CHIP SEALS: ART, SCIENCE OR JUST_plain LUCK?

PURDUE ROAD SCHOOL

MARCH 26, 2008
PURDUE UNIVERSITY
WEST LAFAYETTE, INDIANA

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WHAT ARE CHIP SEALS?
Who, What, When, Where, Why?

- Who?
  - Owner Crews
    - Advantages
      - Patience, Care, Ownership, Experience
    - Disadvantages
      - Experience
  - Contractors
    - Advantages
      - Depends on Contract and Contractor
      - Experience
    - Disadvantages
      - Depends on Contract
Who, What, When, Where, Why?

- What, When, Where?
  - What?
    - Asphalt Pavements
      - Surface Treatments
      - HMA
    - Unsurfaced
      - Earth
      - Aggregate
  - When?
    - Before It’s Too Late
      - Distress Should be Low to Moderate
  - Where?
    - Anywhere
      - Traffic
      - Climate
Who, What, When, Where, Why?

- Why?
  - Waterproof Surface
  - Improve Friction
Design

- Aggregate
  - Properties
  - Spread Rate
- Emulsion
  - Properties
  - Spray Rate
Aggregate

- Properties
  - Crushed
    - 2 Mechanically Fractured Faces
  - Hard

Like THIS Right?
Aggregate

- Spread Rate
  - One Stone Thick
    - Or.....
Designing it One Stone Thick

- Basically, Two Design Methods
  - Hanson/McLeod/AusRoads
    - ALD, Flakiness Index, Unit Weight, SG
  - Kearby/Gallaway/Epps
    - Board Test, Unit Weight, SG
Emulsion

- Properties
  - Thick Enough, but Not Too Thick
  - Fast Setting, but Not Too Fast
  - Sticky

- Spray Rate
  - Embed Chips about 30-70% Initially
  - Traffic Embeds to 50-90%
Estimating Spray Rate (Modified Kearby)

\[ A = \% \text{embedment} \times \text{avg mat depth} \times \{1 - \left( \frac{W}{62.4G} \right) \} \times T + V \]

Where

- \( A \) = Asphalt, gsy
- \( W \) = Loose Unit Weight of Aggregate, pcf
- \( G \) = Bulk Specific Gravity of Aggregate
- \( T \) = Traffic Correction
- \( V \) = Surface Condition Correction
Construction

- Equipment
- Conditions
- Emulsion Application
- Aggregate Application
- Rolling
- Sweeping
- Traffic Control
Equipment

- Distributor Spraybar
  - Nozzles
    - Calibrated Equal Flow
Rollers

- Rubber-Tire
  - 3 mph
    - Around 2 - 4000 sy/hr
  - Equal Tire Pressure
    - 40-90 psi
- Enough for 1 Coverage Before ‘Gelling’
Equipment

Rollers
- Steel-Wheel ?????
  - Why?
    - Smoothes Surface
    - ‘Locks’ chips
    - 3 – 6 t, max.
- Why Not?
  - Crushing
  - Non-uniform surfaces
**Equipment**

- **Brooms**
  - **Why?**
    - Remove 10% Extra for Pickup
  - **What?**
    - Push, Sweep/Pickup
      - EASY Pressure
      - Nylon
      - Wears Out Faster Than Steel, but...
  - **Timing**
    - After Final Embedment
    - When Cooler
    - Before Traffic

Construction
Ideal Conditions

- **Dry**
  - No rain threatening
  - Pavement Dry
- **Low Wind**
  - <10 mph
- **Temperate**
  - 50F Air, min
  - 70F Surface, min
  - However, lower possible if sunny and warm later
Uniform Application

- Calibrate Nozzles
  - Each Nozzle +/- 10% of Mean Flow
  - Edge Nozzles
  - Or… Turn End Nozzle Perpendicular to Bar
- Start and Stop on Paper
- Rate = +/- 5% of Design to Start
  - Check after 1st Distributor
Uniform Application

All Gates Open the Same

Check Transverse Rate After 1st Distributor

Rate = +/- 5% of Design

Look at It - See Voids in Surface

Adjust up slightly for Pick up on Rubber
Traffic Control

- Pilot Cars
  - 15-25 mph depending on traffic volume
Current Research

- Quantify Judgement Items, ie ‘Art’
  - Time to Broom/Traffic
    - Modified Sweep Test (ASTM D7000)
  - Compatibility of Emulsion and Chips
    - Modified Sweep Test
  - Surface Texture
    - Sand Patch
    - CT Scan
  - Field Consistency
    - Portable Viscosity
  - Specifications
    - Emulsions
    - Residues
      - New Recovery Test
Questions ?