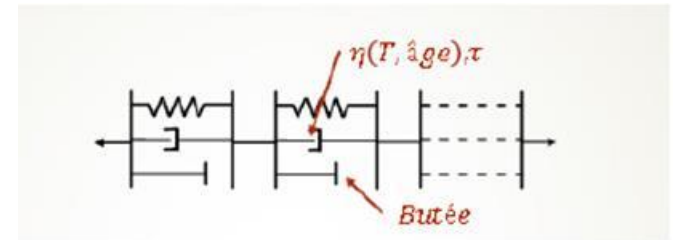
- Structural Gravel emulsion

| Gravel Emulsion  | Type S1    | Type S2    |
|--|------------|------------|
| Modulus  |            |            |
| Setting procedure<br>14 days @ 35°C<br>20%<br>hygrometry |            |            |
| Nottingham AT  | ≥ 1500 MPa | ≥ 2500 MPa |



### CONTINUED RESEARCH

- Thesis underway on the modelling of Gravel-Emulsion: Untreated base course material  
➔ close to HMA after a certain time



### LATEST DEVELOPMENTS

- Use of RAP
- Ultra-thin overlay cold mix





# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-5. A STRUCTURING GRAVE-EMULSION AFTER 18 YEARS OF SERVICE – A. Belkahia - Colas

### EXPERIMENTAL JOB SITE

- Constructed in 1997 – 2000 m section – medium traffic
- 8 to 12 cm Grave-Emulsion
- Overlaid with a surface dressing after 15 years



### MONITORING AFTER 18 YEARS OF SERVICE

- Core analysis: voids, stiffness modulus, fatigue, binder recovery
- In-situ testing:
  - ✓ SHWD : Super Heavy Weight Deflectometer
  - ✓ REC (Road Eagle Colas) : HD pictures and transversal profile, Rut/Crack detection

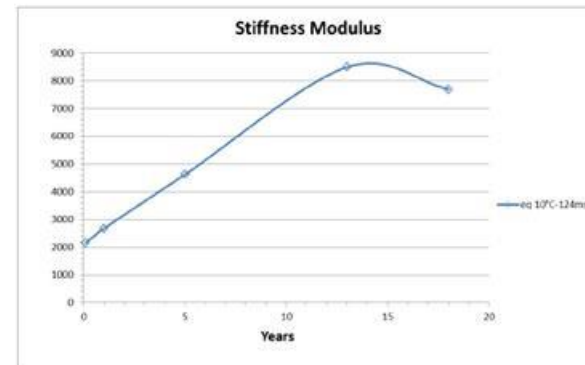
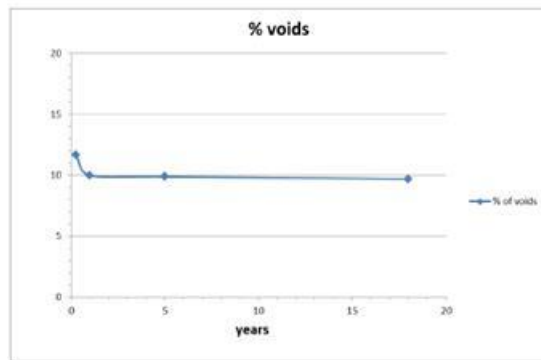


# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

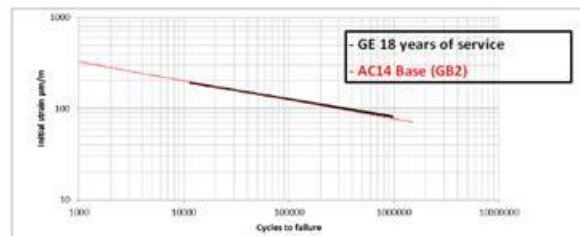
## 1-5. A STRUCTURING GRAVE-EMULSION AFTER 18 YEARS OF SERVICE – A. Belkahia - Colas

### ANALYSIS OF CORES

- Rapid densification of the GE
- Consolidation during the first 15 years, then stabilization or slight decrease
- In line with the observed hardening of the recovered bitumen



- Resistance to fatigue gets close to that of an HMA base course



| GE traffic lane upper part |      |      | AC14 Base (G82) |      |      |
|----------------------------|------|------|-----------------|------|------|
| -4,4                       | 14,3 | 0,85 | -4,7            | 14,9 | 0,98 |
| 75,1                       |      |      | 72              |      |      |
| 108,0                      |      |      | 108             |      |      |



## 1-5. A STRUCTURING GRAVE-EMULSION AFTER 18 YEARS OF SERVICE – A. Belkahia - Colas

### IN-SITU TESTING

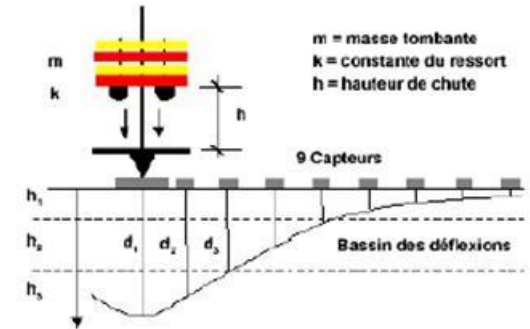
- SHWD back-calculations

**After 18 years, the GE responds similarly to a hot mix asphalt base course**

- Pavement surface analysis

**No cracks after 18 years**

**Low rutting: 4 to 6 mm**



## 1-6. PHOSPHORIC ACID BASED MICRO SURFACING SYSTEMS – S. Hogendoorn – Akzo Nobel

**GET THE SAME ADVANTAGES AS THOSE OFFERED BY HIGH ACID VALUE BITUMEN**

### PHOSPHORIC ACID IN CATIONIC EMULSIONS

#### ADVANTAGES

- Simple replacement of acid in soap preparation
- Less corrosive acid, higher pH emulsions
- Acid is easier to store, fewer fumes
- Not regulated in some countries, unlike hydrochloric

#### DISADVANTAGES

- Complexity of storing and using two acids
- Restricted range of compatible emulsifiers

### PHOSPHORIC ACID IN MICRO SURFACING SYSTEMS

#### ADVANTAGES

- Eliminates the need for acid dopes in bitumen
- Provides a quick-traffic slurry system that works in cooler temperatures and at night
- No need to change the usual latex or SBS grades
- Can use normal break retarders
- Mix controllable with cement in the field

#### DISADVANTAGES

- Not compatible with hydrated lime filler



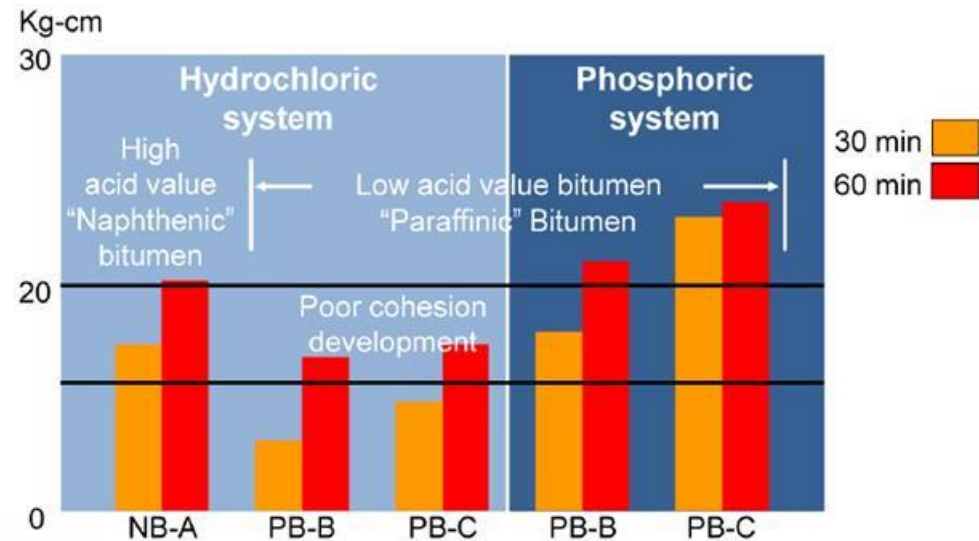
# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-6. PHOSPHORIC ACID BASED MICRO SURFACING SYSTEMS – S. Hogendoorn – Akzo Nobel

**GOOD COHESION IS POSSIBLE WITH LOW ACID VALUE BITUMEN**

### POSITIVE FEED-BACK FROM THE FIELD

- Regular use in Ontario
- Switch from HCl solutions required some equipment and technique changes
- Phosphoric acid solutions used again for the resurfacing of the Confederation Bridge in 2015





## 1-7. CHARACTERIZING EMULSION EFFECTS ON AGED ASPHALT CONCRETE SURFACES USING BBR MIXTURE BEAMS – A. Braham – U. Arkansas

### OBJECTIVES AND EXPERIMENTAL SET-UP

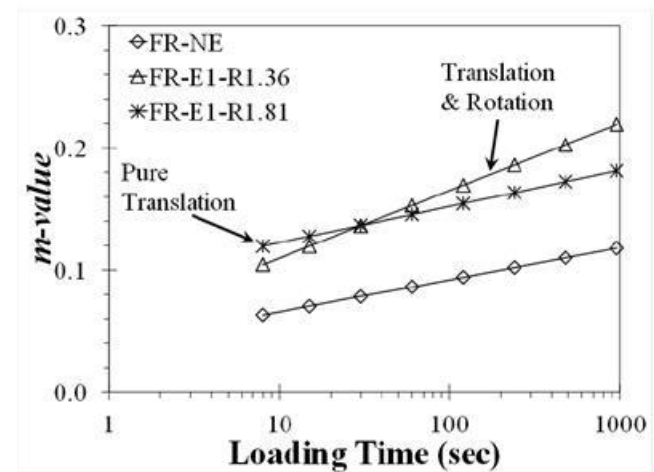
BBR equipment has been modified to test creep properties of asphalt concrete samples



Used to test the impact of a “rejuvenating” film of emulsion on aged AC surface

### SOME RESULTS

- Emulsion application increases m-value (hence the ability to disperse stresses) while stiffness results are not as consistent
- Using only 60 s results can give incomplete information



