Unpaved Road Chemical Treatments; Where Are We After 110 years?

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DUST KILLS!
Keep your distance
And in Australia...
## USA/NZ in Perspective

<table>
<thead>
<tr>
<th>Parameter</th>
<th>USA</th>
<th>New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land area (km²)</td>
<td>9,834,000</td>
<td>268,021</td>
</tr>
<tr>
<td>Population</td>
<td>323,100,000</td>
<td>4,693,000</td>
</tr>
<tr>
<td>Km’s unpaved</td>
<td>±2,500,000</td>
<td>31,151</td>
</tr>
<tr>
<td>% of network</td>
<td>±50</td>
<td>±33</td>
</tr>
<tr>
<td>National asset?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td># of countries in the country</td>
<td>&gt;50</td>
<td>1</td>
</tr>
<tr>
<td>Petrol price (NZ$)</td>
<td>0.98</td>
<td>1.80</td>
</tr>
<tr>
<td>Diesel price (NZ$)</td>
<td>1.01</td>
<td>1.20</td>
</tr>
</tbody>
</table>
Outline

- Introduction
- The dust problem
- History of road dust control
- Where are we after 110 years?
- What are we doing about it?
- Conclusions
Introduction

- Unpaved roads
  - Critical function
  - All weather problems
  - Questionable sustainability
  - Questionable management approaches

- Improvement options
  - Upgrade to a sealed standard
  - Fines preservation (dust control)
  - Surface stabilization
  - Need to understand the role of each before choosing / implementing
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The Dust Problem

- Safety hazard
- Health hazard
- Air and water pollution
- Vehicle operating costs
- Reduced agricultural yields
- Loss of fines
  - Increased rate of gravel loss
  - Increased maintenance frequency
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Air Pollution (PM10 & PM2.5)

- Dust
- Fuel combustion
- Agriculture
- Industrial
- Mobile
- Miscellaneous
- Fires
- Solvents

Air Pollution (Fines Lost)

- Unpaved Roads: 8,000,000 Tons (PM10) 1,000,000 Tons (PM2.5)
- Paved Roads: 2,000,000 Tons (PM10) 500,000 Tons (PM2.5)
- Construction: 2,000,000 Tons (PM10) 500,000 Tons (PM2.5)

Loss of Fines

- In perspective
  - > 8 million tonnes per year
  - 267,000 30T trucks
  - Back-to-back Los Angeles-New York-Los Angeles

- Fines loss through erosion (1mm/yr)
  - 14 million tonnes per year

- Loss of fines equates to accelerated deterioration leading to corrugation and raveling
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History of Road Dust Control

- **Before 1900**
  - Water

- **1907**
  - Chlorides

- **1913**
  - Lignosulfonate

- **1913 – 1970’s**
  - Bitumen/tar based
  - Tall oils and resins
History of Road Dust Control

- Before 1900
- 1907
- 1913
- 1913 – 1970's
- After 1970
  - Concentrated liquid stabilizers
  - Plant oils
  - Synthetic polymer emulsions
  - Petroleum resins and base oils
  - Blends of different products
>200 products available in the U.S.
- Two primary groups
  - Fines preservation and stabilization
  - Six main categories covering both groups

Fines preservation (dust control)
- Water/wetting agents
- Water absorbing
- Organic non-petroleum
- Organic petroleum
- Synthetic polymer emulsions
Chemical Treatment Categories

- Surface stabilization
  - Organic petroleum
  - Synthetic polymer emulsions
  - Concentrated liquid stabilizers
Status Quo in the USA

- Multiple “owners” of unpaved roads
  - Federal Lands
    - NPS, FWS, BLM, etc.
  - U.S. Forest Service + private forestry
  - U.S. military
  - Border patrol
  - Counties
  - Railroad companies
  - Mining companies
  - Agriculture
Status Quo (USA and Elsewhere)

- Nobody “owns” the problems
  - Inconsistent specifications and guidance covering a range of road types, material types, terrain, and climates
  - No specifications for chemical treatments
  - Very limited formal research
    - Mostly one-off applications to “see how long a product will last”
    - No protocols or formal test methods
  - No formal product evaluation procedures
- Impacts of the energy boom
  - Oil, wind, solar, ethanol
Status Quo (USA and Elsewhere)

- Very limited road funding
  - LVRs are at the end of the queue for funds
  - Worst-first approach to road management
  - Limited research and training
  - Increasing interest in “unpaving” of distressed low volume sealed roads

- Large variation in way treatments are used
  - Numerous successful implementation programs
  - But, inappropriate use is common
  - Products are sold as “wonder products”
Status Quo (USA and Elsewhere)
Kootenai County, Idaho

- 190 km of unpaved road (50%)
- Average cost untreated
  - $5,600 /km /yr
- Average cost treated with MgCl
  - Year 1: $2,800 /km /yr
  - Year 2+: $1,700 /km /yr
- Benefits from reduced grader maintenance and regravelling
U.S. Case Studies

- Weld County, Colorado
U.S. Case Studies

- Weld County, Colorado
U.S. Case Studies

- Kootenai National Forest, Montana
Role of Chemical Treatments

- Earth
- Gravel
- Chem Treatment
- SandSeal
- Grav-OttoSeal
- Single Seal
- Double Seal
- Asphalt-Concrete

