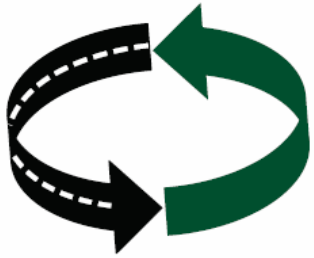
FULL - DEPTH RECYCLING OF ASPHALT PAVEMENTS WITH PORTLAND CEMENT

Dick Martin

Pavement Recycling Specialist



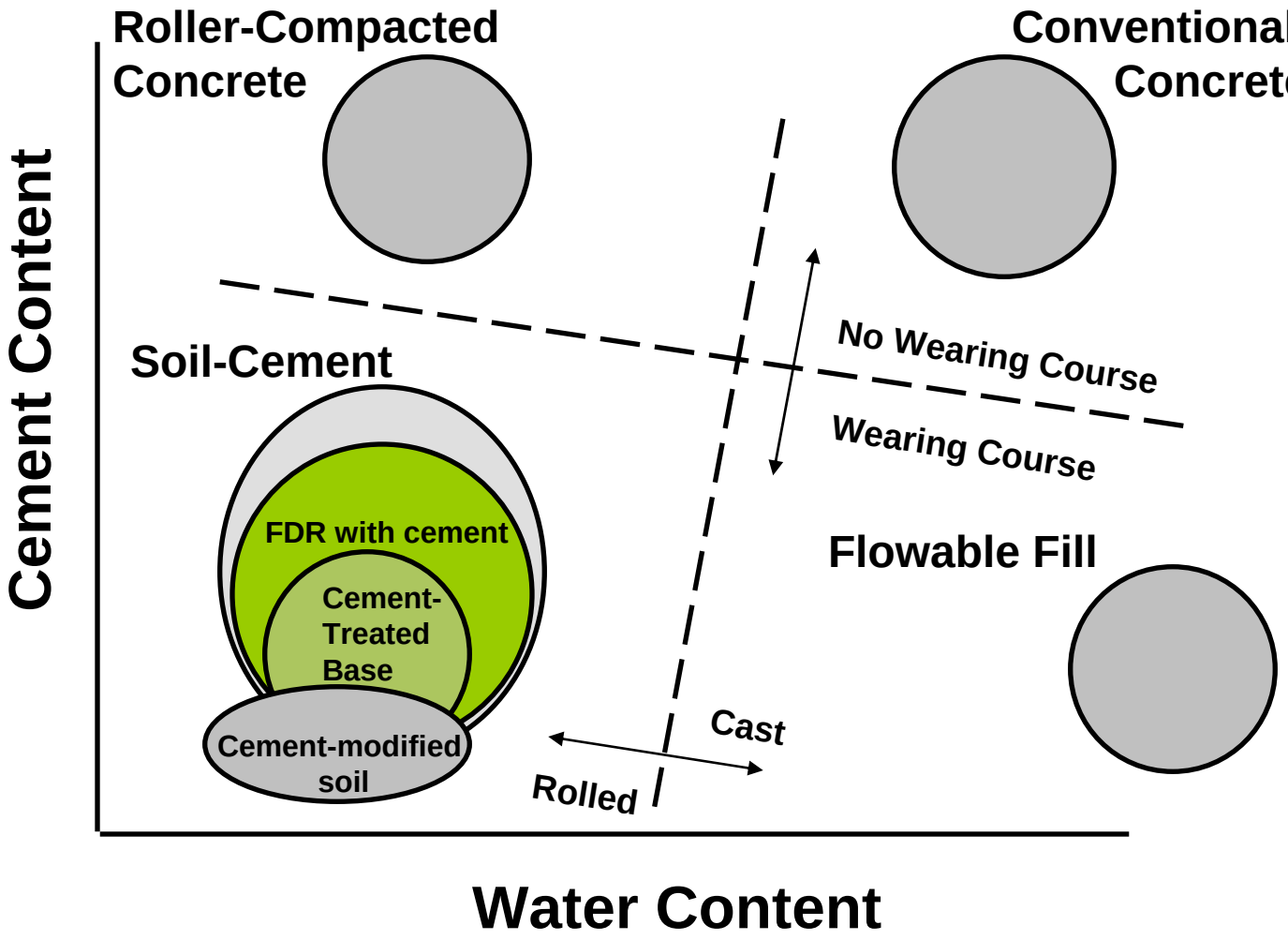
Road Recycling Council

New England Region

What is Full Depth Reclamation?