*Testing artefacts ?*



# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-8. CONFLICTING REQUIREMENTS: TECHNICAL PERFORMANCE VS REGULATIONS – R. Inoubli – CECA Arkema

### THE BACKGROUND

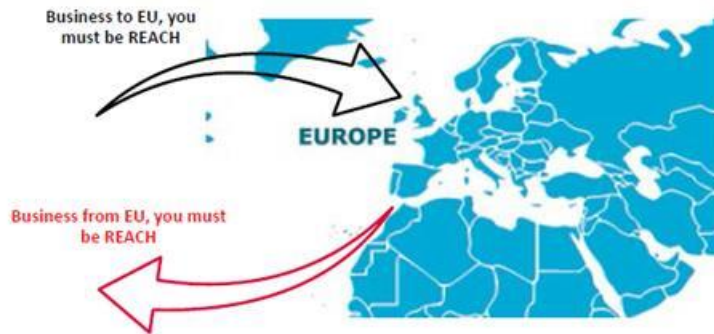
→ Europe registration ⇒ REACH (equivalent to TSCA US system)

Chemicals

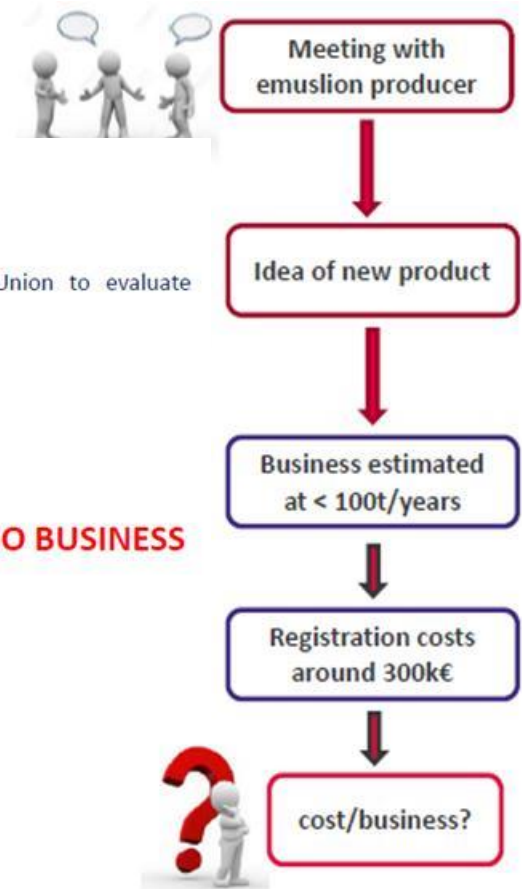


#### Registration Evaluation Authorisation of Chemicals

⇒ Registration of chemical products produced or imported in European Union to evaluate protection level for health and environment



**NO REACH = NO BUSINESS**





# AEMA 2016 ISAET – Emulsion Issues Worldwide (Session 1)

## 1-8. CONFLICTING REQUIREMENTS: TECHNICAL PERFORMANCE VS REGULATIONS

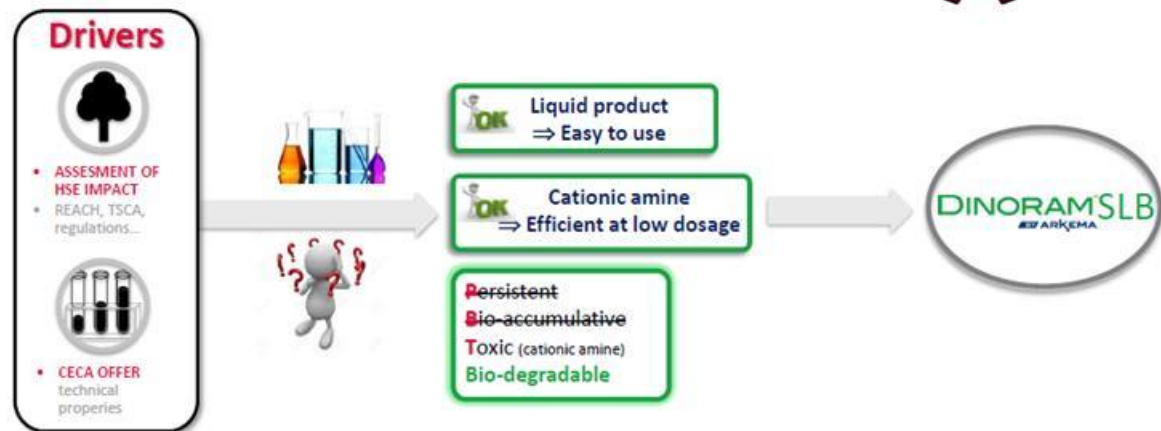
– R. Inoubli – CECA Arkema

### THE MESSAGE

Consider Regulation as a DRIVER for each new surfactant project

Example:

- Well none bitumen emulsion surfactant : derivative of tallow diamine
- Dinoram SL  $\Rightarrow$  Regulation = will not be anymore use for Cationic Rapid Setting



~~Regulations vs Technical Performance~~

$\Rightarrow$  Regulations AND Technical Performance



## SESSION 1 - SUMMARY

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### **Pavement Preservation is our first business**

- Change from product supplier to solution provider

### **Development of new emulsion test methods and specifications**

- EPG Specifications for surface treatments
- Test methods closer to underlying phenomena

### **Development and performance testing of cold mixes**

- More performance oriented specifications - Better understanding of the material

### **Coping with bitumen variability**

- Emulsion viscosity and stability
- Microsurfacing

### **Rejuvenating emulsions (search for a better characterization of efficiency)**

### **HSE requirements to become part of product development projects**



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### SESSION 2

### Testing & Development



Feb. 28th, 2017 - Paris



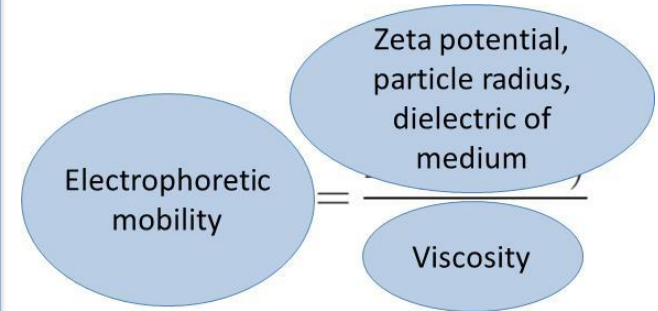
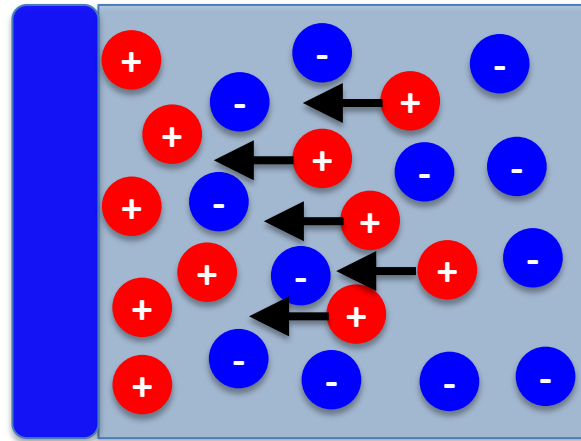
**iberf**  
International Bitumen  
Emulsion Federation

# AEMA 2016 ISAET – Testing and Development (Session 2)

## 2-1. Characterizing Stability of Asphalt Emulsions Using Electrokinetic Techniques - Amit Bhasin – University of Texas

### METHOD AND TYPICAL MEASUREMENTS

$$\mu_E(t) = \frac{v(t)}{E(t)} = \frac{2\epsilon(t)\zeta f(kr)}{3\eta(t)}$$



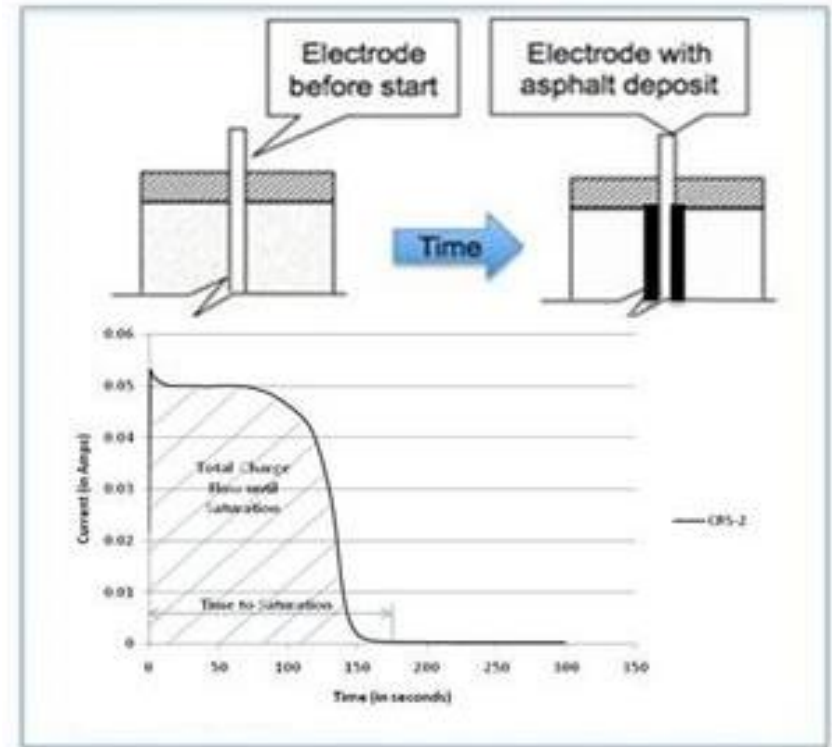
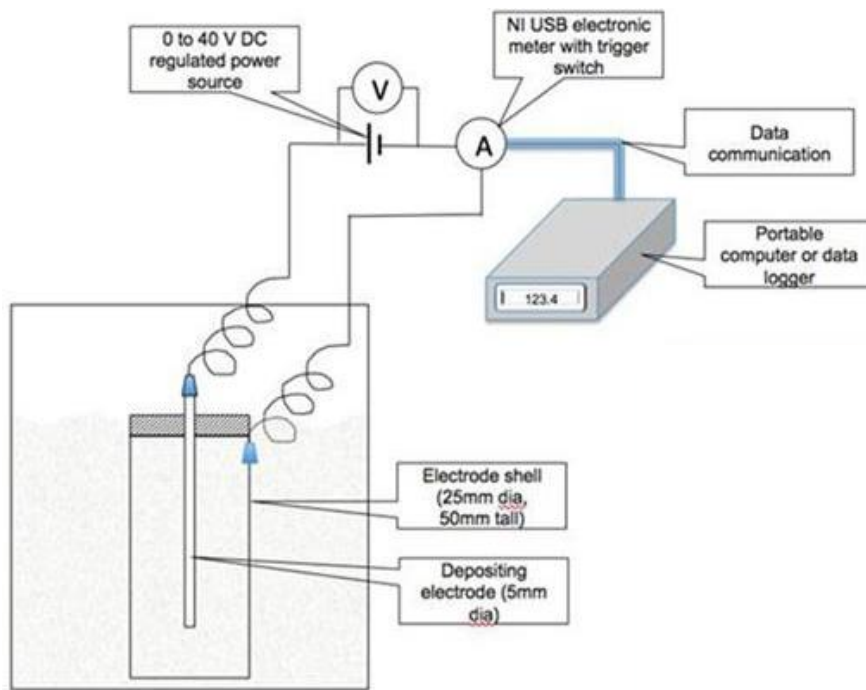
- Goals:**
1. Develop a portable and rapid test method to quantify stability and breaking of asphalt emulsions.
  2. Demonstrate the sensitivity of the test procedure to:
    - type of emulsion,
    - dilution ratios, and
    - mechanical agitation.



