PEA Northwest Pavement Management Association 2012 Conference – Vancouver WA

Full-Depth Reclamation with Cement

think harder.

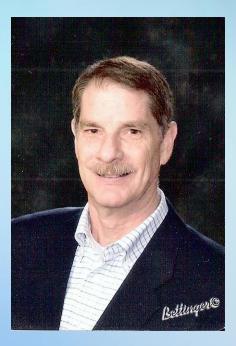




Full-Depth Reclamation with Cement

Course Instructor:

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Benefits
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Construction
Field Testing
Performance

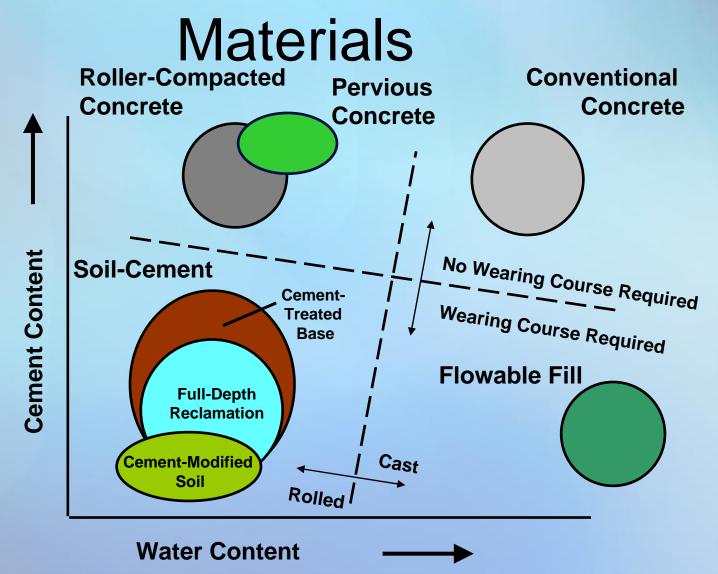


Introduction





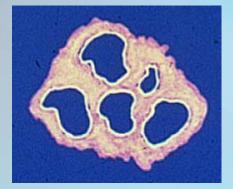
Cement-Based Pavement





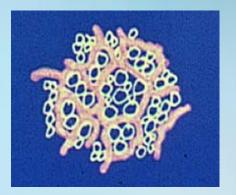


Concrete





Soil-Cement



Cementitious Gel or Past Hydration Products

coats all particlesfills voids

all particles not coated
voids not filled
linkages bind soil agglomerations together





Definition of Full-Depth Reclamation

Method of flexible pavement reconstruction that utilizes the existing asphalt, base, and subgrade material to produce a new stabilized base course for a chip seal, asphalt, or concrete wearing surface.







Types of Reclamation Methods Mechanical Stabilization Bituminous Stabilization emulsified asphalt expanded (foamed) asphalt Chemical Stabilization portland cement – kiln dust slag cement – lime - fly ash - other



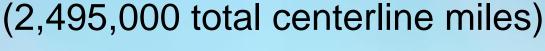
Applications

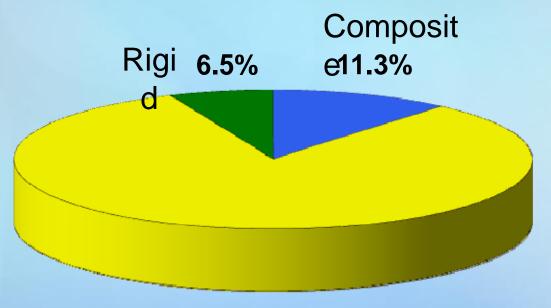
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Surfaced Roadways in the United States





Flexible82.2%



Challenges Facing Our Roadways

- Continuing growth
- Rising expectations from users
- A heavily used, aging system
- Environmental compatibility
- Changes in the workforce
- Funding limitations

Combined with large increases in traffic volumes and/or allowable loads often leads to serious roadway base failures!





How do you know if you have a base problem and not just a surface deficiency?