"FDR is the rehabilitation technique in which the full thickness of the asphalt pavement and a predetermined portion of the underlying materials (base, subbase, and/or subgrade) is uniformly pulverized and blended to provide an upgraded, homogeneous material"

Cement-Based Pavement Materials



Advantages of Full – Depth Recycling with cement

Technical Advantages

- ✓ Eliminate base and surface problems simultaneously
- ✓ Improve the load bearing capacity of the pavement
- ✓ The profile of the road remains unchanged
- ✓ On widening projects, materials will be uniform across the new road's width

Economical Advantages

- ✓ Cut costs by re-using existing roadway materials
- ✓ Save time by using in-place construction techniques
- ✓ Minimize traffic disruption, detours, and downtime
- ✓ Minimize traffic of construction trucks

Environmental Advantages

- ✓ No new aggregates needed for the base
- ✓ No material for disposal
- ✓ Save in energy use

Candidate Roads for FDR with cement

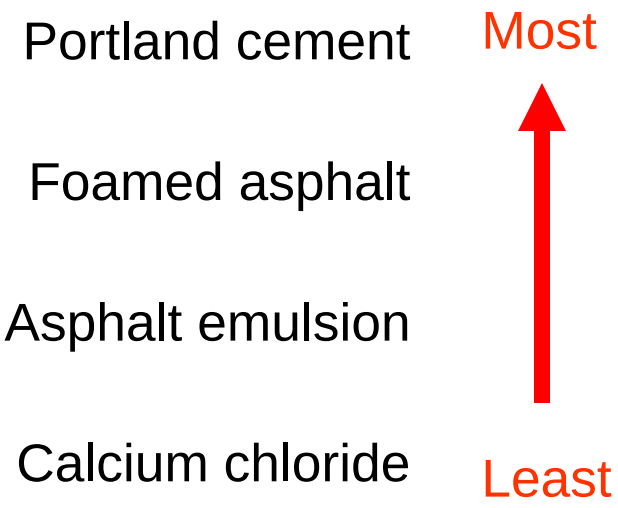
- Roads with base and surface problems (Pavement Distress)
- Roads that need to improve its load bearing capacity (Existing narrow thin paved structure)
- Widening projects
- Upgrade a dirt / gravel road
- Special projects (extreme conditions - fast reconstruction)

Candidate Roads for FDR with cement

- Clay or high amount of fine materials. Cement can be used with many different types of soils; it even allows you to work with more than 30% of fines materials.
- Moistures problems (high water tables). The cement stabilization creates a more impermeable base, keeping water out of the pavement.
- Heavy traffic: heavy loads (trucks) with potential rutting problems on the base, rutting on the base will be significantly reduced or eliminated when using cement.
- No uniform materials along your project (many patching areas, changes on the base materials or in the moisture content).

FDR: Stabilizers

Amount of strengthening



- **Versatility through use of cement**
  - Stabilizes many materials: old base, asphalt surface, granular or plastic subgrade. Including wide variety of soil types (Gravels, Sands, Silts, and Clays)
- **Fast operation.**
- **Keep traffic during construction (Traffic Control).**
- **Roads have evolved from gravel roads at some time in the past.** In some cases the materials that were left in place to form the base course were not suitable for the job. Stabilization can help improve its performance.

Construction Process

Simple and Fast Process!