# AEMA 2016 ISAET – Testing and Development (Session 2)

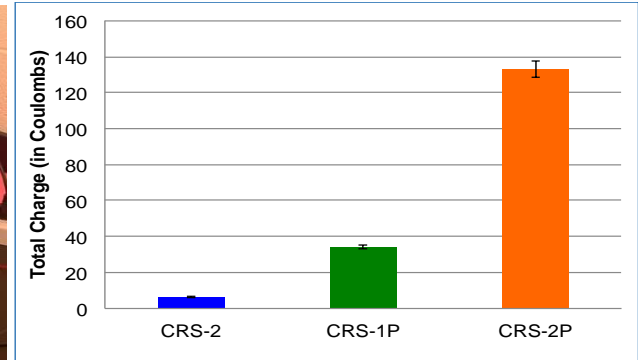
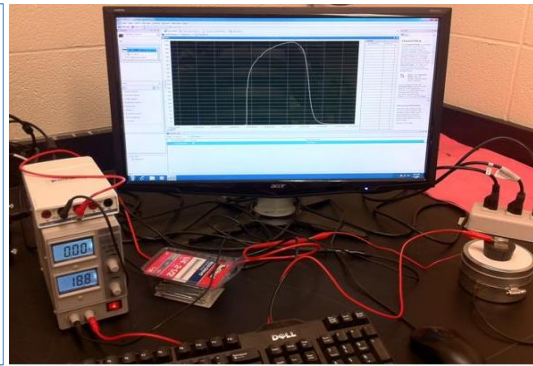
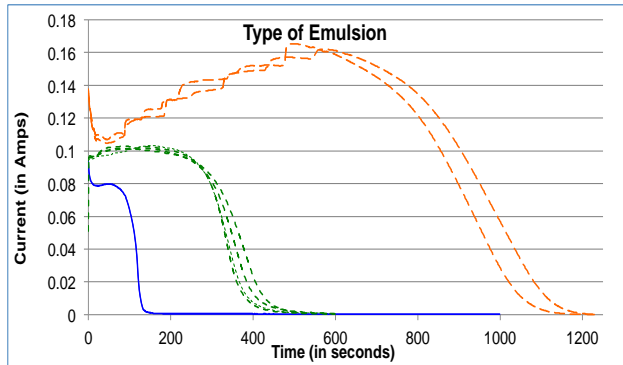
## 2-1. Characterizing Stability of Asphalt Emulsions Using Electrokinetic Techniques - Amit Bhasin – University of Texas

### METHOD AND TYPICAL MEASUREMENTS

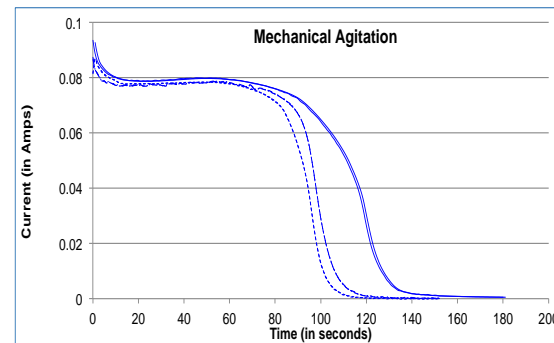
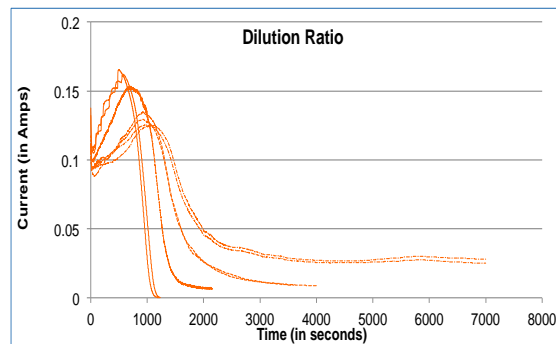


# AEMA 2016 ISAET – Testing and Development (Session 2)

## 2-1. Characterizing Stability of Asphalt Emulsions Using Electrokinetic Techniques - Amit Bhasin – University of Texas



- Rapid stability test based on electrokinetic method with minimal hardware
- Can be used for formulation and QC purposes
- Test is repeatable and sensitive
- Can also be used to extract binder for performance testing and QC testing

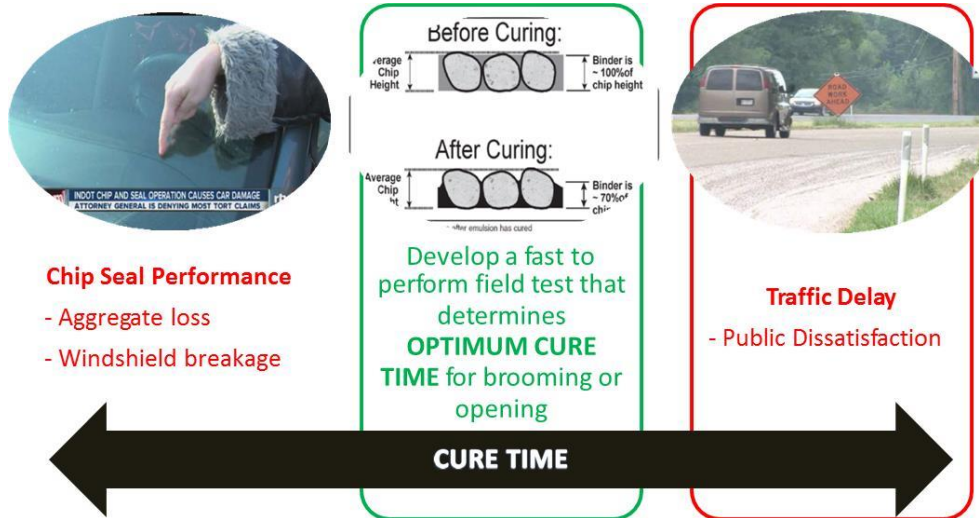




# AEMA 2016 ISAET – Testing and Development (Session 2)

## 2-2. Using Electrical Properties to Quantify Chip Seal Cure Times – Miguel Montoya – Purdue University

**INTRODUCTION – Chip Seal Success and Life Expectancy Directly Related to Best Practices, Construction, Sequence and Cure Time.**



## BACKGROUND

*Correlation between chip seal mechanical strength and moisture content (Shuler, 2011).*

*Relationship between electrical properties of bitumen emulsions and water content (Sowa et al., 1995).*

## HYPOTHOSIS

**Chip seal mechanical strength =/? Asphalt emulsion electrical properties**





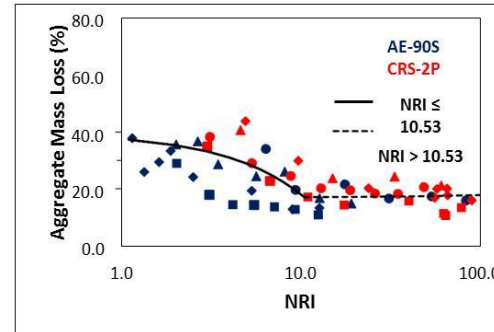
# AEMA 2016 ISAET – Testing and Development (Session 2)

## 2-2. Using Electrical Properties to Quantify Chip Seal Cure Times – Miguel Montoya – Purdue University

### PROPOSED METHOD

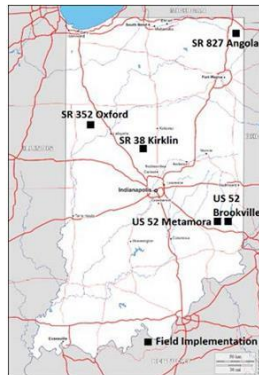


*LCR meter two-point probe resistance measurement (7.6 cm distance between probes).*

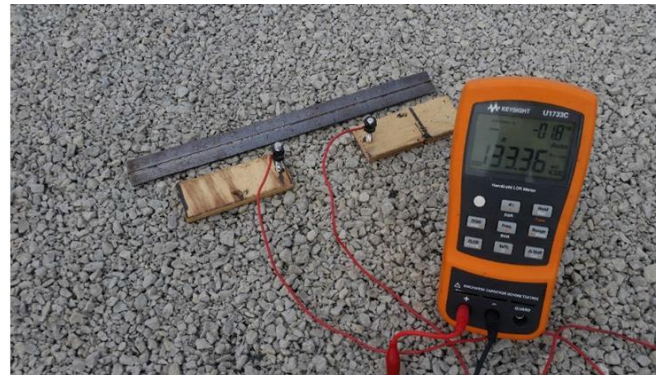


*Sweep Test (ASTM, D7000) results using a variety of chip seal materials.*

### METHOD IMPLEMENTATION



*Full-scale chip seal projects.*



*LCR meter two-point probe resistance measurement (7.6 cm distance between probes).*



## 2-2. Using Electrical Properties to Quantify Chip Seal Cure Times – Miguel Montoya – Purdue University

---

### FUTURE STEPS

- Normalized resistance measurement can be used to quantify chip seal cure times ( $\text{NRI} \geq 10$ ).
- Longer-lasting chip seals that perform as designed.
- Electrical resistance measurements for quality control of asphalt emulsion applications.