Examples of Pavement

Distress

- Alligator cracking
- Rutting
- Excessive patching
- Base failures
- Potholes
- Soil stains on surface





WARNING

2 88

EREX



Benefits





Advantages of the FDR Process Use of in-place materials

- Little or no material hauled off and dumped
- Maintains or improves existing grade
- Conserves virgin material
- Saves cost by using in-place "investment"
- Saves energy by reducing mining and hauls
- Very sustainable process







Benefits of FDR with Cement

- Increased rigidity spreads loads
- Eliminates rutting below surface
- Reduced moisture susceptibility
- Reduced fatigue cracking in asphalt surfacing
 Allows for thinner pavement
 - section





Rehabilitation Strategies

	Rehabilitation Strategy		
Attribute	Reclamation with Cement	Structural Overlay	Removal and Replacement
New pavement structure	\checkmark	\checkmark	\checkmark
Fast construction	\checkmark	\checkmark	Х
Minimal traffic disruption	\checkmark	X	X
Minimal material in/out	\checkmark	X	X
Conserves resources	\checkmark	Х	X
Maintains existing elevation	\checkmark	Х	\checkmark
Low cost	\checkmark	Х	X



Sustainable Element of FDR

PEA



1 mile of 24-foot wide, 2-lane road, with a 6-inch base

WARNING

10 100

TEREX



Design





Pavement Thickness Design Procedures 1993 AASHTO Pavement Design Guide

- Structural Numbers
- Layer Coefficients
- Proposed New AASHTO Design Guide
 - Mechanistic-Empirical Design
 - Evaluates effects of pavement materials, traffic loading conditions, environmental factors, design features, and construction practices



Pavement Materials Tests

- Sieve Analysis (ASTM C136)
- Atterberg Limits (ASTM D4318)
- Moisture-Density (ASTM D558)
- Durability Tests
 - Wet-Dry (ASTM D559)
 - Freeze-Thaw (ASTM D560)
- Soluble Sulfates (ASTM C1580)
- Compressive Strength (ASTM D1633)





Laboratory Mix Design

- Obtain representative samples of roadway material
- Usually about 100 pounds of material is required
- Determine the maximum dry density and optimum moisture content at various certain (ASTM D558)
- Typical designs vary between 2 and 8 percent cement by weight of dry material
 Prepare samples
 Cure samples



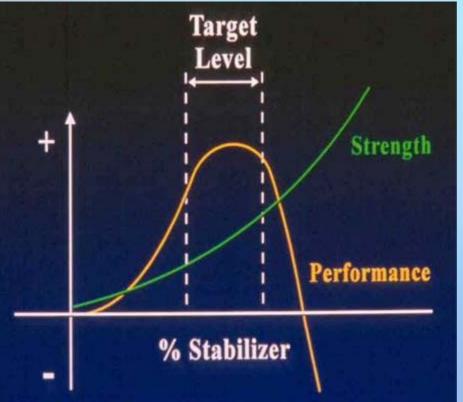


Strength Determination Unconfined Compressive Strength Testing ASTM D1633 Used by most governing agencies Simple and quick procedure 7-day strengths ranging from 300 to 400 psi are generally recommended Proven strength (support) under extremely heavy traffic conditions Proven performance (durability) in wet-dry and freeze-thaw environments





Please keep in mind that strength and performance are NOT the same thing!



The purpose of the mix design procedure is to select the correct amount of stabilizer that most closely balances both strength AND performance for the roadway materials!



Construction

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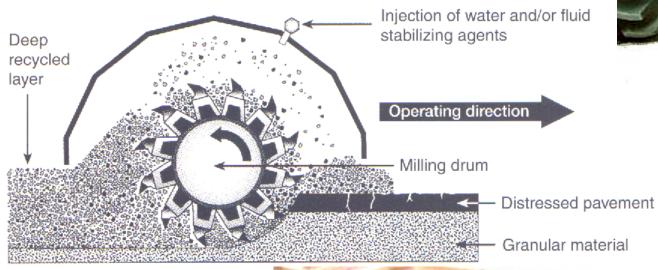
FDR Construction Process Pulverize, Shape, Add Cement, Mix In Place, Compact, and Surface

Bituminous Surfacing				New Surfacing
Granular Base	Pulverized	Pulverized	Stabilized	Stabilized
Subgrade	Subgrade	Subgrade	Subgrade	Subgrade
Existing road	Pulverization to desired depth	Removal of excess material (if necessary) and shaping	Addition of cement, mixing, reshaping, and compaction	Final surface application





Inside a Reclaimer









Pulverization

Pulverize mat to appropriate gradation
 Usually, only one pass is required!