Level of Service/Cost
Role of Chemical Treatments
Role of Chemical Treatments
## SA Example PPGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Expected Performance</th>
<th>Guaranteed Performance</th>
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<tbody>
<tr>
<td></td>
<td>Untreated</td>
<td>Treated</td>
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<tr>
<td>Blading interval (days)</td>
<td>40</td>
<td>200</td>
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<tr>
<td>Gravel loss (mm/year)</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>Dust level (visual)</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Days impassable</td>
<td>5</td>
<td>0</td>
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</table>
Status Quo (USA and Elsewhere)

- Fragmented industry selling mostly proprietary products
  - No industry association (anti-trust concerns)
  - Only road-related industry that does not have an association
    - National and state asphalt and concrete paving associations, Portland Cement Association, Asphalt Recycling and Reclaiming Association, Asphalt Interlayer Association, etc.
  - Some professional companies, some dodgy ones as well
    - Products are often marketed with no documented product testing
- Treatments are the only products used on roads that do not carry a formal specification
- Poor track record has led to general skepticism
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U.S. Initiatives

- TRB LVR Committee Task Group
- Workshop on road dust management (2008)
  - Committee established
  - Survey to understand issues (FHWA)
  - National scan tour (FHWA)
  - Handbook on best practices
- 2nd Workshop (2011)
  - Unpaved Road Institute proposed
  - Testing protocol scan
  - Product evaluation procedure
U.S. Initiatives

- Chemical Treatment Selection Guide (2013)
  - Based on 1999 US Forest Service Guide but advocating use of treatments in a road management approach “to keep a good road good”
  - Manual, spreadsheet, and web-based tools give ranked selection with basis of ranking
  - Includes performance-based system for understanding / selecting material
  - Example treatment category and application specifications
  - Standard SDS template
  - Accompanying database of treatments (>200)

- USGS Environmental Testing Protocol
Guidance on Selection and Use

Unpaved Road Chemical Treatment Selection Tool

Roadway Parameters
- Traffic (AADT): < 100
- Climate: Damp

Environmental & Other Influences

Objective
- Short-term dust control (spray-on)
- Long-term fines preservation (spray-on)
- Long-term fines preservation (mix-in)
- Long-term stabilization (mix-in)

Material Test Results
- % Passing 25: 100
- % Passing 4.75: 61
- % Passing 2.36: 46
- PI (or BL, Ss2): 10

Predicted Material Performance for Untreated Road

Treatment Ratings

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<tr>
<th>Treatment</th>
<th>TR</th>
<th>CL</th>
<th>PI</th>
<th>FC</th>
<th>HV</th>
<th>SG</th>
<th>SC</th>
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<tbody>
<tr>
<td>Calcium Chloride</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>0</td>
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<tr>
<td>Magnesium Chloride</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Glycerin Based</td>
<td>1</td>
<td>1</td>
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<td>1</td>
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<td>0</td>
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<tr>
<td>Lignosulfonate</td>
<td>1</td>
<td>1</td>
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<td>1</td>
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<td>0</td>
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<tr>
<td>Tall Oil</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Petroleum Resin</td>
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<td>0</td>
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<tr>
<td>Synthetic Fluid</td>
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<td>Synthetic Fluid + Binder</td>
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<td>Sodium Chloride Brine</td>
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<td>1</td>
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<td>Molasses/Sugar</td>
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<td>1</td>
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<tr>
<td>Base Oil</td>
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<tr>
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<td>Asphalt Emulsion</td>
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<tr>
<td>Water</td>
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<td>1</td>
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<tr>
<td>Water + Surfactant</td>
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<td>1</td>
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<td>0</td>
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<tr>
<td>Concentrated Liquid Stabilizer</td>
<td>3</td>
<td>2</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Bentonite</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
U.S. Initiatives

- Unpaved Road Institute Launch (2014)
  - Business and membership plans
  - Website
  - Preliminary procedures / protocols
  - Fit-for-purpose evaluation procedure
  - Training / technology transfer plan
  - Research roadmap for unpaved roads
  - Stalled due to:
    - Inability of industry to organize themselves
    - Lack of federal support
U.S. Initiatives

- UCD City and County Pavement Improvement Center (2017)
  - Provide support to California cities and counties
  - Training
  - “Re-package” guidance and specifications to suit
  - Assistance with pilot projects and forensic investigations
  - Resume URI initiatives, specifically in terms of the research roadmap
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Conclusions

- Fines loss from unpaved roads is a significant environmental and road management issue
  - No national “owner” of the problem in the U.S.
  - No formalized approach to dealing with it
- Mixed success with the use of chemical treatment programs
  - Most successful have been use as part of a road management program to extend maintenance and regravelling intervals (keeping good roads good)
Conclusions

- Numerous initiatives are in place to improve unpaved road management approaches
  - Progress will depend on:
    - Industry formally organizing themselves
    - National leadership

- So where are we after 110 years?
  - Not making much progress at a national level, but numerous success stories at local government level
Thank-you

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