# AEMA 2016 ISAET – Testing and Development (Session 2)

## 2-3. Difference in Properties of Residues of Polymer Modified and High Float Emulsions from Different Recovery Methods – Haichun Zhai – Idaho Asphalt

### COMPARISON OF RECOVERY METHODS/EMULSION TYPES/TESTS

- Low Temperature versus High Temperature Recovery
  - Neat versus Modified
  - Polymer versus Latex
  - High float – Gel Structure
- Are we measuring the correct properties?
  - DSR (PG/MSCR/LAS)
  - Traditional Tests:
    - Penetration/Softening Point/Float/Elastic Recovery

PG Grade

|          | CRS-2 |      |       | CRS-2P (SBR) |      |       | CRS-2P (SBS) |      |       |
|----------|-------|------|-------|--------------|------|-------|--------------|------|-------|
|          | LT    | Eva. | Dist. | LT           | Eva. | Dist. | LT           | Eva. | Dist. |
| PG Grade | 61.2  | 63.6 | 60.7  | 64.0         | 66.0 | 62.1  | 66.7         | 66.2 | 64.6  |

|          | CQS-1H |      |       | 3% SBS |      |       | 3% SBR A |      |       | 3% SBR B |      |       | 3% Neoprene |      |       |
|----------|--------|------|-------|--------|------|-------|----------|------|-------|----------|------|-------|-------------|------|-------|
|          | LT     | Eva. | Dist. | LT     | Eva. | Dist. | LT       | Eva. | Dist. | LT       | Eva. | Dist. | LT          | Eva. | Dist. |
| PG Grade | 69.1   | 68.8 | 66.7  | 88.3   | 79.8 | 76.3  | 75.0     | 78.6 | 75.8  | 74.9     | 79.3 | 75.2  | 71.7        | 78.8 | 74.2  |

Neat and Latex True Grade: Evaporation > Low Temp > Distillation

PMA: Low Temp > Evaporation > Distillation

|               | HFMS-2 (Fuel) |      |       | HFRS-2 (No Fuel) |      |       | HFRS-2P |      |       |
|---------------|---------------|------|-------|------------------|------|-------|---------|------|-------|
|               | LT            | Eva. | Dist. | LT               | Eva. | Dist. | LT      | Eva. | Dist. |
| PG True Grade | 58.2          | 65.1 | 74.0  | 46.0             | 63.0 | 60.5  | 59.1    | 71.0 | 70.4  |

High Float: Distillation > Evaporation > Low Temp



# AEMA 2016 ISAET – Testing and Development (Session 2)

## 2-3. Difference in Properties of Residues of Polymer Modified and High Float Emulsions from Different Recovery Methods – Haichun Zhai – Idaho Asphalt

### COMPARISON OF RECOVERY METHODS/EMULSION TYPES/TESTS

| Modified Emulsion Residue By <b>Distillation</b>                      |  |                  |
|---|--|------------------|
| Test Method   | Description  | Specification    |
| AASHTO T 49   | Penetration, 25° C   | <b>40-90</b>     |
| AASHTO T 53   | Softening point  | <b>57° C Min</b> |
| AASHTO T 59-modified (a)  | Residue by distillation  | 62% Min.         |
| AASHTO T 316  | Rotational Viscosity 135° C  | 650 CPS Min      |
| Modified Emulsion Residue By Evaporation, AASHTO PP 72-11 Procedure B |  |                  |
| AASHTO T 315 (b)  | Original DSR, G* at 58° C, kPa   | 7 - 14           |
| AASHTO T 315 (b)  | Original DSR, Phase Angle, d, at 58° C   | 75 Max.          |
| ASTM D 7405 (b)   | Multiple Stress Creep Recovery (MSCR) at 64° C, % recovery at 3.2 kPa stress level   | 25 Min.          |
| (a)   | Modified distillation procedure – Heat emulsion residue to 177 ± 5° C and maintain that temperature for 20 min. Perform the distillation within 60 ± 15 min.   |                  |
| (b)   | Do not reheat on completion of evaporation. Complete residue testing within 48 hr of performing the evaporation procedure. Pull small specimens from the evaporation sample for rheological testing and ball by hand using gloves that will not affect the residue such as nitrile gloves. |                  |





### 2-3. Difference in Properties of Residues of Polymer Modified and High Float Emulsions from Different Recovery Methods – Haichun Zhai – Idaho Asphalt

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#### FINDINGS

- Oven evaporation method and Low Temperature evaporation based AASHTO PP72 Method B produced stiffer materials than that from distillation.
- SBS polymer modified asphalt emulsions:
  - Stiffness: LT > Eva > Dist
  - ER/MSCR: Not influenced by Recovery Methods
- SBR polymer modified asphalt emulsions:
  - Stiffness: Eva > LT > Dist
  - ER/MSCR: Much lower values after low temperature evaporation
- High Float Emulsions
  - Low float number after low temperature evaporation
- Based on LAS test, residues from Low temperature evaporation showed the best resistance to fatigue.
- Polymer improves the resistances to both rutting and fatigue.



# AEMA 2016 ISAET – Testing and Development (Session 2)

## 2-4. 4mm DSR Testing of Asphalt Emulsion Residue and Field Recoverd Binders – Gerald Reinke – Mathy Technology and Engineering, Inc.

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### Background & Development of 4 mm DSR Test

- A. Idea and test method presented by Sui, et al at 2010 TRB meeting based on her work at Western Research Institute (WRI)
- B. Further developments and refinements conducted by WRI, presented by Farrar
  - a) 2011 TRB
  - b) 2012 Eurobitume meeting:  
(*Eurasphalt & Eurobitume 5th E&E Congress-2012 Istanbul* (pp. Paper O5ee-467). Istanbul
- C. MTE has moved forward refining and using the test for a variety of materials
  - a) Significant time saver in investigating materials—including emulsions
  - b) Utility and Value too important to

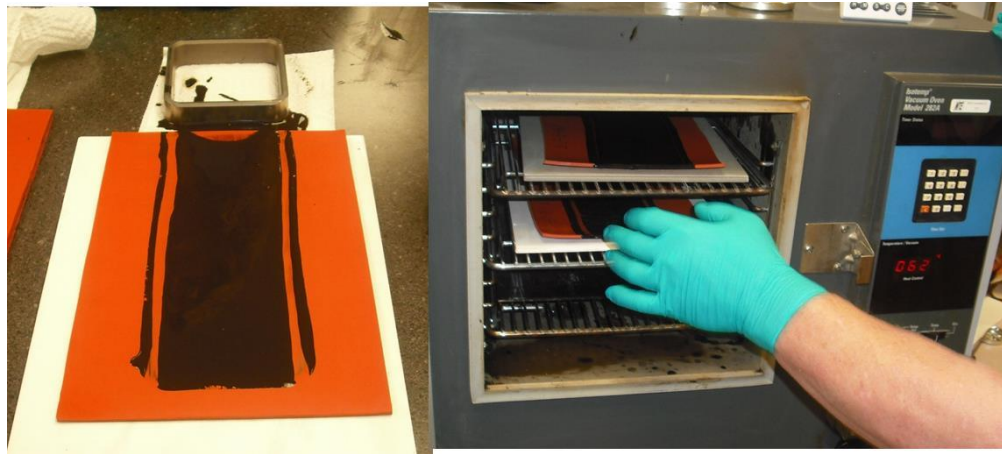


## AEMA 2016 ISAET – Testing and Development (Session 2)

### 2-4. 4mm DSR Testing of Asphalt Emulsion Residue and Field Recovered Binders – Gerald Reinke – Mathy Technology and Engineering, Inc.

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#### USE 4 mm DSR TEST—CHARACTERIZE EMULSION RESIDUES



#### USE FOR RECOVERED BINDERS FROM FIELD SAMPLES



#### USE TORSION BAR TEST FOR VALIDATION OF RECOVERED BINDER





## AEMA 2016 ISAET – Testing and Development (Session 2)

### 2-4. 4mm DSR Testing of Asphalt Emulsion Residue and Field Recoverd Binders – Gerald Reinke – Mathy Technology and Engineering, Inc.

