Pavement Alternatives for Low Volume Roadways

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GRAVEL - (Unpaved)
LVR – The Problem

- Gravel Roads lose about 1” of Agg/yr
- It costs > $5,000 to add 1” of gravel/mile
- Maintenance costs depend on blade cycle
- Maintenance creates additional problems
- Road network too large to sustain
- Developers often create future problems
- Innovation needs to address problems/cost
Cumulative maintenance costs/mile for a gravel road

Cumulative Total Cost ($)

Time (years)
IOWA DOT – HR 265

– Highway Research Board
  – Paving Gravel with 300 – 400 Vehicles / Day: 15% Rate of Return
  – Economically Justifiable
  – Break Even at 100 Vehicles / Day (15 Day Blade Cycle)

When to Pave a Gravel Road

– Vermont Local Roads Program
  – 50 Vehicles / Day = Consider
  – 400 Vehicles / Day = Serious Consideration
  – Use Stage Construction
Traffic’s effect on maintenance costs/mile

- Roads grouped by traffic volumes and surface type
- An increase in traffic should lead to an increase in maintenance costs, particularly for gravel roads
  - More gravel needed
  - More blading and smoothing of road
Double Chip (DC) over Gravel

- **Prime, Blotter, DC**
  - Prime .25 - .30 GSY
  - Sand @ 12-18 lbs/SY
  - 3/8”/1/4” DC or

- **PASS CR, 2P DC**
  - Pass CR @ .5 with 1/2”
  - CRS2P @ .45 & 3/8”

- **Good Base a must**
RAS & RAP – Blue Earth Cty

- Staged Construction
- Interim Upgrade
- Use Recycled Matl’s & EE to reduce cost
- Agency/Industry Collaboration
- New Process?
Identifying Roads for Rehabilitation

Extensive *structural distress*; could be accompanied by functional distress
- Adequate base strength/stability
  - Weak areas/soft spots need to be corrected
- Subgrade quality/Drainage
- Sufficient base depth
- Patching: OK, but adds variability in materials
Pre-overlay Treatments for Bituminous and Concrete Overlays

- **Grids/Fabrics**
  - Acts as localized reinforcement over cracks
  - Delays reflective cracking
  - Reduces the number and severity of reflective cracks
Recycled materials should get first consideration in materials selection
  – Recycling ⇒ engineering, economic & environmental benefits
  – Review engineering & environmental suitability
  – Assess economic benefits
  – Remove restrictions prohibiting use of recycled materials without technical basis
Definitions

- **Mechanical stabilization** - 1st step in reclamation; also used to describe FDR without addition of binder (Pulverization)

- **Chemical stabilization** - FDR with chemical additive (Base One, Calcium or Magnesium Chloride, Lime, Fly Ash, Kiln Dust, Portland Cement, etc.)

- **Bituminous stabilization** - FDR with asphalt emulsion, emulsified recycling agent, or foamed / expanded asphalt additive

- **Combination stabilization** - Any 2 or more of above
Soil Modification/Stabilization

Soil Modification – Typically Lime for Drying
- PI > 30
- 2% application rate depending on moisture

Soil Stabilization – Typically Cement for Strength
- PI < 30
- 3 to 8% application rate; target 200 to 400 PSI

General Rule of Thumb
- Each 3 points over optimum add 1% cement
- Dry by farming to reduce cement loading
Cold In-place Recycling (CIR) The Train Machine Concept

Used when the Engineer’s design requires milled material needs to be screened, be of a uniform size and fully mixed in a pugmill.
Turn back Roads – Barnes Cty

Scenic Byway
- Highly cracked HMA
- Reduced Cracking Goal
- High Maintenance
- High Truck Volume / Gravel Pits
- Binder Selection based on goals not trucks
Full Depth Reclamation (FDR)
Stabilized FDR (SFDR)

Full-Depth Reclamation: Theory of stabilization

Stabilization Options

• Cutbacks/Roadmix
• Proprietary Products – (Base One)
• Engineered Emulsion
• Lime/chlorides
• Foamed Asphalt
• Flyash/Cement
• Combinations of above
Full Depth Reclamation (FDR)
Keys to Success

Stabilization Considerations

- Cutbacks or Road Mix
- Proprietary Products
- Engineered Emulsion
- Foam Asphalt or Lime
- Fly Ash or Cement

Prone to Rutting
Flexible
Granular

Prone to Cracking
Stiff
Organic Clay
Max Tensile Strain

Pavement Foundation

1” UTBWC

Zone of High Compression

High Modulus Rut Resistant Material

2”

Flexible Fatigue Resistant Material 6 - 8”

LRRB Pavement Rehabilitation Selection
Base Stabilization vs. HMA Overlay

Over Poor Existing Base

**Base Stabilization**
- Strengthens base
- Reduces Overlay Thickness
  - Flexible
  - Better Fatigue Resistance
- Ready for
  - Staged construction
  - Future growth

**4-6” HMA Overlay**
- Over existing base
- Poor base = overlay failure
- Requires widening, curb, gutter, slope corrections
The Stabilization process will increase the structural coefficient of the material.

The structural coefficient of Stabilized material is dependent upon:

- Stabilizing Material
- Amount of P200 (fines)
- Angularity of recycled material
Additive Application

Slurry Application. Portland Cement and Hydrated Lime may be applied in slurry form.

Dry Application. Type C Fly Ash, Portland Cement or Hydrated Lime may be spread dry in front of the recycling train.
ADDROCK
Barnes County, ND  2009
What you get depends on what you start with.

- EE treated granite
- EE treated RAP & base
- EE treated high fines limestone
- Foam treated high fines limestone
System Expectations

• Site Assessment Critical
  – Can’t fix poor subgrades
  – If pre-construction assessment not done (borings, FWD, etc.), problems should be addressed during construction

• Fines amount must be manageable
  – If surface or gravel base too thin, subgrade may introduce too many fines unless sufficient additional rock can be added

• Construction start-up expectation
  – Additives shouldn’t be added until moisture content is correct, most notably
    • On all-gravel roads
    • After heavy rainfall or high water table areas
Typical production = 0.5 – 1.0 centerline mile / day (reclaimer, trucking and lay down expertise)

Coating
- Don’t expect 100% coating, unless 100% RAP
- More fines = lower coating
- With Foam – only the fines are coated

Weak spots
- Boring & sampling won’t catch all thin areas / weak spots
- Address during construction
System Expectations, cont.

• Account for variability in road
  – *Sufficient sampling & testing*
  – *Adjust as necessary during construction*

• May require multiple reclaimer passes
  – *For adequate sizing*
  – *For emulsion dispersion (high fines)*
  – *For moisture management*

• Manage time to compaction
  – *Too soon, soft areas*
  – *Too late, raveling*
What are short and long term plans for road?
What Roadway History information is available?
Do I know the root cause of pavement issues?
What options fit my desired result?
What additional information do I need to evaluate my options?
Where can I go for help?
Rehabilitation Selection
BARM

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Most Appropriate → Least Appropriate
Questions?