Cement Spreading

Cement is spread on top of the pulverized material in a measured amount in either a dry or slurry form











Blending of Materials and Moisture Addition

Cement is blended into pulverized, reclaimed material and, with the addition of water, is brought to optimum moisture







Compaction and Grading

Material is compacted to 96 to 98 percent minimum standard **Proctor density** and then graded to appropriate Plan lines, grades, and crosssections







Curing



Bituminous Compounds (cutbacks or emulsions)



Water (kept continuously moist)



Field Testing

1





Testing Requirements

Gradation/Uniformity



A common gradation requirement is for 100 percent to pass a 3-inch sieve, a minimum of 95 percent to pass a 2-inch sieve, and a minimum of 55 percent to pass a No. 4 sieve (ASTM C136).

Density



A common density requirement is to be between 96 and 98 percent of the established laboratory standard Proctor density (ASTM D558).

Moisture



A common moisture requirement is to be within 2 percent of the laboratory established optimum moisture content (ASTM D558).



Traffic and Surfacing

- Completed FDR base can be opened immediately to lowspeed local traffic and to construction equipment
- Subsequent pavement layers can be placed at any time





Case Studies

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Laramie County, Wyoming

Started using FDR for county roads in 2007







Little Sahara Rec Area

- 60,000 acres in south central Utah
- Reclaimed over 14 miles of park road
- Decision to use cement over another stabilizer saved \$350,000









Richland County, Montana

- Just completed third year of FDR of chip seal and gravel roads
- Cement content developed for each road reclaimed – around 7%
- 2012 project included 29 miles

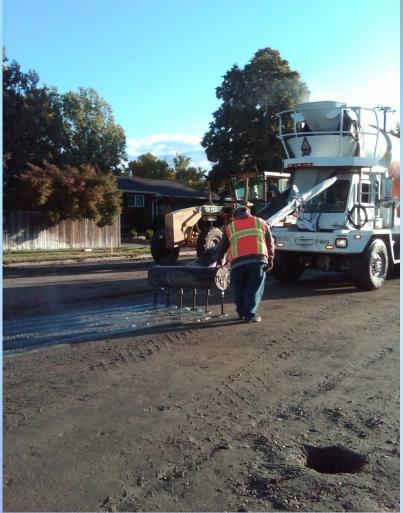






Spanish Fork, Uta

- Two block long reconstruction project
- FDR process with cement saved \$33,000 (21%) over conventional reconstruction
- Used micro-cracking
 Used the "Coyle" spreader

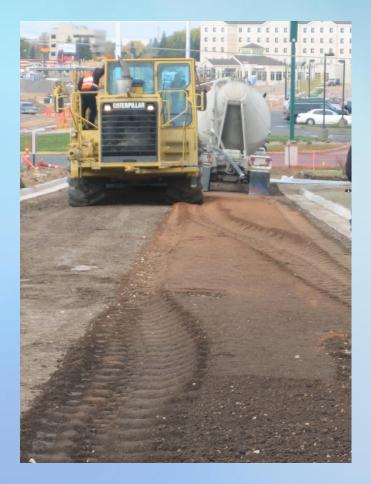






Counties who have purchased rec

 Weld County, Colorado
 Montrose County, Colorado



PCA



Performance

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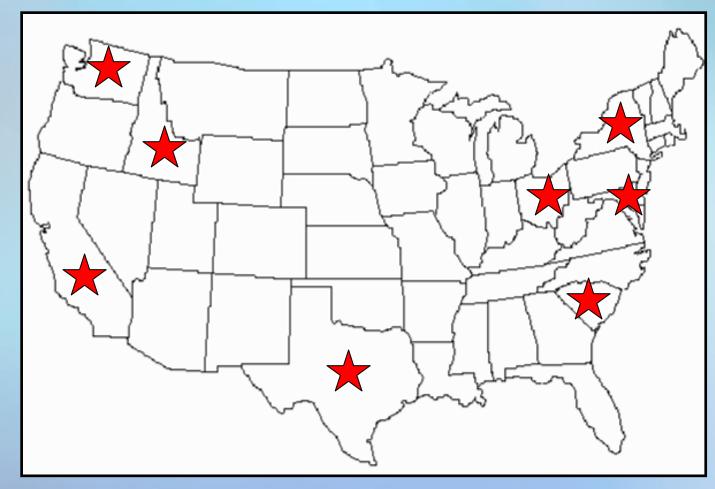
PCA Funded Project

- Study conducted in 2005
- Identified candidate project sites in concert with PCA
 - State (DOT), County, City Agencies, Private
- Interaction with select officials
- Visual Pavement Condition Index (PCI) survey
- Extracted roadway cores for UCS measurements