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- A. 4 mm DSR test can be extremely useful tool to evaluate low temperature properties of emulsion residues
  - a) Enables use of thin film, low temperature residue recovery procedures
- B. Can be used to ascertain when binder in a field has reached a point where pavement preservation treatment should be considered
  - a) Can be based on High and Low temperature grade properties
  - b) Can be based on  $\Delta T_c$ , R-Value, Glover-Rowe properties of binder
    - i. Minimally invasive sampling from the field can provide much data
- C. Can be used to evaluate impact of pavement preservation treatments
- D. Does require a research grade DSR to obtain good results



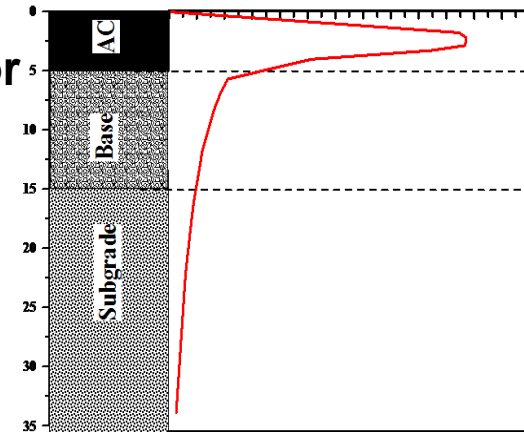
## 2-5. The Effect of Tack Coats on Asphalt Pavement Performance – Louay Mohammad – Louisiana State University

### Importance of Interlayer Bonding: **Tack Coat**

- ☐ Used to ensure a bond between surface being paved and underlying course
- ☐ Interfacial bond is necessary to transmit traffic loads down through the whole pavement structure.
- ☐ Not properly bonded
  - increase the tendency for
  - Debonding (delamination/slippage/sliding), and/or
  - Fatigue cracking
  - ...and thus failure in the new overlay



Shear Stress (psi)

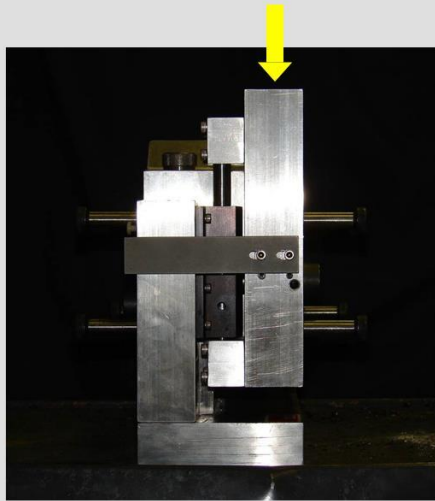


# AEMA 2016 ISAET – Testing and Development (Session 2)

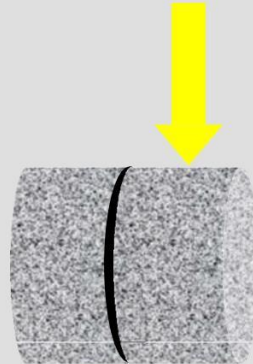
## 2-5. The Effect of Tack Coats on Asphalt Pavement Performance

– Louay Mohammad – Louisiana State University

### Louisiana Interlayer Shear Strength Tester (LISST)



Loading rate  
2.54 mm (0.1 in.) per minute.  
Interface Shear Strength  
–ISS  
–% CV < 15%



### Factors considered in the development of Test Method

- ☐ Simple, repeatable, easily-calibrated,
- ☐ quick, not requiring highly-trained personnel,
- ☐ utilizing low-cost equipment.
- ☐ Based on measuring fundamental properties
  - relate to interface performance
- ☐ Sensitive to subtle changes in tack coat properties

### Field Projects

- different climatic conditions
- relatively high traffic volume

Climatic Zones:

- - Wet-Freeze
- - Wet-No Freeze
- - Dry-Freeze
- - Dry-NoFreeze



## 2-5. The Effect of Tack Coats on Asphalt Pavement Performance

– Louay Mohammad – Louisiana State University

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### Effect of Pavement Surface Type

- Interface shear strength was largely dependent on type of **pavement surface**
  - In general, **milled HMA** surface yielded the greatest interface shear strength, **PCC** surface was lowest
  - Pavement surface texture

### Effect of Tack Coat Material Type

- Trackless tack coat materials (RS) resulted in greater ISS than SS tack coat materials (SS-1 and SS-1H)
  - stiffer base asphalt cement used in Trackless tack coat materials



## 2-5. The Effect of Tack Coats on Asphalt Pavement Performance – Louay Mohammad – Louisiana State University

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### Effect of Application Rate

- ISS increased with an increase in application rate

### Effect of Service Time

- Interface bonding strength increased with service time in all field projects and for all surface types.
  - tack coat curing
    - more pronounced with SS tack coat materials
- Laboratory ISS results correlated well with short-term cracking performance of field pavements.
  - sections with ISS > 40 psi were associated with sections that have lower number of cracks





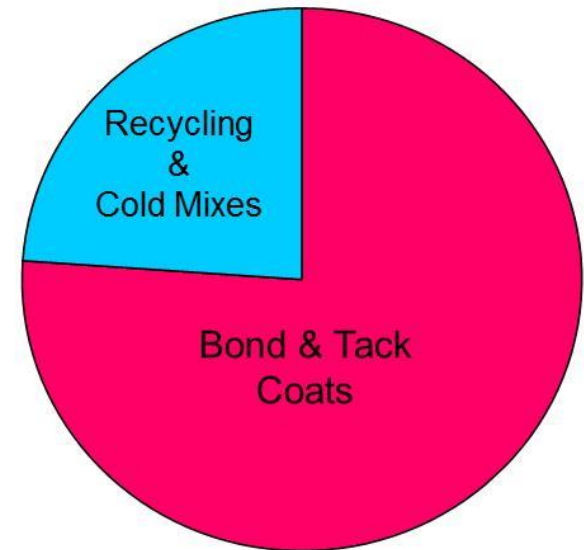
## 2-6. Trackless tack coats in Japan: experience and standard - Tatsushita

### CURRENT SITUATION FOR ASPHALT EMULSION IN JAPAN

Use of Asphalt Emulsion in Japan (Year 2015)

#### PROBLEMS OF CURRENT TACK COAT

Sprayed tack coat stuck to the tire of construction vehicles and peeled off from the applied surface





# AEMA 2016 ISAET – Testing and Development (Session 2)

## 2-6. Trackless tack coats in Japan: experience and standard - Tatsushita

### Application for Trackless tack coat



**Sprayed by Distributor**

### Application for Trackless Tack Coat



**Trackless Tack Coat**



**Unstuck to vehicle**



## 2-7. VOC Measurement of Asphalt Emulsions - Arlis Kadrmas - BASF

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- Request to ASTM for VOC Method
  - ASTM subcommittee on Emulsion Testing was asked for methods of measuring VOC on emulsions (as is, and applied)
  - They were currently using the %oil distillate from D6997 as the VOC's of emulsions
  - Subcommittee decided that the %oil distillate did not give an accurate reading, as most felt it gives too high of a measurement for VOC's
  - Subcommittee decided since no Standard existed, to gather data to check validity before making any decisions
    - Decided not to pursue a Standard, but it can be started quickly if necessary

**< 5,000 ppm is the limit on calling a paint product VOC-free**



### 2-7. VOC Measurement of Asphalt Emulsions - Arlis Kadrmas - BASF

- TVOC procedures can be run on emulsions and their residues successfully
- Asphalt emulsions without petroleum distillate addition are well below the 5000 ppm that is the baseline for “VOC-free” product designations
- Using 2% (bwe) or less of any petroleum distillate will usually fall below 5000ppm measured VOC
- The VOC measurements based on test measurements are lower than those based on VOC calculated on %oil distillate
  - 1,000 ppm is 0.1%
  - 5,000 ppm is 0.5%
  - 10,000 ppm is 1%
  - 50,000 ppm is 5%
  - 100,000 ppm is 10%

Math Test for ppm to %oil distillate



## SESSION 2 - SUMMARY

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### **Electrokinetic Emulsion Characterization**

- Rapid, repeatable, sensitive test for formulation, quality control and residue recovery

### **Quantification of Chip Seal Cure Times**

- Simple laboratory/field method to assess cure in lieu of oven evaporation/constant weight

### **Comparison of Emulsion Residue Recovery Methods**

- Evaporative recovery appears to more accurately depict actual field performance

### **4mm DSR Testing of Asphalt Emulsion Residue**

- Accurate DSR method applicable to minimal sample size to provide full scale of testing

### **Effect of Tack Coat on Asphalt Pavement Performance**

- NCHRP LSST test for evaluation of pavement bond coats

### **Trackless Tack in Japan**

- Japanese experience with the quality of bond coats on pavement performance

### **VOC Measurement of Asphalt Emulsions**

- Improvements in VOC measurement of asphalt emulsions 5,000ppm = 0.5% added oil



## **Highlights from the ISAET Congress in Washington Nov. 2016**

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### **SESSION 3**

### **Manufacturing & Applications**



Feb. 28th, 2017 - Paris



**iberf**  
International Bitumen  
Emulsion Federation



## 3-1. BALANCED MIX DESIGN APPROACH FOR CIR – B. Cox – US Army Corps of Engineers

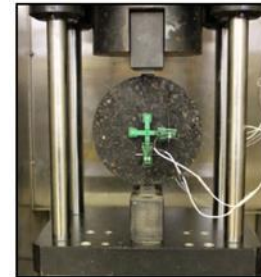
### BACKGROUND AND OBJECTIVES



- **SCB** (single component binder) systems : 1 binder or 1+secondary binder  $\leq 1\%$
- **MCB** (multi component binder) systems : may offer a better technical/economical balance

### EXPERIMENTAL PROGRAM

- Backed on US-49 CIR Project
- Wheel-tracking : APA, wet PURWheel
- IDT testing : resilient modulus, strength, critical cracking temp., fracture energy





## 3-1. BALANCED MIX DESIGN APPROACH FOR CIR – B. Cox – US Army Corps of Engineers

### INVESTIGATED MIXES

- US-49 RAP - 6% MC for all mixes
- SGC compaction at 30 gyrations
- Oven curing at 40°C – 35-50% humidity

### RESULTS

- **SCB** systems:
  - ✓ Cement SCBs yielded low cracking resistance, high rutting resistance, lower costs
  - ✓ Emulsion SCBs yielded the opposite
- **MCB** systems:
  - ✓ Rutting, cracking and cost can be better balanced by proportioning binders

| Cement SCB | Cement/Emulsion MCB | Emulsion SCB |
|------------|---------------------|--------------|
| 2.5c       | 3.5c1e              | 2e1HL        |
| 3.5c       | 2.5c2e              | 3e1HL        |
| 4.4c*      | 1.5c3e              | 4e1HL*       |

\*US-49 design binder blends

***Sustainability triple bottom line (economics, environment and social wellbeing) could be positively impacted through the use of MCB systems within CIR***



