NEW TOOLS FOR SELECTING UNPAVED ROAD CHEMICAL TREATMENTS

David Jones, PhD
University of California Pavement Research Center

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Overview

- Introduction
- Background to additive selection
- New selection guide
- Summary
Introduction

- **Gravel road problems**
  - Fines loss (dust)
  - Wet weather passability
  - Safety
  - Environment

- **Recommended approach**
  - Focus on addressing above
  - Start with building the best possible road
  - Use chemical treatments (or seal) to keep a good road good
  - Set up a GRMS
  - Justify approach through extended life of road and reduced maintenance
Introduction

- Two main categories of additive
  - Surface stabilizers to control fines loss (dust control)
  - Full-depth stabilizers for improving passability, preserving material, and fines preservation (dust control)

- Additive selection
  - Currently based on:
    - Experience
    - Guides
    - Preferred lists
    - Marketing by manufacturers and vendors
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## Background

- **1999 US Forest Service Guide**

<table>
<thead>
<tr>
<th>Dust Palliative</th>
<th>Traffic Volumes, Average Daily Traffic</th>
<th>Surface Material</th>
<th>Climate During Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Light &lt;100</td>
<td>Medium 100 to 250</td>
<td>Heavy &gt;250 (1)</td>
</tr>
<tr>
<td>Calcium Chloride</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
</tr>
<tr>
<td>Magnesium Chloride</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
</tr>
<tr>
<td>Petroleum</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lignin</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
</tr>
<tr>
<td>Tall Oil</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>X</td>
</tr>
<tr>
<td>Vegetable Oils</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Electro-chemical</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Synthetic Polymers</td>
<td>✓ ✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Clay Additives (6)</td>
<td>✓ ✓</td>
<td>✓</td>
<td>X</td>
</tr>
</tbody>
</table>
Background

- 1999 US Forest Service Guide
- New developments since 1999
  - More products (±200 in USA)
  - More/refined categories
    - Dust control vs. stabilization
  - Additional experience
    - Documented field trials
  - Requests for more detailed guidance, preferably with ranking
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Additive Selection

- Ten-step process
- Have a clear objective
  - Temporary dust control
  - Long-term fines preservation
  - All weather passability
  - Unpaved road management
    - Reduced maintenance
    - Extended gravel replacement intervals
- Keep a good road good
Keep a Good Road Good
Keep a Good Road Good
Keep a Good Road Good
Keep a Good Road Good
Additive Selection

1: Review experience
2: Understand materials
3: Set objective
4: Select traffic and climate categories
5: Select plasticity index and fines content
6: Consider road geometry
7: Calculate performance / rank for selection
## Additive Selection Table

<table>
<thead>
<tr>
<th>Additive Category/ Sub-Category</th>
<th>Traffic &lt;100</th>
<th>100-250</th>
<th>&gt;250</th>
<th>Climate Average Daily Traffic</th>
<th>Humidity/Storm Intensity</th>
<th>Plasticity Index</th>
<th>Wearing Course Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Not cost effective as a long-term fines preservation strategy</td>
<td>Not cost effective as a long-term fines preservation strategy</td>
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<td></td>
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<tr>
<td>Water + surfactant</td>
<td>Not cost effective as a long-term fines preservation strategy</td>
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<td>Water absorbing</td>
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<tr>
<td>Water absorbing</td>
<td>Sodium chloride brine</td>
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<td>Glycercin based</td>
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<td>1</td>
<td>50</td>
<td>1</td>
<td>1</td>
<td>50</td>
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<tr>
<td>Clay Additive</td>
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<td>1</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

### Additive Selection Table - Remarks

#### Key to Colors and Explanation Notes in Selection Charts

- **Red**: Significant influence on performance
- **Yellow**: Some influence on performance
- **Green**: No significant influence on performance

1. Water and trucks at higher speeds may break surface crust and accelerate washboarding and raveling. If so more frequent rejuvenation will be required.
2. More than 20 days with less than 40% relative humidity
3. High humidity storms
4. Likely to leach out and/or down into lower layers during storm events
5. Soaked California Bearing Ratio (CBR) and abrasion resistance must be checked/increased with increasing number of trucks to ensure all-weather passability
6. Materials have little or no effective binder content and are prone to washing out and raveling. Treatments may leak down into road structure
7. May become slippery when wet
8. High fines content may require higher application rates to be effective
9. Requires a minimum humidity level to perform effectively
10. May leak down into layer, but dry back of the material plus a light water spray / rejuvenation will return it to surface
11. Generally not suitable as a spray-on application. A "skin" can form on the surface which is damaged by traffic
12. Requires frequent rejuvenation
13. Relatively high initial product cost price, but life-cycle cost could be lower than other treatments
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Traffic 125</th>
<th>Climate Damp 50</th>
<th>PI 7</th>
<th>Fines 8</th>
<th>Perf</th>
<th>Rank</th>
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<tbody>
<tr>
<td>Water</td>
<td>50</td>
<td>50</td>
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<td>50</td>
<td>200</td>
<td>NS</td>
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<td>Calcium chloride</td>
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<td>Mag. chloride</td>
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<td>7</td>
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<td>Sodium chloride</td>
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<td>1</td>
<td>50</td>
<td>102</td>
<td>NS</td>
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<td>7</td>
<td>16</td>
<td>3</td>
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<tr>
<td>Tall oil</td>
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<td>1</td>
<td>1</td>
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<td>16</td>
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<td>Asphalt emulsion</td>
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<td>1</td>
<td>7</td>
<td>16</td>
<td>3</td>
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<td>Base/mineral oil</td>
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<td>1</td>
<td>1</td>
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<td>Petroleum resin</td>
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<td>1</td>
<td>53</td>
<td>NS</td>
</tr>
</tbody>
</table>
Additive Selection

1. Review experience
2. Understand materials
3. Set objective
4. Select traffic and climate categories
5. Select plasticity index and fines content
6. Consider road geometry
7. Calculate performance / rank for selection
8. Understand environmental impacts
9. Understand other limitations
10. Do performance testing
Web-Based Tool

- www.ucprc.ucdavis.edu/dustcontrol
- www.roaddustinstitute.org
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Summary

- Huge selection of additives
- There are no wonder products
- Select based on
  - Problem/objective
  - Traffic, climate and materials
  - Cost-benefit
  - Vendor credibility
- Understand performance
- Apply and maintain appropriately
- Testing is inexpensive, but will save money
Thank-you

djjones@ucdavis.edu  www.ucprc.ucdavis.edu
(djones.consult@gmail.com)