Short Overview of Emulsion Applications
Alan James
AkzoNobel Surface Chemistry LLC
Spray Applications

- Chipseal
- Graded Aggregate Seal
- Sand Seal
- Tack and Prime
- Fog Seal
- Dust Control
- Penetration Macadam
- Scrub Seal
Mix Applications

• Slurry Seal
• Microsurfacing
• Open-Graded Cold Mix
• Dense-Graded Cold Mix
• Soil Stabilization
• Warm Mix
• Pre-Coated Chips
Other and Non-Paving Applications

- Cold Pour Crack Fill
- Sealcoats
- Waterproofing
- Coal binders
- Metal Coating
- Roofing
- Mastics
Selection of Emulsion for Application

- For each application there is an appropriate emulsion grade or grades.
- The droplets in emulsions can have a positive (cationic) or negative (anionic) charge and emulsions come in three basic reactivities: slow, medium and rapid-setting.
- Match the reactivity of the emulsion to that of the aggregate or substrate – “reactive” or rapid-set emulsions are used for “unreactive” aggregates. “Unreactive” or slow-set emulsions are used for “reactive” aggregates.
- The emulsions may further have different asphalt contents, and the residues may have different consistencies. Some grades contain polymer.
- ASTM D3628 – Selection and Use of Emulsified Asphalts
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<th>Spray Applications</th>
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*a) May contain up to 10% solvent  b) Need not pass cement mix test  c) May contain clay*
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</table>

**Notes:**

- ✔️: Indicates compatibility
- a) May contain up to 10% solvent
- b) Need not pass cement mix test
- c) May contain clay
Overview of Asphalt Emulsion Applications in North America
Peggy Simpson
Emulsions used in various Applications (1999)
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Brewster NY 10509
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Cell: 914 525 5307
E-mail alan.james@akzonobel.com
1. Definition
2. How it fits with Pavement Preservation
3. Principle
4. Benefits
5. Where to use Chip Seals
6. Types of Chip Seal
7. Materials
8. Equipment
9. Design method
10. Conclusion
Definition

- A sprayed film of binders (Asphalt cement, cut-backs, emulsion)

- A layer of single size aggregate on top

- This is not a structural process !!

- But it retains the life of the pavement
How it fits with Pavement Preservation

Like your car or your home

- Roads wear, age and therefore need to be maintained

- Actually the worst first
Principle

• Apply the right treatment

• on the right pavement

• at the right time
Benefits

- Seals small cracks and surface imperfections
- Waterproofs pavement surface
- Improves skid resistance
- May rejuvenate the surface
- One of the most cost-effective pavement preservation treatments
Where to use chip seals

- Low and medium traffic
- Low level of cracks
- No deformation under traffic
- Just renewal of top layer
Types of Chip Seal

Single layer Chip Seal

Single Chip Seal; FiberMat Type A; Single graded seals (Canada).

Multi-layer Chip Seals

Racked-in chip seal; Double chip seal; Sandwich seal; Cape seal; Triple chip seal; Sandwich seal double chipping; Inverted double chip seal; Double graded seals (Canada)
Type of Chip Seal

Single Chip Seal

Chip Seals

- Fog seal (optional)
- Chippings
- Binder
- Substrate

Single Chip Seal
Type of Chip Seal

Racked in Chip Seal
Type of Chip Seal

Double Chip Seal

- Fog seal (optional)
- Secondary chippings
- 2nd layer of binder
- Primary chippings
- 1st layer of binder
- Substrate

Double Chip Seal
Type of Chip Seal

Sandwich Chip Seal
Type of Chip Seal

Cape Seal

Diagram of Chip Seals showing:
- Fine slurry seal
- Chippings
- Binder
- Substrate
- Cape Seal
Type of Chip Seal

Inverted Chip Seal

Chip Seals

- 2nd layer of chips
- 2nd layer of binder
- 1st layer of chips
- 1st layer of binder
- Substrate

Inverted Chip Seal
Type of Chip Seal

Single Graded Seal

Graded-Aggregate Seals

- Graded-aggregate
- Binder
- Substrate

Single Graded-Aggregate Seal
Materials - Aggregates and Chip Seals

- Direct contact with the tire
- Higher Quality
- Fines low as possible
- Moisture
Materials – Binders and Chip Seals