## 3-2. EVALUATION OF THE AMOUNT OF P200 ON WEAR RESISTANCE OF MICROSURFACING MIX SYSTEMS – A. Rosales – Idaho Asphalt

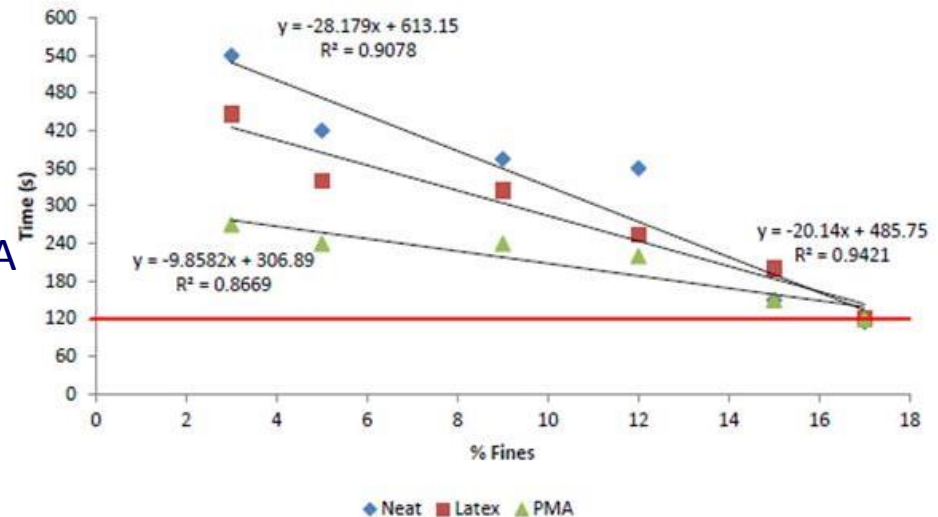
### OBJECTIVES

- To understand the role fines play in WTAT performance
- To understand how emulsion affects performance

### EXPERIMENTAL PROGRAM

- **ISSA WTAT TB-100:**  
1 hour soak / 6 hours soak
- **6 fine contents:** 3, 5, 9, 12, 15, 17%
- **3 emulsions:**  
CQS-1H, CQS-1HP Latex, CQS-1HP PMA
- **Target:** same residual binder content

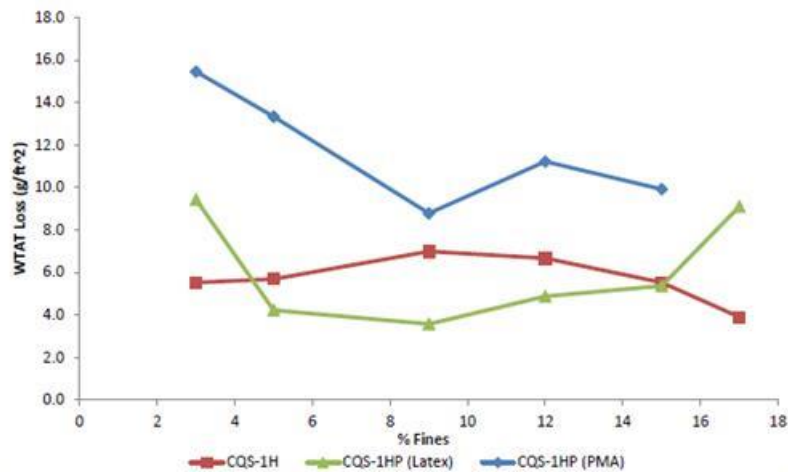
### Impact on mixing time



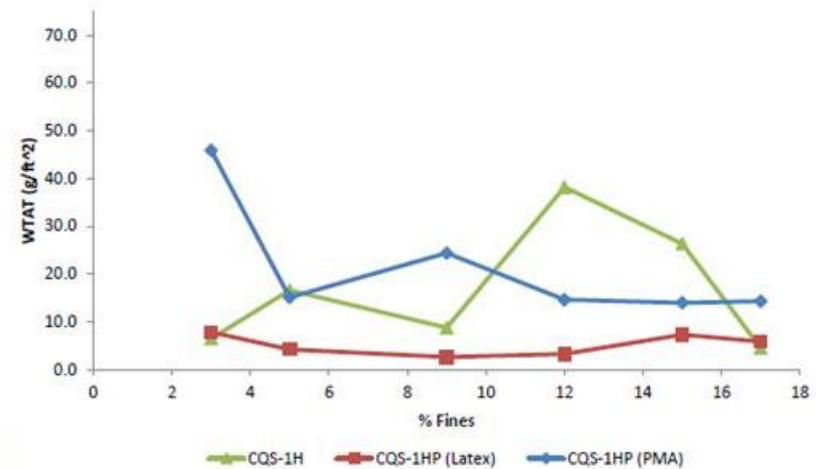
## 3-2. EVALUATION OF THE AMOUNT OF P200 ON WEAR RESISTANCE OF MICROSURFACING MIX SYSTEMS – A. Rosales – Idaho Asphalt

### MAIN RESULTS

1 Hour Wet Track



6 Days Wet Track



- No clear trends
- Impact of emulsion type seems to be greater than impact of % fines
- Some interactions between emulsion type and fines content ?



## 3-3. PERFORMANCE ORIENTED GUIDANCE FOR MISSISSIPPI CHIP SEALS

– I. Howard – Mississippi State University

### PERFORMANCE ORIENTED FINDINGS FROM MDOT STATE STUDIES 202/211 AND ERGON A&E SUPPORTED INFILTRATION TESTING

- **Chip and scrub** (additional broom to push emulsion into cracks) seals
- Most currently used types of emulsions and aggregates

#### FIVE ASPECTS OF PERFORMANCE

- ***Structural Integrity Preservation from Sealing***
  - ✓ 1 project, chip seals, scrub seals, no treatment
  - ✓ FWD used to determine if seal treatments slowed the rate of structural deterioration
  - ✓ After 1 year : Chip seal > scrub seal >> no treatment
- ***Moisture Loss Monitoring for Traffic Opening***
  - ✓ Readiness for re-opening to traffic for a moisture loss corresponding to 10% mass loss by ASTM D7000



## 3-3. PERFORMANCE ORIENTED GUIDANCE FOR MISSISSIPPI CHIP SEALS

– I. Howard – Mississippi State University

### FIVE ASPECTS OF PERFORMANCE (cont'd)

#### ○ *Compatibility Evaluation via Sweep Testing*

- ✓ It is better to evaluate the complete system than the individual components
- ✓ A mass loss of below 10 to 15% according to ASTM D7000 after 4 hours of curing at 35°C is suggested as a beginning acceptance criterion

#### ○ *BBR Mix Beams for Rejuvenation Assessment*

- ✓ BBR method thought to be better than viscosity measurements
- ✓ What should be specified for the  $\Delta m$ -value ?

#### ○ *In Place Infiltration Measurements Over Cracks*





## 3-4. MICROSURFACING: IS ASPHALT FILM THICKNESS A DESIGN OR A CHEMISTRY PROBLEM ? – W. Jordan – Paragon Technical Services, Inc.

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### OBJECTIVES OF THE STUDY

- Correlate AFT to key design parameters (WTAT and SBR)
- Determine AFT at optimum contents and interpret in relation to design and (aggregate/emulsion) chemistry

### TEST PLAN

- Design parameters and information in regards to previous and current designs
  - ✓ 1 Hour WTAT
  - ✓ 6 Day WTAT
  - ✓ 6 Day SBR
- Calculated parameters based on design parameters
  - ✓ Surface Area
  - ✓ Asphalt Film Thickness
  - ✓ % Passing N° 200



## 3-4. MICROSURFACING: IS ASPHALT FILM THICKNESS A DESIGN OR A CHEMISTRY PROBLEM ? – W. Jordan – Paragon Technical Services, Inc.

### RESEARCH RESULTS

- There is a correlation between AFT and optimum conditions
- AFT is highly dependent on both design and chemistry
  - ✓ Surface area of aggregate and amount of absorbed binder
  - ✓ Residue of the emulsion used – produces performance
- Research confirms literature findings
  - ✓ Thicker AFT : better durability, control, less ageing but risks for bleeding and rutting
  - ✓ Thinner AFT : economic but can cause raveling issues
- Good performance for AFT less than 15  $\mu$  - where is the lower limit ?
- Research to be continued with other chemistries and mix properties (mix time, set time, work time, ....)



## 3-5. PERFORMANCE OF BIO-MODIFIED REJUVENATION SCRUB SEAL EMULSIONS

– A. Hanz – Mathy Technology and Engineering

### COMPONENTS OF SCRUB SEAL

- Polymer modified rejuvenating emulsion (CMS-2P)
- Well graded cover aggregate

### OBJECTIVES

- Introduction of a performance based approach for the selection of rejuvenator type and dosage
- Investigate the use of bio-based rejuvenators instead of petroleum based recycling agents
- Implement new tests for emulsion specification :  
paddle viscosity, residue recovery, DSR for residue characterization
- Field studies in comparison to chip seal – Evolution of properties with depth



## 3-5. PERFORMANCE OF BIO-MODIFIED REJUVENATION SCRUB SEAL EMULSIONS

– A. Hanz – Mathy Technology and Engineering

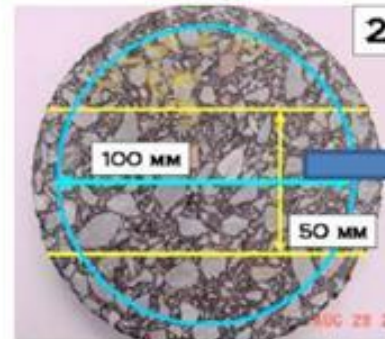
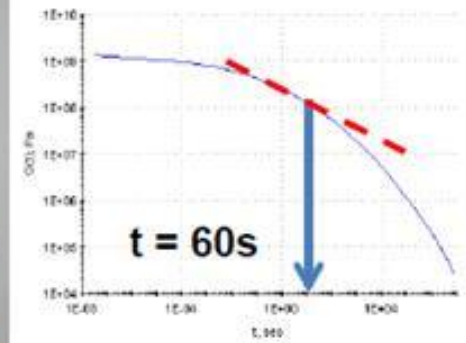
### EXPERIMENTAL FEATURES

#### Binder Rheology (DSR)

- 25 mm Parallel Plate
  - High temp. PG (AASHTO M320)
  - Polymer Presence: MSCR (AASHTO T350)
- 4mm Parallel Plate
  - Low temp. PG: Inter-conversion of  $G^*$  master curve.
  - Durability:  $\Delta T_c = S_{crit}(60) - m_{crit}(60)$

#### Mix Torsion Bar Testing

- $G^*$  master-curve (ASTM D7552) used on field cores to confirm recovered binder data.