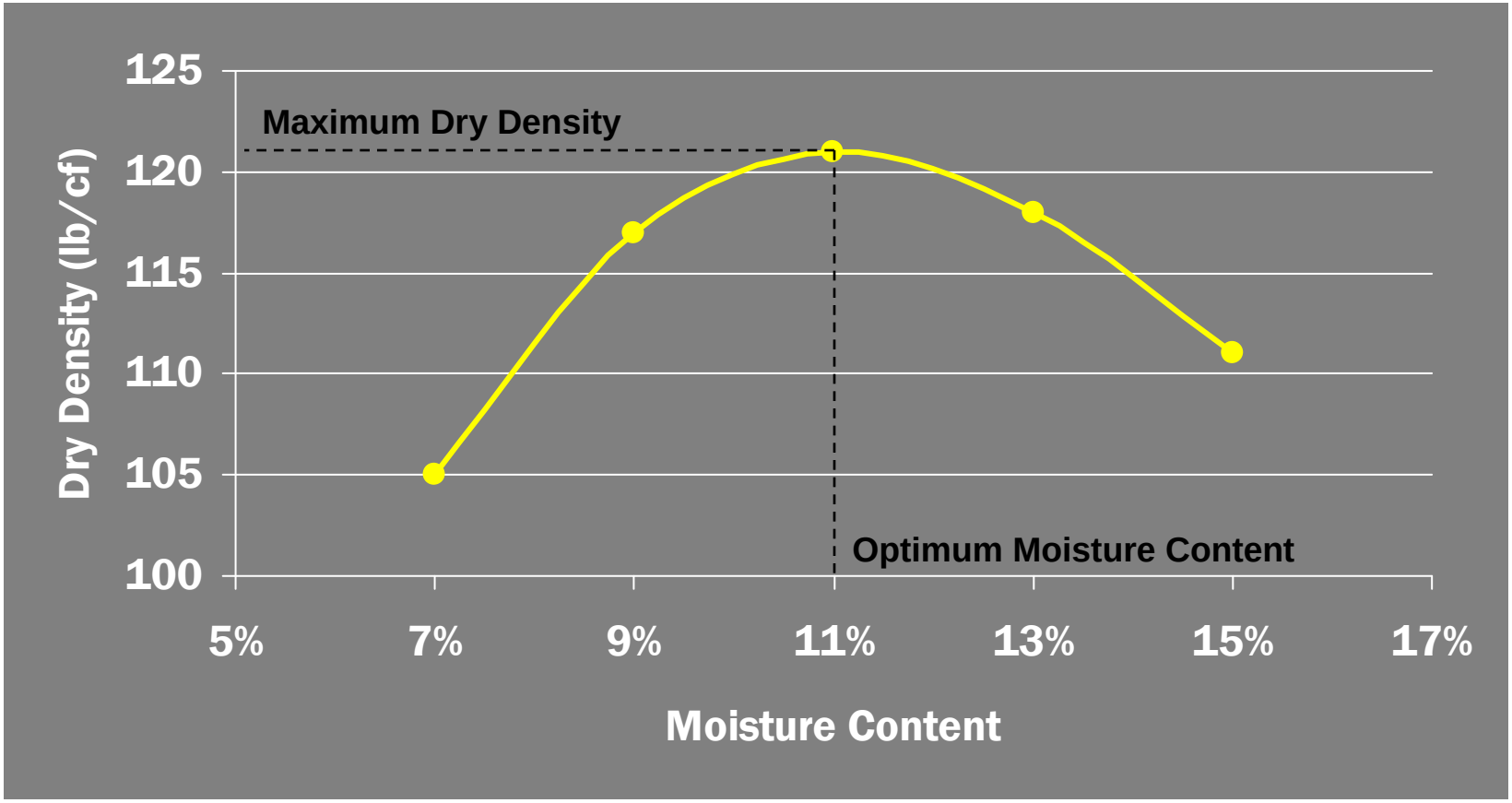
- Design
- Processing
- Compaction
- Finishing
- Curing
- Surfacing

Mix Design

Mix Design Proportioning

- Obtain representative samples of roadway material
- Can use up to 50% Reclaimed Asphalt Pavement (RAP)
- Pulverize to anticipated gradation
  - ✓ 100% passing 50 mm (2”)
  - ✓ 55% passing 6 mm (#4)
- Estimate cement content
  - ✓ Usually 3 to 6%
  - ✓ By dry weight
- Run moisture/density curve
  - ✓ Standard Proctor
  - ✓ (ASTM D558)
- Unconfined compressive strength
  - ✓ (ASTM D1633)

Moisture/Density Relationship



ASTM D558

Mix Proportioning

Determine cement content:

- Durability tests
  - Wet/dry - ASTM D559
  - Freeze/thaw - ASTM D560
- Unconfined compressive strength
  - ASTM D1633
- Tube suction test
  - Being developed by Texas A&M