• Emulsion – modified or not

• Cutback

• Hot applied asphalts/polymer modified

  – Viscosity, residue and compatibility tests
Equipment

1. Sweeper
2. Distributor
3. Chip spreader
4. Rubber tire rollers
Design Methods

Two Philosophies

Empirical (Art)
–Past experience

Engineered (Science)
–Engineering algorithms
–Highly customized

<table>
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<tr>
<th>Method</th>
<th>United States (%)</th>
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<td>McLeod/Asphalt Institute 1969</td>
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<td>45</td>
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<tr>
<td>Empirical/past experience</td>
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<td>Own formal method</td>
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<tr>
<td>No formal method</td>
<td>26</td>
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</table>
Design Methods

- Design guides & best practices documents
  - Design guide for road surface dressing - Road Note 39 (UK)
  - Enduits superficiels d’usure: Guide technique (France)
  - Minnesota Seal Coat Handbook (USA)
  - Surfacing Seals for Rural and Urban Roads – TRH 3 (S.A.)
  - Austroads Provisional Sprayed Seal Design Method (Australia)
  - Chip Seal Best Practices – NCHRP Synthesis 342 (USA)

- Softwares
  - Alogen (France)
  - Seal Coat Design (Minnesota)
  - Surface dressing design software (under development) (UK)
Design Methods

BEST PRACTICES FOR DESIGN: USE ENGINEERING PRINCIPLES

- Evaluate surface texture of existing road;
- Evaluate traffic conditions: volume, speed, percentage of trucks, etc.;
- Evaluate climatic and seasonal characteristics;
- Evaluate and select type of chip seal;
- Evaluate aggregate selection;
- Determine binder application rate; and
- Determine how many hours per day are available for construction operations.
Design Methods - Climate Considerations

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<th>Jun</th>
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- **High risk**: High risk of failure
- **Significant risk**: There is some risk, extra care in the design and execution of the system is required.
- **Some risk**: Good possibility of success in favourable weather conditions, but with a higher risk of failure in late season.
- **Low risk**: Normally successful provided the weather conditions are appropriate.

*Source: Design guide for road surface dressing, Road Note 39, 5th Edition, TRL Ltd., UK, 2002*
Conclusion

• A valuable tool in the Pavement Preservation toolbox.
• Cost effective treatment
• One type does not fit all situations.
• Examine materials in detail
• Equipment needs to be checked
• Designs are a useful but end performance is what matters.
Cold In-Place Recycle

Brief History of the Process

What Have We Learned?
Early History

• First CIR project done in Arizona 1981
• Early projects done mostly in Southern California and Arizona
• Mid to Late 1980’s the process spread to New Mexico and Oregon
• Much of the early research was done in Oregon with Oregon State University and Dr. Gary Hicks
1990’s

- Use of CIR began to spread to all of the western states
- Much of the research into mix design, type and amount of emulsion, and use of lime occurred in this time frame
- As a result of this research along with more projects, the belief that CIR was just a low volume road application began to change
Current Trends

• Equipment – Multi unit trains are still prevalent although there are more single unit trains in the industry

• Electronics – virtually unchanged – very similar to hot plant electronics – very accurate

• Materials – Lime slurry specified by many agencies in the West
Current Trends (Cont.)

• Materials – Emulsion has seen the most change over time

• Originally, type of emulsion specified was regional – CMS-2S in the Northwest, HFE (High Float) in the Southwest and Midwest, and ERA type products in California

• Environment regulations have affected what type of emulsions can be produced in certain areas of the country
Current Trends (Cont.)

• As a result of these regulations, the use of solventless emulsions began

• Use of solventless emulsions created new benefits – higher early strength, shorter cure time, higher initial densities, greater resistance to freeze/thaw, early return to traffic, shorter construction zone
Where Are We Now?

• CIR is no longer just a low volume road application – there have been a number of projects successfully completed on the Interstate system as well as high volume urban projects

• As the quality of the finished product continues to improve, the choices for surface treatment have expanded
What Have We Learned?

- Project selection is the single most important element.
- Adequate depth of existing asphalt surfacing is important.
- Adequate base material is important.
- Stable subgrade is important.
- Is there heavy crack seal or fabric present?
Project Selection Criteria (Cont.)

• Are there steep grades on the project?
• Will there be traffic control issues to deal with?
• Will there be significant amounts of shaded areas on the project?
• Are there varying widths on the roadway?
Conclusion

- CIR is a cost effective choice for pavement preservation/rehabilitation
- CIR conserves natural resources and has a lower carbon footprint than other recycling alternatives
- Not every project is a good CIR candidate – proper investigation of the existing roadway is important