1. Farrar, Sui, et al. 4 mm Plate Development – TRB 2011, 2012, Eurobitume 2012 and others.



## 3-5. PERFORMANCE OF BIO-MODIFIED REJUVENATION SCRUB SEAL EMULSIONS

– A. Hanz – Mathy Technology and Engineering

### MAIN FINDINGS – LABORATORY STUDIES

- A bio-based alternative to petroleum recycling agent has been found
  - ✓ 1 grade decrease in low temp. PG-grade
  - ✓  $\Delta T_c$  after 2 PAV better than control and petroleum additive
  - ✓ Dosage at 4% vs 7% for petroleum additive
- DSR-based testing should continue to be used to replace current residue tests

### MAIN FINDINGS – FIELD STUDIES

- Functional requirements of the scrub seal were met
  - ✓ **Crack sealing:** Material still present in cracks 10 months after application
  - ✓ **Durable wearing surface:** Field survey showed no aggregate loss or breakdown
  - ✓ **Pavement rejuvenation:** Recovered binder properties showed improved low temp. PG and relaxation properties. Torsion bar modulus confirmed these results.
- Monitoring to be continued over time





## SESSION 3 - SUMMARY

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### **Cold In-Place Recycling**

- Optimization of composite binder (cement – Emulsion)

### **Optimization of microsurfacing**

- Impact of filler content
- Asphalt Film Thickness in relation to design parameters and aggregate/emulsion chemistry

### **Search for better, field related, performance indicators**

- Performance of chip seals

### **Rejuvenation scrub seals**

- Selection of products based on advanced test methodology
- Validation through field tests



## Highlights from the ISAET Congress in Washington Nov. 2016

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### SESSION 4

### Applications



Feb. 28th, 2017 - Paris

# AEMA 2016 ISAET – Applications (Session 4)

## 4-1. Implementation of the Surface Performance-Grade (SPG) Specification in Texas – Amy Epps-Martin – Texas A&M University

| <b>with PP 72 Method B Recovery</b><br><b>FP <math>\geq</math> 230 by T 48</b><br><b>RV <math>\leq</math> 0.15 Pa*s @ 205°C</b><br><b>by T 316</b> | <b>Performance Grade</b> |      |      |      |               |      |      |      |               |      |      |      |
|--|--------------------------|------|------|------|---------------|------|------|------|---------------|------|------|------|
|  | <b>SPG 67</b>            |      |      |      | <b>SPG 73</b> |      |      |      | <b>SPG 79</b> |      |      |      |
|  | -13                      | -19  | -25  | -31  | -13           | -19  | -25  | -31  | -13           | -19  | -25  | -31  |
| Average 7-day Maximum Surface Pavement Design Temperature, °C  | <67                      |      |      |      | <73           |      |      |      | <79           |      |      |      |
| Minimum Surface Pavement Design Temperature, °C  | >-13                     | >-19 | >-25 | >-31 | >-13          | >-19 | >-25 | >-31 | >-13          | >-19 | >-25 | >-31 |
| <b>Original Binder</b>   |                          |      |      |      |               |      |      |      |               |      |      |      |
| Dynamic Shear, T315<br>G*/Sin $\delta$ Minimum: 0.65 kPa<br>Test Temperature @10 rad/s, °C   | 67                       |      |      |      | 73            |      |      |      | 73            |      |      |      |
| Phase angle ( $\delta$ ), Max, @ T where G*/sin $\delta$ = 0.65 kPa  | —                        | 80   | 80   | 80   | 80            | 80   | 80   | 80   | 80            | 80   | 80   | 80   |
| <b>Pressure Aging Vessel (PAV) Residue (AASHTO PP1)</b>  |                          |      |      |      |               |      |      |      |               |      |      |      |
| PAV Aging Temperature, °C  | 100                      |      |      |      | 100           |      |      |      | 100           |      |      |      |
| Creep Stiffness, T 313<br>S, Maximum: 500 MPa<br>Test Temperature @ 8s, °C   | -13                      | -19  | -25  | -31  | -13           | -19  | -25  | -31  | -13           | -19  | -25  | -31  |

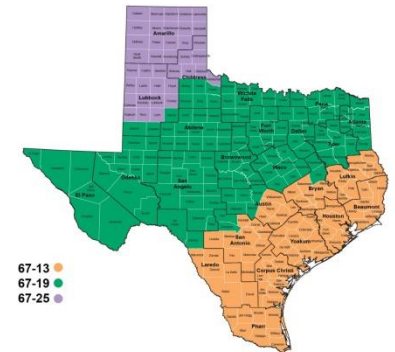


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## 4-1. Implementation of the Surface Performance-Grade (SPG) Specification in Texas – Amy Epps-Martin – Texas A&M University

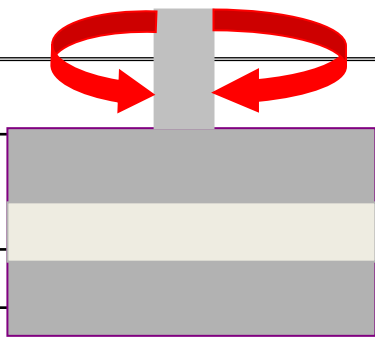
| with <b>AASHTO PP 72 Method B Recovery</b><br>FP $\geq 230$ by T 48<br>RV $\leq 0.15$ Pa*s @ 205°C by T 316 | Performance Grade |      |      |      |
|---|-------------------|------|------|------|
|   | SPG 73            |      |      |      |
|   | -13               | -19  | -25  | -31  |
| Avg 7-day Max <b>Surface</b> Pavement T, °C   | <73               |      |      |      |
| Min <b>Surface</b> Pavement T, °C   | >-13              | >-19 | >-25 | >-31 |

- Method B for Emulsion Residue Recovery
  - Thin Film on Silicone Mat
  - 60 °C for 6 hrs



# AEMA 2016 ISAET – Applications (Session 4)

## 4-1. Implementation of the Surface Performance-Grade (SPG) Specification in Texas – Amy Epps-Martin – Texas A&M University

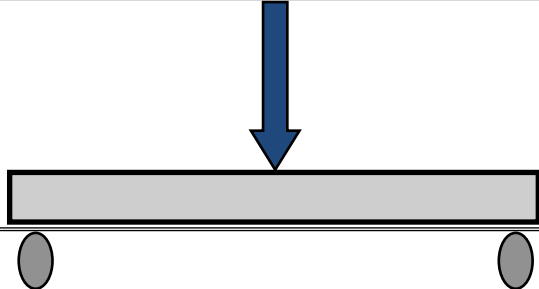
| $\delta$ REQUIRED FOR $UTI \geq 86^{\circ}\text{C}$ @ $T_{\text{HIGH}}$ THRESHOLD         |  | Performance Grade |      |      |      |
|---|--|-------------------|------|------|------|
|   |  | SPG 73            |      |      |      |
|   |  | -13               | -19  | -25  | -31  |
| *MAX d FOR EMULSION<br>RESIDUE = 84   |  | <73               |      |      |      |
| Original Binder   |  | >-13              | >-19 | >-25 | >-31 |
| $G^*/\sin\delta > 0.65$ kPa by T 315  |  | 73                |      |      |      |
| Test Temperature @ 10rad/s, °C  |  |                   |      |      |      |
| <u>Phase angle (<math>\delta</math>), Max,</u> @ temp. where $G^*/\sin \delta = 0.65$ kPa |  | 80*               | 80*  | 80*  | 80*  |





## AEMA 2016 ISAET – Applications (Session 4)

### 4-1. Implementation of the Surface Performance-Grade (SPG) Specification in Texas – Amy Epps-Martin – Texas A&M University

|      | Performance Grade |      |      |      |
|--|-------------------|------|------|------|
|  | SPG 73            |      |      |      |
|  | -13               | -19  | -25  | -31  |
|  | <73               |      |      |      |
|  | >-13              | >-19 | >-25 | >-31 |
| <b>PAV Residue</b>   |                   |      |      |      |
| <b><math>S \leq 500</math> MPa by T 313</b><br><b>Test Temperature @ <u>8s</u>, °C</b> | -13               | -19  | -25  | -31  |

### 2017 SPG SPECIFICATION



## 4-2. Performance Evaluation of Pavement Preservation Techniques used in Nevada over a 15 Year Period – Ellie Hajj – University of Nevada Reno

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### TWO PART PROJECT

PART 1- Effectiveness and Optimum Time for  
Single (Phase I) and Sequential (Phase II)  
Applications of Slurry Seal

PART 2- Long-Term field Performance of Cape  
Seals

#### **PART 1: Performance Evaluation of Slurry Seal Phase II: Two Sequential SS Applications**

- Collect & evaluate historical performance data of asphalt pavements (review of PMS data):
  - With a first slurry seal applied at either 0, 1, 3 or 5 years after construction.
  - With a second slurry seal applied at either 7 or 9 years after construction.
- Identify effectiveness & optimum time for sequential slurry seal application.



### 4-2. Performance Evaluation of Pavement Preservation Techniques used in Nevada over a 15 Year Period – Ellie Hajj – University of Nevada Reno

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#### PART 1: Performance Evaluation of Slurry Seal

##### Phase II: Conclusions

- Application of first SS **immediately or 1 year after** construction is **not effective** in terms of both the benefit to users and benefit cost ratio for the agency.
- Regardless of construction activity, **optimum time** for a **sequential slurry seal** is when **first SS is applied in year 3 & second SS is applied in year 7** (i.e., 4 years after the application of the first SS)
- Pavement service life was extended by **2.0 to ~4.0 years** when first SS was applied in years, 3 or 5 and second SS in either year 7 or 9.
  - Sequential SS was effective in delaying the time for reconstruction.