Test for Strength

Unconfined Compressive Strength Test

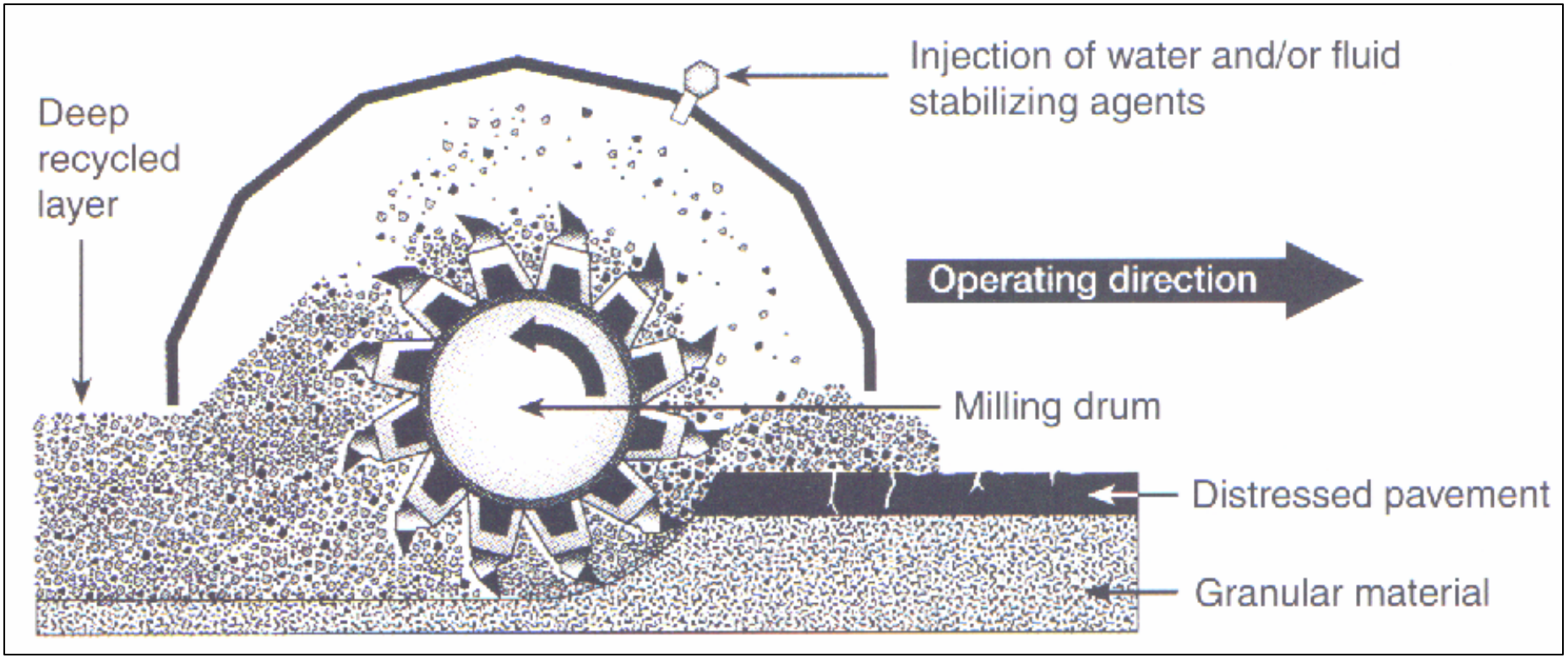
- ✓ Used by many State DOT's (Simple and Quick)
- ✓ 7-day requirements range from 1.5 Mpa to 5.5 Mpa (200 psi to 800 psi)
- ✓ 2.4 Mpa to 3.1 Mpa (350 psi to 450 psi) generally recommended

CONSTRUCTION

Pulverization

- Pulverize mat to appropriate gradation
- 1 to 4 passes

Inside a Reclaimer



Aggregate Adjustment (if needed)

Cement Spreading

Cement Spreading (Dry)

Cement is spread on top of roadway in measured amount

Cement Spreading (Slurry)

Integrated Slurry Mixing Process

Blending and Moisture Addition

- Cement is blended into pulverized, recycled material
- Water is added to optimum moisture

Grading

- Material is graded to appropriate Plan line, grade, and cross-sections
- Excess material is removed from roadway (rare occasions)

Compaction

Material is compacted

(Proctor density)

Curing

Water

Bituminous Compound

Testing

Moisture

Density

Testing
During and After Construction

- Density: Checked with a nuclear gauge every 100 feet in each lane.

- Coring: Two cores taken to verify compressive strength. Should be taken after 7 day cure.

Surfacing

Surface course is applied last

- ✓ Chip Seal
- ✓ Asphalt
- ✓ Conventional Concrete
- ✓ Roller Compacted Concrete

Completion:

Rehabilitation of asphalt pavements

Websites on FDR with cement

Road Recycling Council (RRC)
http://www.roadrecycling.or

Portland Cement Association (PCA)
http://www.cement.org/FDR

Thank you!!!

Dick Martin

Pavement Recycling Specialist

Address: P.O. Box 606 East Taunton, MA 02718

Phone: (857) 998-0119 / Fax: (508) 823-4502

Email: dmartin@roadrecycling.org

Website: www. roadrecycling.org