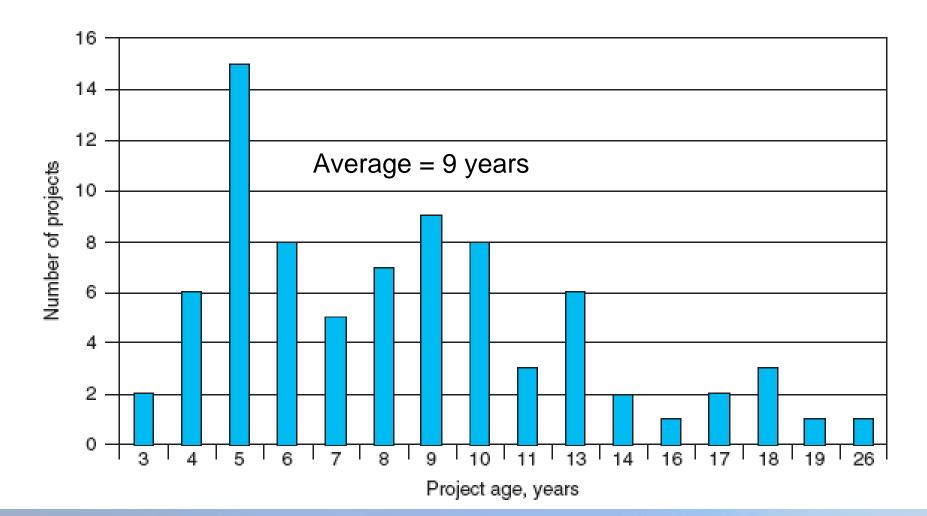
Performance Evaluation







79 Projects Studied

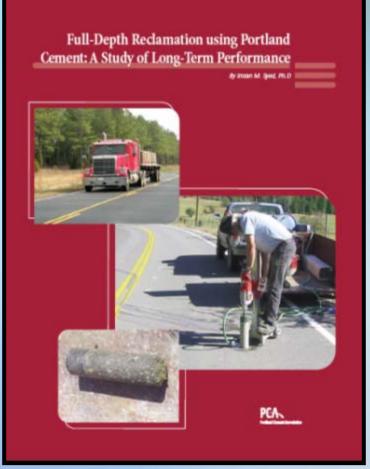


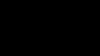




LTP Study Conclusions

- Overall, excellent LTP
- Average PCI of 89
- UCS of cores 260 to over 1,000 psi
- Cement contents 2 to 12 percent with average being 5 percent
- Most surface distress was in the asphalt layer
- No major failures attributed to the cement-stabilized base
- Owners are happy with







Concluding Comments

- Use of in-place materials
- Very sustainable process
- Fast operation
- Constructed under traffic
- Structurally better than granular base
- Can apply local traffic almost immediately



30 to 60 percent less expensive than removal and replacement





For more on full-depth reclamation, visit the PCA website at www.cement.org/pavements

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PAVEMENTS OVERVIEW	Pavements	Pavements E-Newsletter	Find a Cement Supplier		I
SOIL-CEMENT Roller-compacted concrete	A variety of cement-based products can be used in pavement applications. They are all similar, in that they all contain the components of portland cement,	E-mailed 6 times a year, Pavements contains the latest information on soil- cement and RCC pavement projects, FDR case studies,	Cement used for S/S treatment can be delivered in bags or in bulk. Click here to find a supplier in your area.		
CONCRETE PAVEMENTS RESOURCES TECHNICAL SUPPORT	aggregates and soils, and water. Click here for more info. Paving: The New Realities	training and events, FAQs, new resources, and more. View current issue. Access back issues. Sign-up for future issues and occasional relevant news and information:	Tech Support Need help? Contact our industry experts. Click here		_
STAY INFORMED Find a cement supplier Find Help Near You	Listen to webcasts, download white papers, and get the latest information on the impact of the stimulus plan, concrete's	Email:	Stay Informed		
CONFERENCES AND TRAINING	advantage over asphalt, and the economic outlook. Click here for more info.	SIGN UP	interests and subscribe to free information. Click here		
Portland Cennet Association 5420 06 Orchard Read - Stekke, IL 60077 847:966.6200 MH - 647.966.8389 FX 500 New Jersey Ave., N.N. 7th Floor Washington, DC + 20001 2024:040344 PH + 2022.040.0877 FX	Soil-Cement Soil-cement pavements have many uses from city streets, county roads, state routes, and interstate hichways, to	Upcoming Webinars +Full Depth Reclamation with Cement - May 6	Printer friendly page		
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Questions?

For further information please contact: Don A. Clem, PE dclem@cement.org