### 4-2. Performance Evaluation of Pavement Preservation Techniques used in Nevada over a 15 Year Period – Ellie Hajj – University of Nevada Reno

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#### **PART 2: Long-Term Field Performance of Cape Seal - Why Cape Seals?**

- Snow-Plow Damage
- Chip Loss
- Quieter
- Longer Life

#### **PART 2: Long-Term Field Performance of Cape Seal - Overall Findings**

- The effective performance life of micro-surfacing cape seals is 7 years in the Truckee Meadows and 5 years in Incline Village
- The effective performance life of slurry seal cape seals is 3.5 years in the Truckee Meadows and 3 years in Incline Village
- The LCCA indicates that the micro-surfacing cape seal is more cost effective than the slurry seal cape seal at both locations of Truckee Meadows and Incline Village.

**Recommendations** Continue to use the micro-surfacing cape seal as a preventive maintenance treatment



# AEMA 2016 ISAET – Applications (Session 4)

## 4-4. NCAT Test Track/Lee Road Pavement Preservation Research Update - Buzz Powell - NCAT

### BACKGROUND



IBEF Exchange Seminar - Feb. 27th, 2017 - Paris



# AEMA 2016 ISAET – Applications (Session 4)

## 4-4. NCAT Test Track/Lee Raod Pavement Preservation Research Update - Buzz Powell - NCAT

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### EXPERIMENTAL ASSUMPTIONS AND CONSIDERATIONS

- Benefits =  $f$  (pretreatment condition, traffic, climate, quality)
- Pretreatment condition ranging from poor to good
- Roadways with traffic volumes ranging from low to high
- Hot (e.g., bleeding) and cold (e.g., snow plows) climates.

### PERFORMANCE SUMMARY

- Crack sealing - Significantly effective as standalone or combination
- Chip seals - Least cracking in scrub/triple/FiberMat, then double, then single
- Micro surfaces - Less cracking in double layer/crack sealed, best in Capes
- Thinlays - No cracks in Cape/CCPR base sections, more in 50% F-RAP & 5% RAS
- Cape seals - Least cracking in scrub/Thinlay, then FiberMat, then chip



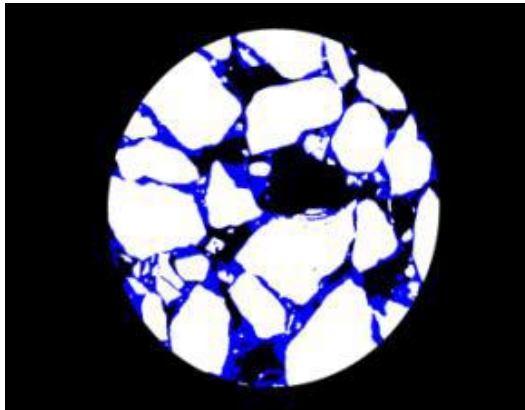
## 4-5. Preservation of Porous Asphalt - Bert Jan Lommerts - Latexfalt

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### MAINTENANCE OF POROUS ASPHALT – NEW BIMODAL EMULSION

Multi-component emulsion, different rate of breaking of the components[BioStabMY technology]

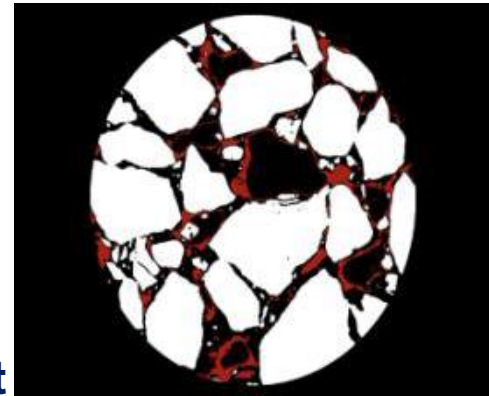
- Latexfalt rejuvenator package
- Fast diffusion, medium-high viscosity
- Replenishment of bitumen
- Excellent wetting characteristics



Perfect wetting of the surface

Good distribution of the binder  
Over the surface

Throughout the depth of the asphalt



Good adhesion



### **4-5. Preservation of Porous Asphalt - Bert Jan Lommerts - Latexfalt**

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**BioStabMY technology provides new opportunities for emulsion design**

**Bi-Modal Emulsions with different breaking properties can be designed**

**Good rejuvenators have a stabilizing effect for oxidation**

**Rejuvenation of old porous asphalt is technically and commercially viable**

**Increase of the service life of the open-graded top layer is demonstrated to be > 5-6 years(50%)**

**No hazardous components, no recycling issues, no concerns for poor anti-skid resistance, .....,**

**EMULSIONS PROVIDE EXCELLENT SOLUTIONS**



### 4-6. Volatile Solvent Free Penetrating Prime Coat Emulsions with Higher Performance than Cutbacks – Sundaram Logaraj – Akzo-Nobel

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#### Factors that could enhance the performance of Prime coat emulsions

- Formulate emulsions that can withstand reactive base material
  - Type of emulsion (anionic, non-ionic or cationic)
  - Choice of emulsifiers and dosage
- Emulsion formulation that can result in fine particle size distribution
- Emulsions with diluents/solvents that do not contain VOCs
  - Bio-Solvents

#### Types of emulsions evaluated

1. Anionic SS emulsions with some non-ionic emulsifiers
2. Cationic SS emulsions with Bio-solvents
3. Anionic SS emulsions with Bio-solvents



## 4-6. Volatile Solvent Free Penetrating Prime Coat Emulsions with Higher Performance than Cutbacks – Sundaram Logaraj – Akzo-Nobel

### Anionic SS emulsion with non-ionic emulsifier Redicote E-7000 and a non-ionic emulsifier

- 60% anionic emulsion with some non-ionic emulsifier
- Dilutable in water
- Good resistance to hard water
- Very good wetting power
- Smaller than normal particle size
  - Important criteria



Good prime coat soaks in



Poor prime stays on surface



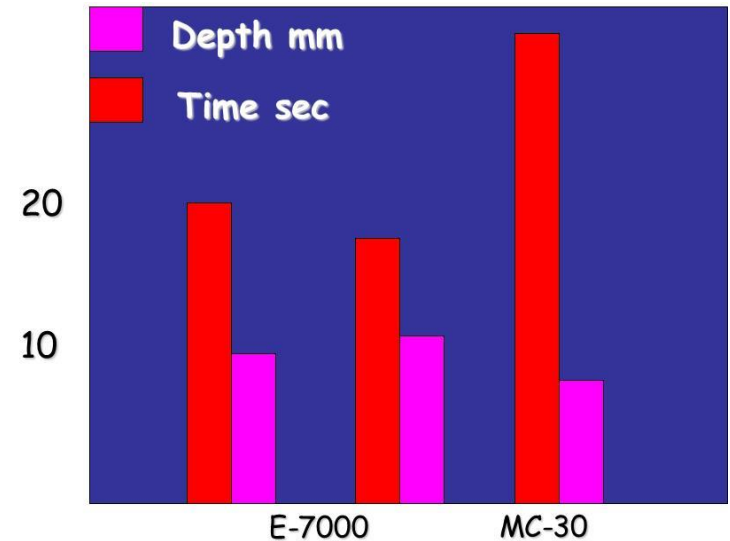


## AEMA 2016 ISAET – Applications (Session 4)

### 4-6. Volatile Solvent Free Penetrating Prime Coat Emulsions with Higher Performance than Cutbacks – Sundaram Logaraj – Akzo-Nobel

#### Some observations from Lab tests and trials with Redicote E-7000 emulsion

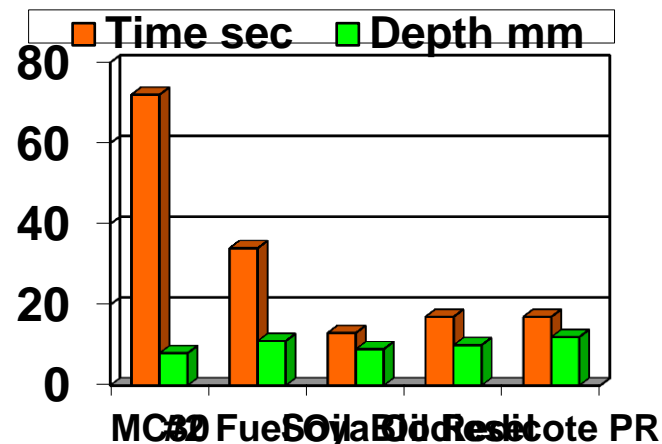
1. Emulsion diluted to <40% for good penetration.
2. Best results with Redicote E-7000 and non-ionic emulsifiers
3. If particle size bigger than the voids penetration not good
4. Breaking up the surface helps



### 4-6. Volatile Solvent Free Penetrating Prime Coat Emulsions with Higher Performance than Cutbacks – Sundaram Logaraj – Akzo-Nobel

#### Cationic Asphalt Emulsion Prime (AEP) with “Bio-solvents”

- Fuel oil replaced with “Bio-solvents”
- What are Bio-solvents?
  - High boiling point, do not emit VOCs
  - Renewable resources
  - **Soya Oil**
  - **Soya methyl ester (Biodiesel)**
  - **Redicote PR (AN Bio-solvent)**



#### Penetration Test Results

- Better results with Bisolvents compared to MC30 and Fuel Oil emulsions
- Better penetration in shorter time
- Soya oil, Biodiesel & Redicote PR gave comparable results
- Bio-solvent content can be further optimized
- Further testing with materials from the field



## SESSION 4 - SUMMARY

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### **Surface Performance Grade (SPG) in Texas**

- PG based specification for emulsion residues and hot applied surface treatments

### **Evaluation of Pavement Preservation in Nevada**

- Sequential Chip Seals and fog sealed Micro Surfacing prove to be viable techniques

### **NCAT Test Track Pavement Preservation Research**

- Reports of combined field research of NCAT and MNDOT prove preservation viability

### **Preservation of porous asphalt**

- A new bi-model emulsion for preservation and rejuvenation of Porous Asphalt

### **Volatile solvent free penetrating Prime Coat Emulsions**

- Dilutable SS emulsions with improved penetration.
- Use of bio sourced oils to replace petroleum based oils in cationic emulsions

